Collective Action and Technology Development:

Up-scaling of innovation in rice farming communities in Northern Thailand

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Dit onderzoek is uitgevoerd binnen de onderzoekschool: CERES – Research School for Resource Studies for Development.

Collective Action and Technology Development:

Up-scaling of innovation in rice farming communities in Northern Thailand

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Proefschrift
ter verkrijging van de graad van doctor
op gezag van de rector magnificus
van Wageningen Universiteit,
prof. dr. M.J. Kropff,
in het openbaar te verdedigen
op maandag 4 juni 2007
des namiddags te Wageningen om 13.30 uur in de Aula.

Limnirankul, Budsara (2007)

Collective Action and Technology Development: Up-scaling of innovation in rice farming communities in Northern Thailand.

Keywords: small-scale rice farmers, collective action, community rice seed, local innovations, green manure crop, contract farming, participatory technology development, up-scaling, technological configuration, grid-group theory, Northern Thailand

ISBN 978-90-8504-684-4

Dedicated to my parents

Abstract

Limnirankul, B., 2007. Collective action and technology development: Up-scaling of innovation in rice farming communities in Northern Thailand. PhD thesis, Wageningen University, Wageningen, The Netherlands. 249 pp.

Many small-scale rice farmers practise collective action to overcome production constraints, and to generate and redistribute benefits for maintaining improved household livelihoods. The practice is particularly important for small-scale rice farmers in Northern Thailand where rice-based livelihood diversification prevails.

The thesis seeks to build an understanding of farmer capacity in cooperation, as well as to identify crucial enabling factors that stimulate collective action to enhance continued learning and adaptation for sustainable development, via analysis of group attributes in relation to four sets of elements: agro-ecological conditions, socio-economic variables, cultural context and the role of government intervention. The study focuses on small-scale rice farming in Northern Thailand, with the aim to understand the social and technical relations involved in rice based farming systems, and to illuminate scope for participatory technology development more generally. This thesis targets rice farmers because of their important contribution to the country's food security and social economic development.

The research was carried out during 2003-2005 in a village with viable forms of collective action (Dong Palan, DPL) and in another village (Buak Mue, BM), included for comparative purposes, where off-farm employment affects labour use and household composition in such a way that collective action eroded or has a different orientation. Both qualitative and quantitative methods were used for data collection. Semi-structured interviews of key informants, group meetings, focus group discussion, farmer workshops and participant observation were all employed. The collective action was explored under four case studies including (i) community rice seed production scheme, (ii) local innovations in rice farming (frog protection as integrated pest management practice, modification of weed slashing machine as hand-held rice harvesting equipment, and double rice transplanting technique), (iii) participatory technology development in green manure crop, and (iv) contract farming.

There are various forms of collective actions, and the forms suitable for technology development depend on social and material circumstances in the local context. The varying organizational forms of collective action reveal a hybridity of institutional modalities, which is further described, using grid-group theory, by the level of regulation of individual behaviour and the level of absorption of individuals in group memberships. The most important institutional and individual mechanisms are flexible forms of benefit sharing, recognizing and managing common interests, trust building, and finally, joint problem solving and knowledge exchange among farmers themselves and between farmers and external agencies.

This thesis evidently shows that effective technology development and agro-technological innovation depend on social relationships and, more specifically, on the capacity to link to existing forms of collective action. Technology that works is a configuration resulting from a combination of agro-ecological conditions, technological artifacts and social arrangements, including collective action.

The incentive for people to participate in technology development as well as the management and development of resources is a major enabling factor for sustainable collective action. In addition, collective knowledge can make an important contribution to technology development and innovation so that people with long experiential learning from trial and error in rice farming are able to integrate their own knowledge with outside knowledge in developing technology.

This thesis indicates that horizontal up-scaling worked in the context of DPL which exhibits good social networking among farmers, but not in BM village.

The observed variety in organizational forms and social coherence leads to an important lesson for the practice of participatory technology development, namely that attractive technologies may be incommensurable with realities in rural economies. Hence, an insight from this thesis is that constructing a fit-for-all model of collective action for small-scale and sustainable technologies may not be desirable because of the different social and material conditionalities in the field.

Key words: *small-scale rice farmers, collective action, community rice seed, local innovations, green manure crop, contract farming, participatory technology development, up-scaling, technological configuration, grid-group theory, Northern Thailand*

Acknowledgements

I first came to Wageningen University in early 2002 with an idea of investigating participatory approaches in green manure technology development, and formulating processes for up-scaling of green manure crops in rice-based farming systems in Northern Thailand. I positioned myself as a knowledge broker, linking between on-station studies and on-farm research, with the aim of delivering services to benefit smallholder farmers, whom are often by-passed and excluded in the development process. I know that I need integrative social science research skills to help me to meet the challenge. The first ten months in Wageningen attending short courses, seminars, group discussion and formulating research proposal were a real test for me. I ended up with confusion, worrying about theoretical support to my field work. Then Paul Richards came to a rescue. Despite his busy schedule, he managed to find time and work me out, encouraging me to communicate deeply with farmers, trying to understand the local context, and putting away the research proposal for a time being.

During my field work in Chiang Mai, Neil Röling's one-week training session on social science concepts in relation to multi-agents modeling in October 2003 encouraged me to have a closer look at community frog conservation after listening to my brief comment on collective action in rice farming. Leontine Visser's visit to my research site in Chiang Mai gave me valuable guidance and her step-by-step coaching technique helped me to see more actors in community rice seed production. My scope of research had eventually gone beyond the green manure crop technology to encompass more social technical elements in relations to local practices in collective action and technology development.

Many people had kindly extended their time and efforts to provide stimulating and valuable learning experience throughout my studies at Wageningen and in Chiang Mai.

Paul Richards is always critical but warm, encouraging me to explore new challenging issues of sociology of agricultural technology, socio-technical interrelation in local innovation, and much more. Leontine Visser, with her social skills, helped me integrate social aspects in technology development, so that I can see the linkage. Sietze Vellema, with strong systems thinking and practices, complemented his expertise in contract farming, technology innovation and institutional linkage which helped to integrate Paul and Leontine's ideas on case studies during his two-time visits to Chiang Mai at the time of my writing. Collectively, Paul, Leontine and Sietze had provided valuable comments and helped me to put everything in shape. The learning process and experience I considered a privilege for me to learn from and share with them.

The Technology and Agrarian Development group (TAO) provides stimulating and dynamic intellectual discussion and exchange. Conny Almekinders greatly helped me get settled with my studies, especially my first encounter with the Dutch environment. Kees Jansen and Harro Maat, both provided valuable guidance during my studies. My African cohorts, Prossy, Christopher, Geoffrey, and

Francisco and Lanying offered warm friendships and exposed me to a broad range of ideas of people and development. This also includes Edwin and other African friends in the second and third cohorts. Both Dini Pieterse and Inge Ruisch gave a wonderful administrative support.

In the Netherlands, I would like to thank Thai students, Laxana, Orathai, Achara, Siam, Usa, Anon, Naiyana, Nipaporn, Warangkana, Thodsawan, Chantita, Supawut, and Thanawit whose friendship makes my staying in Wageningen a joyful one. I wish I had more time to interact with the lovely family of Scotten from both Kees and Busaba who bring me warm welcome especially during the time in Netherlands, thanks to make me feel at home.

I am deeply grateful to the staff of the Multiple Cropping Centre at Chiang Mai University for their support and forbearance from my first stage through finalizing this dissertation. Ajarn Phrek, my local supervisor who strongly encouraged me undertake this research, provided moral support during my time in Wageningen and Chiang Mai with his valuable advice and pointing me to the light. I particularly thank Ajarn Methi and Ajarn Benchaphun for their moral support. My thanks also go to Chorpaka who accompanied me during the field survey and assisted me from beginning till writing up process. I would especially like to thank my colleagues, Niramon for her assistance during the field survey, Pinpetch for her skill in formatting the thesis. Thanks also go to Woralux, Somjit, Pradthana, Malinee, and the MCC staff who always give enthusiastic support.

My main debt of thanks is to farmers in Buak Mue and Dong Palan villages. I am indebted to Kasem, Chumnong and Vichit, rice group leaders and to khun Thanu, the former extension officer and also to the rice members while hosting me, and with whom I shared a lot of ideas and with their advice and support.

My studies at Wageningen and my research were mage possible through financial support from the Rockefeller Foundation, as well as from TAO. I specially thank Dr. Ruben Puentes of the Rockefeller Foundation for encouragement and support.

The love and encouragement of my family and my close friend (Punnaporn) have made everything possible. My father who was unfortunately not be able to see my completion of studies, always gives me hope and strength, and I am dedicating this piece of work in his memory.

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Abbreviations

BAAC	Bank for Agriculture and Agricultural Cooperatives
BCU	Biological Pest Control Unit
BM	Buak Mue village
BF	Bio-fertilizers
CF	Contract farming
CFP	Community Frog Protection
CM	Chiang Mai
CP	Chareon Pokaphand
CRSP	Community Rice Seed Production
DANCED	Danish Cooperation for Environment and Development
DOA	Department of Agriculture
DOAE	Department of Agricultural Extension
DPL	Dong Palan village
EM	Effective micro-organisms
FAO	Food and Agriculture Organisation of the United Nations
FFL	Farmer-First-and-Last model
FFS	Farmer Field School
FSR	Farming Systems Research
GAP	Good Agricultural Practice
GxE	Genotype-by-environment interaction
GMCC	Green Manure and Cover Crop
HYVs	High Yielding Varieties
ICRAF	International Centre for Research in Agroforestry
IRRI	International Rice Research Institute
KDML105	Kao Dawk Mali 105 (jasmine rice or *hom mali* rice)
KT	Kaset Tambon (Extension officer)
LDCs	Less Developed Countries
LDD	Land Development Department
LDSC	Land Development Service Centre
MCC	Multiple Cropping Centre
MOAC	Ministry of Agriculture and Agricultural Cooperatives
MTAC	Mae Teang Agricultural Cooperatives
NPLs	Non-Performing Loans
NGOs	Non-Governmental Organisations
OARD1	Office of Agricultural Research and Development Region 1
OTOP	One Tambon One Product
PDA	Population and Development Association
PE	Plant - expert
PO-LDS	Provincial Office of Land Development Station
R&D	Research and Development
RD 1	Rice Department 1 (non-glutinous rice no. 1)
RD 6	Rice Department 6 (glutinous rice no. 6)
RD 15	Rice Department 15 (non-glutinous rice no. 15)
RID	Royal Irrigation Department
SADP	Sustainable Agriculture Development Project
SAF	Sustainable Agriculture Foundation

SATHAI	Sustainable Agriculture Thailand Foundation
SMC	Seed Multiplication Centre
SME	Small and Medium Rural Enterprises
SMS	Subject matter specialists
SPT 1	San Pathong 1 (glutinous rice variety)
SRI	System of Rice Intensification
TAO	Tambon (sub-district) Administration Organization
TAMC	Thai Asset Management Corporation
TI	Technology Innovations
TM	Tambon Municipality
TOT	Transfer of Technology
TTC/TTTSC	Tambon Technology Training and Service Centre
T&V	Training and Visit agricultural extension approach
VH	Village Housewife Groups
VHV	Village Health Volunteers
VS	Village Saving Groups
VW	Village Welfare Associations
WAU	Water Users Association

Chapter 1

Introduction: agricultural development and collective action in Thailand

1.1 Problem statement

The Multiple Cropping Centre [MCC] works with participatory technology development to improve lives of small farmers who have diverse livelihood strategies and have engaged in different forms of collective action in the village. Accordingly, the conditions for participatory technology approaches vary. What does this mean for supporting agencies? Also, the history of Thai agriculture reveals interesting ways of managing resources and innovation collectively. What are the opportunities for building on these different organisational forms in participatory approaches? What types of socially embedded functions encourage feed back and interaction between farmers and external agencies?

Several cases have shown the power of cooperation in Thai communities in the fields of agricultural production and natural resource management, which enabled small farmers to survive through the economic crisis from 1997. Through collective action, such as labour sharing or community participation, irrigation users, forest users, and agricultural producers can improve, protect and sustain resource for their lives. In socially bounded rural Thai communities local resource users possess valuable knowledge and social linkages that help create and enforce sustainable agriculture and environment management. Many communities of users have a long-standing tradition of cooperation and are capable of organizing themselves to help and care for each other. However, there is little support from institutions towards local cooperation in agriculture development. There is lack of understanding of crucial conditions for stimulating and sustaining collective action in community development and almost no linkage between research institution, local organizations and local community to collaborate in agriculture development.

Collective action is assessed as an organisational form that both brings people together and generates and redistributes benefits associated with improved farming livelihoods. The study seeks to understand why, in Northern Thailand, some groups are far better organized for collective action and are better at mobilizing resources and labour for collective purposes than other groups. The emphasis is on exploring and explaining the conditions under which the group is likely to be successful in collective action, via analysis of group attributes in relation to four sets of elements: agro-ecological conditions, socio-economic variables, cultural context and the role of government intervention. Furthermore, some attention is paid to individual decision-making as an aspect of participation: why are some individuals motivated to join in and others. Overall, the thesis seeks to build an understanding of farmer capacity in cooperation, as well as to identify crucial enabling factors that stimulate collective action to enhance continued learning and adaptation for sustainable development.

It will be shown that conventional governmental approaches to farmer capacity building are less effective than the approaches of the non-governmental organizations, which are based on working more closely with farmers using participatory approaches. The thesis also explores a third approach – contract farming induced by agribusiness and food companies – to see how economically interdependent actors collaborate to ensure good performance in agricultural production. This performance-oriented approach enables a process of continuous learning, which can throw light on the strengths and weaknesses of NGO-based participatory approaches that help to select technological recipes and then delegate the learning process entirely to local communities. Likewise, the approach can inform agri-business companies to recognize the value of viable social relationships. The companies, which deliver agro-technologies through organizing farmer training or through their own field technicians, tend to adopt a rather rigid focus on business venture, and create dependency and undermine scope for farmer initiative.

The thesis suggests that participatory approaches might be useful in farmer capacity building across the board – in small farmer interventions by both government and business as well as in the NGO sector. The thesis will outline some lessons for improved collective action, as applied to rural technology generation and adoption, among small-scale farmers in Northern Thailand.

This chapter first sketches the context of agricultural development in Thailand, especially in the North, to outline the historical background of collective action, mentioning in particular self organized groups in irrigation management and community forests and governmental initiatives in establishing civil groups for social and economic development at village level. The evolution of participatory technology development research and transformation of extension systems is also explained. The thesis also has an interest in up-scaling local initiatives. Hence, the context is followed with a brief overview of development and agricultural policy in Thailand which emphasizes institutional development, decentralisation and empowerment, and a shift to agro-industrial and business development. The overview of agricultural policy is complemented by a brief history of technological change in Thai rice farming, such as adoption of modern rice varieties, changing cultivation practices, introduction of cash cropping and integrated farming, etc.

The chapter further presents the research objectives, their relevance and the research questions addressed. The section on theoretical perspectives explains the grounding of the analytical focus on forms of collective action in relation to technology development. Cultural theory, in the form of grid-group analysis proposed by Mary Douglas, offers a way of addressing different patterns of group behaviour associated with different organizational environments for technology innovations. Notions of an actor orientation in development processes and the idea of social capital, as a framework to grasp the social and network resources required by agro-technological innovation processes, are also introduced. The chapter ends with a brief discussion of the area of study, and of the two case study villages under the Mae Teang irrigation system in Northern Thailand.

1.2 Context

A history of collective action in the Northern Thai context

Culturally, the rural Northern Thai village still exhibits strong cooperative social activities and mutual aid, unlike urbanized society. The rural society was thus able to absorb external shocks and survive financial crisis during the 1990s. This is indicative of this community's social cohesiveness. Cooperative activities commonly observed include cultural ceremonies, gatherings to performs funeral rites, community work on special occasions, maintenance of irrigation canals, co-management of community forest, and the sharing of family labour in crop production. The history of collective action in Northern Thailand includes maintaining the *muang fai* (weir system) irrigation (Surarerks, 2006). These systems developed over 700 years through the collective action of water users in constructing weirs or diversion dams to block the waterway in the upper part, and digging irrigation canals (*lam-muang*) to direct the water to the lower plains. A *muang fai* community system also involved the formation of an organisation of administrators and managers in charge of systematic water usage for cultivation.

Rural communities in Northern Thailand have tended to maintain their experiences and wisdom in irrigation system management, but in some cases this has involved adaptation to or the adoption of state-framed legislation. For example, collective action involving labour participation developed after 1939 to cover the repair of weirs and clearing and dredging of canals. Labour inputs were determined by the amount of land owned by each member. This reflected the simple logic that those with smaller amounts of land use less water, so should supply less labour, as indicated in section 16 of the People's Irrigation Act of 1939. Thus, for example, every 0.1-10 *rai* (0.016-1.6 ha) of land owned by the farm household should contribute 1 labourer (Surarerks, 2006).

Community participation also holds good in forest co-management, where various stakeholders are empowered to organise into local forest protection committees and establish their own rules and responsibilities for community forest management in order to stabilise forest use. Such cooperative activities involve management by village groups. A better understanding of how these groups form and work could become the foundation for participatory development. Here an implicit hypothesis could be developed to be examined through the case studies analysed below namely, that the village with a better social infrastructure of effective self-organized sub-groups is more likely to perform better in initiating a development activity and be less dependent on external supports.

Still, small-scale farming remains important. The modernization of the small-scale sector has been harder to achieve. A question posed in this study is whether better use could be made of institutions associated with small-scale farming for technological modernization in Thai agriculture. A number of rural institutions of interest in the present study have been around for many years in Thailand. They include village savings groups, farmer associations, women's groups, and production and marketing cooperatives. A majority of these rural institutions, however are small-scale in scope and affect only a limited number of farmers. Funding remains a constant concern in this informal village-based organization. Only a minority are registered and thus recognised by government and other development actors (Doungkaew, 1999).

Collective action is widely assumed to be a positive force for rural development in Thailand. Groups are seen as a way to empower individuals and to improve various aspects of agricultural production, including the use of technology and market participation. Individuals getting together with others are also thought to be a way to facilitate coping with risk, particularly when neither the private sector nor the government provides any safety nets or insurance. In general, group performance could be a driving force for poverty alleviation. Thus, it is important to study more closely how exactly co-operative activity works in the typical village setting in Northern Thailand, to have a better idea of the extent to which group participation might be a tool for development. This is the task addressed in this thesis.

Overview of agricultural policies and national development plans (1961-2006)

This section reviews agricultural policies and national development plans during 1961-2006, using relevant policy documents (Table 1.1). This overview, with a focus on institutional development and technological change, helps to explain the conditions for up-scaling of locally embedded initiatives and experiences in the field of technology development. It highlights evolving views and strategies on participation and innovation at the level of national policy. In addition, it indicates evolving technological change in typical rice farming systems in Northern Thailand.

Thailand has embarked on national economic and social development plans every five years for over four decades since the inception of a first plan in 1961. The underlying philosophy of economic planning in Thailand is a commitment to a market economy (Warr, 1993). The country has evolved from an agriculturally-based agrarian economy to a more diversified multi-sectoral economy, with manufacturing and service industries overtaking the agricultural sector in importance since 1985.

During the early phase of state-mediated national development (*i.e.* during the first three plans, 1961-1976) the agricultural sector was treated simply as an input in the drive towards industrialization. Moreover, rather than using the resources generated from the deliberate policy of depressing rice prices during the 1950s and 1960s, the Thai Government invested this surplus in activities of no long-standing social benefit. At the same time, the period associated with the globalization project (1970s to 1990s) saw the greatest economic recession since the 1930s. One of the notable beneficiaries of government policies has been agri-business *e.g.* feed and flour milling supportive of livestock farming, manufacture of canned pineapples, seed industries, etc.) which has been the fastest growing sector since 1975. Investment in agri-business by indigenous capital and transnational corporations –

often working with Thai partners as joint ventures - was encouraged by the Investment Promotion Act of 1972 (revised 1977) (Hart *et al.*,1989).

In regard to agriculture, the fourth to seventh plans (1977-1996) put emphasis on increasing production efficiency, increased diversification, and at the same time increased production for export markets. During the 4th Plan period, the Ministry of Agriculture and Agricultural Cooperatives (MOAC) adopted the Training and Visit system of agricultural extension under a World Bank Loan for Agricultural Reconstruction to modernize agriculture. New college graduates were recruited as sub-district agricultural extension agents (*kaset tambon*) throughout the country.

The 1978 Agriculture Census showed only 29% of farms reporting the use of any hired agricultural labour. However, local studies indicate a considerable increase in the use of wage labour in agriculture since 1978, a continuing decline in the use of exchange labour, and many wage-labour-employing households also supplying wage labour in turn (Turton, 1989). Family planning was implemented through active campaigning by the Population and Development Association (PDA), a non-governmental organization, with consequent success in Northern Thailand, particularly in Chiang Mai province. The success of family planning seems to be the most important explanation of low population and labour force growth (Jitsuchon, 2005). The fertility of Thai woman has declined steadily over the past forty years, reaching a level of 1.9 births per woman in 1999. However, family labour constitutes the greatest proportion of farm labour.

Before mid 1980s, the amount of agricultural land increased steadily due mainly to deforestation. During that period agricultural land expansion played an undeniable role in raising per capital economic growth. However, since mid 1980s the total area of agricultural land has stopped expanding, caused by three factors. The first factor was the new government policy to close the forests in the early 1980s. Secondly, the economic boom in non-agriculture activity since the mid 1980s drew workers from the agricultural sector into the urban areas. The third factor is the rapid mechanization of agricultural production (Jitsuchon, 2005). Agrarian trends are also problematic. Agricultural tenancy is also problematic. In 1976 some 20 percent of agricultural households were tenants, and just less than 12 percent of total land was operated by tenants. The situation was more serious in rice growing areas in the North (*e.g.* Chiang Mai) and other areas in the Centre (*e.g.* Ayuttaya), where in certain districts and in some villages, all operators were tenants, and land was owned by a single landlord (Hart *et al.*, 1989).

In the 5th Plan (1982-86) the strategies for agricultural development emphasized improvements likely to benefit farmers with middle and higher incomes, leaving the majority of small farmers to the attentions of the Rural Poverty Eradication Program. The 5th Plan also aimed to encourage participation and envisaged a greater role for local level institutions, especially the expectation that sub-district councils would take locally relevant decisions on development issues (Turton,1989). This had the effect of strengthening existing local powers and local influence groups. The 6th and 7th Plans (1987-91) concentrated on increasing production efficiency, enhancing diversification, and at the same time increasing production for export markets. The private sector and the government sector together with farmers were encouraged to work in collaboration to promote value-added agro-processing for a number of products, etc. Subsequently, the policy and process of decentralization began to affect agricultural development and local empowerment. In the early 1990s attempts were made to develop a bottom-up approach and to integrate it into the agricultural planning process (Na Bangshang, 2005). The aim was to increase participation of people at the grassroots or communal level, to mitigate the adverse consequences of over-centralized control and to motivate people to become more involved in activities directly related to them.

Major changes effected at sub-district (*tambon*) peoples' council or Tambon Administration Organization (TAO) level since 1995 can be considered as among the main consequences of this drive towards decentralization and empowerment. The TAO now formulates its own action plan on agricultural development within the sub-district administrative boundary, using its own financial resources, but it can also work with *kaset tambon* (KT) in order to elicit support from the Ministry of Agriculture and Agricultural Cooperatives (MOAC). The TAO can also deal directly with governmental institutions offering support services, which include credit and material inputs and assistance in acquiring sites for development projects. The TAO has authorization to manage its own resources through the elected *tambon* council committee. This is a major shift of management policy away from the centre. Thus the TAO is the local organization to negotiate and form partnerships with public and private institutions to support agricultural development and non-farming rural enterprises. It is the major local institutional framework for guiding technology decisions of relevance to small farmers oriented towards participatory development

The financial crisis in 1997 resulted in massive unemployment, and the role of the agricultural sector as social safety net became apparent, when it made a disproportionate contribution to absorbing the unemployed. Meanwhile, the dual-tract policy using food sufficiency approach for the marginalized regions and food export promotion in the agriculturally advanced areas had served to mitigate certain social crises resulting from sudden economic recession. The 8th Plan (1997-2001) introduced a new paradigm in Thailand's national development to recognize human beings as the centre of development. The focus was on holistic development, first to empower people as prime movers of development. Second was to distribute wealth to the people, as the centre of development. Third was to minimize effects on underprivileged groups, provide welfare and generate opportunity for development to meet their potential. In the formulation of the 8th Plan, a new social innovation emerged. For the first time there was to be participation of people from different occupations in the planning process. Never before had the drawing up of the national development plan involved a bottom-up approach, with different levels of public platform being organized for input and consultation. The Plan also provided guidelines for implementation based on area, function and participation. This turn towards sustainability and participation from 1997 is a major reason the present thesis is seeking to assess the effectiveness of some of the ensuring rural initiatives. Since1997, the leading role has been taken over by manufacturing, which provided 46.2 percent of export earnings, reaching 75.3 percent in 2001 (MOC, 2004). Developments in agriculture now appear less significant for the country's macroeconomic performance. Nonetheless, agriculture remains the largest source of employment, with 60-65 percent of the labour force, and it is the largest provider of income for the majority of the population. Moreover, the country's poorest populations are concentrated in the agricultural sector.

Sustainable agriculture was introduced for the first time as an objective in the 8th National and Development Plan in order to meet ambitions to include multiple objectives in agricultural development. The financial crisis in July 1997 prompted the government to adopt the idea of a Sufficiency Economy, as proposed by His Majesty the King and the New Theory[1] farming system, as a solution to achieve food security, income stability and environmental integrity, leading in turn to the emergence of self-reliant farming communities.

The Sufficiency Economy philosophy and accompanying policy directives were continued into the 9th Plan (2002-2006)[2] which is the present national development framework. Importance is given to the balanced state of people, society, economy and environment. Equally important is the adoption of a middle path strategy to steer the country through a series of crises to a sustainable and quality presence in the world community. This sustainable development direction is seen in various national strategies, namely, the strategy on natural resource and environmental management, the strategy to increase national competitiveness, the strategy on human development and social protection, and the strategy to achieve sustainability of rural and urban development through participation of all social sectors.

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[1] The new theory initiated by His Majesty the King promotes sustainable agriculture at farm household level. The initial stage of the New Theory focuses on food security at individual farm households. The second stage is to promote self-reliance at community level. Farmers are encouraged to organize into groups for cooperation for processing, marketing as well as social welfare. The third and last stage envisages fair trade relationships between the private sector and local community organizations. The government is fully devoted to the application of The New Theory to the development of small farmers under the Sufficiency Economy Philosophy (www.moac.go.th). His Majesty's concern about water shortages afflicting rain-fed farmers led to the promotion of his plan for small scale farm management. According to the plan, each plot of between 10 and 15 *rai* (1.6-2.4 ha) is divided into four main sections. The general formula is 30:30:30:10, which corresponds to the relative proportion to be allocated to a reservoir, rice fields, fruit and vegetable orchards, and residence/livestock areas, respectively. To ensure an adequate supply of water throughout the year, a system of individual ponds, a community reservoir and a larger basin is recommended. In case of drought, the dried-up pond will be filled from the next largest in the hierarchy. His Majesty's concept has been successfully tested at an experimental field at *Wat Mongkhon Chaipattana* in Saraburi province.

[2] Within this relatively abstract framework, the more specific elements of the Thaksin government's economic policy strategy in 2001 included 7 elements: 1. farm debt restructuring, including a three year suspension of some debts owned by poor farmers to state banks, 2. village funds financed by grants of one million micro-loans, 3. the transfer of non-performing loans (NPLs) to the newly established Thai Asset Management Corporation (TAMC), required for state-owned operations and voluntary for private ones, to promote more efficient debt restructuring, 4. special attention to small- and medium-sized enterprises (SMEs) by state-owned lending agencies, 5. promotion of product specialization by village groups, called the "one *tambon* (group of five or six villages), one product" scheme inspired by a similar Japanese program; 6) the establishment of the People's Bank, administered through the Government Savings Bank (GSB), allowing GBS account-holders to apply for small loans (up to about 30,000 baht or $370) mainly for small retailing or commercial ventures; and 7) a restructuring of the economy away from heavy dependence on imports and towards more reliance on local resources, especially agricultural.

It can be said that Thai agriculture enjoyed rapid growth during the first four Plans during with agriculture was the leading sector in the Thai economy (Siamwalla *et al.,* 1993), after which the sector was over taken by manufacturing and service sectors.

Table 1.1 Agricultural development plans and policy on institutional and technological development in Thailand from 1961- 2006

year	1961	1972	1976	1981	1986	1997	2001	2006
Agriculture development plan								
	Export oriented growth aiming for productivity of export commodities such as rice, sugar cane, cassava, maize etc., based on a good endowment of resources (land and labour) and infrastructure facilities (irrigation, communications, and transportation			Agro-industrial development, linking agriculture to manufacturing and processing		Cluster development for integration and combination of competencies	Regional specialization, based on value adding to agricultural materials (OTOP)	
		Green Revolution strategy based on modern rice varieties	Combination of production efficiency, diversification, and mechanization	Agricultural modernisation of middle farmers	Export promotion	Proposed shift to environmental sustainability in agriculture and food security		
			Family planning policy					
			Strong emphasis on training and visit of extension workers	Emphasis on role of local institutes		Area based strategies and decentralized governance structures	More executive power at the level of the local government units (TAO)	
				Explicit strategies for rural poverty eradication, decoupled from agricultural modernisation		Introduction of social innovation targeting food sufficiency, self-reliant farming communities and social safety nets.		
Technological change in rice farming								
	Introduction of ideo-types with package of fertilizer and agro-chemicals		Continuous development and introduction of new rice varieties					
	Agricultural development, highways, irrigation, and industrial development in the private sector		Improvements in the rural infrastructure: mechanisation – tractors and broadcasting – reducing use of family labour and increase in hired labour. Growth in the financial and commercial sectors.					
					Introduction of specialized cash crops		Promote food safety and GAP	
						Integrated farming, Mixed cropping systems		
						Development and introduction of new technologies targeting sustainability and self-reliance- bio-fertilizers and bio-control of pests		

Technological change in rice farming

A brief historical profile of technology change in rice farming and change in agriculture is introduced according to the agricultural development plans. As far as agriculture is concerned, the first three Plans (1961-1976) emphasized increasing productivity of export commodities such as rice, sugar cane, cassava, maize etc., based on a good endowment of resources (land and labour) and infrastructure facilities (irrigation, communications, and transportation). The percentage of irrigated land doubled, from 14.5 percent to 30.5 percent between 1970 and 2000 (Jitsuchon, 2005). In the period of 1961-66 the plan aimed to raise the standard of living by means of greater agriculture, industrial, and power development. In the second of the development plan (1967-71), emphasis was placed on agricultural development, highways, irrigation, education and industrial development in the private sector. The third development plan (1972-76) placed special emphasis on improvements in infrastructure, growth in the financial and commercial sectors, and further assistance to crop diversification and to import–substitution industries. Towards the end of the 3rd Plan period, Green Revolution technologies were implemented, with more comprehensive research support for rice and maize. The influence of high yielding varieties of semi-dwarf rice from the International Rice Research Institute (IRRI) and broad-based synthetic maize varieties developed by the National Maize and Sorghum Research Centre supported by the Rockefeller Foundation expanded cultivation of these two cash crops in irrigated lowlands and rainfed uplands respectively.

The system of rice cultivation changed from the time of the 3rd Plan (1972-76) when the Green Revolution technology began to have its effect on rice improvement in Thailand. New modern non-glutinous rice varieties were released with incorporation of the IRRI (International Rice Research Institute) germplasm. These varieties displayed the favoured IRRI ideotypes - *i.e.* a semi-dwarf, erect plant type responding to fertilizer, with non-photoperiod sensitive growth habit. The variety RD 7 was among the most promising non-glutinous variety developed for irrigated lowlands, possessing good quality grain characteristics and with high yield. As a consequence of the introduction of this and other improved varieties, the campaign to increase rice yield by replacing local rice varieties with input-responsive high yielding varieties was launched, together with extension of chemical fertilizer for rice production. The new rice production technology package consisting of new IRRI-type non-glutinous rice and chemical fertilizer was adopted by the extension services as a response to the rice export promotion policy in the plan. Use of agricultural chemicals has increased steadily ever since, and Thailand has become a leading rice exporting country, with an annual export volume of over 7.5 million tons. In the mid 1980s more than half of Thailand's working population was still engaged in agriculture, most producing rice as a main or subsidiary crop, and rice remains the most important single crop by value (World Bank, 1980).

Traditional varieties have now been replaced by high quality modern rice varieties. There are three major rice varieties (all genetically related, and derived from one variety). These are the non-glutinous rice, KDML 105, and two varieties derived from X-ray radiation induced mutations of KDML 105, namely RD 6 (glutinous) and RD 15 (non-glutinous). All three varieties are photo-sensitive, and cover over 95 percent of the lowland rice growing area of the Upper North. A modern high yielding, non-photosensitive glutinous rice, SPT1, was introduced in 2000 to improve cropping intensity of irrigated lowland.

The agricultural sector saw rapid capital formation between 1980 and 1998 (Jitsuchon, 2005). The uses of big tractors and water pumps increased more than 6 times. This is consistent with much slower land expansion and the emigration of agricultural labour into non-agriculture activities and to the urban areas. Despite the tractors and pumps the quality of life in many rural communities did not improve, and income disparity between the agricultural and non-agricultural sectors widened.

Farm machinery, particularly various types of combined harvester have speeded up rice production, and offer advantages not only to commercial rice farmers, but also to semi-subsistence rice farmers who experience tight labour constraints during the rice harvest period. Recently, a mechanical rice planter has also been promoted by a private company, with private contractors offering services to cope with labour bottlenecks in irrigated rice agriculture. Farmers without access to the planter have adopted broadcasting methods to overcome a planting labour bottleneck, despite the generally lower yields associated with broadcasting of seed. Broadcasting techniques and farm machinery in rice production address labour constraints. The introduction of machinery will have to be taken into account by breeders seeking to develop new seeds for farmers in the region. In the lowlands, rice is still the major crop in both rainfed and irrigated areas. New cash crops are constantly being introduced by traders, buyers or companies, often via contract farming on the irrigated lowlands after rice harvest. Vegetable crops, sweet corn, hybrid maize seed, and vegetable soybean have all been introduced into the new irrigated areas under contract farming arrangements. The contracted crops are grown for processing and for seed.

Other new production technologies introduced during 8th plan (1997-2001) include the development of bio-fertilizers through fermentation of plant and animal waste with molasses. Use of effective micro-organisms (EM) in nutrient management, and green manure crops in rice farming, are actively promoted by the Land Development Department and the Department of Agriculture. Farmers have also developed their own formulations for production of bio-extracts for pest management and bio-fertilizers. Integrated farming has been introduced for achieving the Sufficiency Economy by H.M. the King. Moreover, since the beginning of 2000, the DOA has developed Good Agricultural Practice (GAP)[3] to upgrade quality of agricultural commodities and food standards. The quality standards of great concerns are variety, size, shape, taste, colour and food safety

[3] This is the practical guideline of the production system at farm level for obtaining good quality of agricultural products that meet standards. Key aspects of GAP are, for example, soil and water management, pest management, chemical residue control, harvesting and processing at the farm level, good storage, waste management, animal welfare, human health awareness, safety operators, and biodiversity conservation

standard, which includes free from chemical residues, and safe production processes from farm to consumers.

1.3 Scope of study

The present study focuses on small-scale rice farming in Northern Thailand, with the ambition to understand the social and technical relations involved in rice based farming systems, and to illuminate scope for participatory technology development more generally. This thesis targets rice farmers because of their important contribution to the country's food security and social economic development.

The research concentrates on several case studies. The main goal of the case studies is to understand what makes for success and failure in different forms of collective action addressing agriculture technology development and what scope there is for support by external institutions. The four case studies relate to research conducted in two locations: Buak Mue (BM) and Dong Palan (DPL) (Figure 1.1) in Chiang Mai, two communities with contrasted biophysical and social cultural characteristics (see detail in Chapter 2). The main research questions (given below) address the forms and characteristics of collective action in technology development, how and why people want to cooperate in such action, and what holds them together as groups. The key features of the four case studies are summarised in Table 1.2. The research results are expected to help bridge the gap between institutions, researchers and local communities for effective cooperation in development.

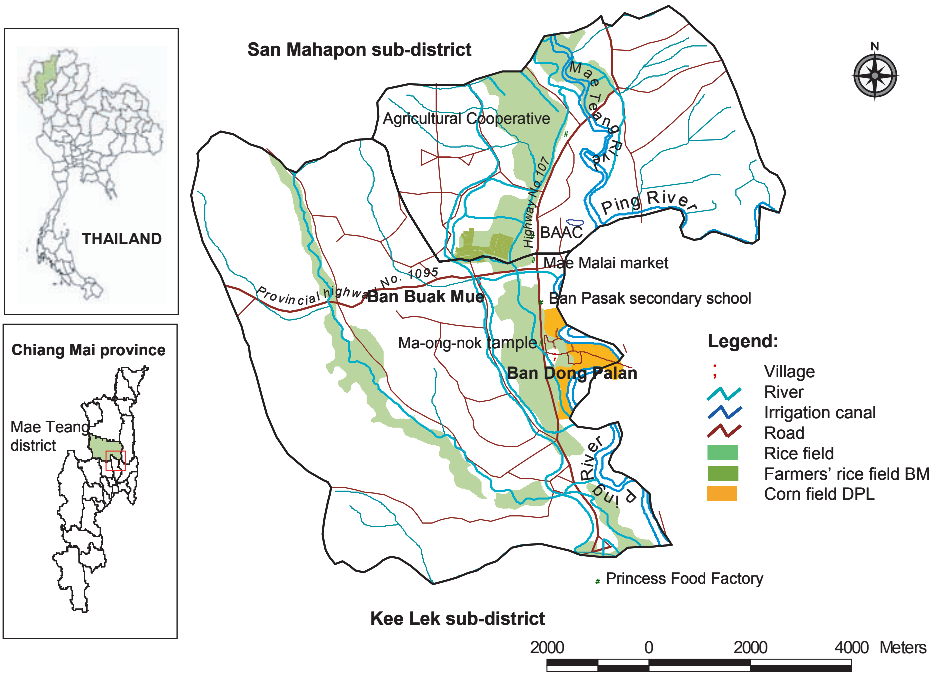


Figure 1.1 BM and DPL villages, Mae Teang district, Chiang Mai

The research questions and objectives

The research objectives

The overall objective of this research is to provide better understanding of local practices in collective action and benefit sharing. It also includes the conditions for successful and effective cooperation in mobilizing resources and labour, and in participatory agro-technological innovation for sustainable agricultural development.

The objectives

The specific objectives of the research project are the following:

Specific objective 1

To explore forms of collective actions and analyse their basic conditions in order to arrive at principles of collective action, which are capable of providing opportunities for technology development

Specific objective 2

To identify the key factors in collective action that contribute to success and failure, in order to make suggestions and offer guidelines for sustainable agriculture technology development

Specific objective 3

To explore local innovation and dissemination processes as a way of offering feedback to research and development (R&D) about what works and what is less successful, in order to strengthen ties between cooperative rural development initiatives and institutionalised research

Specific objective 4

To assess potential links between community organization and external organization. The implications are for further developing cooperation and co-management between governmental organizations and communities, or between contracting agro-production companies and communities, while fully reflecting the national policy emphasis on strengthening grassroots capacities for sustainable agricultural production and development.

The research questions

The main research questions (itemised below) relate to community approaches to technology development and focus in particular on the distribution of benefits from such initiatives. The thesis addresses four main research questions.

Main research questions

1. What are the forms and conditions for collective action among the rural poor in northern Thailand?
2. How do farmers in northern Thailand manage collective action for technology development in different cases?

3. What makes collective action work for technology development and agro-technological innovation?
4. How can collective action for technology development by small-scale farmers in Northern Thailand be improved, and what can it contribute to the improved sustainability of village agriculture?

1.4 Theoretical perspective

This research is mainly focused on collective action as a mechanism to improve outcomes of agro-technology development among small-scale farmers. The focus is on the conceptualisation of three aspects of collective action: (1) forms of collective action, (2) management of collective action in specific technology development cases, and (3) outcomes of interaction in up-scaling of technological innovation. For further unravelling these concepts this research draws on three bodies of theoretical literature in the social sciences: (1) cultural theory or grid-group theory, (2) social capital and collective action theory, and (3) the actor-oriented approach to local knowledge. First, I focus on the approach of Mary Douglas (1987) to analyse the four moral frameworks (fatalist, hierarchical, individualist and egalitarian) through which she suggests collective action is made accountable to a community. Second, I pay some attention to the concept of social capital as a way of understanding the social resources - *e.g.* social network relations, and shared knowledge, norms, rules, and expectations about patterns of social interaction – brought by groups and individuals to technology development (see chapter 4 especially). Third, I make use of the actor-oriented approach to development interventions, as advocated by Long (2001) concerning the processes through which different agents engage and together produce individual and collective responses, and how these responses, more than external forces, influence outcomes. The present study makes use of this concept to understand the processes through which actors engage in knowledge creation. The interaction of actors can take various forms, such as farmer-to-farmer, farmers-to-organization, or farmers-and-brokers, with each kind of actor capable of influencing the outcome in development.

Cultural theory or grid-group theory

The point at issue is that the logic of collective action varies according to organizational form. Accordingly, the research aims to describe the specific organizational forms of collective action as a hybrid of different management styles and world views. Grid-group theory (following Durkheim) propounded by Mary Douglas and others (Douglas, 1978, 1985, 1987, 1996; Douglas and Wildavsksy, 1982; Douglas and Ney, 1998; Thompson *et al.*,1990) helps to categorise the different institutional modalities observed in forms of collective action. Douglas identifies two basic dimensions of sociality – grid (or coercive ties) and group (or affective ties) - arguing that moral restraints and cultural notions of group identity and belonging can always be assessed and classified according to these two basic dimensions. Grid-group analysis is a way to distinguish, parsimoniously, between approaches or styles of building social cohesion and expressing social solidarity.

The *group* dimensions, Douglas explains, tap the extent to which 'the individual's life is absorbed in and sustained by group membership. A lower group score would be given to an individual who spends the morning in one group, the evening in another, appears on Sundays in a third, and gets his livelihood in a fourth' (Douglas, 1982: 202). Group stands for incorporation into a bounded group. The group factor is strong when the individual is a member of one corporate group, and weak when individuals do not belong to any such groups. The *grid* dimension stands for 'the cross-hatch of rule to which individuals are subject in the course of their interaction (Douglas, 1978: 8, or 1982: 192). A high grid (a highly regulated social context) is characterized by an explicit set of institutionalised classifications that keeps individuals apart and regulates their interactions (Douglas, 1982: 203). Moving down-grid, individuals are increasingly expected to negotiate their own relationship with others. The analytical scheme resolves into four basic solidarities – hierarchy, fatalism, individualism and egalitarianism (or communalistic)[4]. portrays the scheme and the styles of social interaction it captures. Analysis via the grid-group approach attempts to characterize individual behaviours and patterns of interaction between individuals at a collective level. Organization can be assessed as voicing a cultural bias in interactions with other organizations, *i.e.* actors are not free to act 'except the institution does the thinking' (Douglas, 1987). Thus, for example, even though (objectively) it might be shown that certain advantages will accrue to adopting a common approach to land management problems, the hierarchists, egalitarians, and fatalists will all assess the fruits of collective action differently. Egalitarians, for example, will tend to over-assess the benefits, whereas as individualists may tend to minimize them. This is why, according to Douglas, the logic of collective action cannot be specified independently of an analysis of the modalities constituting a specific organizational form.

[4] Strong group involvement coupled with minimal regulation (low grid) produces social relations that are egalitarian. When an individual's social environment is characterized by strong group boundaries and binding is prescriptive (high grid) the resulting solidarity is hierarchical. Individuals are subject both to the control of their fellows and the demands of socially imposed roles. It is contrasted to egalitarianism, in which the individual is subject to the controlling influence of a membership (*i.e.* collectivity). Hierarchy "has an armoury of different solutions to internal conflicts, including upgrading, shifting sideways, downgrading, de-segregating, redefining" (Douglas, 1982: 206). The rules and regulations assigning different roles to different people enable them to live together more harmoniously than under alternative arrangements. Where social solidarity depends less on group or corporation we encounter an individualistic solidarity, in which boundaries are provisional and subject to negotiation. Thompson and his team defined the individualist as 'free from control', but that may mean that he or she is engaged in exerting control over others. The individualist's success is often measured by the size of following commanded (Thompson *et. al.*, 1999). The last form is fatalistic solidarity; found where a person excluded from group membership aligns with other exclude in ceasing to attempt to influence the decisions that rule his or her life (strong grid but weak group in corporation). Thompson (1997) argues that the cultural types of the grid-group scheme can be operationalised at any scale, from village to world. Interpretive flexibility can be seen as an asset of this theory. Thompson argues that for individualists, human nature is extraordinarily stable and self seeking. For fatalists, human nature is unpredictable. For hierarchists, humans are 'born sinful but can be redeemed by good institutions' (Thompson, 1997: 35) whereas egalitarians assume the opposite, that 'man is basically good but his nature is highly susceptible to institutional influences' (ibid.: 36). Hierarchists and egalitarians seek, respectively, to respect and dump the system.

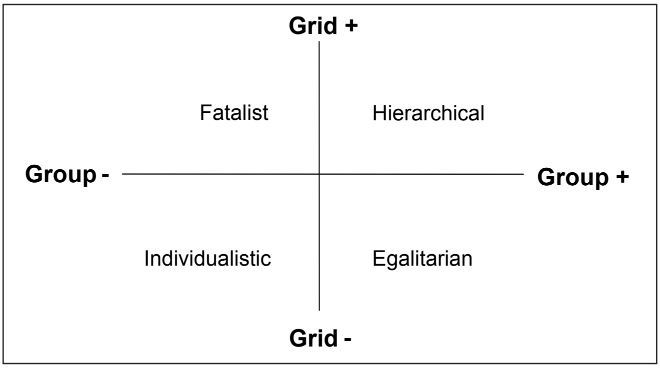


Figure 1.2 The four moralities framework of Mary Douglas (1978)

Collective action and social capital

The literature on collective action and social capital is extensive (*e.g.* Ostrom, 1990; Ostrom, 1992, Olson,1965; Meinzen-Dick *et al.,* 2004). Olsen (1965) proposed a logic of collective action, to explain under what conditions rational individuals might pursue a common goal. By collective action Olsen referred to group efforts to further group interest. His logic therefore encompasses almost all acts of participation where benefits are shared among a group of people. These goals may relate to tangible goods or to immaterial benefits, but they all have in common that if the goal is achieved, everybody benefits. A problem is that this can often be regardless of whether an individual contributed to its provision. This is sometimes known as the 'free rider problem', and it is a major barrier to effective functioning of cooperative groups. It was once assumed that commonly owned or managed resources were inevitably doomed to exploitation by free riders. But analysts such as Ostrom have shown that groups can, often, successfully exclude free riders. Commonly owned land, for example, is not necessarily a free-for-all, but subject to quite stringently enforced rules of membership and access.

The concept of social capital draws attention to the importance of relationships of trust, reciprocity and exchange, common rules, norms and sanctions, and the network connectedness of groups as an aspect of functionality in social processes. Important mechanisms for building social capital assets are listed by Wu and Pretty (2004). Typical examples in this study include the various mechanisms that stimulate social solidarity, such as the trust building, reciprocity and networking behind pest control, in which groups of farmers negotiate and set up roles and rules collectively for community frog protection. Many studies show that a positive balance of social capital facilitates collective action (Putnam *et al.,* 1994, Ostrom 1999). The World Bank has organized a wide range of discussions concerning the application of social capital in development activities. But in criticism, some people argue that social capital is no different from other forms of capital, in allowing or encouraging big people or *jao pho* to accumulate it to the disadvantage of the community. An example would be where a powerful local business position was created through a combination of aggressive entrepreneurship coupled with local political connectivity to exploit new profit making opportunities emerging as a result of the expanding Thai economy (Turton, 1989). To build up their informal influence in the local community, *jao pho* extend patronage to ordinary people, including low ranking officials, and develop their own inner circle of friends, associates and dependants (Phongpaichit, 1994: 85). There are several definitions of social capital. The notion, as used in this thesis, centres on ideas about shared knowledge, norms, and rules, and expectations about patterns of social interaction that groups of individuals bring to activities, and in this case apply to local technological development.

If social capital refers to a structure of social relationships, then collective action can be understood as one of the flows associated with it (Uphoff, 2000). Uphoff sees social capital as a kind of cognitive resource (knowing with whom and how to combine resources and effort). In effect, the two forms of social capital exist side-by-side in structural and cognitive forms. Both forms arise from the mental rather than the material realm, so both are ultimately cognitive. But structural forms are indirectly rather than directly based on mental processes and relatively external and objective, whereas the latter forms are purely mental, and thus interior to the mind and not observable like structural forms. Under the category of structural social capital, Uphoff (2000) includes roles, rules, procedures, and precedents as well as social networks that establish on-going patterns of social interaction. In particular, roles for decision-making, resource mobilization, communication, and conflict resolution are supportive of collective action. On the other hand, norms, values, attitudes and beliefs that predispose people to cooperate are forms of cognitive social capital conducive to mutually beneficial collective action (MBCA); Uphoff considers MBCA as the benefit most generally associated with social capital. There are also beliefs and cultures containing basic elements of social capital, but social structures and shared values can be devalued through neglect or misuse. On the other hand, individual motivation is fundamental for building social capital assets, which are now viewed by some authors as being comparable with natural, physical, financial, human and political capitals, and instrumental in building other forms of capital (Meinzen-Dick *et al.*, 2004). However, other analysts tend to regard social capital as collective goods (Ostrom, 1994; Putnam, 1993). Social capital is, on either reckoning, a way of labelling the basic social equipment with which collective action is undertaken. By implication, where it is lacking collective action will prove inadequate or impossible.

Actor-oriented approach and knowledge

The actor-oriented approach in development studies takes a social constructionist approach to the understanding of how different stakeholders shape or react to technical and social change. The social interaction of actors and their knowledge and agency is, according to Long (1992), the focus of the actor-oriented approach. An example would be the form of interaction in agro-technology development exemplified by the decision of individual farmers to become involved in double transplanting, where knowledge has a long time developed and diffused among farmers as agents. Similarly, contributions by individual farmers towards modifying the weed slasher machine for rice harvesting could only be fully understood by taking account of the individual agency of the actor, even though a full account of actors and agency also requires taking into account both the collective representations and social capital. For this reason the three perspectives are treated – in this thesis – as combined explanatory elements. Long (1992) stresses that individuals are part of or even constituted by a wider web of relationships that impinge on their practices and actions. Hence, he proposes to speak of the social actor rather than the individual. This means that any changes affect not just this individual, but also the group to which the individual belongs. The approach helps to understand what holds society together. However, what actors do should not be overlooked, and researchers need to be interested in what interests actors, what they believe, why different actors choose to do what they do, and what motivation lies behind their actions. The individual actors are thus considered central focuses of concern, notwithstanding that individuals have certain roles within the community or group. The focal point of the actor-oriented aspect of the present study is how people interact, negotiate and cooperate around technology development. Agro-technological intervention results in actual changes to the status quo and the expectation of further changes. These changes are what Long (1992) calls structural discontinuities, *i.e.* they are what people react to when they decide how they are going to adapt and transform a technology and their social networks to meet their needs and ambitions.

Analytical approach

The overall research aims to contribute to sustainable agricultural development through a focus on the organised interaction of farmers around technology generation, and on the necessary institutional linkages to enable this collective approach to technology development to be up-scaled to serve as a regional or national approach to provision of technological services to small-scale farmers. Primarily, the research focuses on the impact of forms of collective action on effective use of technology in the context of rural communities in Northern Thailand. Likewise, it takes an interest in the reinforcing effect of technology use and innovation on the sustainability of forms of collective action (Figure 1.4). Collective action is considered as a mechanism to improve outcomes of agro-technology development among small-scale farmers. The focus is on the conceptualisation of three aspects of collective action: (1) forms of collective action, (2) social organisation of collective action in specific technology development cases, and (3) outcomes of the forms and management of collective action in technological innovation. The research examines the social organization of benefit sharing, trust building and sharing knowledge, which are key aspects in managing collective action. The roles of key actors in the village are described for the different case studies in terms of how they contribute to these processes.

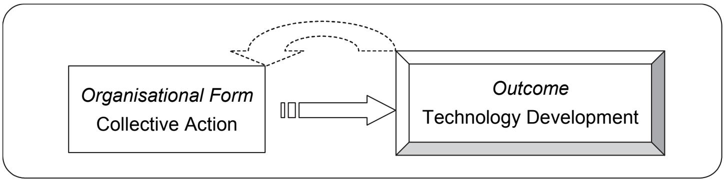


Figure 1.3 Analytical focus: the configuration of collective action and technology development

Grid-group theory will be used as a framework for trying to unravel the hybrid nature of the specific organizational forms of collective action. The case studies investigate how these specific forms affect the success of participatory agro-technology development in various cases of rice farming in Northern Thailand (community rice seed production (CRS), community frog protection (CFP), development of a weed slasher machine harvester, adoption of green manure technology, and introduction of contract farming. Relating successes and failures of agro-technology development to the organizational form of collective action potentially offers a way of conceptualizing ways of improving collective action for rural development. Additionally, by using the grid-group approach, an attempt will be made to understand the form and function of two cases of organizational hybridity. In the Green Manure Cover Crop project (Chapter 5) a grid-group analysis pinpoints some areas for reform of the NGO participatory approach. In the second case - contract farming (Chapter 6) – the club-like organizational form associated with the green-manure project is replaced by a form where the joint-interests of farmers and companies depend on mobilizing social solidarity and collective action as well as on concerted planning by farmers and companies, to reduce crop risk and to achieve desirable performance.

The success or failure of collective action often depends on a combination of organizational forms and the articulation of feedback and brokerage via participatory approaches. This explains the research's interest in the social actors managing interfaces, building on the actor oriented approach, between the community and external agencies, such as the monk, the village leader, the extension officer or the company's field technician. These actors can play a decisive role in supplying feed back and they can also be engaged in brokerage between community interests and institutionally remote agencies, such as government or companies. In its approach, the thesis recognises the importance of socio-economic and agro-ecological conditions for explaining the sustainability or absence of forms of collective action in specific villages. The research took place in a village with viable forms of collective action and in another village, included for comparative purposes, where off farm employment affected labour use and household composition in such a way that collective action eroded or had a different orientation. However, the research design is not meant as a systematic comparison of the conditions for collective actions in the two villages. The contextualisation of the configuration between collective action and technology development, the prime focus of this research, is summarised in Figure 1.3.

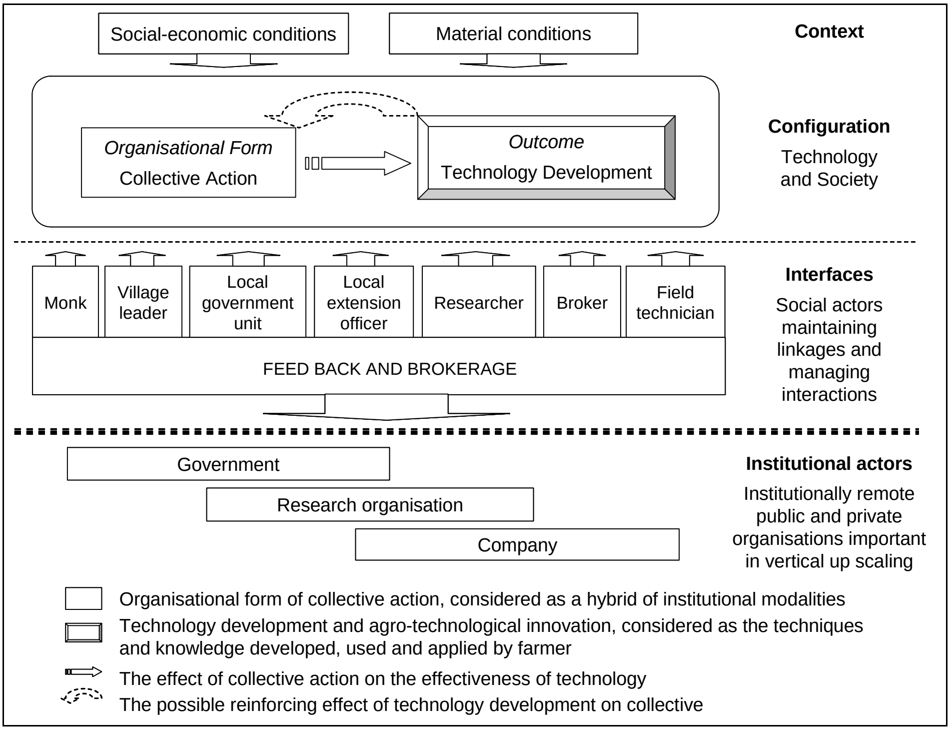


Figure 1.4 The analytical framework of collective action as a mechanism for technology development.

1.5 Research methods

The research is based on several case studies in the villages of Dong Palan (DPL) and Buak Mue (BM) in the same irrigation scheme in Mae Teang district, Chiang Mai province, Northern Thailand. Both qualitative and quantitative methods were used for data collection. The methods and techniques used depended on specific or prevailing circumstances at each stage. Qualitative methods are flexible, allowing the researcher to adopt methods to fit the local situation. Qualitative methods can also be used to help design and implement quantitative methods. On the other hand, information from quantitative methods helps the researcher to choose case-study sites with more in-depth analysis (Kanbur, 2003). Semi-structured interviews of key informants, group meetings, focus group discussion, farmer workshops and participant observation were all employed in the present study. Interviews were used to reconstruct the interaction of the social group, and individual respondents were treated as sources of general information (Schwartz and Jacobs, 1979; 38-45). The case-study analysis is based on fieldwork in which participant observation of farming activities throughout an agricultural season was combined with farming systems data collection procedures (*e.g.* through transects, questionnaires and rice field monitoring to collect data on irrigation, and soils).

In this section I describe the combination of methods used during three phases of my research: beginning stage of exploration and survey, second stage of moving forward with participatory observation and field work, and interview, and the last stage of assessing of evidence and the way forward.

Interviews and measurements

The participant observation method provides opportunity for the field worker to place individuals in a group context and gain a realistic picture of the dynamics of individual and group behaviour (Whyte, 1984). When combined with the interview, this offers a potentially powerful way to consider evidence concerning whether a purported relationship does or does not exist (Schwartz and Jacobs, 1979: 45-58). Participant observation gives meaning to certain attitudes or beliefs through the activities and interactions these attitudes and beliefs generate in a given setting (Crabtree and Miller, 1992: 47). On the other hand, social interaction analysis indicates the characteristics of different people as self-organized for group activity and group interaction. Patton (1990) describes the way in which human beings interact to create social ecological constellations that affect how participants behave toward each other in the environment.

Beginning stage: exploration and survey

The initial phase of exploration and survey was carried out in order to select sites for case studies. The initial phase in 2002 was organized with informal meetings in different locations. The objectives were to get ideas about what really was happening on the ground and to assess farming situations and key issues in rice and soil management practices regarding sustainable rice production. The subsequent farmer workshops and group meetings included local leaders and group representatives from different locations. Focus group meetings were also held with key informants in places where the green manure crops had been introduced. History also plays an important part in understanding the social environment (Patton, 1990: 216-223) and many studies have demonstrated how important historical enquiries can be as a critical part of the learning process in the field (Whyte, 1984:153-61). The historical context in regard to village setting, land use, and cultural practices was derived from focus group discussion with old aged people and follow up by individual interviews where necessary. Early in the 2001-2003 fieldwork period a meeting with the extension officer was organized for site selection and to assess farming characteristics and human relations. Subsequent interviews were conducted with agricultural services personnel and village farming development plans were inspected. Individual interviews with the director and field staff of the Provincial Office of Land Development Department [LDD] was aimed at understanding the current situation and gathering background information on soil improvement technology interventions established by LDD, in order better to explore farmer practices in green manure and cover crop usage. Desk reviews helped understand the physical characteristics and general state of rice farming in Northern Thailand.

Second stage: moving forward

After familiarization with farmers' practices, participant observation was undertaken with farmers, involving work in agricultural activities in the field and informal meetings during lunches and celebratory occasions, etc. to understand the performance of local rice agriculture, the social relationships involved, and patterns of social networking. In 2003, the main information was gathered on management practices and general farming and non-farming activities, and on conditions for group activities, based on farmer dialogues and group meetings. Then, an open-ended questionnaire was used on group management activities and the benefits from those activities. Videos were recorded of particular group activities and shown later to groups to get feedback on technologies developed in a group context, and to probe further about agricultural group activities and social mobilization activities in the village.

Key actors such as village headmen, group leaders for rice production, frog and maize groups, housewife groups, committee members, a monk and a retired teacher were interviewed to understand the whole picture and the part played by these key actors. In the case of community rice seed production, non-group members and group members of the community rice seed production (CRSP) in two villages were interviewed in 2004 (62 households in DPL and 70 households in BM village). The information on communal rice seed production was included in the 2005 interview round at DPL where farmers had produced community rice seed on communal plots instead of on individual plots. Monitoring and evaluation processes were undertaken together with farmers and an invited researcher from the rice research centre of the Department of Agriculture in order to help farmers understand the selection procedure for foundation seed production.

Additional open-ended questionnaires were used to randomly interview farmers in the two villages on management practices, strategies and decision making in pest management through frog conservation, double rice transplanting and bio-fertilizers as plant nutrients. Several methods were used to collect data on contract maize farming, such as focus group meetings, to understand the contract process and farmer practices with hybrid maize, labour arrangements and the incentive systems. In-depth interviews were carried out with 50 households in DPL who had engaged in maize contract farming. They were asked about their management practice, and about the costs and benefits of the contract system. Individual interviews also included the issue of farmers' perceptions on maize production under contract farming.

The in-depth case study was carried out in Mae Teang district, an area where there are differences in cultural background and in community rice seed production project activities. BM village was the first area where the green manure crop technology was started in 2001, and DPL village was where farmers started to experiment with a green manure crop in 2004. Interviewing was carried out mainly in two villages where soil improvement technology had been introduced. The interview included questions on local knowledge and local practices of soil fertility improvement, perceptions of green manure crops, and the input costs, including labour, for green manure technological practices. The contract farming case was a focus of attention in DPL village where two contract companies were involved.

During 2004-2005 various kinds of information on aspects of community development, especially in regard to agricultural development, were collected from researchers at various institutional levels; Department of Agriculture Extension, Department of Agriculture, and Land Development Department. The head of the field research staff of the Pioneer Maize Company in Lamphun province and various brokers were interviewed for an overview of the contract system, the incentive system, and relevant issues concerning company policy on maize contract farming in Northern Thailand.

The last stage: assessing of evidence and the way forward

The condition of collective action in DPL was accessed from formal meetings with key actors. Individual interviews and group meetings were organised at various times in 2003 and 2004. In 2004-2005, the information gathered during field work was discussed in group meetings with farmers in DPL and BM, in order to make further corrections and to receive farmer responses on their problems and how they might be mitigated. At the final stage, the challenge was how to expose the research findings so that they influence research in local technology development institutions. Therefore, two stakeholder workshops were organized, aiming at farmer feedback and visioning activities on the future of farming and the possible ways of improving contract farming to make it a socially just system. The village headman, agriculture group leaders, both men and women, and other key leaders from the *tambon* council were invited to the workshops in DPL and BM villages.

Scale of analysis

The primary research units are the villages of Buak Mue and Dong Palan, Mae Teang district, Chiang Mai province. Multiple units of analysis, including households, community, groups and institutions were used to generate data on participation in collective activities, as well as outcomes from collective action. The intra-household level data - such as the cost–benefit distributions-vary between male and female members and from individual to individual in the same household. However, to understanding the effectiveness of collective action and collective cooperation requires multiple units of observations and analysis, including at individual, group, farm and landscape levels. The temporal scale is also important, and at times analysis is required across an historical profile in order to understand the socio-cultural dynamics of community orientation towards collective action.

1.6 Structure of the thesis

This thesis consists of seven chapters, including this introductory chapter. Chapter 2 aims to present local context and communities' practices at the beginning to better understand what happens on the villages and to have some general pictures before going into analysis of case studies in Chapters 3, 4, 5, and 6 (Table 1.2). The chapter explains the physical and social context of the two study villages including the community setting, farming system, land use and labour systems, local organization in response to community development, and some characteristics of cooperation and group behaviour in Thai culture as applicable to the two locations from which four case studies will be drawn. The empirical findings associated with these case studies are presented in Chapters 3-6 (Table 1.2). Chapter 3 is a detailed case study on collective action in CRSP in both villages (BM and DPL). The chapter aims to find out how farmers manage collective action and how CRSP technology works and in what conditions.

Chapter 4 considers local initiatives and technologies in rice farming systems and explains how these initiatives emerge and work. The chapter also explains how collective action contributes to sharing knowledge and helps to develop certain technologies. The three local innovations analysed in Chapter 4 are community frog protection, double transplanting, and adoption and modification of a weed slasher machine for harvesting rice.

Chapter 5 explores the participatory approach in technology development, involving both collective action between farmers and between farmers and research institutions, the Multiple Cropping Centre [MCC] and the Land Development Department [LDD]. Specifically, the case study concerns the initiation and adaptation, and the changing nature of farmer adoption of a green manure and cover crop (GMCC) as a soil improving technology for rice productivity in the irrigated lowlands of Chiang Mai province and other rice growing areas of Northern Thailand. The chapter aims to understand how agricultural systems could be made more sustainable through the right kind of interaction between various actors linked by feedback mechanisms associated with the participatory approach.

Chapter 6 is a case study of contract farming as a business modality for 'participation'. This chapter looks at technology performance and collective action in two companies: Chiang Mai Frozen Food and Pioneer. It focuses on the extent to which contract farmers and companies have a joint interest in making technology work.

The concluding Chapter 7 reviews and summarises the outcomes of the case studies and elaborates upon the possibility of scaling up approaches to participatory forms of technology development, and strengthening the links between local communities, development agencies and technological research institutions.

Table 1.2 The key features of case studies

Case study	Institution support	Location	Technology	Outcome of technology development
1. Participatory seed multiplication	DOAE support	DPL-BM	Rice seed production	- communal seed plot - access to market - produce own seed
2. Local innovation				
2.1 community frog	DOAE	DPL	Pest control	- pest control
2.2 rice harvester	Farmers	DPL	Weed slasher machine for rice harvester	- more efficiency in harvesting
2.3 Double transplanting	Farmers	DPL	Double transplanting	- maintain productivity under unfavourable conditions
3. Learning or diffusion in green manure	MCC	DPL-BM	Green manure crop	- reducing the use of chemical fertilizer
4. Joint problem solving in contract farming	Company	DPL (island)	Maize, sweet corn and vegetable soybean	- Performance improvement in contract farming of cash crops

Chapter 2

The environmental and socio-cultural context of two farming case-studies in Northern Thailand

2.1 Introduction

The present chapter looks at the environmental and social background of two farming case-studies to be presented for subsequent discussion of land use and farming systems later in this thesis. The case study villages, Buak Mue (BM) and Dong Palan (DPL), are set within the regional context of Northern Thailand. The case study analysis is based on fieldwork where participant observation of farming activities throughout a farming season was combined with more quantitatively-oriented farming systems data collection (*e.g.* soils and irrigation practices) using transect survey, questionnaire and rice field monitoring methods. The present chapter will provide a basic idea of the local context in Northern Thai villages where farming is a complex interaction between biophysical and social cultural contexts. Livelihood analysis and historical accounts of collective action are presented according to different technology innovations. The chapter provides support for Chapters 3, 4, 5 and 6, in which different forms of collective actions are examined in the two case study settings. The discussion in the present chapter will also include commentary on the main conditions in village for collective actions, such as constraints imposed by land use and land tenure systems and organization of labour, and address issues concerning the part played by non-farm labour and family labour (especially gender roles) in rice farming and production of other cash crops. The two typical livelihood strategies of rice farmers: farming based and farming with off-farm based, are presented, as well as the social functions that affect collective action in the village.

Smallholder rice farmers are faced with challenges that will increasingly affect their future. These are labour constraints, reduced access to land, marketing risks, and increasing costs of inputs. Under such circumstances, smallholder rice farmers adopt livelihood diversification strategies to cope with uncertainties, such as seeking off-farm work, arranging exchange labour, designing crop diversifying land use systems, improving cost-effective or cost-reducing production practices, and engaging in contract farming. The majority of small-holder rice farmers in the irrigated lowlands are (in part) tenants, farming parcels of land they both own and rent from absentee landlords. Since the 1980s, cash crop expansion, trading and urban business have created highly profitable local monopolies of individuals or local families, also through collusion with local officials. These rural businessmen became known as *chao pho* or *spirit lords* who distributed their patronage around their locality while often themselves moving to the city (Phongpaichit and Baker, 1997: 29-30).

Two contrasting strategies are common with the smallholders. One is dominated by off-farm work and focus on cultivation of a less intensive rice-soybean cropping system. The other is to pursue a farming-based livelihood strategy by continuously adopting intensive crop-based systems, and seeking crops with a more secure market through various forms of contract farming arrangements. Social infrastructure in the village is an important element determining the sustainability of smallholder farmers in the globalizing economy. Villages with better interwoven social groups provide stronger support for the land use intensification option. Contract farming, which demands skilled farm workers, has been shown (Watt, 1994; Vellema, 2002; Glover and Kusterer, 1990a; Glover and Kusterer, 1990b) to work best in villages where smallholder farmers have strong social relationships. As a majority of farmers are tenants, the future of the farm-oriented livelihood system largely depends on the right of access to land. Recently, there has been an increasing trend for an absentee landlord of the village to take back his farmed land and turn it into housing estates and other non-farm uses. Off-farm employment has become major source of household income especially with the younger generation, who are leaving the farms, so any continuation of the farming-based strategy will have to be highly adaptive not only to environmental but also factors of social change, such as labour mobilization and labour substitution of tenant farmers, and non-farm land use strategies of business oriented land owners.

2.2 Geographical and agro-ecological features of rice ecosystems in the Upper North

Topography

Buak Mue and Dong Palan are located in Kee Lek sub-district in Mae Teang district and situated in the north of Chiang Mai province. Both villages are well connected to the road system, which starts about 42 km north of Chiang Mai. The Mae Teang is under irrigation area. The main water source is the Mae Teang irrigation project and Ping River as later will be explained in this Chapter. The two villages studied, Buak Mue (BM) and Dong Palan (DPL) are among 10 villages administratively under the sub-district *tambon* Kee Lek. The district is *amphoe* Mae Teang, and province is *changwat* Chiang Mai. In BM, where half of the residential and farming areas are situated on the eastern boundary near the highway, the people and the land are governed by the San Mahaphon *tambon* Municipality (Figure 2.2).

The village of BM is located at the western side of the Chiang Mai-Fang Highway No. 107 (Figure 2.2) to the North of Chiang Mai, where it crosses the road No. 1095 that runs toward the Western hills of Mae Hong Son province and what is known as ''city of the three mists'', a touristically highly attractive region where the hill tribes live. All the lowland paddy fields are distributed along the western side of the main highway. A transect walk from this highway to the foothills in the West revealed lower patches where water accumulates. The area is flood prone and farmers use it to plant dry season rice (Figure 2.1a and 2.2). The village of DPL is located on the east side of the Chiang Mai-Fang Highway No. 107 and its residential and farming areas are bounded by the Ping River on the east. The paddy fields of both villages are connected and located on the western side of the highway, in a block (55ha) in which 115 households cultivate rice. However, on the eastern side of the highway, in the lowland fields, farmers invest in tube wells or pump irrigation from the Ping River. The farming area between the residential area and the Ping River is locally known as the island, because annual flooding tends to isolate this land in the loop of the river. Farmers are able to use the farming area of the island to grow sweet corn, vegetable soybeans, hybrid maize and vegetables (Figure 2.1b, 2.2).

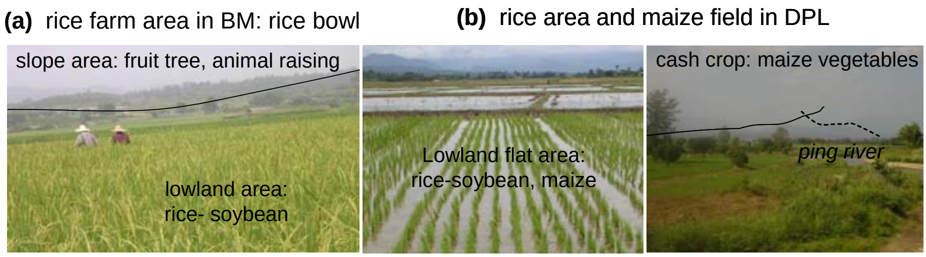


Figure 2.1 Topography of farm area (a) rice farm area in BM and (b) rice area and maize field

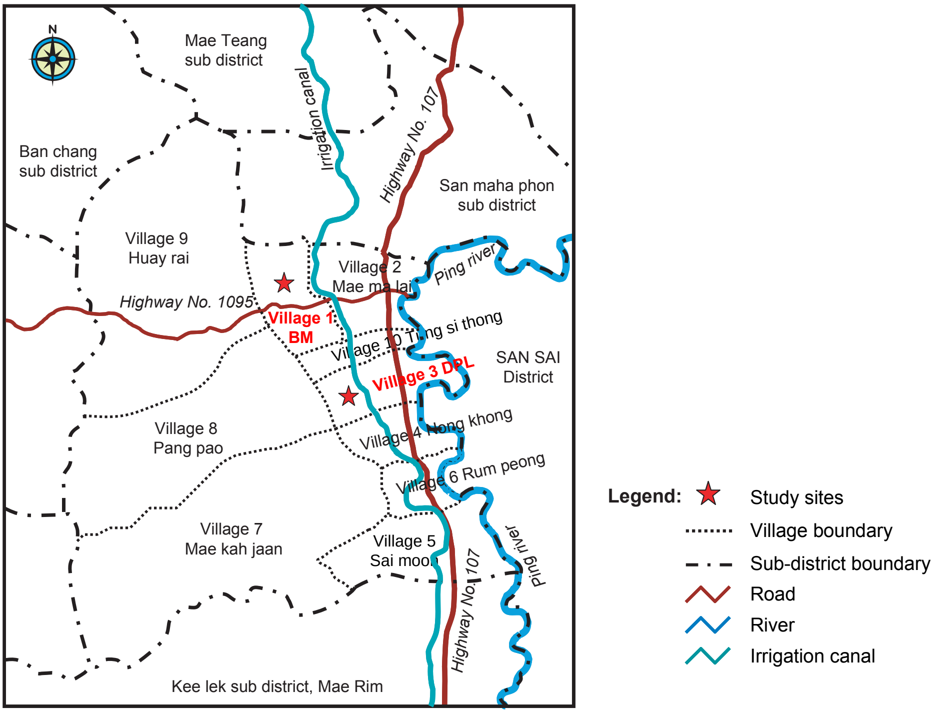


Figure 2.2 Topography of two village studies

tambon Kee Lek occupies 6,054 ha of land. About 50 percent (3,014 ha) of the total land area is upper terrace or hill slope and 32 percent (1954 ha) is lowland. The remainder of the area comprises water bodies (2 percent) and unclassified land (16 percent) (Table 2.1). BM village has total area of 302 ha or about 5 percent of the *tambon* Kee Lek land area. Within BM lowland accounts for 89 percent (269 ha) and the rest is sloping land (8 percent), water bodies (1 percent) and others (2 percent). DPL on the other hand, occupies a smaller area (about 276 ha) within which lowland accounts for 57 percent (158 ha). There is relatively large proportion of unclassified land (36 percent). Sloping land comprises 7 percent (19 ha). The villagers have occupied the sloping land, but members of the community are allowed to use the un-cropped area for cattle grazing during the rainy season. Fruit trees such as *longan (Dimocarpus longan)* are the crop most commonly grown on the sloping land.

Table 2.1 Topographic characteristics of case study areas

village	Total area		Lowland area		Slope area		water		Others	
	ha	(%)	ha	%	ha	%	ha	%	ha	%
Buak Mue	302	5	269	89	24	8	3	1	6	2
Dong Palan	276	5	158	57	19	7	1	0.3	98	36
Total of *tambon*	6,054	100	1,954	32	3,014	50	94	2	992	16

Source: Department of Agricultural Extension, 2005

Climatic conditions

Chiang Mai has a semi-humid tropical climate with a total average annual rainfall in the range 1,100-1,300 mm, with a dry spell of three weeks commonly occurring between late June and Mid-July. Most of the rainfall occurs between May and October, with August and September being the rainiest months (Figure 2.3). In areas where irrigation water is less available, farmers commence their annual rice planting season when the dry spell is over, from late July until the first week of August. Agronomically, the Upper North (including the study area) has three growing seasons; the hot-humid rainy season from July to October when annual rice is planted, a cooler dry season (November-February) when rice is matured and harvested (to early December) and in which crops such as temperate vegetables, onion, garlic, soybean, tobacco, potato, tomato, etc (Table 2.2) are planted to capitalize on the cooler growing conditions from November to January, and a hot dry season from March to June when short-maturing crops such as sweet corn, vegetables, can be planted under irrigation. Long maturing small fruit – type spice crops such as chilli can be planted in mid-February, and begin to provide a first harvest from late May until July. With irrigation water, the lowland rice farmers can adjust their cropping systems according to take account of favourable sunlight conditions in the drier seasons.

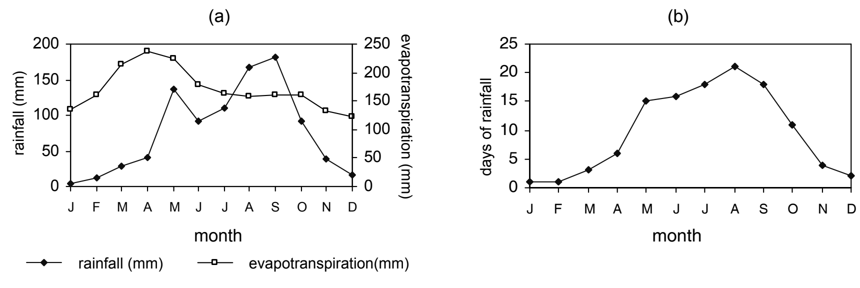


Figure 2.3 (a) average monthly rainfall (mm) from 1981-2005 and evapotranspiration (mm) from 1971-2000) at Chiang Mai (b) monthly rainfall (day) from 1990-2005

Source: OAE, 2005

Table 2.2 The cropping seasons of the irrigated lowland study area in *tambon* Kee Lek

Area	Rainy season				Cool season				Dry season			
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Upper North*	non-glutinous (RD6) rice (RD 15, SPT1, KDML 105, etc.				vegetables, chilli, garlic, soybean, onion potato, tomato, potato				sweet corn, vegetables			
mae taeng district **	non-glutinous (RD6),early mature rice (SPT1) or KDML				maize, sweet corn, vegetables, soybean, tobacco				maize, sweet corn, vegetables, rice			

Source: * Ekasingh, 2004, **Survey, 2004

Sources of water for agriculture

The Ping River and its tributaries are the major water resources for agricultural intensification in Northern Thailand. The irrigation systems - traditional and communal[5], known locally as *muang fai*[6], or the government system (under the responsibility of the Royal Irrigation Department) - are diversion systems (see Figure 2.4). Both systems are designed to provide supplementary water for rainy season rice, particularly during land preparation and transplantation, and to overcome dry spells in late June to mid July. The amount of irrigable land for dry

[5] According to the Peoples Irrigation Act of 1939 the government attempted to replace older social and water management structures with water user groups, although this intervention was unsuccessful until embodied in the National Irrigation Act of 1942. In fact, traditional *muang fai* and national systems worked side by side in the North until the 1960s, when pressure to conform became overwhelming in the face of limited water use choices for small traditional schemes surrounded by the national systems. By then, the high maintenance and replacement cost of the traditional weirs was also a disincentive. Government officials assisted this modernizing influence through irrigation committees where their status overshadowed the traditional path to local power for village from water manager to headmen of the *tambon* (Falvey, 2000; 128-129)

[6] The *muang fai* irrigation system was used on fast flowing streams up to twenty metres in width, across which weirs elevated water by up to two or more meters (cf. Vanpen, 1989). The *fai* held back water which was directed to major and minor canals known as *muang* in which gates, tang, controlled flow rates. Where a *muang* could be constructed by diverting water from a river, no *fai* was needed. Constructed from bamboo and wooden stakes driven into river bed against which rocks, poles and sand were placed, the *fai* allowed water to pass through and over the barrier while restricting the rate of flow and thus raising the water level. Annual maintenance necessitated by peak wet season water flows formed the basis of community ownership of these resources. The system allowed the development of pollitics ruling over several *muang fai* in a river valley, although schemes on the larger northern rivers remained independent through to the nineteenth century (cf Cohen, P.T. 1980). The system required social organization (cf. Attwater, 1998) and systems were managed through the local rulers as a mean of coordinating irrigation or rice fields belonging to a significant proportion of the populace. The social organization on which the management of the system was based evolved to rely on officials, such as the *khun Nai Fai* and the *Hua Na Fai*, as managers of systems on behalf of the ruler. These offices become the basis of local leadership. Leaders were elected by those participating in the irrigation system. The irrigation manager's responsibility was to calculate the a month of water and its allocation to individual farmers, coordinate the initial construction of weirs and canals, coordinate annual repair required after each wet season, manage propitiatory and other rituals associated with rice culture and collect frees for irrigation system maintenance and associated rituals. The *muang fai* system serving Thai agriculture until the twentieth century, the *muang fai* system was eventually incorporated in the national Royal Irrigation Department system where it was superseded by developments in pumping and piping technology (Falvey 2000).

season cropping will depend on the amount of rainfall during the rainy season along the upper water-shed or beyond the headwork of the diversion weirs. In addition to access to systems based on diversion weirs for dry-season irrigation, farmers also invest in tube wells using diesel pumps to draw water for irrigation. Electric pumps along the main river have also been installed by the Department of Energy Promotion, to provide irrigation water for small areas of about 3000 *rai* (480 ha).

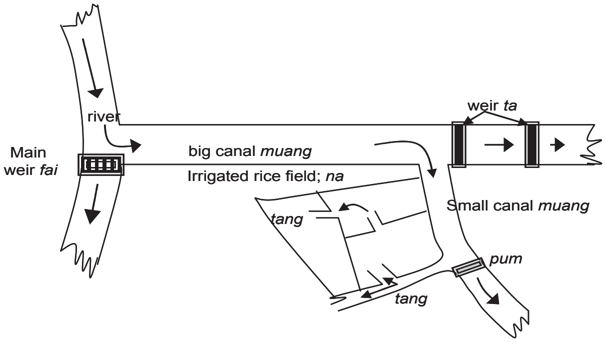


Figure 2.4 The *muang fai* irrigation system adapted from Surareks, Vanpen (1998).

In Chiang Mai, there are three major irrigation projects, namely Mae Teang, Mae Fak-Mae Ngad, and Mae Kwaung, capable of irrigating 67,980 ha, or about 32 percent of the total agricultural area in Chiang Mai (Royal Irrigation Department, 2006). The Mae Teang Irrigation Project is of diversion type without reservoir to store water. Dry season irrigable land is less than in the Mae Fak-Mae Ngad and Mae Kwaung Projects which have included reservoirs in the system. However, the proportion of land use during the rainy season is highest in the Mae Teang irrigation project (Table 2.3).

The Mae Teang Irrigation Project is the largest diversion weir irrigation system in the Chiang Mai valley. The headwork is located at Mae Teang district. The two village studies are located in areas supplied by the Mae Teang diversion weir, built across the Mae Teang River, one of the tributaries of the Ping River. The scheme provides irrigation facilities to five districts of Chiang Mai Province (Mae Teang, *mae rim, muang, hang dong, and san patong* district) covering an area of 24000 ha during the rainy season. During the dry season, the Mae Teang Irrigation Project can cover only about one-third of the irrigable area (8,000 ha). The Mae Teang Irrigation Project (MIP) was completed in 1970. In fact the system was superimposed on a long-established traditional communal irrigation system. Rules and regulations on water use were established, long before the governmental scheme, through Water Users Associations (WUA), making irrigation water management a successful instance of community-based resource management. The distribution of water along the main canal and its 23 lateral canals is co-managed by the Royal Irrigation Department (RID) water engineer and the farmers' WUA. At the end of rainy season, the RID announces the amount of water available for dry season cropping. The WUA, with its community irrigation experts, *kae muang* will hold a joint meeting to decide about water delivery schedules.

The lowland paddy rice in both BM and DPL is irrigated by the Mae Teang Irrigation Project and farmers normally pay a water fee of *Baht* 15 per *rai* per year (*Baht* 93.75 /ha). This is paid by individuals directly to the WUA. In the dry season, priority will be given to non-rice annual crops, such as soybean, vegetables, onion, garlic, maize, tobacco, chilli, etc. Only in low lying waterlogged areas is dry season rice recommended. Fruit tree growers along the lateral canal or sub-lateral canals receive water last. In *tambon* Kee Lek, the area in which the case study villages BM and DPL are situated the lowlands are serviced by the lateral canal no.2. The communal irrigation expert *kae muang* is the village headman of BM. In each village, the community will nominate two farmer representatives to be assistants to the irrigation headman. In DPL, two farmers from the community rice production group have been nominated as village representatives for the communal irrigation system of lateral canal no.2.

Table 2.3 Planted areas serviced by three major irrigation projects in Chiang Mai

Irrigation Project	Rainy season		Dry season	
	Target Irrigable area (ha)	Planted area (%)	Target Irrigable area (ha)	Percentage of total irrigable area (%)
Mae Teang	23,680	70	9,472	40
Mae Kwaung	28,000	51	14,000	50
Mae Fak-Mae Ngad	16,000	55	11,200	70

Source: Modified from Ekasingh *et.al.*, 2005

Soil texture and soil suitability

The Chiang Mai region's soils are sandy loams, sandy clay loams, and clay soils. Organic matter content is typically below 1.5 percent, with P ranging from very low to low (10-30 ppm), and typically, K is below 50 ppm. (Gypmantasiri *et.al.*, 2004). The major soil textures in the study area are sandy loams for topsoil and sandy clay loams for lower soil. This type covers 58 percent of *tambon* Kee Lek (Figure 2.5a). Clay soil suitable for rice planting is also found in the area of BM and DPL villages (the total area suitable for rice in *tambon* Kee Lek is 260 ha). Some parts of DPL have a sandy clay soil texture (Figure 2.5b). DPL has two distinctive soil types and hence land use systems. Where the soils are clay loam similar to BM, rice-soybean is the main cropping system. Where sweet corn has been introduced, the crop is planted on raised beds to improve drainage. But in both villages soybean is planted with minimum tillage on clay soil, for the crop is more tolerant of wet soil than maize.

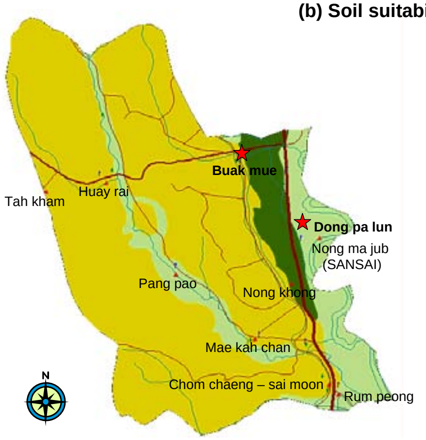
(a) Soil type map

Legend:

Soil Unit	Soil type	Area (ha)	%
Soil unit 16	Silt loam soil	5.61	0.12
Soil unit 29D	Clay soil	181.37	4.20
Soil unit 35B	Top soil – sandyloam Lower soil – sandy clay loam	124.08	2.88
Soil unit 48B	Top soil – sandy loam Lower soil – loamy clay	32.76	0.76
Soil unit 48D		1689.29	39.18
Soil unit 48E		818.96	18.99
Soil unit 5	Clay soil	260.04	6.03
Soil unit 59	Alluvial soil	722.27	16.75
Soil unit 62	Sloping area	478.16	11.09

- village
- temple
- school
- water way
- road

(b) Soil suitability for rice production



Legend:

Soil suitability	Area (ha)
Soil suitable for rice production	260
Soil suitable for rice production but sandy-clay soil texture	727.36
Soil not suitable for rice production due to high sloping area or cannot hold water	3329.44

- village
- temple
- school
- water way
- road

(c) Soil suitability for maize and sweet corn production

Legend:

Soil suitability	Area (ha)
Soil suitable but highly clay or sandy soil texture	124.16
Soil not suitable due to gravel mixture	32.80
Soil not suitable due to high slope area or cannot hold water	181.44
Soil not suitable due to flooding or highly water level destroy crop	987.52
Soil not suitable due to high gravel mixture	2513.12
Soil not suitable due to high slope area or cannot hold water	478.24

- village
- temple
- school
- water way
- road

Figure 2.5 (a) Soil unit map of Kee Lek sub-district, Mae Teang district, Chiang Mai province (b) Soil suitability for rice production of Kee Lek sub-district (c) Soil suitability for maize and sweet corn production of Kee Lek sub-district

Source: Land Development Department and Multiple Cropping Centre, 2000

Farming activities

Farming systems

Four types of farming systems dominate the farm landscape of *tambon* Kee Lek, Mae Teang district. These are (1) the less diverse irrigated rice farming system in the lowland, (2) the dry season rotational cropping after rice on rice land, and in the flood recession fields, *i.e.* the Island of DPL village, (3) fruit trees as permanent orchards on the upper terrace slopes, such as *longan*, and (4) the livestock integrated system (Table 2.4). The lowlands are under the Mae Teang Irrigation Project, and are provided with water almost throughout the year. The DPL farmers begin their rice planting land preparation when they have completed their cropping cycles in the island (Figure 2.7). The area is serviced by a tube well powered by a diesel pump, and water pumped from the Ping River. This water is available throughout the dry season. Several cropping sequences of non-rice crops, mainly sweet corn, glutinous corn, and hybrid maize seed are planted on contract (Table 2.2). Chili and egg plant are relay-cropped into sweet corn, making the island the most intensively cropped area from October to July.

Table 2.4 Farming systems in BM and DPL villages of *tambon* Kee Lek, Mae Teang district, Chiang Mai Province.

village	Rice			Soybean			*Longan* (fruit tree)			Livestock			Cash crop		
	ha	%	hh	ha	%	hh	ha	%	hh	ha	%	hh	ha	%	hh
BM	102	23	194	103	45	194	35	5	77	5	0.3	8	10	7	30
DPL	55	12	115	50	22	115	19	26	34	-	-	3	12	-	50
Total of *tambon*	447	31	1,352	228	16	991	748	12	787	23	0.5	20	144	10	613

Source: Department of Agricultural Extension, 2005

Note: Cash crop: tobacco, maize, corn, livestock; piglet, cow fattening

Rice farming

The rice growing areas in the Northern Thailand occupy about 2 million ha, or about 22 percent of the national rice area. The Upper North, consisting of 9 provinces, accounts for about 0.57 million ha, while the Lower North, covering 8 provinces, accounts for the balance of 1.43 million ha Physical conditions in the North, and particularly in Chiang Mai, are favourable to rice growing. Given an average rainy season, yields of 2.69-3.21 t/ha can be expected. These are substantially higher than the national average. The average dry-season rice yields are much higher, averaging 3.90 t/ha in Chiang Mai. Both regions have only about 30 percent of rice land under irrigation. The remaining 70 percent of rice is rainfed and allows single cropping only. In the single-cropping systems, the land remains fallow for about 7 months each year after the rice harvest.

The rice grown in the Upper North is mainly used for subsistence, based on a glutinous rice type, RD[7] 6, used in home consumption. Only in two provinces of Chiang Rai and Phayao, where farmers have larger farm sizes, averaging 3 ha per household does commercial rice production prevails. These two provinces are the major producing areas for high quality non-glutinous rice, KDML 105 and RD 15. The irrigated lowland rice system is characterized by diversified double or triple cropping systems (*i.e.* two or three harvests a year). Short maturing post-rice cash crops are planted sequentially, and include soybean, tobacco, potato, onion, garlic, tomato, and sweet corn. A majority of farmers who grow cash crops are independent farmers, producing and making direct marketing arrangements through local traders. Only recently – in connection with production of hybrid maize seed - has contract farming been introduced by the Pioneer-Hi-Bred International and by the Chiang Mai Frozen Food Company for vegetables, sweet corn, and soybean.

Mae Teang district has been served by the traditional communal irrigation system long before the construction of the Royal Irrigation Department (RID) initiated Mae Teang Irrigation Project. The completion of the RID Mae Teang Irrigation Project in 1970 marked the beginning of Green Revolution Technology in rice farming in Northern Thailand. New modern high yielding varieties (HYVs) were introduced to replace the traditional varieties. These new varieties included RD 1, RD 7, RD 10, etc. but these varieties were short-lived, for the *Lanna* (Northern Thai) farmer consumes glutinous or sticky rice, and the modern HYVs possessed poor grain quality. It was only after the new improved glutinous RD 6, derived from irradiated materials of the high quality non-glutinous KDML 105, was released in the 1980s in Chiang Mai province, that farmers throughout the North began to adopt a Green Revolution variety with enthusiasm. This has subsequently become the major glutinous rice variety in the North and Northeast regions. However, during the period of fieldwork in 2003-2005, a new high yielding glutinous rice variety, *san patong* 1 (SPT1) was introduced by the district agricultural extension officer for use in the community rice seed production project. Farmers in some areas have changed from RD 6 to SPT1 because of its higher yield than grain RD6.

Lowland rice farming system

In Chiang Mai, farmers start to plough the land in July when rainwater is sufficient. The land preparation for rice planting in Chiang Mai is later than in Chiang Rai and Phayao Provinces. During June-July most farm labourers are engaging in seasonal fruit picking of *longan*. The rice farmers would wait until they have finished with fruit picking, either from their own farms or working as waged labour.

Ploughing is done by small two-wheel hand-held tractors or by big tractors on contract. Transplanting is carried out by family labour, with hired and/or exchange labour from mid July until early August. Farmers try to complete rice planting before August 15. Late planting shortens the vegetative growth period, causing

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[7] RD stands for the Rice Department. The modern rice varieties released by the Rice Department are named after the Department. The even number denotes glutinous rice, while the odd number represents non-glutinous rice.

photosensitive rice varieties to flower too early. After transplanting, farmers will maintain water levels about 5 cm. Farmers will flood the rice field when the soil is semi-dry. There is variation in the practice of maintaining water levels after transplanting. In rice fields with heavy incidence of pest (pink snail), farmers will tend to drain the field to reduce pest problem. But in fields infested with crab, farmers try to reduce crab damage by flooding. Therefore, farmer water management choices are determined by plot history in relation to infestation, whether pink snail, crab, or weed.

In areas with a high water table and low lying fields, where flooding frequently occurs during August-September, farmers use a double transplanting technique (*klah sim*) to overcome flood damage. The system is more suitable to photoperiod sensitive varieties with tall plant type, such as RD 6. The principle is to strengthen the rice stem at a certain plant height so that the rice plant can withstand flood water (see details on double rice transplanting in Chapter. 4). The first transplanting is carried out when the rice seedling is 20 days old. Clumps of young rice seedlings, consisting of about 10-12 plants, are inserted into the flooded mud soils at closed spacing of 10 x 10 to 15 x 15 cm. Farmers leave some space between 6-8 rows of transplanted seedlings to ease the pulling of rice seedlings during the second transplanting (20-25 days after the first transplanting) in early August.

Farmers will not keep the rice field flooded all the time. In practice, they allow the field to be wet and dry through an alternation of irrigation. Farmers explain that the wet and dry system would allow the root to respire (*hai jai*), facilitating gaseous exchange, and making rice growth better. From the booting, the flowering (milk) stage (*kaow nam-num*) to the grain filling stage, farmers will be careful about water level. Water shortage during the reproductive stage will reduce grain yield. This is the critical stage in the rainfed environment where dry spells could affect yield. About 20-25 days before harvest, the field will be drained to facilitate harvesting either by combined harvester or manually. During harvest, various systems are used by farmers in Mae Teang according to labour and climatic constraints. The traditional harvesting process, which requires both household and non-household labour, involving rice cutting, then piling and threshing, requires 40-50 man-days per ha.

The use of the combined harvester (see detailed analysis in Chapter 4 of use of the weed slasher machine for rice harvesting), first introduced in large scale commercial rice production in the Lower North and the Central Plain, is available on contract. The service is provided by contractors from the Lower North during the harvesting season. In Chiang Rai and Phayao provinces, where farmers are increasingly shifting to broadcasting rice because of labour constraints, the combined harvester has speeded up the harvesting process, and thus transformed the rice cultivation system.

The irrigated lowland rice

The irrigated lowland rice system in the Chiang Mai Province is the most intensified and diversified land use system in the North. The case studies are situated in the lowland rice system. It is characterized by multiple cropping systems, with sequential planting after the rainy season, in which the main crop is rice and most cropping systems are capital and labour intensive. The impact of low crop price and limited availability of land has shifted farm labour to non-agriculture activities. As farm holdings are fragmented, with an average farm size of 0.8 ha, farm mechanization emphasizes small equipment such as the two-wheel tractor, which forms the most important asset of most rice farmers. The ox-plough and draught animal traction have completely been replaced by two-wheel tractors for land preparation. Where labour is expensive, hired tractors, rice combined harvesters and soybean threshers are readily available. Farmers constantly search for farm machinery to speed up the on-farm processes and keep the planting schedule on time.

The rice planted during the main rainy season is still the subsistence crop planted for household food consumption. Those who own more land will invest input in commercial rice production, planting high quality rice, KDM 105, as a cash crop. Almost all the rainy season varieties adopted by the lowland farmers, both rainfed and irrigated, are photo-sensitive varieties, harvested from November 26 to the first week of December. These include RD 6 (*kor cor* 6), KDML 105 (*hom mali*) and *niew san patong*. Labour is in high demand during the short harvest window for photo-sensitive rice. So the labour saving harvester fits well with the local, system. Cooperative action for labour exchange also helps maintain the process. However, there is a tendency for those who invest in high input-high return cropping systems to select non photo-sensitive non-glutinous rice varieties such as *san patong* 1 (SPT1), or early maturing local glutinous rice, so that farmers can capitalize on the early cool season in late October to mid November for planting of high value tuber crops, vegetables and small fruits. The high input cropping systems in the irrigated lowland involve rice, rice-soybean, rice-tobacco, and rice-maize combinations, etc., and are followed by third crops in the dry season such as vegetables, maize, and sweet corn (Table 2.2).

The high value cash crops grown in the cool season following rice are planted on a raised bed system; the beds are made by hired labour. Most of these crops are grown under contract, either for food processing (potato, tomato), or for frozen food and vegetables (sweet corn, vegetables). Only tobacco, which is a contract crop under a tobacco monopoly, is grown for the export market. These intensive land use systems mainly depend on chemical fertilizer, since there is no time slot for inclusion of green manure crops prior to rice cultivation. The double cropping systems such as rice-soybean are usually cultivated by farmers who have fewer resources of capital and labour. Soybean is the oldest crop grown by farmers in combination with rice. After the completion of the RID irrigation systems in 1970, the planted area of soybean in the Chiang Mai Valley steadily increased until it replaced the second rice crop in the dry season in the mid-70s. Its planted area declined relatively when farming areas were transformed to either fruit crops or housing estates. But among dry season crops, soybean continues to occupy the largest single proportion of planted area. The system makes better use of the full growing season, with long maturing rice varieties harvested in early December. The soybean will be planted under a minimum tillage system after rice in late December to early January. Early planting in November or in early December will retard seedling growth because of low night temperature. Thus soybean cultivation is regarded as the best late crop for rice-based cropping systems in the irrigated lowland. Soybean farmers normally also work as on-farm waged labour in the high input cropping system, as mentioned above. Crop management for soybean is less intensive than other cool season crops, thus offering chance for farmers to work off-farm during January to April, in activities such as handicraft, cottage industry, and construction work. The soybean planted after rice is about 110 day crop, and will be hand harvested during April. Occasional rain storms in mid April can cause severe lodging and crop damage. Most of the threshing is done on contract. The introduction and availability of threshers has helped the crop to escape weather damage during harvest. The land will be left fallow after the soybean harvest. Thus this system provides opportunity for inclusion of a green manure crop *(Sesbania rostrata)* as in May, before rainy season rice is planted. All double cropping systems in the irrigated lowland offer the possibility of incorporating *S. rostrata* as green manure crop.

Other crops

Other crops grown in this area include *longan*, an important economic fruit crop in Chiang Mai-Lumphun Province, established in permanent fruit orchards on sloping areas and in lowland areas around homesteads. Fruit trees are well adapted to Chiang Mai climatic conditions, and have been promoted widely during the last ten years. The processed dry *longan* is exported to China, the main market. With highly fluctuating prices, over-production and market failure, earnings from *longan* have decreased over the last four years. A new perennial industrial tree recently introduced by MOAC throughout the North and the Northeast is rubber. Rubber prices have increased due to increasingly high demand on the Chinese market. As a consequence, rubber has moved from its traditional production areas in the South to the East and then to the North and the Northeast. The village headman of DPL is the key person who began to introduce rubber in Mae Teang district, bringing rubber seedlings directly from the South and distributing to farmers in Chiang Mai.

Another cash crop, tobacco, has steadily declined since the Thai Anti-Smoking Campaign Project was formed in 1986 closely followed by the establishment of the National Committee for the Control of Tobacco Use in 1989. Mae Teang district was well known for production of flue-cure tobacco, but today the majority of farmers have stopped planting the crop. The Tobacco Monopoly, a state enterprise under the Ministry of Finance, contracts some farmers in BM to produce a cigar-type of tobacco for export. The Tobacco Monopoly pays four farm households in BM to grow cigar-type tobacco at *Baht* 5,000 per *rai*. They basically manage the crop in the field. All inputs are provided by the Tobacco Monopoly.

Crops driven by market demands, such as hybrid maize and sweet corn, are among the major cash crops at present, especially in DPL. These crops were introduced to *tambon* Kee Lek less than 10 years. They have good support, being close to processing plants, well connected highways and good irrigation facilities. Two contracting companies have invested ventures with Mae Teang farmers, namely Chiang Mai Frozen Food and the Pioneer Hi-bred Company (see details and discussion on contract maize in Chapter 6.

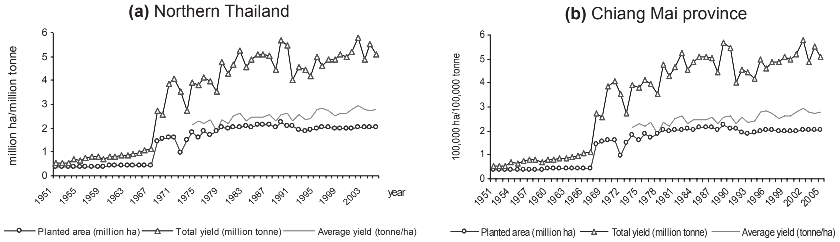


Figure 2.6 Rice planted areas, total yield and average yield (a) Northern Thailand, 1951-2005 (b) Chiang Mai province, 1976-2005

Source: Office of Agriculture Economics

2.3 Land tenure

Patronage systems and political power in Thai rural communities

The rural Thai agricultural community before 1984, as described by Nartsupha (1984, 11-18), can be characterised as follows: first, the family is the subsistence unit of production combining agriculture and manufacture; second, we find communal ownership of land and a high degree of autonomy of the community, supported by cooperative work; third, the village is exploited by the outside world, including the state; fourth, we encounter an apparent classless social structure and (relative) lack of exploitation within the community. Based on extensive studies of about two hundred villages across the country, Nartsupha identified three most influential groups consistent with architecture of rural power also found in the present study. First, there is a rich, landlord class, some living outside the villages but controlling agricultural land according to a class-like differentiation between landowner and the landless within the community (Nartsupha 1991: 232). This is seen in DPL although farmers have a right to use land without paying rent for maize. Their dependence on the landowners makes the farmers vulnerable, because land owners can reclaim land for non-farming purposes. This renter class is mainly made up of externally based bureaucrats and merchants. Second, there is a mercantile group whose wealth was built up through trade. These rural businessmen (Phongpaichit and Baker, 1997) exercise a power of patronage over villagers, for example by offering loans or necessary purchases on uncompetitive credit terms and through politics. Specifically, village representative are normally selected according to their wealth and the expectation of poorer villagers that they will continue to provide for community on favourable terms. Certain benefits are extracted in return. Thus, for example, the village headman in BM was observed to ask farmers to help his small business construction activities without payment. Moreover, in an urgent situation, the village headman can demand farmers to represent him in a seminar or meeting, and some of the poorer, more indebted farmers are not able to refuse. Among the group of rural patrons we must also class individuals with higher educational levels, such as teachers, councillors, *kamnan*, etc, who are highly respected, and therefore capable of exerting pressure and control over local politics and policies. Studies of participation in action cannot afford to ignore the power exercised by patrons. Sometimes, participation is not what it seems but the expression of the capacity of the well-placed to command the time and attention of other, less powerful or influential villagers. The case studies below will be alert to this possibility, as a factor in explaining why cooperation works, and where it begins to break down.

Land ownership in BM and DPL has changed hands for almost four decades, but land sales became more numerous during the economic boom of the early 1990s. Good farming land in the irrigated areas, as well as along the Ping River, was sought by influential individuals from either Chiang Mai city or Bangkok. More than 80 percent of farm land has been sold to big people from these two places. For instance, the majority of farm lands in BM are now owned by four rich families living in Chiang Mai. But in DPL, particularly on the island, most of the land belongs to politicians and rich business people from Bangkok. In late 2005, eight farmers in DPL, who used to cultivate sweet corn and hybrid maize seed on the island site, were asked to stop farming in the area, since the land owner had filled up the plots to free from flooding and turned them into construction sites. In both villages, the land is becoming too expensive for farming. Almost half of the farm households do not own land. Those who manage without renting land generally have farm sizes less than one hectare (average 4 *rai*, or 0.64 ha, for details see section on land use in this chapter). The large land owners, who formally resided in DPL and BM, have since migrated to the city, and offer their rice land for rent. The landless and land-deficit farmers have cultivated on rented lands for over two decades. Those large land owners who continue farming also set aside some part of their land for rent; they lack enough labour to cultivate more than about 5 *rai* (0.8 ha). However, given the generality of labour shortage, both large and small land-holders have to share labour for rice cultivation through exchange labour arrangements, especially during transplanting and harvesting periods, typically the major bottlenecks in wetland rice cultivation (Richards 1985).

A majority of farmers in both villages cultivate on rented land (56 percent of BM and 43 percent of DPL, Table 2.5). Based on data gathered from interviewing 122 farm households in both villages, the land tenure situations of farmers can be grouped into 5 types: 1) farmers farm on land they own, 2) farmers farm on plots they own and plots they rent, 3) farmers farm only on rented land, 4) farmers farm land offered by relatives without rent payment, and 5) landless households, plus those who do not engage in farming. Land is normally inherited by children from parents. In Thai agrarian society it is customary for the parents to give land first to their sons, and only to give to daughters when they have no sons. Some land owners when not using their land for farming would normally offer it to their relatives to cultivate without any rent but the farmers who used the land would offer rice as a reciprocal gift to the owners, as a token of appreciation. Only a few farm households (5-6 percent) cultivated land for free in both villages. The farmers who operated on their own land were small farmers with and average farm size ranging from 0.42 ha in DPL to 0.54 ha in BM. About 17 percent of the farm households in BM were smallholders who were able also to access rented land. But in DPL, only 7 percent of farm households were able to rent extra land for farming. In general, DPL had less land available for renting. Also, there were more landless households than in BM. The landless households had moved in from other villages, with no land to inherit from family sources.

Farmers preferred to produce the rice varieties KDML 105 and RD6 which are easier to market for a good price (8 *Baht*/kg. and 7 *Baht*/kg., respectively, whereas other varieties, such as SPT1, sold only at 5.50 *Baht*/kg. Some farmers produced certified seed (*i.e.* rice for sale as planting material) which sold at a higher price, 10 *Baht*/kg. However, the maximum area farmers were able to plant with rice each season ranged from 0.5 to 0.8 ha Limited in what they could plant, many farmers placed a higher priority on rice for household consumption over rice for sale. Farmers made careful decisions on any new practices, so as not to interfere with their production stability. Farmers who farmed on rented land only make verbal arrangements with the landlord about the method of payment. In practice, these tenant farmers have been farming their rented lands for decades. There was not much room for negotiation, since the terms of payment were determined by the landlord. But in BM, the village headman helped negotiate terms of rent payment. There were two (equivalent) arrangements - payment in cash was *Baht* 1,000 ha/year, while payment in kind was 625 kg of paddy rice/ha/year (Table 2.6). When the landlord wanted cash instead of paddy rice, the farmer might sell rice and return with cash. However, in DPL the rent payment depended on agreement between land owner and tenant farmers. Three types of rent payment were observed: cash, rice/in kind, and share cropping (50 percent of rice production). Generally, the rental payment was negotiable, but farmers preferred to pay by cash in both DPL (34 percent and BM (62 percent). The cost of cash payment in DPL varied from 2,200 to 6,000 *Baht*/ha (Figure 2.7). Payment in kind was the second most preferred way of payment. In fact, in BM farmers preferred this means (625 kg/ha). The range of variations in rent payment from farmer to farmer is shown in Figure 2.10. The fact that rental payments vary by a factor two, in both systems of payment, suggests that more factors are at play than a strict market for rental land. History, patron-client relationships and custom seem to play a part. The third method was a share-cropping system in which the rice harvest was equally divided between the landlord and the tenant farmer. However, in this case, the land owner paid for ploughing and seed, and in fact chose the variety to be planted. The tenant farmer meanwhile paid for fertilizers, pesticides and labour (Box 2.1).

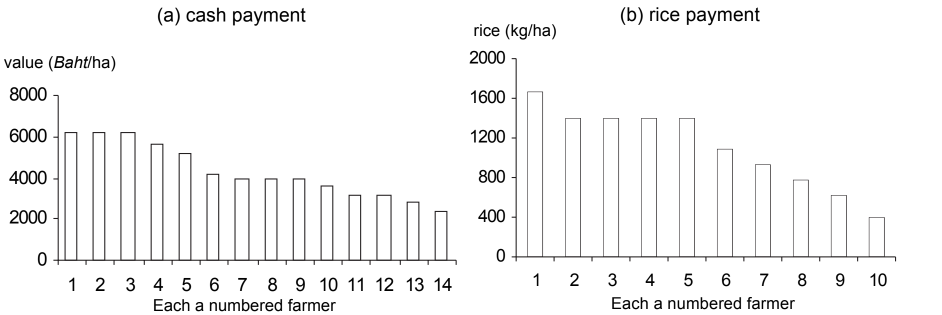


Figure 2.7 The example of payment system for land rent of rice cultivation (a) cash payment (n=14) (b) paddy rice payment (n=10)

Box 2.1 Examples of land rent payment systems, the plight of landless and land-deficit farmers in DPL

1. *The rent is fixed and paid in kind. Farmer Boontom rents 4.5 rai (0.72 ha) of land to cultivate rice for home consumption and for cash. He has to pay the rent in kind with 1200 kg of paddy immediately after the rice harvest. Boontom is entitled to use the land for the whole year without any further payment. In the 2004 season, Boontom was able to produce 4,900 kg of rice from a 4.5 rai plot, averaging 1089 kg/rai or 6.81 t/ha, which is considered to be an extremely high yield. Boontom will keep about 1,500 kg for annual consumption and for seed materials. He will have about 2,200 kg of rice to sell. Boontom selects the high yielding glutinous rice variety, SPT-1, which is a higher yielder than the older high quality rice RD 6. Boontom is expecting to sell his rice at over 5 Baht/kg For the owner, receiving payment in rice seems to be better than in cash, since in the 2004 season the rice price is expected to be high. With fixed amounts of rice as rent, farmers will tend to select high yielding varieties. At present, SPT-1 is the highest yielding glutinous rice variety available to farmers. Its quality is second to RD 6, but it is acceptable by local consumers.*

2. *The rent is in cash at a fixed amount of Baht1000/rai. Farmer Sangvorn rents 5.5 rai of land at Baht 5000 per year. The land is of good quality. In the 2004 season, Sangvorn invests in the rented land for cultivation of a high value rice variety, KDML 105. The government's rice price support policy includes rice mortgage by using rice as security for a loan. Farmer will receive 80 percent of guaranteed price upon loan approval, and pay no interest within the first three months. At present, the mortgage price for KDML 105 is Baht 9/kg He is expecting to achieve a rice yield of over 900 kg/rai. So his gross income from rice would be about Baht 44,550. After paying his land rent, he would receive at least Baht 39,550. Had he selected to plant SPT-1, his total income from rice would be less than expected. Boontom is a commercially oriented farmer. He selects high quality rice with the highest market value.*

3. *The shared crop system. Sanit has rented 5 rai of paddy land to plant rice on the share cropping system. Sanit and the land owner will split the rice production on a 50:50 basis. The land owner pays for land ploughing, chooses the variety to be planted, and will provide the seed material. Sanit will take care of the crop, including fertilization, pest and weed control, and irrigation scheduling. The land owner so far prefers the RD 6 glutinous variety. In the 2002 season, Sanit obtained 4,860 kg from a 5 rai plot, equivalent to 972kg/rai, or 6.08 t/ha With RD 6 planted on good fertility soil, as the farmer explained, chemical fertilizer is hardly used. In this case, Sanit applied a total of 10 kg of 16-20 on certain spots to ensure good growth and yield. In the 2002 season, Sanit received a total of 2,430 kg of rice after splitting it with the land owner. About 1,500 kg was kept for consumption, leaving him 930 kg for sale. His main objective is to produce to meet household consumption needs; the surplus is then sold for extra income. Sanit was satisfied with the renting arrangement, simply because he would not have to pay cash for the land preparation, which would otherwise cost Baht 500/rai. However, when converting the total return the land owner received, at Baht5.3/kg, the rental fee for a 5 rai plot amounted to Baht (2,430x5.3-2,500-750) was 9,629 kg of rice, i.e. a very high return of Baht1,925kg/rai). The land owner will always select the high quality glutinous rice for planting, partly the variety provides premium grain quality to meet eating preferences, and partly because it can always easily be sold at high prices. Generally price of quality rice, RD6 and KDML 105 are relatively stable.*

   The 50:50 shared crop renting arrangement between farmer and land owner was commonly practiced in the past, but the system was less accepted by the tenant farmers. The land owners have to change the system otherwise the land will be left idle. In Sanit case, a certain incentive, such as cost of land preparation and seed material, is provided by the land owner.

Table 2.5 Type of land ownership and average farm size in different land types in BM and DPL

Type of land ownership	BM (n=64)			DPL (n=58)		
	HH	%	Average Farm size (ha)	HH	%	Average farm size (ha)
1. Farm on free land*	4	6	0.66	3	5	0.54
2. Farm on own land	13	20	0.54	16	28	0.42
3. Farm on own land and rented land	11	17	0.40 /0.77	4	7	0.40/0.40
4. Landless and farmed on rented land	36	56	0.94	25	43	0.74
5. Landless and do not farm	-	0	0	10	17	0
Total households	64	100	0.80	58	100	0.50

Source: Survey, 2005

Note: * Land belongs to other family's member,

Table 2.6 Payment types for land rent in case studies

Type of payment for land rent	BM				DPL			
	Total area (ha)	%	Average Rice (kg/ha)	Average Cash (*Baht*/ha)	Total area (ha)	%	Average Rice (kg/ha)	Average Cash (*Baht*/ha)
1. Cash	16	36	-	6,250	12	45	-	4,319
2. Paddy rice	33	65	625	-	6	32	1,112	-
3. Paddy rice 50:50	-	0	-	-	5	23	2119	-
Total	49	100			23	100		

Source: Survey, 2005

Note: BM farmers have agreement on rent cost; rice payment 625 kg/ha, cash 6,250 *Baht*/ha, (rice price 5-6 *Baht*/kg, 40 *Baht* =1 $)(Land rental payments by farmers: 47 household (73%) in BM and 29 household (50%) in DPL, 2005,

2.4 Social-economic features of the two case study villages

Both BM and DPL villages are well connected to road system and have access to basic infrastructures. Eighty percent of farmers in both villages have received at least four years of compulsory education. Since 1999, the basic requirement has changed to 12 years, covering 6 years of primary and 6 years of secondary education. The average farm-size is 1.36 ha in BM and 1.08 ha in DPL, which is about the provincial average. Socio-economic data (Table 2.7) shows that households in BM have a lower income per capita (*Baht* 27,757), and a lower net income per household (*Baht 77,226*) than in DPL (income per capita of *Baht* 29,288 and per household of *Baht* 90,085). The poverty survey carried out by Department of Community Development, Ministry of the Interior reveals that about 27 or 7 percent of the households in BM have incomes below the national poverty line, while only about 6 households or 3 percent in DPL fall below the poverty line (Table 2.7). More people in BM, the poorer village, earn their income from off-farm employment. Farmers in both villages participating in community rice seed production earned their income more from farming than from non-farming activities (Table 2.8). However, in DPL where farming is more intensified and diversified than in BM, the proportion of household income from farming was higher than non-farm income (74:26), where in BM the proportion was relatively lower (55:45). The households in both villages which did not participate in community rice seed production earned their income more from non-farm activities. Farming had become a part-time occupation.

Table 2.7 Village basic information

Categories	*tambon* Kee Lek	BM village	DPL village
Total population (person)	6,310	600	626
No. of household (hh)	2,653	390	194
Education level **	Na	80% primary school	80% primary school
Farm size per hh (ha/hh)	Na	1.36	1.08
Village income per capita	29,972	27,757	29,288
No. of hh practice in farming	1,352	194 (49%)	115 (59%)
% of hh off-farm activities **	Na	90.49	80.46
Net income per hh (*Baht*/year)	Na	77,226	90,085
No. of member per hh	Na	1.5	3.2
No. of hh under the poverty line* (*Baht*/year)	120	27 (6.9%)	6 (3.0%)

Source: Kee Lek TAO, 2006, * the poverty line: household income below 20000 *Baht*/year (55 *Baht*/day; 1.3 $) (Community Development Department, Ministry of Interior, 2005), ** survey 2005

Table 2.8 Farmer source of income in BM and DPL, 2004

Village name	Average income (*Baht*/hh/year)			
	BM-CRSP (n=16)	**%**	**DPL-CRSP** (n=49)	**%**
Income from agriculture	84,500	55	126,160	74
Income from non-agriculture	68,000	45	45,100	26
total income	152,500	100	171,260	100
	BM-Non-CRSP (n=46)	**%**	**DPL-Non-CRSP** (n=21)	**%**
Income from agriculture	93,572	35	6,600	5
Income from non-agriculture	171,835	65	127,320	95
total income	265,407	100	133,920	100
	BM average	**%**	**DPL average**	**%**
Income from agriculture	89,036	43	66,380	44
Income from non-agriculture	119,918	57	86,210	56
total income	208,954	100	152,590	100

Source: Household interview, 2004 (n = number of households interviewed from BM and DPL community rice seed production households (CRSP) and non-community rice seed production household (non-CRSP))

Both villages have similar demographic features, with an age profile biased to older people. The relatively small proportion of youth and teenagers may be the consequence of family planning, which was highly publicized during the 70s. Northern Thailand (especially Chiang Mai province) has been recognized as the most successful area for family planning in the entire country. In BM village, about 10 percent of households were immigrants from the Northeast and had been permanently settled in the village for over 15 years. The Northeast migrants are socially and economically integrated with the local community, but they still are considered outsiders even intermarried with the locals which gives them access to land. In recent years, there are also hill tribe migrants from the nearby highlands who have come to BM village to work as waged labour, and some have subsequently rented paddy fields to produce rice for their own consumption.

The total population of *tambon* Kee Lek was 6,310 persons in 2005 (Tambon Agricultural Plan 2005), with 3,209 women, and 3,101 men. Both villages of BM and

DPL have more or less the same population size, 600 and 626 persons respectively. BM has the larger number of households (390), compared to DPL (194 households). Both villages have a high number of older farmers (Figure 2.8).

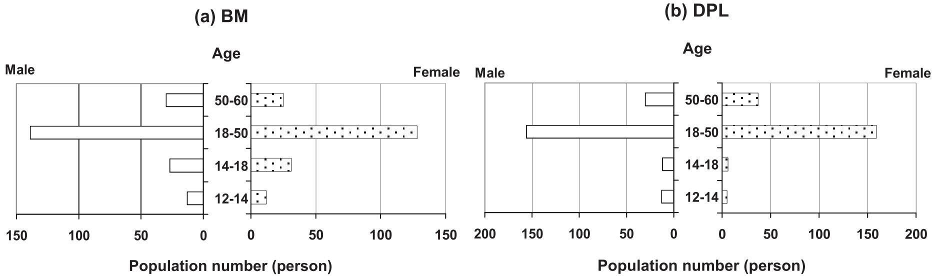


Figure 2.8 Population structure of BM (a) and DPL (b), 2003
Source: Kee Lek TAO, 2006

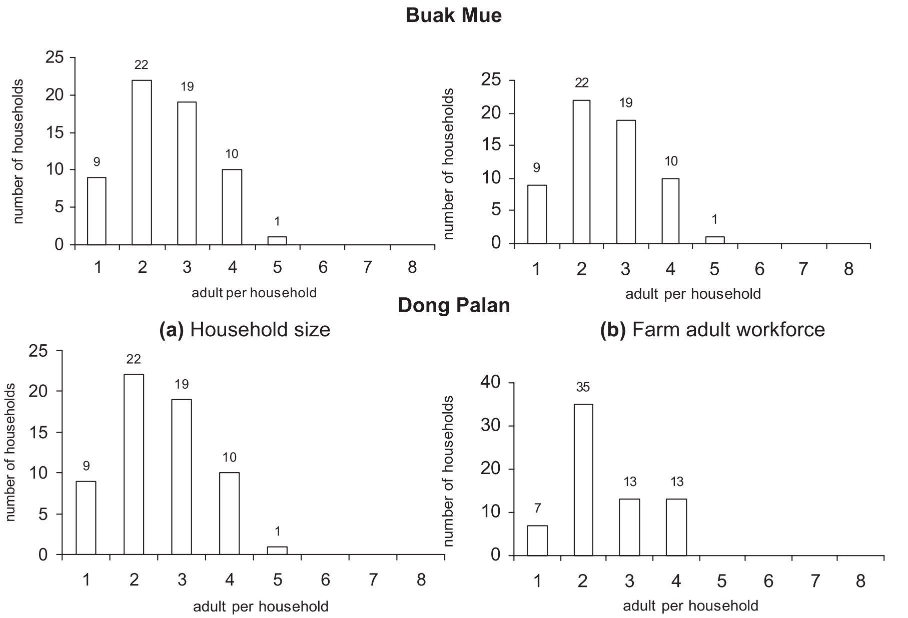


Figure 2.9 The size and composition of farm households (case study villages, 2004) (a) household size, and (b) farm adult workforce.
Source: Survey, 2004

The farm household

Since the inception of family planning in the North, the number of births per woman has declined from 6.4 in 1960 to 1.9 in 1999. Family size has become much smaller, now averaging 2-5 persons per household, with more single families with only 2-3 working members to engage in farming. To cope with increasing economic pressure on household livelihoods, the farm family adopts less labour-intensive farming systems, such as rice-soybean, and seeks off-farm employment in the time saved, cooperates in collective labour exchange to overcome labour constraints, or leaves farming altogether. Rice farming requires high labour input during transplanting and harvesting of wet rice. For instance, it requires about 5 persons per day to finish transplanting and harvesting a 0.16 hectare plot. Rice farming requires both regular inputs of household labour for routine activities and periodic inputs of hired labour to cover the most urgent and demanding tasks (Richards, 1986). In the current case study region the household unit generally comprises one or two adult men, one or two adult women, and one or two children in the age range from 2-15 years.

The study also found one or two old aged people living together with daughters or sons, and engaging in harvesting activity. There is considerable variation in size and composition over the 132 farm households for which data were gathered in BM and DPL in 2004 (Figure 2.9). The smallest unit comprised a middle age man and woman (3 such households) farming alone. The largest unit was a single household of 8 people in BM. The mean household size across the sample was 3.71 persons. The maximum number of adults in any farm household was 5. The distribution of adults workers was as followings: 73 households contained one to two adults workers (accounting for 56 percent of the total workforce), 32 households contained three adult workers (account for 25 percent of the total workforce) and 24 households contained from four to five adult workers (19 percent of the adult workforce). The modal class of full time adult farmers per household was 2 persons (accounting for 44 percent of all households, see Figure 2.9), and generally comprising one adult man and one adult woman.

The whole process of rice planting though harvesting requires about 120 man-days/ha. Therefore, non-household labourers are necessary for rice farming, particularly during harvesting. The processes of crop cutting, piling up rice plants after three days of drying, threshing, and taking threshed rice to the barn, requires good labour organization so that tasks can be completed without weather damage (occasional rain might damage grain quality, for example).

There are two types of family farm labour engaged in farming activities: full time and part time farmers. The full time farmers are engaged in agriculture from July until the end of rice harvesting in December. The life of the full time farm household is centred around the farm. The farm family spends daytime working in the farm. Lunch is prepared there, and the farm becomes a place for social activities during transplanting and harvesting. The family labourers and kin groups work together in their own farms and the farms of kin. Wives and husbands, and sometimes their children, and other relatives, formed the family unit workforce. Full time farmers divide tasks among family members. One might join the labour exchange arrangement with others, while another might take care of irrigation or weeding. In other words, when the family unit is unable to work as a group due to other social obligations, the male and female members tend to split up to fulfil both personal and social commitments. Increase in the number of part-time farmers is a feature of recent years. In the case-study villages, part-time farmers still always aim to plant enough rice for household food security. Many part-time farmers work as salaried employees, and manage their rice fields in the morning or after working hours in the late afternoon.

Non-household exchange labour

Non-household exchange labour is most important during the growing season when their own farm household labour is not enough for all activities. The most important time for non-household labour - whether exchange or hired labour - is during planting and harvesting times. The family farm becomes the site of modest socialization after the end of the day's activities, and where exchange labour is involved food and drinks are prepared. However, in some villages, the culture of offering food and drink after work has changed depending on the agreement among farmers. For instance, after sharing labour in BM, only drinks will be offered in a shortened post-work social gathering in order to reduce cost.

Table 2.9 Farm labour and non-farm Labour used in rice production process, 2005

Activities	Labour (man-days)				Percent (%)			
	family	exchange	hire	total	family	exchange	hire	total
RD 6 (average area 0.7 ha), n= 9								
Land preparation	3	5	28	36	2	4	23	30
Prepare seedling	2	2	-	4	2	2	-	3
Rice transplanting	5	14	8	27	4	11	7	22
Apply fertilizer	2	-	-	2	2	-	-	2
Herbicides, insecticides	2	-	-	2	2	-	-	2
Harvesting	4	12	13	29	3	10	11	24
Pilling	2	6	2	10	2	5	2	8
Thrashing	2	6	4	12	2	5	3	10
Total	22	45	55	122	18	37	45	100
KDML 105 (average area 0.4 ha), n=6								
Land preparation	3	-	17	20	3	-	17	20
Prepare seedling	1	-	-	1	1	-	-	1
Rice transplanting	2	12	8	22	2	12	8	22
Apply fertilizer	1	-	-	1	1	-	-	1
Herbicides, insecticides	1	-	-	1	1	-	-	1
Harvesting	2	6	13	21	2	6	13	21
Pilling	2	6	16	24	2	6	16	24
Thrashing	1	7	2	10	1	7	2	10
Total	13	31	56	100	13	31	56	100
San pathong 1 (average area 0.6 ha), n=19								
Land preparation	2	-	20	22	1	-	14	15
Prepare seedling	1	-	-	1	1	-	-	1
Rice transplanting	4	22	25	51	3	15	17	36
Apply fertilizer	1	-	-	1	1	-	-	1
Herbicides, insecticides	3	-	-	3	2	-	-	2
Harvesting	3	6	16	25	2	4	11	17
Pilling	2	8	9	19	1	6	6	13
Thrashing	2	10	9	21	1	7	6	15
Total	18	46	79	143	13	32	55	100

Source: Survey, DPL, 2005

Note: Hired labour cost in rice activities are calculated from the amount received in cash (120 *Baht* or $3 per one 8 hours per day), and in kind (1 bag of rice costs 120 *Baht* or $3)

The average labour input in rice production in Mae Teang was 100-143 man-days for a planted area of 0.4-0.7 hectare (Table 2.9). In the 2005 cropping season, exchange labour constituted more than 30 percent of the total labour requirement, particularly during rice transplanting (11-16 percent) and harvesting (17-20 percent). Exchange labour accounted for about 40 days labour out of a total average of 122 days. Both men and women are treated equally in the exchange labour system but not the hired labour system. Exchange labour among a socially closed group provides better performance and quality of output than results form the work of hired labourers.

Hired labour

Hired labour is the most important supplement for family labour during planting and harvesting. The intensive farming systems offer opportunities for landless households to earn money. Farm work helps to fulfil household needs for food and school fees in June, at the beginning of the school year. However, some families still need to pawn items and borrow money. A majority of hired labour is temporary and seasonal. The hired labourers are either landless people or farmers who have completed their routine work and want to earn an additional income during their free time. During the rice season, rice farmers might work from one to two months as waged labourers to supplement their household income. Hired labour accounts for more than 10-20 percent of labour requirements from planting, through harvesting to threshing (Table 2.9). Hired labour is paid in cash and kind. In Northern Thailand, the normal standard for labour in agriculture is 120 *Baht* per day (year 2004) or 30 kg of rice. Men receive higher daily wage labour rates (*Baht* 150 or $3.75/day) than women (*Baht* 120 or $3.0/day) for harvesting. Men also work on threshing and loading rice on trucks.

Gendered division of household farming tasks

The agricultural family has always been important to Thai rural society as a role model for the division of labour. Tasks are first divided between gender and age in accordance with the human resources available (Francis, 1994). While this is common knowledge and practice globally in family agriculture, the division of labour of the Northern Thai farm family presents a simple and convincing illustration of the significance of the division of labour. The farm household unit copes with the routine business of the farm. The work is to some extent specialised by gender and age. Men clear, plough, make bunds bordering the rice fields and waterways to the rice fields. Women normally take responsible for cooking, planting, weeding, tidying up the farm after ploughing, and women manage the post-harvest production process. However, there are some activities that are shared between both men and women, such as planting and harvesting. This seems broadly similar for peasant rice agriculture across continents (Richards 1986).

During the rainy season, in early June to early July, the men clean and clear the land for cultivation and wait for rain water, then plough the soil by either small two wheel tractors or a hired large tractor. The soil is worked two or three times; the first time is to turn it over and allow weeds and other vegetation to decompose under submerged conditions. When water is sufficient, a second ploughing is performed to break the soil clumps, and followed by the third operation of soil levelling. The men are normally responsible for mechanical work, using machines to plough soil, undertaking soil preparation, applying fertilizer, spraying pesticides and handling irrigation. Women then take over planting activities, while men divide their time making the waterways and canals for water delivery. During the rice vegetative growth stage, men often find jobs outside the village, such as electrician, or waged labour in city, etc. However, before leaving the village for their work, men will visit the field in the morning to maintain the water level.

Meanwhile, women work as hired labour on other crops in the village or in villages nearby. Both male and female members of the part-time farm family seek of-farm employment to generate cash income.

In DPL village, women have taken up the work of irrigating maize fields, fertilizer application and detasseling. The farm family in DPL cannot leave its field unattended, since sweet corn and hybrid maize seed production systems require full time work. In addition, with staggered planting of contract crops, exchange labour would be arranged in rotation, so that family members had either to attend to their own plots or engage in a neighbour's plot. With full time engagement in agriculture, farmers have less time to work outside the village. Men and women do not specifically divide the task of picking up the children from school. It depends on who finds it more convenient and is available. Young men and young women aged 18-25 do not stay in the village, but study in the city and come back during summer holidays and weekends.

A majority of farmers do not want their children to follow in their parents' footsteps in farming. They try as much as possible to support their children to enter higher education and not to follow their parents. There are also some women above the age of 20 who do not continue higher education, but work in non-agricultural employment in a nearby village or in the city, for example in food processing plants and factories. The perception of the hard work and little benefit from agriculture, compared to non-agricultural employment, encourages young family members to seek non-farm employment elsewhere. Some young men seek other sources of income according to their skills as construction workers, carpenters, etc. Young and adult women normally are responsible for housework and cooking while men find food through fishing. Moreover, women handle the money for children's school uniforms, books and supplies, and a variety of household and farm expenses. In Thai agrarian society, although historically men take the leadership roles and make decisions, women play an increasingly important role in making joint decisions with men on farming activities. This can be seen in all farming systems in the study area. Francis (1994) calls this a helpmate relationship, and it constitutes a basis for mutual support and respect. This illustrates how changing gender relationships and family structure continue to furnish a basis for men and women working together for their mutual benefit.

However, knowledge of these changes in the social division of labour is critical for extension workers and other change agents who are in contact with agricultural families. The majority of men prefer meetings or trainings, while women think it is a waste of time, although the knowledge is relevant to their work. Women expect men to transfer the experience from these meetings to their womenfolk. However, from observation of daily household work, men and women work equally hard. In fact, the family has developed a division for labour for the realization of effective production, and perpetuates this cooperative family structure through reproduction and socialization of children, but also extends it to embrace inter-household cooperative relations of production. The exchange labour system, and the small rituals and mutuality, upon which it rests, reflect the lessons learned in the governance of the Thai rural family. Family agriculture contributes some interesting examples for today's society at large about how women become empowered through their involvement in the planning of family and farming activities.

BM farmers take up off-farm employment all year round. Some farmers are employed as full time security guards with the Mae Teang Irrigation Project and in local factories. These farmers carry out their farm work either in the morning or after office hours, mostly irrigating rice fields. On-farm waged labour is available during August, November, December and January. However, the evening time activity is undertaken by women and elderly people, *e.g.* husking tamarind fruit for a local trader. Farmers get about *Baht* 60 ($2.00) for 3 to 4 hours work. Non-farm incomes contribute significantly to farmers' household budgets in both villages, as shown in Table 2.8. In BM, non-farm incomes constituted 57 percent of the average total household income, and in DPL non-farm incomes provided 56 of the average total household income. Tasks were divided among women and men during and after farming. Male farmers often seek off-farm employment in Chiang Mai city, and some women worked in factories such as the Chiang Mai Frozen Food Company, garment manufacturing companies, etc., and return home each day. The factory and agro-food industry provides transportation between village and factory, with a minimal fee paid at the end of the month. The income from factory work is 200 *Baht* ($ 5.3) for an 8 hour day. The daily wage on construction work within Chiang Mai city was 200 *Baht* ($ 5.3) for men and 120 *Baht* ($ 3.2) for women. The farm hired labour cost per day is 150 *Baht* ($ 4) for a man and 120 *Baht* ($ 3.2) for a woman, during transplanting and harvesting. In BM, individual farmers do not organize themselves as a group to take up contract work as observed in DPL. Individual farmers have different skills and prefer to work independently.

A comment on gender

It was observed that in DPL that female members were more active in taking up leadership roles and assuming certain specific responsibilities, such as financial secretary of the community rice seed production group. In this case and similar ones, the female villager was interested and involved in village representation because of her own interest, and not because men expected her to assume these duties. Sometimes this is just the luck of the draw. For example, the female village representative on the TAO council for community development was a talented negotiator, well able to convey the message from the TAO policy to the DPL community and able to conceptualize and write up proposals. In BM, by contrast, even if a female talent could be found, she had no opportunity to express itself. Here, all the activities at the committee level were taken up by men. Informants (including women) claimed that women in BM were less interested in participating in council representation. This suggests less not lack of capability but a cultural difference between the two villages in orientation towards activism we will return to later.

Financial assets

Farming households in both villages need external financial resources to support their farming operation. Borrowed money is also used to support other household needs, particularly at the beginning of the school year. Farmers would not use all their savings to invest in farming enterprises. Two kinds of financial support, available from formal and informal financial institutions, are available.

The two important formal, external financial sources are farm credit facilities made available locally through the Bank for Agriculture and Agricultural Cooperatives (BAAC) and the Mae Teang Agricultural Cooperatives (MTAC). Farmers have to be registered as members before they are eligible for loan application. The BAAC provides both short term (one year) and long term (three years) loans, while the MTAC only provides short term loans, ranging from six months to one year. Two to three farmers are required to guarantee the loan. A majority of farm households are clients of both financial institutions. With the BAAC system, approval of loans depends on farmer credit worthiness. Farmers with good repayment record will receive priority for loans. So when farmers cannot meet the deadline for repayment they would borrow from other sources to repay the BAAC, to keep a clean record with the formal institution in order to get a subsequent loan. The BAAC charges a 10-12 percent interest rate for new clients in the first year. Farmers with a good record of loan payment will have their interest rate reduced to 7 percent in the second year, and to 5 percent in the third year. The interest rate will be maintained at 5 percent after the third year with a continuing good record of payment. In contract farming, as described in Chapter 6, the private company contractor will require farmers to be clients of the BAAC in dealing with financial matters.

There are also informal credit schemes. Within the village, the community establishes various kinds of informal self-help saving schemes to provide small funds for short term loans. The burial fund is a common savings arrangement in which all households participate. A committee is elected to serve for a two-year term. Each member contributes a certain amount (*Baht* 50 per share) collected monthly by the committee. The fund is solely used for burial rites. Revolving funds are also arranged by different production groups, *e.g.* revolving funds for rice, soybean, corn, etc. Funds from production groups are small and provide only small loans. Farmers normally borrow money from the production group to pay for land preparation, seed, etc. Farmers also seek financial support from other informal sources, such as relatives and friends. These are reciprocal loans, and only carried out among trusted individuals. Other informal sources are provided by brokers in contract production arrangements. The credit can be in kind and in cash.

Payment is effected after the crop has been harvested. In cases of urgency, farmers can borrow money from rich people or traders either in the village or in a neighbouring village. The interest is high, about 2 percent per month. During the cropping season, when farmers run short of money and the matter is urgent – *e.g.* the beginning of the school year or an illness in family - farmers often sell their crops before harvest. This is common in for rice and fruit crops. It was observed that there were more community saving groups in DPL than in BM, particularly saving arrangements made by crop production groups. A few farmers in BM sold their "green crops" before harvest to obtain money for urgent needs, since they had few other informal local schemes to act as safety nets for urgent needs. I did not see any farmers selling their produce as green crops (*kai keaw*) in DPL, where farmers had more access to informal credit.

The amount of credit required, especially in DPL village, increases each year because of higher investment costs in farming resulting from increasing input costs. The crop production systems in DPL, such as vegetable soybean, sweet corn, hybrid corn seed and inbred-line maize seed production, require high investment, hence high costs. All crop production groups in DPL established a revolving fund to provide short-term loans to farmer members. The majority of farmers would first seek short-term loans from the crop production group, simply because it was convenient, even if the amount available was small. The group committee would grant funds to those farmers with good records of attendance and involvement in group activities. This was a tactic to encourage farmers' participation.

Farmers in BM have rice-soybean as their main cropping system, which requires lower external inputs. They have a revolving fund for rice production. The fund is mainly used to purchase chemical fertilizers in bulk, and this is made available to farmer-members on credit at relatively cheaper prices than in retail stores. One common feature to both villages is that farmers seldom invested their own cash in farming operations. Saving is used for daily household consumption, and for monthly payments to different savings schemes, related to either agricultural or social welfare activities.

The DPL rice group was able to justify and convince the TAO to provide a grant of *Baht* 50,000 to be used as capital for a revolving fund scheme (Table 2.4). The fund was used to provide support for the community rice seed initiative. In addition, the group members each paid *Baht* 100 for membership fee. The group income mainly derived from the sale of rice seed, and the margin from selling of inputs to members. Support from local organizations (TAO) as well as the district agricultural extension office, provided incentives for group farming activities. The fund generated from group performance was then used to provide small loans to farmer members. The normal loan requested for farming, and approved by the group committee, was not more than *Baht* 5,000 per person per year. The concept was to provide equitable distribution of loans with low interest to all members when in need. The system enabled farmer members to farm without borrowing money from external sources at high interest, and without selling 'green crops' to traders at low prices.

The BM farmers, whose farming was less intensified, had chosen the low-input soybean production system as a cash generating crop planted after rice. In fact, little rice was sold, while farmers were establishing the soybean crop. This minimized the need for farmers to borrow money to invest in their farming operations. Some farmers produced their soybean seed on the upper terrace during the rainy season; others purchased seed from seed farmers in the neighbouring village, or from the Seed Multiplication Centre through arrangement with the local extension agent. The BM farmers, with their less intensive farming systems, did not depend as much on credit support for their farming operations because their daily income from off-farm employment provided household needs and savings. They were more independent. In fact, the soybean system during the dry season cropping provided the BM farmers opportunity to engage in off-farm employment, even further easing their cash flow requirements.

2.5 Social and organizational features

Local administration and politics

The Thai administrative organization is hierarchical, with the village as the lowest level (*ban*), and the sub-district (*tambon*), district (*amphoe*), and province (*changwat*) at the more inclusive levels. In a northern Thai village (*lanna*) there are separate residential and farming areas. Within the residential area, five to six hamlets may be formed. Each hamlet will nominate a household leader to represent the hamlet (Figure 2.10), providing basic administration for members of the hamlet and linking with the leaders of other hamlets. Very often, members within the same hamlet are close kin. Farmers in both BM and DPL own their residential areas, but many are tenant farmers, that mean they farm, at least in part, on rented land).

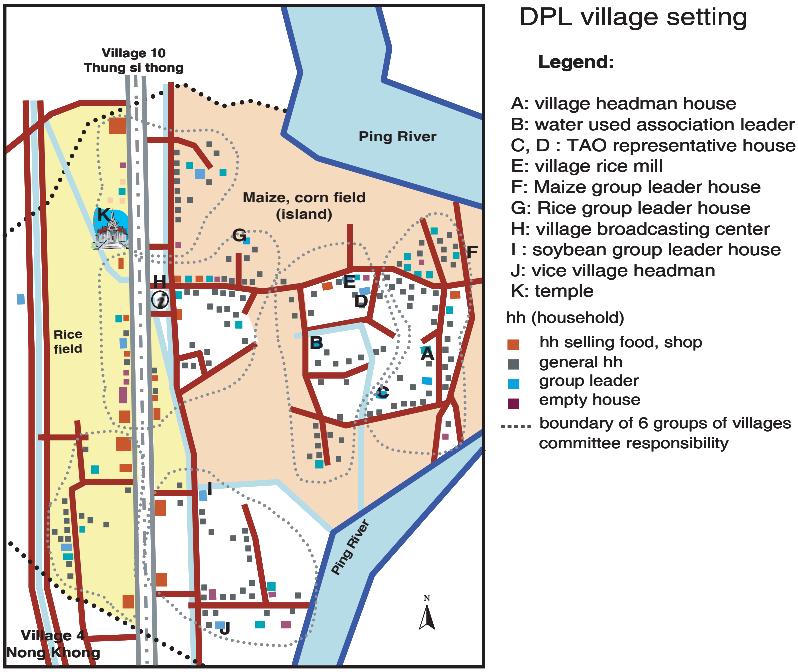


Figure 2.10 Village household setting, social organization and function of DPL
Source: Modified from DPL map, 2004

Under the Department of Local Administration there are three classes of village, depending on number of households. The small village has fewer than 200 households; the medium size village ranges from 200 to 250; the large villages have more than 250 households. In 2005, one of the populist political strategies of the Thaksin administration was to provide village funds directly to villagers, by-passing the provincial governor, district officers and the TAO. The fund is known as SML (small-medium-large) providing money for small, medium, and large villages (*Baht* 200,000, 250,000, and 300,000 respectively, for one year). The funds aim to provide initial support for income generating rural enterprise, and are not to be used for construction. But in practice, many villagers have used the fund for other purposes, and the original objective has not been achieved. In DPL, for example, the villagers finally decided to invest the fund of *Baht* 200,000 to buy utensils for a village housewife group, while part of the fund was allocated to purchase sound equipment to provide rental services to other villages.

The village headman, *phu-yai-ban*, was almost a voluntary worker in the past, selected by the villagers, received a small stipend from the government, and once elected in the office until a retirement age of 60 years. Today village headman now has a fixed term (of four-years). A *tambon* is made up of a large number of villages each headed by *kamnan* (or *tambon* headman. The *kamnan* is more closely linked with state authorities at district and provincial levels, and is an influential figure in national as well as local politics. The *kamnan* has a four-year term as well. Both village headman and *kamnan* are key canvassers for political parties during national election campaigns. Since the 8^{th} National Economic and Social Development Plan, the Government has allocated more direct funding to the Tambon Administration Organization (TAO), an elected local council legislature overseeing the administration, laws, and welfare of the village communities. Since introduction of the TAO the role of *kamnan* and village headman has decreased in significance, and they have lost political power. They now serve mainly as checks and balances on the system. The chief councillor of the TAO, is elected representative, and cannot be the same person as *kamnan*. Thus at the *tambon* level, three key actors who are supposed to be looking after the communities are the village headman, *kamnan,* and the TAO councillor. While village headman and *kamnan* are still affiliated to the government bureaucratic system, working under the district chief, the TAO councillors are local representatives, and relatively autonomous. By law the TAO contributes significantly to the rural development.

A further important figure is the district officer. The main duties of district officers are to oversee the laws and policies of the central government, and their powers are extensive (Further detail on the roles of key actors in support of agriculture, especially the village headman, are to be found in Chapters 3 and 6). A district officer's major line of duties is to supervise the collection of taxes, keep basic registers and vital statistics, register schoolchildren and aliens, administer local elections at the commune and village levels, and coordinate the activities of field officials from Bangkok. Additionally, the district officer convenes monthly meetings of the headmen of the villages to inform them of government policies and instruct them on the implementation of these policies. As the chief magistrate of the district, s/he also is responsible for arbitration in land disputes; many villagers refer these disputes to the district officer rather than to a regular court. At the next lower level of local government, every district has at least one district sanitation committee, usually based in the district capital. This committee's purpose is to provide services such as refuse collection, water and sewage facilities, recreation, and road maintenance. The committee is run by ex-official members (*i.e.* seconded administrative personnel) headed by the district officer. Like municipalities, the sanitation districts are financially and administratively dependent on the government, notably the district administration.

The *tambon* extension agent, *kaset tambon* (KT), used to be important in agricultural development. In general, a KT prefers to work with groups of farmers, and, accordingly, the organizational level in a village impacts on the service provision. With respect to BM and DPL, the former KT played a significant role in providing good services to farmers during the period 2001-2004. The KT helped the farmers to set up a community rice seed production group (Chapter 3) before his early retirement. During his last few years in office, this particular officer was assiduous in participating in farmers' activities, meetings and workshops, and also in village social events. Farmers claim they are still waiting to receive any services from the new KT, who spends more time on his own business.

Centrally managed extension projects were not many; the most recent activity of this kind was a three-year community rice seed production project (2002-2004). The Tambon Agricultural Technology Transfer and Service Centre (TTC), which was formerly operated and managed by the KT, is now under the management of a 15-member committee, chaired by the chief councillor of the TAO, and the KT is the secretary. The TAO is the main source of funding. Many TAOs continue to provide financial support to community rice seed production even though the project was terminated by the DOAE. Many active KT had made requests to transfer their positions from the DOAE to the TAO, but the TAO refused simply because some of the KT has high salaries. The transfer would add a financial burden to the TAO. The fate of the KT is uncertain. In general the KT gained a reduced role in extension services over the last three years.

Social organization and functions

With the new constitution enacted in 1997, local organizations have gained greater administrative responsibilities, with annual budgets provided by the Government. The Tambon Administration Organization (TAO) has encouraged local communities at village level to form groups when seeking support. Therefore, in a village where the village headman is active, and has good working relationship with the TAO, one might expect to see many local groups organized, some formed through internal and some through external initiative. Commonly, such groups include village saving groups (VS), small and medium rural enterprises (SME), village welfare associations (VW), village housewife groups (VH), village health volunteers (VHV), and specific agricultural production groups, such as rice seed production, soybean production, sweet corn, organic fertilizer production group, etc (Table 2.10). A high number of group initiatives are observed in DPL, where villagers created a number of such agricultural production groups according to their need, like soybean, maize, vegetables marketing groups. The reason behind their initiatives is a desire to mobilize funds via each production group activity, to be able to borrow money from formal (state) lending institutions.

Each group has a specific function. The group committees are nominated and selected by members according to experiences, individual skill and dedication. Some organizations are single gender groups, but the majority are mixed groups. However, very often, in the mixed groups, fewer women than men participate in meetings, being mainly represented by men. It is almost a general practice of household participation in community activities that a male household head will take a leading role in any committee meeting and or decision making, while female household members take responsibility for field and house work. It is thus a common phenomenon seen in this study that more men attend the committee meeting and more women working in the fields. When the work pressure is intense, and all household members are needed for farm work, meetings will be suspended. Occasionally important meetings have to be conducted during night time. Several working committees in either of the two villages were formed to enhance social cohesion directly related to the maintenance, productivity and overall welfare of households. Group activities were formulated similarly in both BM and DPL, but they were less active in BM. The number of farmers working as committee member in group activities of DPL is higher than BM Figure 2.11. The committees can be grouped in accord with their functions as follows:

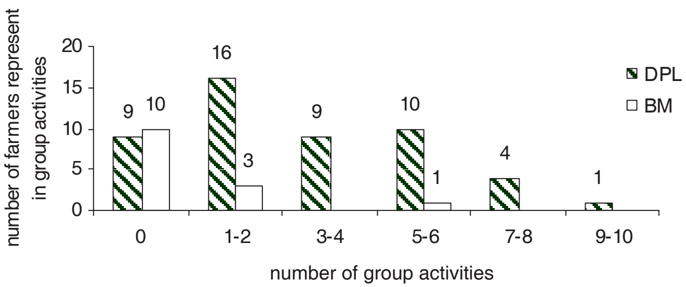


Figure 2.11 Farmers working as committee members in different group activities in BM and DPL
Source: Survey, 2005

Table 2.10 Social organization in two villages, BM and DPL

Category	Committee	Function	Initiative	
			BM	DPL
Village committee	Village committee group	provide services toward village development	Farmer	Farmer
	Housewife group	Creating and developing women's activities to support village livelihoods	Farmer	Farmer
	Youth group	Developing activities for young people to prevent drug problem	-	Farmer
Resource management	Conservation of aquatic resources	Protecting the frog population in rice fields for pest control purposes	-	Farmer
	Community forest	Preventing forest fires	Farmer	-
Agricultural production and marketing Marketing	Community rice seed production	Producing quality rice to meet own community need, and for general market within *tambon*	Farmer/ DOAE	Farmer/ DOAE
	Soybean production group	Acquisition of quality seed and production of quality grain soybean	-	Farmer
	Maize production group	Negotiating contract agreement with private company	-	Farmer

Table 2.10 (continued)

Category	Committee	Function	Initiative	
			BM	DPL
	Poultry group	Organizing the local farmers in poultry raising	Farmer	-
	Pesticide free vegetable group	Producing pesticide free vegetables for urban market and within *tambon*	-	Farmer
	Marketing group	Organizing the local market place for distributing farm products	-	Farmer
Maintenance services	Farm mechanization group	Providing maintenance services and developing labour saving farm tools	-	Farmer
	Water group	Providing maintenance services for household water supply	-	Farmer
	Water user association	Overseeing the distribution of irrigation water for farming	Farmer	Farmer
	Electricity group	Management of electricity system in village and for particular events	Farmer	-
Financial capital	Village fund	Establishing household savings to provide credit	Farmer	Farmer
	Fund for poverty reduction	Managing funds from the government to provide financial support to the poor households	Government	Government
Cultural activities	Cultural group	Collecting remittances and donating money to the temple	Farmer	Farmer
Welfare	Care for the old age	Looking after the old aged people, allocating suitable employment for the older people, etc	Provincial/ TAO	Provincial/ TAO
	Care for the death	Collecting remittances and donations for a fund to deal with death in the family	Farmer	Farmer
Health	Health volunteer	Providing basic health services through working closely with Public Health Office	Provincial/ TAO	Provincial/ TAO
Continuing education	Village library	Managing reading materials in the village for general reading pleasure	-	TAO

Source: Survey, 2004

In DPL the community appreciates the village head's devotion and commitment, so they always seem willing to lend full support to his initiatives. As can be seen from Table 2.10, many social organizations have been initiated by local farmers. On the contrary, in BM, the village headman is less enthusiastic about farming, but is very keen on non-agricultural activities, *e.g.* making handicrafts, especially 'wooden palaces' used for decorating the coffin for cremation. The wooden palace is a symbol of heaven after death, and will be placed on top of the coffin during the funeral rite; the whole structure is burnt together with the coffin). The headman in BM has created part-time employment for women and men for making of these wooden palaces (*pra sard*). He assigns all farming activities to his deputy-headman, when proposing projects for funding to the TAO. Many farming initiatives are shared by the same individuals, thus creating a heavy workload, resulting in poor performance. Participation in group meeting is marked by poor attendance due to disagreements, and sometimes only few people will volunteer to serve on committees. Some farmers say they are still seeking money, so they feel these duties should fulfill by people who already have a secure income (see more detail in Chapter 3).

Both villages have knowledgeable people in different occupations, who ideally could take leading roles in advising and articulating group work and community-based development projects to be supported by the TAO. However, in BM these knowledgeable individuals are more interested in non-farm activities, and would decline to take up a position as representative of farming groups in the local council. We see only the deputy village headman, who is the village representative in the TAO council, attending the monthly meeting. The agricultural issues brought up by the deputy headman, if any, would be only briefly discussed. So if the issues are not well prepared, or the proposed project is not in written form, it is unlikely to get TAO support.

The case of DPL village representatives in the TAO council are more concerned about the overall welfare of the DPL community. They tend to be more responsive to opportunities, and are able to present written proposals within a short time for TAO council consideration and approval. Evidently, from a social and human capital perspective, DPL is better equipped with dedicated people willing to work as team to fulfill the need of the wider community. The key leaders are able to mobilize knowledgeable people to work for the betterment of the whole community. In BM, where income differentiation between the rich and the poor seems higher between households the high income households with permanent occupations, less are willing to act on behalf of the poorer farming households in the community. These farmers do not have enough economic security to work at the council level as they need to spend all their time on income-generating activities. So overall, more agricultural development projects go to DPL village, either supported by the TAO or by external agencies. We will be interested in later chapters in exploring this contrast, and trying to answer the question whether "participation" is a cause or effect of development.

The DPL farmers, whose livelihoods are rooted in crop-based farming systems, are more dependent on credit availability. For this reason they designed a scheme to gain access to credit by forming commodity-based production groups and establishing revolving funds in each group (agricultural group credit, AGC) as shown in Table 2.11.

Community labour

Community labour is a common feature in agrarian societies, for example when the community collaborates to achieve rice sufficiency for individual households and the whole community. Ceremonies during rice harvest are an annual event, where farming households will bring milled rice to the temple as an offering. Today, community work in rice cultivation has tended to decline but offering rice to the temple lives on. However, community labour for community development in the village also persists today. Within the *tambon* level, the TAO would organize community activity in connection with social, cultural or religious events. Examples include clearing of public land, maintaining the public crematorium, repairing bridges, repairing temples, etc. The Water Users Association organizes an annual event for clearing the canals before the rice growing season. Community participation in construction work such as road repairs, or building bridges, is mainly carried out by males. Only recently, when job-creation activities were formulated by various implementing agencies, has the practice arisen of the village headman, or group leader, bidding for a contract, and work then being allocated to both men and women community members in order to provide equal access to income generation activities. In DPL village, with its better social infrastructure and where many voluntary groups were observed, community activities requiring collective action would be readily undertaken cooperatively by various groups. Each collective activity would be performed by at least 30 people at a time; and individuals might take turns to participate in the labour activity.

Table 2.11 The sources of credit in DPL and BM, 2004

sources	Sources of credit	Average loan (Baht/year)		Remarks
		DPL	BM	
internal	Housewife group	-	no	
	CRSP	3000	-	AGC
	Soybean group	3500	no	AGC
	Maize Group	3029	no	AGC
	Pesticide free vegetables group	-	no	AGC
	Relatives	9333	20000	
	Old age fund	4428	no	
	Village fund	12718	-	No interest
	Fund for poverty reduction	-	2000	No interest
	Total	36008	22000	
external	BAAC	26706	8812	5-10% /year
	MTAC	44068	-	
	Kee Lek rice group	-	-	
	Broker/ Local trader	60500	-	
	Irrigation department saving	-	13000	
	Total	174867	23812	
Average loan		210675	43812	

Source: Survey BM and DPL rice group members AGC= Agriculture Group Credit

2.6 Cultural features

The Thai village economy in the past was a subsistence economy. According to Prawet Wasi[8] (1987, 1988), the two main material and spiritual bases of Thai society

[8] Prawet Wasi is one of the active protagonists of the theory of watanathum chumchon. He lives in almost total denial of the modern value system of Western civil society, with the exception of scientific

were agriculture and Buddhism. He argues that the development of towns and industries ignored this principle and created only small rich elite. If development of agriculture balanced industrialization this would minimize social division and personal agony. He suggests that an economically self-reliant village should possess five essential factors; dharma (spirit), small-scale production, ecological balance, economic subsistence, and a communal cooperative life.

The five precepts of Buddhism are very important in Thai culture: abstain from taking life of any kind; give freely, but take nothing that is not given; abstain from wrong sensual pleasure; abstain from speaking what is false; and abstain from intoxicating drinks or drugs (Girling, 1981). The main themes for the layman are normally about making merit (*tham bun*) and avoiding sin (*bap*). Indeed, the social organization required for religious activities plays a prominent part in Thai behaviour (cf. Bunnag, 1973), although it should be added that attendance at sermons and other religious practices is now diminishing, especially in town (Mulder, 1979). Monks continue to play an important role in rural Thai Buddhism and social life. The detailed role of the monk will be explained in Chapter 3, and the case study in Chapter 4 will illustrate his role in frog protection. The village monks were the most respected leaders in the community, reflecting their wisdom and piety, and they are famous for their activist role in discourses on nature conservation and the state (Taylor, 1996).

Girling (1981) summarizes the four major elements of Buddhist culture for Thai society. First, the rites, ceremonies, and precepts of Buddhism act as a socially integrating and stabilizing force. Shared belief and practices bring people together in a peaceful frame of mind. Monastery fairs, for example, are arranged for the purposes of social cooperation (see Box 2.2, for an example of social cooperation based on fund raising in BM and DPL), and also provide an opportunity for entertainment, buying and selling, and making merry - all combined. But although practices are still organized at community level they differ in style and form from former times, when there was less urban and external influence. Second, the order of monks as an institution encourages social mobility. It provides an assurance of status (the most revered in all Thai society), a means of education, and an opportunity to travel to monasteries throughout the country, open even to the poor and underprivileged. Third, the belief in *karma* is an essential element in the Thai conception of social hierarchy. For those who are superior in status, wealth, or power are deemed to have earned their position as a result of merit acquired in present or previous lives. Similarly, those who are now subordinate may, by their meritorious acts, become respected, powerful, or prosperous in the future. Fourth, the Buddhist view of the impermanence of all living things and of all human creation is reflected, socially, not only in the fluidity of patron-client (superior-subordinate) relationships, which are perpetually subject to dissolution and change

knowledge and technology. He rejects any notion that Thai society is backward. Prawet's best remedy for development is total rejection of the modern Western culture of materialism, and restoration of the Buddhist culture of spiritualism in its place. Put simply, he is the most radical and the most systematic advocate of 'anti-modernism'. His books on Buddhist agriculture (Prawet, 1987, 1988) argues that the collapse of Thai society is caused by disharmony with the subsistence economy and with the nature. Because the subsistence economy is free from the cash economy, it can be free from kilet (lust) and lop (greed). An economy which is harmonious with nature will make mankind, the community and the state self-reliant, and will bring up naturally a culture of mutual aid and generosity.

according to the fluctuating fortunes of the persons involved, but more generally in the uncertainty characterizing Thai expectations of society, nature, and the individual. This attitude is conducive to a desire for dependence on (protection of) superiors (or superior forces) and, at the same time, sustains a sense of wariness, or even distrust (Piker, 1968), because of the fleeting and arbitrary nature of any such arrangements or expectations.

Even so, we must recognize that the practice of Buddhism is subject to change, especially in urban areas, though at village level Buddhist shrines and attendance at temple fairs (*wat* = monastery; *tambon* Kee Lek has12 *wat*, normally one or two per village) remain a major source of entertainment for the humbler people. Support for religion is decentralized at village level, with people in each community formed into quarters of 30 households, with each quarter selecting a leader (*hau mord*) to serve as a collector gathering money and food when religious and cultural ceremonies occur. Chapter 3 will give an example from DPL, where farmers organized *hau mord* to work closely with a monk and thus to secure a good relationship and linkage with members of the group, the good example of the local mobilizing social solidarity in committed ceremony *tod Katin* (Box 2.3) is when farmers self organised in cultural ceremonies. This is a ceremony that asks from the monk that there should be no hesitation to provide help, according to belief in sin (*bab*) and *blessing (dibun*). Blessing returns if you sacrifice yourselves to others, especially for a monk. Normally, the sacrifice would be delivered in terms of own labour, gathering food and donations of money, etc. The aim is, therefore, to behave in a way that ensures a happy state of mind and maybe physical contentment, now or in the near future, and a more fortunate rebirth. The best and most natural way to do this is by supporting the monks (by giving food, alms and by maintaining the order of monks (by giving sons for ordination, repairing monastery buildings, and constructing new ones). The monks reciprocate by blessing the hosts and participants at religious ceremonies and on important occasions in the life cycle-birth (marriage, departures, sixtieth anniversaries, and death).

Box 2.2 The community fund raising fair in DPL and BM

The community rising fund activities is one of committed activities and required a lot of labour for preparation and clean up. The collectively of community labour are important, which people in village has to agreed together and one year plan ahead to be sure that people in village have time to join and help to organized. The activity has been organized 5 year ago. They all agree to hold following idea of village headman that the need for community funds. The preparation for meeting has organized five months before activities to preparing and fixed the date which majority of people in village was time available.

The village headman, member of TAO, committee from group activities such as cultural group, village committee group and housewife group are the key actor. The key actors organized and distribute responsibility. The major activities started from the distribution of work such as advertise event, ticket printing, contract music band, food, security, place and borrow tables and chairs, and etc. Advance money was borrowed from housewife group for preparation in both DPL and BM. More than 80 percent of household labour both men and women; in DPL (altogether about 70-100 peoples) and BM (60-70 peoples), help together for preparation. Although BM lesser people manage during the day times according to non-farm work outside the village, however, the nigh all men and women fully engaged. The responsibilities would among their own skill and individual interest. The participating of farmer in helping activities was depended on individual available time. The farming activities would be stop except the urgent such as watering of corn. The task divided among the family member who will participate in group work and farming. The place and stages building was organized by men. Women were responsible for food and cooking and also the reception in the night. All the men were responsibility for security guard in different positions in event. The organizing committee was play active role and fully participated all the day. The less predicating observed in old farmers in organized. The kid are responsible for selling snack during the party in early nigh. In fact, the raising fund activity was socialization activities and social relief after harvesting for farmer. Therefore majority was eagerly to participating in the activities.

Box 2.3 The local mobilizing social solidarity in committed ceremony *tod katin*

The activities has been observed during rice harvest and raising fund from tod katin for temple building that has been plan one month before. Farmer collective action on moving and piling up rice in the community seed plots of SPT-1 and RD 6 varieties. The community seed group (about 22 members) completed the piling activities of both varieties in two places at lunchtime. In the afternoon, a few continued to pile up the rice plants; other went to the temple to help prepare for the tod katin festival on Friday 26 November 2004. Farmers tried to finish piling up the rice plants as much as possible. They all have committed to help the tod Katin event on Friday. The money and rice has divided among hua mod. The food preparation organized by the housewives and women group. The preparation for longevity was organized by old peoples. All men worked for electricity and construction work. The activity will begin tomorrow, when the residents of DPL will gather first in the temple to conduct the "longevity ceremony" in the temple or ubosot. Then groups of farmers will separately go to each village to raise fund for the tod katin festival. The fund will be used to provide financial support for finishing of the village temple. The worshipers from Samut Prakarn province in the Central Thailand organize the main fund rising.

2.7 Conclusions

This chapter has offered an outline of basic conditions of peasant wet-rice farming in Northern Thailand preparatory to understanding the detailed case study material in subsequent chapters. In turn, these case studies prepare us to understand the main objective of the thesis – to what extent could cooperation among peasants in Northern Thailand be a factor in generating or adopting new technologies for sustainable agriculture and conditions for collective action, which also affect or originate in the interaction between local communities and external developments. As a prelude to understanding this later material and objective we will here draw, in conclusion, attention to some main points from the foregoing survey. The chapter shows differences in local context of two village studies. The five key context conditions are agro-ecological, land tenure, socio-economic, livelihood strategies and social –organisational and culture as given in Table 2.12.

Table 2.12 The key context conditions of two villages

Key conditions	BM	DPL
1. Agro-ecological	- Mae Teang Irrigation (MIR) - no-tube well - Clay-loam soil :rice-soybean - 89 % lowland, 269 ha	- Mae Teang Irrigation - Additional land (Island): secure access to water, additional crop, with tube well - Clay-loam soil : rice soybean - Sandy-clay: maize (island) - 57% lowland, 150 ha
2. Land tenure	- tenancy 73 %, tenant farmers 56 %, owner 17 % - average land holding 1.36 ha	- tenancy 50 %, tenant farmers 43 %, owner 33 %, landless 17% - average land holding 1.08 ha
3. Socio-economic	- average no. of member 1.5/hh - income : per capita 94 % and household 85 % of DPL - poverty line 7%	- average no. of member 3.2/hh - income : per capita 100 % and household 100 % - poverty line 3%
4. Livelihood strategies	- off-farm employment whole year 57%, part time in rice	- off-farm employment 56%, full time in rice
5. Social-organisational and cultural	- group initiative in TAO in non-agriculture 60% - rely on external credit - modest role monk - leadership support for non-agriculture activities, less support social cooperation - exchange labour - WUAs	- group initiatives in TAO, agriculture production groups to mobilize fund 86% - own credit facility - active role of monk - leadership skill and support for agriculture and social cooperation - exchange labour - WUAs

Agro-ecological conditions

First, although the two villages examined in detail in the following chapters belong to a single cultural and environmental realm, they exhibit quite significant variations in response to current environmental and social-economic challenges. The rice based farming systems in the two villages are both based on the RID Mae Teang Irrigation Project superimposed on an existing traditional communal irrigation system. The strong social infrastructure of existing water users association has helped manage the distribution of water to enable equal access of water at the farm and field level. The island provide the additional land use beside the paddy land with farmer can water through tube well from Ping River that provide opportunity for DPL farmers for maize cropping and vegetable for the whole year.

Land tenure

A second theme of considerable importance to the overall debate in this thesis about ways of supporting cooperation for sustainable production technologies in Thai rural conditions is the issue of changing land ownership patterns over the last 20 years. It was found that a majority of farming households in both case-study villages are working on rented lands. The tenant farmers seemingly undeterred by the lack of land ownership, continue to invest on improving rice land. The prospect of transforming farm land into non-agricultural use and the resulting threat for the tenant-farmers because of the increased urbanization of the rural area along the northern highway is real, as observed in both BM and DPL villages.

The discrepancy of rent payment between two villages did not discourage farmers to improve their rice yield. In fact the tenant farmers adopted different rice varieties to pay the land rent in kind as well as in cash. Three types of payments were observed: in cash, in kind, and share-cropping. Despite the wide range of rent payment, farmers have so far been able to produce enough rice and sell the surplus through the stable high rice yields possible from uptake of improved and adaptive rice farming technology.

We should note an important demographic feature. Both villages have an increasingly elderly farming population. Successful "participatory" agro-technical innovation will probably require a stronger contribution form younger farmers. The decreasing interest in taking farming as a living by younger generation is perhaps the single biggest threat to the future sustainability of smallholder farming in both villages. Rejuvenating the older farmers and re-engaging the younger farmers in alternative farming systems, preferably horticulture-based such as fruits and vegetables, to produce quality agricultural food products for urban population may be the key factors in searching for agricultural sustainability among smallholder farmers living near Chiang Mai city, or cities in Northern Thailand.

Socio-economic conditions

The rice farming communities in both villages show small number of working household members. Therefore the non-household exchange labour or hired labour contributes to sustainability of rice production system. The gendered division of household family tasks to some extent are specialized by gender and age, but some farming activities are shared between both woman and man members. In BM, with less favourable farming environment, and the farming households earn income proportionally higher from off-farm employment than from farming, while in DPL, with more favourable farming conditions, the main source of farm household income derives from farming.

Livelihood strategies

Fourth, although both BM and DPL represent the plight of smallholder rice farmers farming with limited resources of land, labour and capital, they react to economic constraints in different ways. BM farmers have taken up less capital and labour intensive cropping systems (*e.g.* rice-soybean) to enable family members to seek off-farm employment In DPL, on the other hand, farmers choosing full time farming activity have taken up intensive farming systems, But to avoid price and marketing risk, a majority of full time farm households are now beginning to grow contract crops of sweet corn, hybrid maize seed production in cooperation with private companies, which provide material inputs on credit. The agricultural intensification in DPL is made possible is partly due to access to favourable farming areas known as the island, where all contract crops are grown.

Social organisation and cultural conditions

It is useful to distinguish social relations within the family and between families in northern Thai villages. In both BM and DPL, for instance, there are three kinds of social relationships within households. The first form is the patrilineal extended family, where male relatives live separately in the same compound. Each male-headed nuclear family unit might work independently, but will come to share the labour during rice planting. The second form is uxorilocal. In this case the husband has moved in to stay with the wife's family, particularly if they do not have an adult man member. Traditionally, a woman moves to the husband's family when married. But today such arrangements are flexible, depending on negotiation and the needs of each partner. Uxorilocal marriage reflects labour demands and modern patterns of out-migration. The third form is a kind of seasonally and spatially scattered family grouping. Brothers who might have settled in different villages will continue to communicate with and help each other during the rice planting season. This kind of social solidarity is important in supporting farm labour requirements as well as village activity. Since the number of household members is decreasing, and the proportion of older people in the village increases, social relations between households and kin groups, as seen in community rice seed production (Chapter 3), are increasingly important in helping solve labour constraints, and in fostering solidarity between land-owning and landless farmers. Intra-family labour sharing works best where the tasks, as in rice farming, are common to the group, and similar from member to member (a condition conducive to "mechanical solidarity", to use the well-known terminology of Durkheim). These "mechanical" relationships are rooted in subsistence rice production as it occurred in the past, and tend to sustain a "moral economy" based on egalitarian values. The culture of sharing rooted in subsistence rice production lives on to some extent in both villages, but in varying degrees to be investigated in later chapters.

The overall conclusion in this chapter is physical context and historical and social cultural background influences the different forms of cooperation encountered in the case-study villages. The practices of farmers in Buak Mue are more individualistic, in both farm and non-farm activities, as observed in the low number of group organizations, including groups for agricultural credit. If local cooperation is to be used in the search for sustainable agro-technology then one-size-fits-all approaches must be treated with caution.

Chapter 3

Local cooperation and collective action in community rice seed production

3.1 Introduction

Smallholder rice farmers with small families in Northern Thailand face time and labour constraints in rice production. Increasing rural out-migration for non-farm employment has made farming more difficult and less viable. To cope with these social and economic limitations, small subsistence rice farmers collectively organize labour exchange arrangement to ease labour shortage during rice transplanting and harvesting. Thus collective action has become one of the most common adaptive strategies for the management of social and economic changes to overcome labour constraints and to achieve rice sufficiency. Collective action is also commonly seen in the management of communal irrigation systems, and the conservation of forest resources and of aquatic resources. Collective action occurs when more than one individual is required to contribute to an effort in order to achieve the outcome (Ostrom, 2004). Farmers define collective action in relation to goal and benefit sharing. The system is generally based on mutual trust and reciprocity. There is need to understand the reasons why farmers cooperate and the conditions that are conducive to collective action.

The community rice seed production initiative was designed and promoted nation-wide by the DOAE in 2001 with the aim of improving farmers to be self-reliance in rice seed. The project was three years (2001-2004). The project was implemented by local sub-district agricultural extension agent or *kaset tambon* (KT). For each village selected as pilot project site, the DOAE required 200 *rai* (32 ha) for community rice seed production. The local extension agent would ask for 40 voluntary farmers to each set aside 5 *rai* of land as seed production plot. In areas where farmers have small farms, the extension agent would include farmers from more than one village, but preferably, he requires contiguous plots so that field monitoring can be easily carried out. The participating farmers will receive basic training in seed production through a farmer field school approach. The DOAE will provide 2 tons of rice seed sufficient for planting 200 *rai* (32 ha), and 5 tons of compound chemical fertilizers (16-20-0) in Year I as a package of incentives to the participating rice farming community. The total cost of inputs will be collected and managed by farmers as a revolving fund. In Year II, only rice seed will be provided, and in Year III, no input is provided; instead only technical advice is given. The DOAE expects that the repayment of seed and fertilizers will allow farmers to continue to run the program.

The Mae Teang District Agricultural Extension Office launched the CRSP project in 2002 in response to DOAE policy. At *tambon* Kee Lek, the KT and his staff held the training for farmer representatives from all villages of Kee Lek. The key farmers from BM and DPL had also attended the season-long training through a farmer field school approach in seed production. In BM there were 16 farmers participating in the CRSP in the first year (2002), and at the end of the third year, only 10 members actively participated in rice seed production. In DPL, thirty households joined the program in the first year, and at the end of third year, the number had increased to 49 households.

This chapter analyses collective action in community rice seed production in two villages, Buak Mue (BM) and Dong Palan (DPL) of *tambon* Kee Lek. We will show that collective action is strongly supported by other institutions (Douglas,1987) and the power of individual actors, like the village leader, head monk, and the extension officer. The chapter also investigates the enabling conditions for farmers to cooperate and achieve self-reliance in rice seed.

3.2 Farmers' choices of rice varieties and seed source

Before the promotion of high yielding rice varieties by the MOAC in mid 70s, the subsistence rice farmers in the Upper North planted local glutinous rice varieties. The varieties were named by names based on the physical morphology of the plant, such as *kao khum lai* (purple and rough grain rice), *kao lai* (rough grain rice), and *kao daeng (*red grain rice). The glutinous rice 'RD 6' variety was widely used in the Upper North since its release in 1977 because of its good cooking quality and high market price. The glutinous rice has a cultural value embedded in rural livelihood. Farmers would ascertain that they have enough rice for consumption and other uses such as for morning alms-giving to the monks, and during religious ceremonies in the temple. Routinely, the farm households would steam glutinous rice in the morning, and the cooked rice would stay all day until the evening. Farmers would carry their sticky rice in basket container for lunch. The sticky rice easily fits with all types of dishes. It is more convenient than non-sticky rice. The good cooking quality glutinous rice would maintain its soft, firm and not too sticky texture and delicate fragrance. Currently, the RD 6 variety has been used by the locals, the Departments of Agriculture, Agricultural Extension, and the private rice mills as the benchmark for high quality glutinous rice.

Farmers' choice in rice varieties and seed source: BM village

In BM village, the rice farmers almost exclusively planted RD 6 because of their preference for its taste. The majority of farmers whose main aim was to produce for household need were not too eager to switch to the high yielding rice SPT 1 variety. They considered that the RD 6 variety could achieve both objectives of household satisfaction and surplus production if possible, and that they could sell it at a higher price than SPT1. The majority of farmers, therefore, kept their own seed of RD 6 for one or two seasons, and then would contact the local extension officer for new seed from the Seed Multiplication Centre. The seed price from the governmental agency had been maintained at *Baht* 15 for many years.

When I started to work with BM farmers in 2001 on the use of *Sesbania rostrata* as a green manure crop in rice production, I had discussed with farmers the idea of producing seed for their own use. Many farmers were enthusiastic at first, but only one farmer, Vichit, took the initiative seriously and began to experiment with a single plant per hill method of planting. Before Vichit started the single plant method of planting, I made an arrangement for the group to visit the Multiple Cropping Centre to observe the seed production by this single plant per hill method to show that its performance was not less than the conventional 3 plants per hill planting method. With single plant planting, farmers would be able to purify their seed to true-type seed within one season, since rice is a self-pollinating crop. During the production process, it would be more convenient for farmers to remove the off-types, or any plants that were doubtful, by pulling out the whole plant. But planting single plant could also present certain problems as perceived by farmers, such as the risk that the seedling would be vulnerable to pest damage; the transplanting of single plants required skilful farmers, and that - in a labour exchange system - it would be almost impossible to control the planting process. Farmers also considered the process of planting a single plant per hill to be more time consuming.

Vichit had produced quality rice seed by the single plant per hill technique since 2002. The main varieties being produced were RD 6, KDML 105, and *mali daeng*. Vichit was particularly interested in producing high value rice varieties. The KDML 105 is premium non-glutinous rice for both the domestic and export markets. The *mali daeng* variety is red grain rice having similar grain quality as KDML 105, but currently it was produced for the niche market of health-conscious consumers, especially when processed as unpolished rice. Vichit tried out all the high value varieties because he wanted to improve land and labour productivity. He was successful with both the *Sesbania* experiment and the single plant method of planting. He had combined his own knowledge, practical experience, and the introduced knowledge from the Multiple Cropping Centre and local extension office to improve his own rice production system. Technically, he had become the most important resource person in the village. Vichit also experimented with producing and using bio-extracts as plant nutrient for rice production, which was subsequently followed by others in BM. Despite Vichit' success in producing quality rice seed, not many farmers in BM had trusted in Vichit's seed during the first two years of operation, because the seed had not been certified by the Seed Multiplication Centre. But when the Seed Multiplication Centre could not secure the availability of RD 6 variety, Vichit had become the main seed supplier in the village. In the 2004 season, the Seed Multiplication Centre aimed to promote the new high yielding variety, SPT1, but the BM farmers preferred RD 6 instead. So the members of the group had turned to Vichit as the main seed source. Vichit had sold his seed at *Baht* 10 per kg, which was *Baht* 5 cheaper than the Seed Centre, and *Baht* 8 cheaper than those offered by the private seed company (the Chareon Pokaphan or CP Group, the largest agricultural conglomerate in Thailand). So the rice growing season in 2004, all the seed-producing members in BM had used the seed produced by Vichit for planting. All had selected RD 6, but a few had added KDML 105, and *mali daeng*.

Farmers' choice in rice varieties and seed source: DPL village

Traditionally farmers in DPL have planted two improved local glutinous, *niew san pa tong* (NSPT) and RD 6. However, NSPT, which originates from natural mutation of a non-glutinous rice and has been recommended since the mid 1950s, has now been almost replaced by RD 6, a high quality glutinous rice derived from irradiated materials from *kao dwak mali* 105 (KDML 105), the most premium non-glutinous rice at the present time. When the new glutinous rice variety, SPT1, was released as recommended variety in 2001, and became available to the DPL farmers in 2002, the high yielding performance of the variety attracted farmers and it was readily accepted. Today, farmers in DPL use only two varieties of glutinous rice, RD 6 and SPT 1. The SPT1 variety is photoperiod-insensitive, and would fit favourably with intensive cropping systems as practiced by DPL farmers. The main distinctive features of RD 6 and SPT 1 as described by farmers are presented in Table 3.1.

Farmers having a larger farm size, more than 5 *rai* (0.8 ha), would select both RD 6 and SPT 1 varieties for planting, and would plant SPT1 in the more fertile soil because of its better responsiveness to high fertility than RD 6. In the low lying fields where annual flooding occurs during late August to September, farmers have selected SPT 1 and would plant the variety in early July so that the stiff stalk and vigorous growth could tolerate sudden flooding. So its photoperiod-insensitive growth habit would allow early transplanting, and together with a stiff stalk and vigorous growth could provide an escape mechanism for heavy short-period flooding during August -September.

Table 3.1 The main features of two glutinous rice varieties, RD 6 and SPT 1 as identified by farmers in DPL, 2004.

Feature	RD 6	SPT 1
Grain quality	Better than SPT 1	Acceptable
Grain yield	Lower (600kg/rai)	Higher (900-1000 kg/rai)
Straw yield	Higher	Lower
Plant height	Taller	Shorter
Lodging resistance	Susceptible	Resistant
Growth habit	Photoperiod-sensitive	Photoperiod-insensitive
Fertilizer response	Less responsive	More responsive
Suitability for double transplanting	Suitable	Not suitable (short straw)
Escape fast flooding	Not possible	Possible
Market price	Higher	Lower

Source: Survey, 2004

The local glutinous rice varieties, which possess photoperiod sensitive growth characteristics, exhibit a moderate range of optimal planting dates, which allow the varieties to be more flexible for farmers to adjust their planting schedules. This means that individual households planting local glutinous rice on different dates within the optimal range still receive similar yields. Farmers would make proper arrangements for planting schedules based on labour availability and dispute over competing dates for optimal planting has never been observed in the village. Farmers having a smaller farm size prefer the SPT 1 variety because of its high yielding performance. The tenant farmers, whose rent payment is in kind (rice), also choose SPT 1 instead of RD 6, as their landlords had no objection to the consumption quality of SPT 1. This variety, by virtue of its photoperiod-insensitive characteristics, matures within 135 days after sowing. Farmers make use of its early maturity to fit diverse cropping systems that require an earlier, cool season for planting, and to escape the high labour demand period during the December harvest of photoperiod sensitive rice.

In addition to the grain yield, the lowland rice farmers put certain value in the straw yield, since the materials are in high demand with farmers who use rice straw for mulching the second crops after rice, such as garlic, onion, shallot, and vegetables. Rice straw is also used for the culture of rice mushroom, and livestock feed. The price of rice straw is *Baht* 250 per *rai* (1600 m^2) without making into bundle, and with tying into bundle would cost *Baht* 417 per *rai*. However, the multiple use of rice straw is only possible when rice is threshed by hand and not by machine, of any rice variety. The blown-away straw as a result of machine threshing will be spread over the field and will be subsequently burnt to clean the field for cultivation of soybean after rice. RD 6, with its taller plant type would produce valuable straw yield than the SPT 1 variety.

3.3 Collective management in CRSP

Rice farming in the Upper North is labour intensive, because farmers have adopted a manual transplanting technique, and harvesting is also done manually. Recently, harvesting is done by small harvester, and a combined harvester on contract. A four-row harvesting machine has been introduced by a private contractor from a neighbouring village, who had been employed as immigrant worker in Taiwan and had seen the machine used by Taiwanese farmers. The price is over *Baht* 300,000, ($ 7,895) which is far too high for individual farmers to purchase, or even for renting its services.

Many farming households who have better off-farm opportunities but have to maintain rice production for household need have to hire the labour for transplanting. Small farmers in BM and DPL were able to organize an exchange arrangement for both transplanting and harvesting. Occasionally, farmers have to combine hired labour with exchanged labour obligation to finish the task of transplanting in one day. The concept of CRSP was to enable farmers produce quality rice seed collectively based on social learning process, so that community could have their own rice seed, and the surplus could then be distributed to neighbouring rice farmers. Individual farm households participating in the project had to form a group, so that cooperative action could be effective. However, it was found that since individual households were heterogeneous with their own livelihood diversification, in addition to rice cultivation many would have different employment opportunities either for off-farm or on-farm activities. Therefore, collective management and action in CRSP were scheduled in accordance to production process (Table 3.2).

Table 3.2 Farming schedule of community rice seed production in BM and DPL villages, Chiang Mai, 2004

Activities	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land preparation				x				
Nursery Preparation			x					
Transplanting				x				
Removing off-types					x	x	x	
Harvesting								x

Source: Survey, 2004

In DPL, the CRSP group had organized the rice transplanting on August 9, three days before the Queen's Birthday on August 12, which is marked as Mother's Day and a national holiday. To promote and publicize the community rice seed scheme, the DPL farmers had organized half a day village fair on the same day of transplanting rice in the seed production plot. Rice would be matured and ready for harvest at the end of November to early December. The CRSP group would select December 5, which is the King's Birthday, as the harvesting day, to again publicize the event. The DOAE has made use of "planting rice on Mother's Day (August 12) and harvesting rice on Father's Day (December 5) as a general recommendation for the production of rainy season rice, the period is agronomically suitable for planting local photosensitive glutinous rice, which could make full use of the whole growing season. In BM village, farmers did not organize a campaign or publicize the community rice seed production.

At the onset of the rice growing season, certain activities had to be carried out either by individual farmers or collectively at the community level.

- Ploughing and rotary-tilling with a heavy tractor on contract to turn over the fallow land and incorporate crop residues of soybean or corn into rice field.
- Flooding the fields to decompose crop residues and to make land levelling more easily.
- Repairing and weeding the bunds or embankments surrounding the rice fields.
- Soil surface levelling with a small two-wheel tractor one or two days before transplanting.

The above process of preparing the soil is carried out individually, but since groups of farmers are sharing water from the same lateral canals, group decisions determine the time of operation. Soil preparation and water delivery along the same lateral canal has to be synchronized. The cleaning of the irrigation canal will be carried out collectively by the members of the community. It is a traditional practice that each village that is serviced by the same irrigation system nominates a farmer representative as member of the communal water management committee to determine a schedule for the water distribution. Such community-based irrigation management practice in the North has been hailed as one of the most successful collective actions of natural resource management where there is no interference from the state authority.

Community rice seed production (CRSP) management

CRSP management in BM

The CRSP organized the monthly meeting on the 10th of each month apart from the community monthly meeting. The main purpose was for reviewing, reflecting and updating rice seed production activities and the related agricultural information from the extension office. The group required the members to participate in certain activities such as the agreement on rice varieties to be planted for seed production, and the working schedules for member participation. The group leader informed them about the date and time that were agreed for the meeting and the field monitoring for all members. During the group activities, at lunch break farmers would go back to have their lunch at home. One woman farmer told me that they would have lunch at home as usual and come back in the afternoon to reduce the cost. But in DPL farmer members would bring their food and share it during lunch time, so that social gathering and information exchange could still continue. It is customary in the labour exchange arrangement for the owner to prepare and offer meals and drink for the farmer members who come and help in the work. The overall group activities in rice seed production for BM and DPL are shown in Table 3.3.

Table 3.3 Household preferences for individual versus collective action in rice production in BM and DPL

Activities	BM		DPL	
	individual	group	individual	group
1. seed acquisition	√			√
2. rice nursery preparation	√		√	
3. land preparation	√		√	
4. transplanting		√		√
5. weeding and applying fertilizer	√		√	
6. field monitoring and removing off-types		√		√
7. harvesting		√		√
8. piling rice bundles to ease threshing		√		√
9. threshing and transportation		√		√

Source: Survey, 2004

CRSP management in DPL

During group activities in relation to CRSP, individual members would be asked to sign an attendance. One household member would be required to participate in group activities. Those who did not participate and did not notify in advance would have to pay a fine of *Baht* 50. This amount was about 40 percent of the daily farming wage. If the same individual was found to be absent for three or more times consecutively without sending any family member as replacement, the group would withdraw his or her membership. The core group had drawn up the production plan, and made arrangements to organize a monthly meeting on the first Saturday of each month. Sometimes the monthly meeting could not be held on schedule, informal dialogues between farmers were freely taken place, such as information about the Community Seed Production of the DOAE. During the rice planting season, the following activities were organized collectively:

- Checking the rice nurseries. The activity aimed to discard the off-type at the seedling stage, to observe any damage by pests and diseases, and to ascertain that the nursery for seed production was set up at a distance from the others to avoid contamination.
- Field monitoring during tilling. This was done about one month after planting to remove the off-types.
- Field monitoring at the pre-flowering stage. The group had decided to conduct field monitoring on 18 October 2004 (about one week before flowering of photosensitive rice) to rogue undesired rice plants or off-types from the seed production plots. The date was specific for the photosensitive rice varieties, such as RD 6 and KDML 105, which would flower on October 23-26 when the day length was about 11.30 hours in the Upper North, So that any rice plants flowered on October 18 would be removed.
- Field monitoring at the seed-filling stage when the spikes were looping. This was the final stage of removal of off-types in the process of seed production before harvest.

The core group collectively walked across the members' fields to detect the off-types. Those who could not participate in the monitoring process would inform the group in advance, and would send the spouse to participate in the activity. It was also agreed that individual farmers would take responsibility to remove the undesired plants before the group activity. The process would safe time for the group monitoring, and if the proposed seed plot was not properly managed by having too many off-types and weedy, the group would reject it as seed plot. During the 2004 season in DPL, the group decided to have communal plots after the unsatisfactory results obtained from individual farmers' seed production practices. The group was able to achieve the first success by having communal plots in 2004 season.

Most farmers in BM organized their seed acquisition individually, but a few farmers shared the same source of seeds from Vichit. During transplanting, farmer members made their own exchange labour arrangements. It was not necessary for the group members to provide labour exchange in rotation within the group members. A few individuals who had close working relationships would form a separate labour exchange group. In DPL, however, the CRSP group members were helping each other in transplanting. During the field monitoring process, the group had planned to have three rounds to remove off-types from the fields. The group decided to have a field monitoring activity on Saturday, since some members were employed as security guards and field workers during the weekdays. It was observed that less than 10 farmers were collectively participating in group activities. Initially it required 15 members to participate in the group monitoring of rice field. It appeared several times that the same farmers were present in all group activities. There was no rule to penalize those absent from the group work, but the

CRSP group in DPL developed a regulatory system to ensure participation in group activities. The group also provided a loan to members on the basis of active participation. Therefore, more farmer participation was observed in DPL. Activities such as harvesting, piling and threshing were normally carried out through the labour exchange system to overcome labour shortage and to reduce labour cost.

The first two years of operation did not provide satisfactory results. In Year I (2002) the quality of the certified seed was below standard by having too many off-types. Field rouging was unable to remove all the off-types with the result of complete rejection from the Seed Multiplication Centre. In the second year (2003), less off-type plants were observed, and farmers were able to remove all the off-types at harvest. But the seed was partially damaged by rain during maturity and harvesting. The seed quality was not accepted by the Seed Multiplication Centre after seed testing. The official from the Seed Multiplication Centre randomly took seed samples from two farmers and found the seed having poor germination (less than 75 percent germination), which resulted in the rejection of the input of the whole group. A few farmers who conducted their own seed testing and found that seed germination met with the testing standard, tried to complain to the Seed Multiplication Centre but all to no avail. Farmers were aware that there was some variability in seed quality among the members within the group, but they did not accept the judgment of total rejection from the official. So they decided to continue producing rice seed in the 2004 season to prove that they could manage, despite having two consecutive years of unsuccessful attempts.

In the 2004 season, the DPL community rice seed production group had decided to organize a communal seed plot where all members shared their input resources in seed production to raise funds to be used as revolving for the group. The reason behind it was to get the good quality seed for next planting season and try to sell seed in other communities. The farmers now had a two-year experience in collective seed production and were determined to produce community rice seed. They decided to plant two communal seed plots of 3 *rai* each with RD 6 and SPT1 glutinous rice varieties each were rented from an absentee landlord. The rent of one plot located on the upper terrace with better water control would cost *Baht* 3,000 (*Baht*1,000/*rai*), while the other plot located on the lower terrace with a higher water level during the peak of the rainy season, hence a high probability of being flooded cost half the price, *Baht*1,500 (*Baht*500/*rai*). Collectively, farmers had completed ploughing the two plots and cleaning the waterway by the end of June. The farmers would use the best selection of their seed stock from the 2003 season as planting material. They would not depend or trust the seed from the Seed Multiplication Centre. They had designed the planting plan as follows:

The CRSP group planted SPT 1 on the upper terrace. The variety is a non-photosensitive glutinous rice, high yielding and possessing acceptable consumption quality. Currently, the seed is in high demand. Transplanting of SPT 1 took place on July 20 2004, when the seedlings were 30 days old. But the CRSP group planted traditional high quality glutinous rice, RD6 on the flood-prone lower terrace. The group carried out double rice transplanting with RD6. The first transplanting took place on July 10, when the seedlings were 20 days old. Young seedlings were transplanted to the plot in clumps at closer spacing, and remained in the field for 30 days. Then the second transplanting took place on August 10. Three to four seedlings per hill were planted with hill spacing of 30 x 30 cm. Farmers used 'very' old seedlings to prevent damage caused by crabs and pink snails because of their stiff and strong stem. The older tissues would be less palatable to crab and pink snail. The two pests were more prevalent in the flood-prone area.

The practice of communal seed production was evaluated after harvesting. Over 90 percent of 40 respondents, consisting of 25 male farmers and 15 female farmers, were satisfied with the first year experiment of the communal seed plot with the collective effort of their members. However, some issues were raised by group members on how to mobilize the labour for both the communal seed plot and the individual plots during harvesting time, and about the lower yield of SPT 1 in communal seed plot. The problem of labour demand at the same time during harvesting would be reduced by the use of the modified weed slasher. The women suggested that increasing number of plants per hill instead of planting a single plant per hill might improve the rice yield of SPT1. The practice could also withstand damage caused by pink snail. The group concluded that the group had enough potential to produce rice seed on more than 6 *rai* depending on availability of land. A few individuals indicated that they might try to produce seed on their own plot, since they had gained experience from the communal plot. The group also indicated that they could make better use of communal plots by producing foundation seed instead of certified seed. Planting a single plant per hill would be adopted so that off-type plants could be easily identified and removed. Farmers would also experience for themselves how single plants would grow and perform. The foundation seed produced from the communal plots then would be used to produce certified seed in the 2005 season. With collective action where labour was not a constraint, the high quality foundation seed could be easily produced. The successful result from the 2004 communal plot helped the group build up confidence in their CRSP initiative. In the 2004 season farmers were able to sell all of the 1,710 kg of SPT 1 variety, and 300 kg of RD 6 variety as seed. The group decided to sell the remaining 2,100 kg of RD 6 as grain before the new rice planting season. With more demand for the SPT 1 variety, the group decided that they would produce only SPT 1 seed in the communal plot during the 2005 season. In the flood-prone area, the rice farmers had switched to the SPT 1 variety because of its stiff stalk, and its ability to withstand and recover from week-long flooding.

About 10 farmers in DPL had their paddy fields subjected to annual flooding. In 2003, they had tried planting the new rice variety, SPT 1 instead of RD 6. The SPT 1 produced satisfactory performance under week-long submergence, giving about 70 percent of the normal yield under un-flooded growing conditions. The 10 farmers had decided to switch to use SPT 1 variety in the 2004 season. Farmers prepared their nursery in early June, and made their first planting in early July, with rice seedling aged over 35 days old. Farmers anticipated that the two-month old rice plants would be able to overcome the flooding hazard in mid to late September. Almost all farmer members of the community rice seed production group would continue to set aside certain plots for rice seed production. Those farmers, who cultivated rented land and had on paid the rent in kind, had pointed out that the product would make no difference to the landlords as long as the agreed amount of grain could be delivered after the harvest. The tenant farmers would not invest their time to produce rice seed when half of the amount had to be paid to the landlord as land rent. These farmers, who could not afford to produce certified seed on their rented plots, would be willing to participate in the communal plots and legitimately had their share in accessing the benefit from the system.

During the discussion, it was suggested that members engaging in certified seed production, should have one *rai* of land as seed plot. This implied that collective labour management supported individual households in three ways: through the communal foundation seed plot, the individual certified seed plot, and the individual plot for grain production. Individual households would be able to produce their own seed on a small plot that could easily be managed, and at the same time allowing them to still contribute their labour input to the communal seed plot. While the larger plot of land designed for grain production would fulfil the household need, rent payment, and provide cash income. With the successful performance of communal plot in 2004 season, the DPL CRSP group decided to continue with the system where the activities listed in Table 3.3 were carried out collectively. The general observation for group activities found in rice seed production, labour exchange, field monitoring and post-harvest handling is depicted in Table 3.4 below.

Table 3.4 Participatory CRSP and connected activities as observed in BM and DPL, 2003-2004

Practices	BM	DPL
Seed production system	Individual plots	Communal plots. A few individual farmers developed their seed plots
Labour exchange	Participating members were about 10 in transplanting and harvesting	Participating members were over 35 in transplanting and harvesting
Field monitoring	Not all members participated in the activity	Majority of the members participated in the activity, with attendance checked.
Post harvest handling	Individually handled. Seed quality was questionable. Two members produced seed by transplanting single plant per hill. Seed distribution was not well organized, but likely to be handled individually	Seed cleaning and packaging were carried out by the group members. The group contacted TAO and agricultural extension office to help inform other communities the availability of quality rice seed
Local initiatives	Extending the use of bio-fertilizer* as plant nutrient for rice and soybean to members. Distributing new soybean varieties, MCC 29 and MCC 54 to replace CM 60 Communal work to maintain irrigation system. Communal forest fire prevention.	Succeed in implementing frog habitat conservation as biological pest management in rice (Chapter 4) Continued to organize labour exchange in production of grain and vegetable soybean, maize, and sweet corn in dry season. The group developed weed slasher to harvest rice as labour-saving farm tool. The group also provided services to other members of the community, and made the tool available to others (Chapter 4) Communal work to maintain irrigation system.
Overall	Rice farmers were less cohesive. About 50 percent of members participated in field monitoring. A few members engaged in off-farm works during the rice season, and would be able to join the group activity if it was on weekends. The group had knowledgeable leaders in rice production, and hardworking village leader with ability to seek financial supports from local administration and outside agencies, but members were independently self-Centred that hampered the collective action and benefit sharing.	Labour exchange helped foster the social connectedness. Daily informal gathering after works facilitated the flows of information, and decision-making. Many voluntary works among members were common, such as repairing and maintaining houses. The village was praised for its solidarity in the district.

Source: Survey, 2004

***** Bio-fertilizer produced by farmers is concentrated extract solution derived from anaerobic fermentation of plant and animal materials with molasses. The concentrate is diluted before use.

Participation and non-participation in CRSP

The non-participation and non-cooperation in CRSP of BM

The farming community of BM consists of small farm households with limited farming areas. Many are tenants; the land inherited from forefathers would not provide sufficient rice for household need. It was observed that both man and woman members of the household had to work either off-farm or on-farm for generating more household income. The economic pressure has forced farm families to seek off-farm employment, thus they spend less time at home. A few households whose family members have different working schedules would have less time to spend together. Consequently, farm families are more independent, and off-farm employment is individually organized, not as group. Members of the community in BM have less time engaging in cooperative activities. The group members of CRSP in BM has diversified their livelihoods including on-farm and off-farm employment as waged labourers (57 percent), self-employed (19 percent), such as trading, school bus drivers, diversified farming activities (19 percent) such as cattle-raising, fruit orchard, corn planting, etc. Two farmers were doing housework, because of old age (5 percent). The rice-soybean system is less intensive, requiring low inputs, and offering opportunities for farmers to diversify their livelihoods during the cropping period. Wage labour is seen as the most important income generating activity in the village.

The village will face a demographic problem in the near future as today already the average age of off-farm workers is over 40. The younger generation has left the farm and worked as wage labour in factories and in Chiang Mai city. The adult males and females of the family are the major workforce in farming. Faced with labour shortage, and ageing family labour, the community has turned to the labour exchange system to keep performing the farming activities of planting and harvesting. The pressure of working off-farm has an impact on farming practice. The rice farmers in BM produce rice for home consumption, household rice sufficiency is more important than cash generation from rice. Farmers would place higher priority on the security or stability of production than on maximum productivity. Consequently, the rice farmers use a low external input production strategy to maintain and stabilize their rice yield. Labour exchange arrangement during rice transplanting and harvesting is the main collective farming activity in the village. The number of farmers becoming a member of CRSP in BM has not increased since its establishment in 2002. The members of CRSP do not organize collective action other than for rice; those who are engaged in the cultivation of corn, tobacco, or pig rising, organize their own labour resources.

Meetings farmers who did not participate in CRSP followed by individual interviews did indeed indicate that the non-participating farmers realize the contribution of CRSP for the supply of quality rice seed within community. But seed production is a time consuming activity for them, and they cannot afford to spend that time on group meetings, field monitoring, and removing off-types from seed plots. The main reasons I collected from interviews with the 36 farmers who were not members of CRSP in BM are the following (see also Figure 3.1):

- Engaging in diverse income-generating activities generate better alternative income earning opportunities compared to engaging in the time-consuming seed production process.
- The majority of farmers are either tenants or smallholders; they produce rice for subsistence. There is no incentive for growing rice for commercial purpose.
- Non-participating farmers consider seed production as tedious and time consuming. The process requires intensive management.

- Rice seed can be sold in small quantities at a time. Small-scale farmers require a sum of money after the rice harvest and expect to sell their entire rice product as at once as grain.
- Some older farmers consider rice seed production as not suitable for them because they would have to work throughout the whole process. Old age prohibits them to follow the whole working schedule in seed production, and they are satisfied with just producing the grain.

There are certain limitations indicated by farmers like the size of the existing group which consisted of only a few members. Farmers were not satisfied with their performance, and did not want to join the group. The non-participating farmers feel that the group does not have a good management system, which leads to poor performance. The CRSP group of BM has difficulty in organizing themselves to take up collective action as evident from poor attendance at night meetings, and poor planning. The result shows that farmers earn more money by working on their own than participating in group activities of CRSP. Since farmers are engaged in off-farm and on-farm wage earning activities, they are more independent, and their non-farm income activities do not require collective action. For example, one farmer (Somkid) had joined the CRSP group for three years on an irregular basis. He was unable to attend the group meetings during the night, so eventually he has given up his membership.

However, other reasons have been indicated for non-participation in CRSP: 1. Group management. Two farmers had withdrawn from the group showing distrust in group management in distributing free rice seed in the second year. Therefore, later they hesitated to join the group; 2. Benefits received by the members. A number of farmers from the non-member group mentioned that the scale of operation was small as a result of small group size. Therefore, they would expect that the benefit shared by the members would also be small. 3. Distrust in the CRSP committee: one committee member with a "not-so –clean" record of managing project funds in the past was the key member of the group. Therefore, non-member farmers hesitated to join the CRSP in BM; 4. The scheme was mainly production-oriented and there was no strategy for marketing rice seed.

Within the group there is one knowledgeable and committed farmer who continues to improve his rice production practices for seed production. For instance, he is able to produce foundation seed by selecting the single plant per hill as his planting strategy, improving soil fertility with the use of *Sesbania rostrata* as green manure crop, developing bio-fertilizers from animal and plant extracts and using on his plot, etc.. However, this innovative farmer (Vichit) who would be expected to be a good resource person in the village is not able to lead the group. It appears that there is a communication gap between him and the other members, since Vichit is not local, but a migrant from the Northeast, and he is less trusted by the members. In addition, Vichit has an outspoken and straight-forward personality, and he could easily offend other members during a discussion. While the local farmers would normally be more reserved in their expression, they would rather remain silent than engage in argument with him.

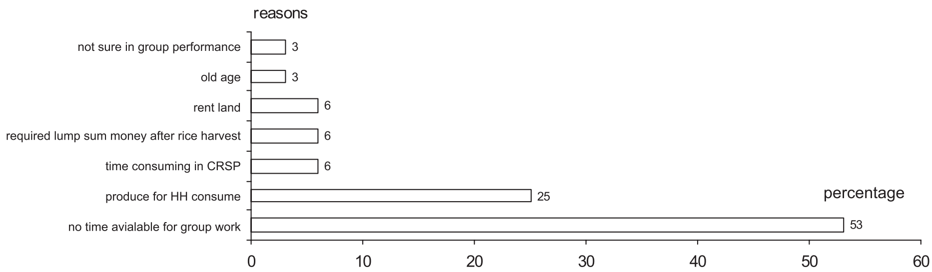


Figure 3.1 Reasons for non-participation in CRSP group in BM
Source: Survey, 2004

All farmer interviewed appreciate the importance of collective action in community-related activities, such as religious ceremonial events, village development work, and funeral rites. The main reasons, as pointed out by farmers, for willingly participating in collective action on the above mentioned non-income generating activities are that these events and activities are rooted in their collective history and culture, and the engagement in such customary events and activities are considered as a symbol of social cohesiveness and solidarity. However, if an individual was found to be negligent of community work or events, particularly during funeral rites, he or she might be socially sanctioned, and would not get any assistance or cooperation from the rest of the community in return.

The majority of farmers in BM who do not participate are the people who have other jobs outside the village. A few female members participate in CRSP and work almost full-time in the village, taking care of rice fields and other farming activities. While their husbands help them doing farm work during transplanting and harvesting, they would spend most of their time contracting off-farm employment outside the village. However, the farmers who grow rice and have their paddy lands under the TAO, point out that they are not aware of the existence of CRSP in BM. It is likely that there is a communication gap between the CRSP group and the rest of the community. The farmers who have paddy lands that are not connected also declined to participate in the seed production.

The non-participation and non-cooperation in CRSP of DPL

The non-participation of farmers in the CRSP of DPL was similar to BM. Also here farmers found it difficult to set aside time to attend group activities. The results from 21 interviews with non-CRSP farmers in DPL on why farmers did not participate in CRSP were (see also Figure 3.2):

- Farmers could not afford to spend their time to be involved in the seed production process other group activities such as meetings, field monitoring and removing the off-type plants. The households with full time non-farm employment as permanent occupation would not join the CRSP.
- Farmers who did not own nor had access to rice fields would not join the CRSP group. But some would cultivate corn and vegetables.

- Farm households consisting of only women would not join because of the group activities required a lot of hard work.

However, farmers responded that 62 percent participated at other group activities such as the village fund (5 percent), housewife group (10 percent), health volunteers (5 percent), corn group (24 percent), soybean group (14 percent) and vegetables group (5 percent). The reasons for joining other group activities in the village are that the work did not consume so much time. Moreover, that farmer also grew particular crops, so they could get access to credit and loans by becoming a group member. The housewife group also provided the saving and loan. Being a health volunteer did not take much time, and people considered it as community service.

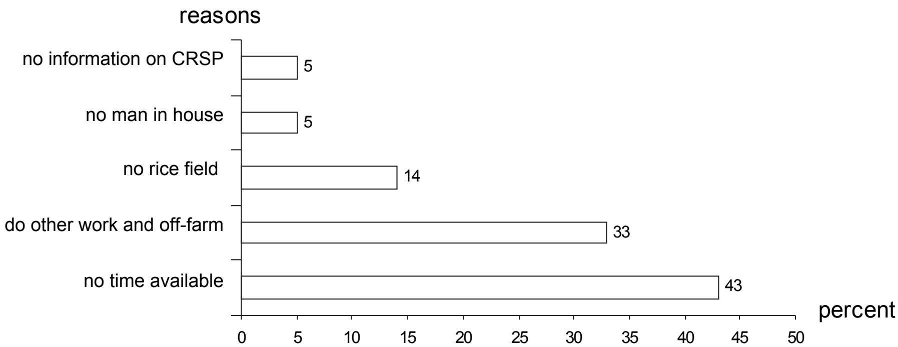
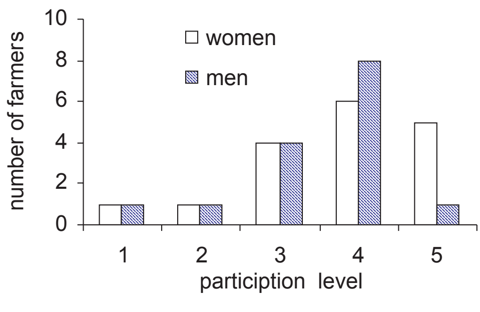


Figure 3.2 Reasons for non-participation in CRSP group in DPL
Source: Survey, 2004

The major farming activities of the 48 CRSP members were the cultivation of rice (77 percent), soybean (42 percent), hybrid corn (65 percent), sweet corn (48 percent), vegetable soybean (21 percent) and other activities (vegetable growing, cattle, fruit orchard, frog raising: 44 percent). Off-farm employment was mainly sought after the rice season such as construction work, wage labour, trading, etc. The farming families who did not participate in CRSP were those who did not have access to rice fields, did not have male members in the family, and were too old to carry out the group activities in time in rice seed production. Also, some non-participating households had earned a high alternative income from non-rice crops such as corn in the rainy and dry season, soybean, and vegetables.

In DPL, there was no rule to prevent non-rice farmers from joining the CRSP group as long as they participated or provided support in the seed production activities. It was found that 10 farmers (23 percent of 48 farmers) in the CRSP group who had no rice land were self-employed, ranging from a trader in the nearby market, a bus driver, truck driver, construction worker, wage labourer in the integrated fruit orchard and cattle raising farm, to the owner of a dynamo repair shop in the village, who did not have time to join the group activities all the time. But they would pay a fee equivalent to the labour cost to the group for not attending the group activities or they would hire another labourer to replace them in the group work. Women farmers were not actively participating because of certain activities that were limited in practice such as land preparation and monitoring the removal of off-type plants. Most women would join in harvesting, piling up rice stalks, and preparing food for the exchange labourers during farming. The CRSP members arranged their workloads within their households. When the male members went for rice work, the female members would take up other farm work such as weeding and watering the corn fields. It was also observed that two females were assigned the task and responsibility of being the group secretary and marketing organizer respectively, because of their skills in note-taking and negotiation. None of these skills was found in the BM rice group.

The CRSP farmers explained that participation meant that farmer members joined the meeting to collectively set up the group target of CRSP, and participate in group activities. Therefore, when I asked about the degree of participation of each member, they would judge from the number of times each member took part in the total of group meetings and group work. This self-evaluation was held during one night's meeting with a group of 17 male farmers and 13 of female farmers. Every farmer received a piece of paper to write down the numbers of times he/she had participated in group activities. They made a scale from 1 to 5 for their self-assessment in participation. Those with the highest frequency of an attendance of more than 10 times would rank with highest with a score of 5, and 1 was the least frequent attendance. The levels of participation for male and female members are shown in Figure 3.4. The average participation of both men and women was high: an attendance of more than 8 times out of the 12 CRSP activities during the 2004 season. Those attending a meeting or participating in group work would sign their name in a note book. The total number of group meetings including night meetings and farm work was 12 times in the 2004 season. All the committee members participated at all occasions, while 5 members participated in only 1 to 3 group activities.



Participation level

level	Meaning
1	1 time from 10 times
2	More than 3 times
3	3 times from 10 times
4	More than 8 times
5	About 10-12 times

Figure 3.3 Participation in CRSP activities in DPL in 2004
Source: Survey, 2004

In DPL there were four farmers who decided to join the CRSP group, but for different reasons (see below). They all joined the group and participated in group activities other than rice seed production because they trusted the group's leadership and appreciated strong cooperation within the group. In other words, group performance, friendship, trust and security within the community were enabling conditions for joining the CRSP.

The first was Dusit, the son-in-law of one of the group members. He had joined the rice group once but withdrew from its membership when he saw better opportunity of earning more income after being contracted to work as mechanic in private company in Bangkok. It turned out that life in Bangkok did not suit him well despite the fact that he had earned more, so he returned and rejoined the group in 2004 season. He appeared to be a great help in threshing the rice and loading the rice back to the barn.

Montri decided to join the group in the 2004 season. His elder sister, whose strong leadership was well known within the community, was the secretary of the CRSP group. Montri observed how group members were helping each other, creating a cohesive social unit that was well recognized by the local administration organization (TAO). The group's success had led to further support from the TAO in the 2005 season. Montri joined the group because he saw that all members genuinely worked toward the same goal.

Somdej owned the truck and worked on contract to a construction firm. He had to earn more to pay for the health care expenses of his son. Although he owned a few plots of upland fields and rice paddy, he had rented them out to others. But when his son passed away, he felt he did not need to earn more. Besides, doing contract work, with greater responsibility and where payment was not always on time, gave him more pressure than farming. So during the 2004 season he returned to farming, and joined the CRSP group. His experience in farm machinery and vehicle repair provided a great help to the group in designing labour saving farm tools.

Prayong did not have any rice paddy. He joined the CRSP group through the labour exchange arrangement. In return for his labour he would receive helping hands from others to assist him in planting and harvesting his corn. As a member, he could access the same benefit as others, such as a loan from the group's revolving fund. Prayong and his wife also took up on-farm work as wage labour, and preferred to be paid in rice. Both would work for at least 20 days as hired labour in rice farming so that they would receive 40 bags of paddy rice (un-milled), which was equivalent to 1,200 kg. This amount would be enough to feed the three members of the family for the whole year. So, by offering labour hours, a farmer who had no rice land could enjoy the same benefits as others in the community when joining the CRSP group.

The system of labour exchange, which is flexible and negotiable between the recipient host farmer and donor farmers regarding the reciprocity of services, is socially equitable and inclusive for landless rice farmers. In the labour exchange system, women and men are treated equally in terms of participation and performance. When the reciprocal payment is in kind, for instance during rice harvesting, women and men would receive the same remuneration, that is one bag of rice per person-day. It is socially and culturally accepted that the rice will be used for household needs, and production to meet household demand will receive highest priority. Among farmers, they will know who are landless and who are in need of rice for consumption in the village.

The existence of a driving force for CRSP

As a result of the successful campaign for the use of modern high yielding or high quality rice varieties by the DOAE, farmers are replacing the local varieties with modern high yielding varieties. The practice also causes farmers to entirely depend on external seed sources. The seed is furnished by the Seed Multiplication Centres of the DOAE, whose numbers rose to 23 Centres distributed all over the country. The farmers who had formed a small CRSP group of about 5-10 farmers were sharing the problem of labour shortage, and they saw the opportunity of increasing their farm income from rice by selling their harvest as seed. They were well organized, both structurally and functionally, and they also shared the problem of lacking the supply of quality rice seed. Individual small farmers usually change their seed material once every two to three years. The seed multiplication and distribution program managed by the DOAE is not effective enough to provide quality seed throughout the country. The community rice seed project (CRSP) was then initiated to provide opportunity for farmers to develop their own seed supply. The farmers in CRSP in BM and DPL villages had been involved in diversified farming and off-farm employment. During several farming meetings they found an incentive to join CRSP in the need for quality rice seed. The participating farmers had received training in seed production, and they joined the extension officials conducting field monitoring on seed plots.

All seed plots were found to be contaminated with off-types, which required frequent removal by hand. In addition, a number of observations emerged from BM and DPL:

1. The 12 farmers in BM who participated in the seed production program originally participated in the testing of *Sesbania rostrata* as green manure crop in rice system. They saw the added value generated by implementing soil improving practices in relation to increasing rice yield.
2. The material support, such as seed and chemical fertilizers, were an important incentive for farmers to organize and participate in community rice seed production. The participating farmer groups were given certified rice seed and fertilizers in the first year, and certified rice seed in the second year. The sub-district extension agent or *kaset tambon* (KT) would help facilitate and monitor the system once it was carried out. Individual farmers who received the material inputs, either seed, or fertilizers or both, would have to pay after the harvest. The payment would be managed and used as a revolving fund in the village.
3. Farmers also perceived that the seed produced would be purchased by the DOAE Seed Multiplication Centre. This was perhaps the most important incentive for farmers to join the Community Seed Production Project.
4. The participating farmers expected that the Seed Multiplication Centre would buy back a certain amount of seed at a 20 percent higher price than the market price of rice grain. So there was a price incentive for producing seed. However, after the rice harvest, no contact from the Seed Multiplication Centre or the district extension agent was observed to

negotiate about the seed and finally the Seed Multiplication Centre did not buy the seed. Thus farmers withdrew from participating in the CRSP because there was no contract arrangement with the Seed Multiplication Centre. This is perhaps a major disincentive for farmer withdrawal.

5. Those farmer groups who were better organized and who saw the opportunity of producing a higher value seed product than grain, actively participated by organizing group activities including transplanting, field monitoring, and harvesting. This was the case of the DPL farmer group.
6. Farmers were willing to sell the product as seed as well as in the form of grain, depending on the market opportunities. This practice was observed in both villages. For instance, one farmer in BM, who had adopted the system of planting single rice plant per hill to produce foundation seed for three years, had maintained and continued his production practice, despite the criticism he received from neighbours. Two farmers in DPL also carefully selected their seed to be used for next season planting. Consequently, their seed plots were almost true to type, with very few off-plant types.
7. A farmers' comparison on incomes from seed and grain sales in BM indicated that 57 percent of the farmers received a higher income from the sale of seed than of grain, because of higher price per unit for seed; 35 percent of the farmers did not see any difference in total income, and 8 percent of the farmers did not respond. These last farmers were subsistence farmers and did not want to sell their rice.

3.4 The role of key actors supporting community rice seed production and collective management

The village of BM is under two separate administration; about half of the 208 households belong to the *san mahaphon* Tambon Municipality (TM), while the other 202 households belong to the Kee Lek Tambon Administration Organization (TAO).

The majority of the farmer households who participated in the CRSP were registered under the TM administration, so the local administration paid less attention and was less supportive to the activity. The minority of the CRSP members, who were under the Kee Lek TAO, had to seek support from the Kee Lek TAO. Unfortunately, the village headman[1] of BM who was not keen on farming was not able to propose and negotiate with the TAO council for financial support in farming. On the other hand, DPL where all household members were under Kee Lek TAO, maintained its rural structure, and farming continued to be considered the main household livelihood activity. There were several key actors in both villages that were crucial in shaping farming development. They were formal

[1] In the past the position of village headman or *por luang* lasted for life. So traditionally, the village headman was an influential and powerful figure. When the government implemented its decentralization policy in early 1990s, the village headman became elected by a village community for a period of five years.

village leaders, representatives in the TAO council, as well as senior citizens who were respected by the community. Villages with a diversity of local talents will have an advantage in designing rural development initiatives.

Key actors of BM

The village headman (*por luang*) of BM: an entrepreneur

The village headman of BM was an emigrant from *san kamphang* district. He married and settled in BM village, and operated his own business in building the "paper palace" used for covering coffins during funeral rites. The structure has a wooden frame built in the configuration of a palace and covered by paper painted as a palace. His craftsmanship was well known, and his product was in high demand. He had offered an off-farm labour opportunity to women in the village to put paper on the wooden frame and to paint the structure. A few old women accepted the opportunity. However, not all the community members were keen to take the job, since many believed that working with the dead involves a bad omen and would bring bad luck to the family. But the business continued to grow, and the village headman spent less time in working to help improve farming conditions of the community. He usually delegated farming activity to his deputy, who happened to be involved in a village fund scandal. Although farmers communicated with the deputy village headman as if nothing had happened, and yet, the majority of farming households doubted the integrity of deputy headman. When I talked to deputy headman, he had many suggestions to improve farming situations of BM village. He always attended the TAO meeting and kept good contact with local and district extension agents. He provided linkage between local community and extension service of DOAE. Information flow from the local authority to community was done either by his direct contact to individuals or through village broadcasting system. He also helped governmental agencies to make village survey. But he did everything by himself, and did not allocate workload or organize the working system to encourage farmer members participate or take responsibility. So many farming projects initiated by deputy headman ended up with poor participation and poor performance.

The farmers blamed the poor support of the local organization on its administrative structure, namely the village not being part of the Kee Lek TAO. So the community was eager to see the separation of the BM village from the *san mahaphon* Tambon Municipality, and become a full member of the Kee Lek TAO. The deputy headman worked so hard toward new separation, and he had been lobbying to be village headman of the new village. in 2005, the establishment of the new village has started.

The poor performance in farming initiatives in BM village was influenced by factors at various levels:

- The administrative structure: the village and its community were under two different administrative organizations. One was more urban-inclined, the other was rural.

- The village headman was less interested in farming, and the deputy head was not fully trusted by the farming households.
- Majority of households were engaged in off-farm work. These conditions decreased opportunities for social gathering, and households were less interdependent.

Group leaders (*pratan gloum*)

A few individuals in BM as well as in DPL had developed themselves as key actors in promoting farming enterprise. These leaders directly and indirectly influenced farmer members in decision making on participation in collective action. They included formal leader, informal farmer leader, cultural leader, religious leader, etc.

1. The deputy village headman of BM was a farmer. He had been delegated by the village headman to oversee all farming activities in the village. He held many positions either as chairperson or committee member of many groups, such as chairperson of Water Users Association in Mae Teang district, secretary of Community Rice Seed Production group, committee member in the *tambon* Kee Lek rice group, village representative in TAO council, and committee member of village fund. Because of heavy administrative workload, he had adopted rice-soybean cropping system. Many farming activities were carried out by his wife, such as weeding and occasionally, irrigating rice and soybean. His communication skill was poor, for he often had passive or negative attitude when he disagreed with farmer participants, so the discussion ended with no progress. This was one reason why they had poor attendance when the CRSP group held monthly meetings on the 10th of each month. But he was very keen in collaborating with local authority, trying to bring in many development projects to BM, particularly job creating activities during the dry season, such as maintaining main irrigation canal and repairing weirs along lateral canals through contract work with the Royal Irrigation Department. He reported all farming failures due to natural causes to district agricultural extension office and TAO for compensation and material supports. But because of his controversial behaviour in handling of village fund in the past farmers were not satisfied with his integrity and did not fully trust him. So any cooperative activities initiated and chaired by him would end up with poor participation and performance, despite the fact that his hard working was recognized by farmer members. However, he was selected for village headman position in 2005 when BM had become a new village under *tambon* Kee Lek, and officially separated from the *san mahaphon* Municipality.
2. Jumnong was a good farmer leader. He had been elected as leader of CRSP group of BM because of his devotion and commitment. He valued the importance of group performance rather than individual benefit. He viewed that once the CRSP group had been socially accepted, they would win trust and the group would receive more support both from within and outside the community. In the CRSP group meetings, he always stressed the importance of collective action. But many participants joined the CRSP

group with varying objectives, many worked off-farm and had other employment, so cultivation of rainy season rice was mainly used for home consumption, only the surplus was sold. Many joined the group in the hope to receive free supply of seed or fertilizers, and to sell rice at a higher price. The "not fully committed and responsible behaviour"of certain individuals within the group had discouraged Jumnong so that he tendered his resignation as group leader. But all members insisted that he should stay.

In 2001 he began to raise pigs on contract to his former employer, who is a well-established pig farmer in *mae rim* district, on the southern border with Mae Teang district. The contractor provided all the inputs, such as piglets and feed. He would take care of electricity and water during pig husbandry. In return he would be paid *Baht* 7/kg of pig raised over three months. Essentially, he was paid at labour cost. He received the fixed wage rate based on pig live weight regardless of variations in the market price. On average he would receive *Baht* 4,000-4,500 per month, which was equivalent to the basic wage of unskilled labour in Chiang Mai. The income from raising pig had provided a stable income throughout the year. He also earned substantially from the additional selling of dry pig manure.

3. Vichit was an innovative farmer. He was from the Northeast and married to a local woman of BM. He did all the farming while his wife worked as factory worker. Vichit was also a good electrician, doing contract work on wiring of electricity. He also grew vegetables on small plot of about 1,000 m^2 size nearby his homestead. The vegetables, mainly local species produced with no chemicals, provided an income of about *Baht* 200 per day of harvest. So when he took up the contract work, the contract work should pay more than his income from vegetables. He was the key farming innovator. He had participated in testing the use of *Sesbania rostrata* as a green manure crop in rice farming, and adopted the system when the circumstances were favourable. He successfully developed bio-fertilizers from plant and animal extracts and used the materials in rice production. He succeeded in producing foundation seed from selected rice panicles and planted a rice single plant per hill. His seed had been proved to be more "true to type" than the certified seed distributed by the Seed Multiplication Centre. So in the 2004 season, the CRSP groups of BM and DPL had decided to use the seed produced by him.

He was straightforward and out-spoken, and because he was not a Northern Thai by birth, he was not well accepted by many farmers in BM, despite the fact that they knew he had vast knowledge and experience in farming. The rice farmers in BM indicated that they would still prefer the rice seed from the Seed Multiplication Centre to rice seed produced by him. However, in 2004 an incident changed some of the rice farmers' attitude toward his rice seed quality. Vichit also volunteered to experiment with the Multiple Cropping Centre, Chiang Mai University on new soybean improved lines. Eventually, two lines, numbered MCC 29 and MCC 54 from his plots were selected on a demonstration plot for farmers to observe, and both varieties outperformed the existing commercial variety, CM 60. Seeds of both lines from his plots had become the seed source for BM soybean farmers. It is evident that without his continued learning and experimenting, particularly in relation to comprehensive rice seed production, and subsequently with new improved soybean lines, the CRSP groups in BM and DPL would not have gained momentum and continued to move forward.

The chief monk (*phra kru*)

The chief monk of the temple (*wat*) in the village is the most important religious leader providing Buddhist teaching, performing religious and cultural ceremonies for the villagers. Religious individuals would avoid meat consumption by becoming vegetarian. Based on the lunar calendar, every seventh or eighth day people would attend the sermon in the temple. When villagers are morally or spiritually disturbed, they would talk to and seek advice from the chief monk. Recently, many monks in the North had formed a network to provide guidance for rural development, encouraging civil activities in the neighbouring villages of the temple. In the past, the temple was already the place where the local poor received basic education in reading and writing. The role of the temple as school declined after formal education in Thailand through the school system was established during the reign of King Rama the Fifth, about 150 years ago. Today, in rural communities, some parents send their boys to enter monkhood to get education up to tertiary level. The communities of BM and DPL used the temples in their villages mainly to conduct meetings.

The *phra kru* of BM was about 75 years old, and was not so active in social and development activities. His main role was to engage in religious and cultural ceremonial activities, as well as funeral rites. He would interact more with the senior citizens who often came to the temple to pray and have a dialogue with him.

Retired school teachers

Educated individuals in the village always earn great respect from the members of the community. Most farmers over 40 received only four years of primary education. They can read and write. But they still ask the *mae kru* (female teacher) or *por kru* (male teacher) for assistance when dealing with legal documents and communication with the authorities. So the retired educated persons are an important human asset to the rural poor. In BM, the *por Kru* had retired from government service more than three years ago and had worked as volunteer providing consultation in development work. He had contacted the Provincial Industrial Promotion to provide handicraft training for villagers, with the aim of providing employment opportunities. The wood carving project was undertaken in 2003, but eventually it ceased operation because farmers could not find time to participate during the planting season. The women farmers who were keen on training indicated that if the training was held after the harvesting season and the class conducted during the evenings, many people would be able to join the activity. This is a case where an indigenous initiative failed because the activity did not fit farmers' circumstances. Also, *por kru* helped the deputy village headman and farmers by correcting proposals submitted for financial support to the TAO. During his occasional presence at the night meetings of CRSP group he had provided useful comments and suggestions.

Key actors of DPL

The village headman of DPL: a broker

The village headman of DPL has a university degree, and he is a keen administrator. His own interest in farming had brought him close to farming community and made him a good broker. He always had good contacts with governmental agencies, from local to provincial level. He was innovative, and always a few steps ahead of his fellow village members. The farmers also indicated that they could not catch up with all his ideas, so they would listen and make decision on those activities that fit their own circumstances. For instance, the village headman himself promoted the cultivation of rubber, as part of the governmental policy to push rubber cultivation in the North. The village headman himself had brought rubber seedlings and planted them on his own property of sloping upland. But no other farmers had followed suit, because they could not afford to invest financially in such a long term activity.

He had encouraged farmers to participate in the CRSP when the local agricultural extension agent had approached them. He helped facilitate the meetings, particularly with overall farming development in the village. He would delegate responsibilities to different individuals so that the workload would not be shouldered by just a few individuals, and resulted in better participation and cooperation. Because of his devotion, he had served a second term as village headman. Under his leadership, DPL village had won the environment price for "greening" the village, cleaning the village environment to be a nice place to live. In 2004, he had successfully organized fund raising activity by having village fair, with a net profit of over *Baht* 60,000 which would be used for village development work. No other village had ever been able to raise such amount of money. In the same year, he had set up Friday open market along the road side in the village to offer space for locals as well as neighbouring households to trade. The market received good response from both sellers and buyers. The local consumers could get food and household merchandise for a cheap and affordable price. Because of his entrepreneurship and innovation, he had been selected by the Provincial government to be the representative of the Chiang Mai's 'One Tambon One Product' or 'OTOP' committee, providing advice and action plan for promotion and marketing of local products (food and non-food).

He organized monthly meetings with villagers on the first Saturday of the month. The meeting lasted half a day to keep DPL community informed about the happenings. The small social distance between the village headman and the community had created good governance conditions and better relationships within community. The village headman had asked other member of the community to manage all the village funds that channelled through him, and he would report the disbursement of fund during the monthly meetings. The community had taken monthly meetings seriously. They collectively had set the rule that the meeting must be attended by at least one member of household. Those who were not able to attend had to notify the group leaders or the village headman in advance; otherwise the unattended individuals would be fined *Baht* 50. Discussion with DPL farmers about leadership issue revealed that the key success factors were:

- The creative relationship and the open dialogue between village headman and community helped foster the link and cooperative action in the community.
- The personal characteristic of village headman, such as his creativity and innovative power, devotion, public service mind, and communicative ability, had won the trust of local community.
- The style of governing of village headman, by encouraging participation of community members through assigned responsibility, had created learning process to empower competent individuals, so that the fate of community would not depend on just a few individuals. As a consequence of collective action, the DPL village had been recognized as outstanding village with respect to farming, environmental protection, and social cohesiveness.

Group leader (*pratan gloum*)

Kasem was the leader of CRSP group in DPL. He formerly worked in a fruit and vegetable processing factory and as a construction worker in Chiang Mai for 14 years since 1977. After marriage in 1990, he turned to farming, by renting most of the land in DPL, cultivating rice, soybean and maize, similarly to others. He had been asked by the DPL village headman to be the leader of CRSP group, supported by the farmer members, and he had served with distinction. He, partly because of his persistence and devotion, and partly because of his good nature, had received good cooperation from farmer members, thus making the CRSP in DPL more successful than BM. The first two years of CRSP in DPL were met with less satisfactory results. In the third year (2004) of operation, he decided to change from individual plots to communal plots planted with two main varieties.

The chief monk (*phra kru*)

In DPL, the *pha kru* was in his mid-fifties, and still active in social development. He was ordained as monk when he was a boy in the DPL temple, so he knew every individual in the community. He had observed radical changes in farming systems, from subsistence farming with low external inputs to commercialized high input systems. He encouraged the community to maintain the labour exchange system to cope with increasing labour shortage. The CRSP group had nominated one member to coordinate with the *phra kru* to oversee all religious activities, and these were always attended by members of the community. The *phra kru* also helped resolve conflicts between individuals or groups, and provide alternative solutions. It might not always work, but as pointed out by farmers, the meeting with the *phra kru* could mitigate the disputes and calm down the opponents. I see the changing role of the temple in the rural society as exemplified by the *phra kru* in DPL. The link between the religious domain and the community is essential for sustainable development. This means that the *phra kru* should get more involved and keep in touch with reality so that he could provide appropriate spiritual guidance and moral support.

There are many instances when the local monks have actively participated in natural resource management, such as in the case of community forestry, where the forest resource is well protected and successfully managed by the local community (Taylor, 1996).

Retired school teachers (*mae kru*)

In DPL, the *mae kru* had retired from teaching in local school for seven years. She was appointed as chairperson in several committees at sub-district (*tambon*) Kee Lek, and district (*amphur*) Mae Teang levels. She was also the leader of DPL village civil group (*prachakhom mu ban*) assessing local needs, and occasionally organizing training in local culture for children and youth groups. She was also the key person organizing the participation of the old aged people in religious and cultural ceremonial activities in the village. She was actively involved in village fund raising for the temple by advising cultural activities during the fair. The teacher was able to coordinate between the local authorities and the community. She closely co-operated with the chief monk, the TAO council, and village headman. She was one of the key members to develop working solutions submitted to TAO and the district office to support a proposal for diverting the water way in Ping River to protect the river bank during the rainy season. In the interview I had with her, she pointed out the important contribution of group leaders to facilitate and encourage local participation in collective action. She also stressed the distribution of appropriate responsibilities to women and men, as she helped to support the housewife group in community work in DPL village.

Local representatives in TAO and *tambon*

The TAO or Tambon (sub-district) Administrative Organization is the local organization established by the Constitution in accordance to the decentralization policy. The TAO receives an annual budget from the central government. In 2006, by law, the government should allocate 35 percent of the national budget to all TAOs in the country (about 7,000). Currently, the TAOs receive about 24 percent of annual national budget.

The chief of TAO is elected. The council consists of representatives from each village nominated by the village community. Two representatives from each village will be members of TAO council. Since BM village consists of two parts, one belongs to Tambon Municipality (TM), and the other belongs to TAO, the village has four representatives. The representatives in TM were essentially part-time farmers, engaging themselves more in non-farm activities for livelihood. They had less experience to organize need assessment meetings with farmers. So the support from TM for agricultural development was insignificant, mainly in the form of compensation for the flood relief program. Of the representatives in the TAO, one was a farmer and the other was deputy village headman; they were less effective in formulating proposals for agricultural development. The process of project formulation took long time, and the deputy village headman had difficulty in getting response or consensus from the farmer members, because of poor attendance and participation.

The representatives from DPL were more active and more capable of formulating proposals for support from TAO. One was a woman, who was studying for her Masters degree at the Sukhothai Thammathirat Open University who had good working experience at the Mae Teang Agricultural Cooperatives. I observed that in one instance during the rice harvest in 2006, she rushed from the TAO meeting to meet farmers who were harvesting the rice crop. She asked for their opinion about the CRSP project, kinds of support did the group need from the TAO. Within a short time, she was able to formulate the farmer needs in writing and had the proposal ready for submission with the CRSP group leader's signature.

The other representative was a young man of just over thirty, who closely cooperated with the woman representative. He had good connections with external agencies and with other village representatives in the TAO council. So he could provide good linkages between villages. Together, both people were able to help negotiate with the Mae Teang Agricultural Cooperative to purchase all the rice seed produced by the group in 2004 season. It is obvious that the village has to have capable representatives at the TAO council, in order to lobby and negotiate for support of rural development. Since in the future, all financial support from the government will be mainly channelled through TAO. In this case, we can see that DPL has highly competent individuals at the local administrative organization what has a direct impact on community development.

The agricultural extension agent (*kaset tambon*, KT)

The Department of Agricultural Extension (DOAE) has placed one extension staff at sub-district level, known locally as *kaset tambon* (KT). The main responsibility of the KT is to disseminate crop production technologies to farmers, and to collect farm survey data for the DOAE. At each *tambon*, the DOAE has established a Tambon Technology Training and Service Centre (TTTSC). Initially the Centre was managed by the KT, but as the TAO grew bigger in terms of finances, the DOAE began to transfer its agricultural extension and service staff to TAO in 2004. Currently, the Centre is administered by a local committee consisting of 15 members, chaired by the TAO chief, and having the KT as secretary. So, he continues to provide the link between DOAE and TAO.

The former KT of *tambon* Kee Lek for over five years and had formed good working relationships with the local farmers in 13 villagers of *tambon* Kee Lek. Before he took his early retirement in 2004, he introduced the CRSP project to *tambon* Kee Lek, and coordinated the farmer field school (FFS) learning approach for community rice seed production with the Chiang Mai Seed Multiplication Centre (SMC). He also invited the technical staff of the Biological Pest Control Unit of the DOAE to provide integrated rice pest management for participating farmers. Farmers indicated that his approach enabled them to have better experiential learning than the conventional type of lectures and training, where the contents were not always locally relevant.

With a lack of travel funds from DOAE, the KT admitted that he had to prioritize and to mainly work with the most promising groups where the farmers had good cooperation among themselves. During the initial phase, he had introduced the

CRSP project to all villagers, and asked for volunteers to be participating in FFS learning. After the training, only farmers from BM and DPL expressed interest in joining the project. The KT had participated in farmer meetings in both villagers, and always provided supportive comments. The CRSP project initiated and implemented by the DOAE nationwide had ended up with positive and negative results. The key success factors as I have observed in DPL village are:

- The working spirit and service oriented mind of the KT to work closely with farmers and a good follow-up system, for instance, by his attending farmers' meetings and conducting field monitoring together with farmers, as I have observed.
- The ability of the KT to establish good working relationships with farmers, and to be able to encourage cooperative activities within the group.
- The ability of the KT to make use of the technology extension service network to benefit local farmers.
- The ability of the KT to work with the TAO through have the Centre Committee by formulating farming development action plans that have local relevance and significance. In the case of CRSP, another example of the relevance of the individual agency of a functionary that is crucial to make it work under institutionally supportive conditions.
- The support of TAO through financial commitment and encouragement of farmer cooperation in the agricultural initiative.

3.5 Exchange labour in rice system

The practice of exchange labour was found in both villages as labour exchange during rice transplanting and harvesting was accounted for by the need to reduce the cost of production. The labour intensive farming systems could be economically viable only if a shared or exchange labour system was operative. The collective action on labour exchange seemed to fulfil individual farmers' objectives. The landless farmers and the tenant farmers applied the labour exchange system to overcome labour constraint in pursuing intensive cropping systems. Labour exchange is an important social system that helps support the continuation of intensive rice-based cropping systems. Exchange of labour is carried out collectively by individual households with the calculation of the labour needed for their farming activities. The individual households then decide on the numbers of days that they can join the exchange system, so that they have enough labour to complete both the collective and their private farming tasks. The basic concept is that all farmers know about farming schedules of participating members by daily communication.

There is no leader or organization to help organize exchange labour in the village. It is self-organized. Individual households have three choices to manage their labour requirement. One is to use family labour; second is to hire labour against payment either in kind or in cash, depending on agreement between farmer and hired labour; and third is to participate in exchange labour as a reciprocal arrangement between households. The household members participating in an exchange labour arrangement can ask for cash payment if they urgently need financial means, and the daily wage rate will be paid by the host household.

The labour exchange system in BM

The exchange labour system continued to be practiced during rice transplanting and harvesting. But the numbers of members participating in labour exchange were only about 5 persons; group size was about a quarter smaller than in DPL. Therefore, additional labourers were hired during harvesting and threshing. The threshing machine was also contracted to speed up the threshing and selling. Some owners of threshing machines were local traders and would buy the paddy after harvest by paying in cash. The price of paddy rice at harvest offered by the traders was lower than market price, because of the high moisture content at harvest, about 25 percent. However, there was no obligation for farmers to sell paddy rice to the owners of threshing machines. Farmers who decided to use the threshing service and sell paddy rice to the machine owners usually needed cash. Since farmers would receive cash immediately after selling the paddy, this would take away some of their financial burden.

Collective action on farming activities other than rice was very little in BM. Farmers were more independent and autonomous. The soybean crop, after planting, could be managed by family labour. Crop management through family labour included irrigation, application of foliar fertilizers, spraying of chemical herbicides, and spraying chemicals for insect pest control during seed setting stage. Indeed cultivation of soybean did not require a full time employment. Farmers increased their labour productivity through other non-farm and off-farm employment. Farmers indicated that as the cost of production was increasing year by year, individual households had agreed to cut down on food sharing in the exchange labour arrangement. In BM village, it was common practice that farmers went back to have their lunch at home and returned to work at 13:00 pm. The social gathering in the early evening after field work was organized with low cost. The cost of social gathering after harvest ranged from *Baht* 200 to 300 for about 5-7 members. It was claimed that the host farmer could save up to *Baht* 500 per day, which was attributed to the supply of local whisky and food for less than 10 exchanged labourers at harvest. When the practice of cost reduction on food and beverage was mentioned to the DPL farmers, they indicated that they had managed within an affordable range of expenses. During the 2005 season, the DPL farmers claimed that the main cost of social gathering was paid on local rice whisky, and all members had determined to reduce the cost.

The BM farmers combined the use of exchange labour and the threshing machine to reduce the cost. A few farmers, who were producing rice for subsistence, shared labour for harvesting and would do the threshing on family labour. The family would have enough time to finish threshing before planting soybean in late December as second crop after rice. The system would not be possible in DPL, as the farmers would try to speed up the harvesting and threshing so that they could continue with cash cropping of hybrid maize, sweet corn and soybean, respectively.

The labour exchange system in DPL

To cope with the labour problem in rice farming in DPL, small-scale rice farmers would cooperate to share a mutual benefit from arranging a labour exchange system during rice transplanting and harvesting. Several activities have been observed in relation to collective activities in rice production. Occasionally, a small proportion of hired labour was included to finish off the work in one day. Farmers of DPL are closely related through kinship, and are well-known for their social cohesiveness. The village is praised for its solidarity as reflected by the continued practice of the reciprocal labour exchange system, extending from rice to cover soybean production, contract farming in hybrid maize seed, and sweet corn production, and some of off-farm activities.

In the Community Rice Seed Production group there are many sub-groups, whose members are more closely related, sharing labour more often among themselves. However, the sub-group members can engage in exchange labour with other sub-groups with no obligation, depending on individual household decisions, and negotiation between the two households on their labour requirements. Exchange labour in rice transplanting and harvesting is done through individual arrangement. Individual members have diverse employment opportunities either during or after rice planting, for instance, as wage labourer, contracted construction worker, etc. A well organized exchange labour system could reduce 30 percent of the total cost in rice production. The size of the labour exchange group varied. In 2004 it was found that about 8 labour exchange groups were organized irrespective of whether they were members or non-members of the CRSP group. The group was formed by individuals who were close friends and relatives, and who were planting the same crops with fitting schedules. The individual household made an estimation of the labour requirement for their farming activities, particularly at planting and harvesting times. A few farmers might increase or decrease planting areas, and change crops. When labour exchange was not possible, they would seek hired labour either within the village or from neighbouring villages. All members of the family would participate in planting. It was often seen that family members who happened to out-migrate to work either in the city or in another province would return to help their family planting rice. For transplanting and harvesting rice, the labour requirement for each activity averaged 5 persondays/*rai* (30 persondays/ha). It was also observed that a few farmers, who did not have access to rice land and did not grow rice, participated in exchange labour arrangements for others. These farmers would accumulate the number of working days that they had provided for others to be used for their own production of non-rice crops, such as hybrid maize seed and sweet corn contract farming.

Hired labour would receive Baht 150 for a man and Baht 120 (2003, 2004 and 2005 seasons) for a woman for one day's work. But if the payment was in kind, a woman and a man would receive the same amount of rice. A bag of paddy rice (about 32 kg) was paid to hired labour during harvest. Old-aged farmers were also involved in exchange labour. I asked one older couple who still produced rice at the age of about 70. They said that they could not join all rice production activities, such as harvesting and piling up the rice stalks for threshing. But they could help tying the rice stalks into bundles. The willingness to help and to participate in group activities was considered being more important than the efficiency of the individual performance in the labour exchange system. It was observed that stronger men would voluntarily engage in more heavy work, such as carrying rice bundles for threshing, and loading rice on the truck, etc. It was also understood that female members might leave earlier to prepare the meal for their families.

The exchange labour system was considered as a process of socialization among farm households. Food was prepared by the women of the host family during lunch time and late afternoon after work. Simple dishes were provided during lunch while the workers would bring their own cooked sticky rice. Snacks, beverages and local rice whisky would be prepared after finishing the day work (Visser, 1989). The big event of socialization was normally found after finishing the harvest of contracted crops such as vegetable soybean, and corn when musical entertainment was included. In cases where low productivity was observed, the spending on food and beverage would be reduced. Talk and communication among farmers included several topics related to livelihood, relaxing issues, farming practices and local politics. However, the cost of food and beverage was about 1000 Baht for 20 farmer participants. Female farmers engaged in labour exchange or worked as on farm waged labour, such as weeding in maize fields before the second application of chemical fertilizers; removing the second ear of the young sweet corn to have one ear per plant, etc. The removed young ears were sold as baby corn. In 2004, farmers had decided to allocate more land to soybeans than during previous years, and had reduced the areas for maize cultivation, as the price of maize was less promising. The timely planting and harvesting of maize and soybean was made possible through the exchange labour arrangement.

The labour exchange system has become the main element in supporting the practice of intensive agriculture as farming families continue to depend for their livelihood on farming. Carefully managed with trust and reciprocity, effective group activities could be further developed as seen in DPL village. When family households diversify their livelihood becoming more dependent on off-farm employment, and agriculture becomes less intensive, as happened in BM village, less exchange labour is organized. This would lead to less social cohesiveness, and eventually collective activities are more difficult to be organized and developed. The meaning of the exchange labour system for rice production for both villages can be seen from its social and economic values in collective action. Table 3.5 below tries to estimate the economic value versus the social value of the exchange labour arrangement.

Table 3.5 Economic and social values of exchanged labour arrangements in rice production in BM and DPL villages, Chiang Mai.

Items	BM village	DPL village
1. Labour cost in rice transplanting (*Baht*/rai)	450-500	450-500
2. Average cost of food and beverage for exchanged labours after harvest (*Baht*/person)	30-50	40-50
3. Participating labour (persons)	5-7	20
4. Areas harvested (manday/*rai*)	4-5	4-5

Source: Survey, 2004

In DPL more farmers participated in exchange labour during rice transplanting than in BM. The leader of the DPL CRSP group would organize enough labour to complete transplanting or harvesting of the individual rice owners within one day, so that the collective support could be arranged in time for the need of the other farmers. I also observed that the quality of the work done in transplanting or harvesting by the members of the collective labour group was better than the work done by the hired or contracting labourers. In both villages, only a few farmers who had other commitments were obliged to contract hired labour to carry out the transplanting. Thus collective action in rice farming, where labour exchange has been arranged within community members, provides better outcome and benefits equally shared by all members.

3.6 Conclusions

In this chapter we have addressed the conditions for collective action in various forms in the CRSP case study. These conditions for the establishment and functioning of CRSP groups are the following:

Culture. Collective action was observed especially in the cultural domain of religious and burial rites, the entering of monkhood ceremony, and other religious events. The collective participation is based on the cultural and social values that invite people to participate. However, cultural ceremonies are not limited to time, so it is free for everybody to join and participate.

Incentives for collective action. By forming production group, farmers will easily have access to governmental services. Group activity is a pre-requisite and a key selection criterion for local extension agent to implement the CRSP. The participating farmers will receive seed and chemical fertilizers as well as training for seed production. The repayment for the inputs is to be used as farmer revolving fund. Through collective action, farmer members are able to come to agreeable labour sharing arrangement effectively in rice production, and overcoming labour constraint during transplanting and harvesting processes. With collective action, farmers are able to negotiate with the TAO into the development of seed market.

Roles of collective action in seed production. In addition to benefit sharing in labour arrangement for rice production, the concerted effort in seed production is fully expressed when farmers develop communal seed plot, which is socially accepted and technically viable for seed production. Regulating system is formulated collectively to ensure full participation. Collective action provides effective and efficient management of communal seed plot for achieving farmers' goals. Individual farmers spend less time on communal plot but receive equal benefits.

Roles of key actors. There are many key actors interplay to have impact on CRSP either directly or indirectly. At field level, farmer leader plays direct role to help mobilize and organize group activities for the whole seed production process. The farmer leader is nominated and trusted by group members. Trust and reciprocity within group members are facilitated and motivated by devoted farmer leader. At the village level, the village headman and village representatives in the TAO council are important lobbyists to help negotiate for the TAO's support for the CRSP in relation to market entry and linkage with governmental institutions. Farmers participated in CRSP in BM and DPL are anticipating having contract seed production arrangement with the Seed Multiplication Centre so that the members could have better and secure income from their joint investment with the Seed Centre, and they expect their representative would be able to help negotiate the joint venture. But it is unlikely to happen in BM village, as there is less concerted effort between the CRSP farmer members and local leaders.

Enabling conditions. The CRSP does work in DPL, but does not work in BM, despite the fact that both villages have similar rice agro-ecosystems, sharing the same water resource from the Mae Teang irrigation project. Rice farmers in both villages organize exchange labour in rice farming, but BM farmers do not go through the whole process of seed production collectively, while DPL farmers are able to manage collective action throughout. DPL has displayed full spectrum of technological configuration, with strong enabling conditions of collective action in seed production and other extended activities that provide benefits to the village community.

It is concluded that the CRSP case study has showed the importance of technological configuration. The community rice seed production scheme has been introduced everywhere in rice farming areas, but to make it works, it requires collective action. The DPL rice community meets all elements in technological configuration including agro-ecosystem determinants, social mechanisms and collective action. The BM village can still receive benefit by using seed produced from the DPL village, but its competent individual farmer can supply foundation seed for the DPL CRSP group. Thus we see the sustainability of CRSP needs hybrid form of collective action, individualistic for innovation, and egalitarian for group cohesiveness. So in practice, BM and DPL can form partnership in rice seed production, where a key farmer in BM produces foundation seed with his pure line selection technique, and supplies it to the DPL CRSP group for production of certified rice seed. Other relevance of the CRSP groups as form of collective action is to provide access to services for the landless, gender equity for woman and man in remuneration in rice.

Chapter 4

Local technologies in rice farming

4.1 Introduction

In traditional rice producing communities, farmers produce rice (at least in part) for home consumption. The production system strongly depends on labour and draught animals. In the Upper North of Thailand, the topography is characterized by hills and valleys, and a long history of farmers collectively building diversion weirs and water delivery canal systems to stabilize rice productivity and increase land use intensity (Chapter 2). Communal irrigation has become an important asset of rice farmers sharing interests and benefits. Terracing and building rice bunds to hold the water is a pre-requisite for adopting the rice transplanting system to stabilize and improve the rice yield. A labour exchange system is practiced among rice farming households in the villages of BM and DPL to overcome labour constraints and to secure a timely production in the rainy season.

There are three case studies in this chapter. The first two cases explore different forms of collective action by the rice farmers in DPL stimulated by an individual technological innovation. The first example concerns the innovation of community frog protection as an outcome of successful cooperation by the villagers in a community rice seed production project. The second case concerns a weed slasher machine for rice harvesting innovated by an individual farmer, but which consequently required collective action to test and modify it, in order to adapt it to local conditions. The third case study focuses on an older-established double rice transplanting system developed to avoid flooding and pests. It is a labour intensive technique, and the case study allows us to examine the scope for collective management contributing to management of pests (crabs) and climatic hazards. The aim of the chapter is to understand the processes of technological innovation and the key factors that make technologies work under different local conditions, as a basis for advocating greater use of local knowledge in the design for the development of locally adapted technologies within agricultural institutional structures at a wider scale.

Innovations are a vital element of the local knowledge system, that help maintain crop production stability in specific locations, particularly in poor and remote areas bypassed by mainstream agricultural research, or in communities where modern technologies have no impact. Biggs and Clay (1981) note that agricultural production is inherently variable and location specific, and that there is no guarantee that a technology package that works in a specific location will be equally successful in another area nearby in the same year. The centralized system of research and development conducted in centralized institutes and the results passed to farmers by means of a network of extension agencies has often failed to improve agricultural productivity. Technologies are developed that may be applicable in one specific context but prove irrelevant to other conditions and contexts.

The conventional mode of technology distribution is known as the “top down” or “transfer of technology” (TOT) model (Biggs and Farrington 1991). Ruttan (1984) describes this as the diffusion model of agricultural development, since emphasis is placed on the spread of technology directly from Western countries to less developed countries (LDCs). There is also the view of authors like Schultz (1964) that farmers are actually quite efficient resource managers but technologies need radical upgrading to meet new international challenges. Clark (2001) stresses that the TOT model was (conceptually) the “engine” of the Green Revolution, and dominated policy thinking until very recently. Its chief characteristics are a belief in the existence of economies of scale in the research and development process, a faith in scientific method as the main source of improved technological practices for the poorest farmers, and a disregard for the tacit knowledge and local performance of farmers themselves (Chambers and Ghildyal,1985; Richards, 1985).

Clearly technological development is important. Clark (2001) argues that agricultural innovation often proceeds less effectively than it might because the institutional context in which it is embedded acts as an inert force. In turn, the conditioning factor is that associated innovation systems do not have the ’connectivity’ needed to link research adequately with economic needs. Therefore, low-cost economically feasible innovation options on the ground need to be further supported and reconnected with development implementing institutions.

Evidence from the three case studies of local innovations in this chapter will show that the farmers of BM and DPL are innovative and open to new technology. During field visits, information was collected through focus group meetings and brief interviews with key informants, and some individual interviews with farmers. . The case studies refer to the community level where collective action plays an important role in supporting local innovation by integrating externally introduced knowledge and local knowledge so that group benefit are attained. This chapter considers different forms of collective action in relation to local design for improved agriculture technology. The focus is on enabling factors of local initiatives, and how groups of individuals come up with inventions under economically constraining conditions. The three case studies also aim to explain what factors bring farmers to work together and to cooperate over innovation. The findings help us to understand the relative importance and limitations of collective action as a modality for technological transformation in a Northern Thai community.

4.2 The three case studies

Community frog protection (CFP) for pest control

Background

The use of pesticides and chemical fertilizers in Thai agriculture has increased steadily during the last four decades. This is in response to governmental policy to push for export promotion of agricultural products. In rice, the introduction of intensive monoculture with high yielding varieties and high rates of fertilizer use has made adoption of pesticides a necessity. Use of chemicals is still regarded by many as important for securing sufficient agricultural production and increasing crop yields. Subsidization of pesticides is one indicator of the durability of this belief in national agricultural policy (Jungbluth, 1997). A sense that undue reliance on pesticides poses a threat is apparent in the passing of the Hazardous Substances Act of 1992. This provides a legal framework for a pesticide control system. Phased registration as recommended by FAO was introduced in 1991. However, the ministerial rules and notifications were still being drafted over decade later.

In Thailand, rice farmers are influenced by major agricultural multinational enterprises. These companies are in the agricultural material input business, such as seeds, chemical fertilizers, pesticide, etc. In some ways, not only are farmers under their influence, but also the government officials and the politicians as well (Vanichanont, 2004). The government invests millions of dollars for importation of chemical fertilizers and pesticides. In 2004, herbicides accounted for about 60 percent of the agricultural chemicals imported to the country (excluding chemical fertilizers). Rice research and development in some programmes and projects has assumed commercial input supply, with increased reliance on chemicals for yield improvement. The findings from such research will be less useful and beneficial to small rice farmers who face increased production costs and various uncertainties, and currently actively seek possible alternative solutions (Chapter. 6).

Since the 8th National Economic and Social Development Plan (1997-2001), public awareness of the impact of agricultural chemicals on health and environment has grown. The national financial crisis beginning July 1997 resulted in reduction of subsidies and thus a sharp rise in the cost of imported chemicals. This further stimulated small farmers to look for alternatives. Research on the use of environment friendly natural materials for fertilizers and pesticides commonly known as bio-fertilizers and bio-pesticides has received good publicity. Farmers are now trained and encouraged to develop their own products from locally available materials for plant nutrients and pest control measures (see Chapter 6). A project on integrated pest control in rice, using the farmer-field school approach, has been carried out jointly by the Departments of Agriculture (DOA) and Agricultural Extension (DOAE) of the Ministry of Agriculture and Cooperatives (MOAC), with the aim of making better use of limited amounts of chemicals for pest control in rice. The implementation of (a code of) Good Agricultural Practice (GAP) by the DOA signals introduction of a package of safe production technologies that it is hoped will result in pesticide-safe products for consumption and export markets. In the 9th National Economic and Social Development Plan (2002-2006), organic agriculture has become part of the national agenda in response to increasing demand from domestic niche markets, both at home and overseas. Production and marketing of organic rice has been jointly worked out by farmers and private exporting companies in the North and the Northeast. The use of organic fertilizers has been promoted through the government-supported organic fertilizer plants in many rice production villages throughout the country. Many private chemical companies, seeing "which way the wind is blowing" are now producing and distributing organic fertilizers in addition to chemical fertilizers.

As a result of these trends the appeal of the conventional technology transfer model in pest management, whereby rice farmers are given a lecture-type of training, and diagnosis is strongly biased towards chemical treatment, is reducing. The farmer-field school approach where farmers are exposed to collective learning and action through a facilitating process is increasingly popular. In an important development, the approach has recently been adopted by the DOAE to implement the community rice seed production project.

In a trial documented below, a group of 25 farmer volunteers participated in a season-long on-site learning-by-doing activity. Subject matter specialists (SMS) in rice pests and seed production helped conduct training workshops on the weekly basis. Key success factors included the facilitation skills of the SMS, and the active participation of farmer volunteers throughout the season. Interactive learning based on site specific realities and sincere dialogue between farmers and the SMS gradually increased farmer competence in pest management in rice production, either for seed or for grain. Such social innovation, as can be observed in the farmer field school learning process, supports progressive social change, decentralization, meaningful participation, cultural autonomy, and conservation (cf. Chambers and McBeth, 1992; Chitere, 1994).

Rice pests in Thai lowland ecosystems are diverse and broad-brush technical (*i.e.* pesticide-based) solutions less satisfactory in providing effective pest control measures across locations. When farmers from different locations gather and participate in the farmer-field school, farmer-to-farmer communication and exchange of experience helps share and refine practical solutions, which can then be put into trials through collective decision and action. The common pests and diseases identified by rice farmers are pink snail or golden apple (*Pomacea canaliculat*a), crab (*Somaniatheohusa dugasti)*, rice blast disease (*Pyricularia grisea*), rice gall midge (*Orseolia oryzae*), white-back plant hopper (*Sogatella furcifera*), etc. Pest management is often more efficient and effective when it is done collectively at the community level covering contiguous paddy fields. This is clearly reflected in the case of frog conservation in rice production, described below. The success of conserving the frog habitat in rice fields for effective pest control depends strongly on group decision and commitment. The subsequent results are so vivid and convincing that there is considerable pressure then to maintain this cooperation in order to sustain a worthwhile practice.

Pest control by frog conservation

Frog is a generalist predator, feeding opportunistically depending on prey availability than by prey selectivity (Hirai and Matsui, 1999). In conjunction with the release of tadpole population, the members of the community rice seed production group declared the rice fields to be the boundary of a tadpole sanctuary or habitat where gathering of tadpoles for food during the rice-growing season was strictly prohibited. Signs of tadpole habitat conservation were visibly installed in various places across the rice paddy fields in DPL. The results of encouraging frogs as a pest control agent were very impressive. Farmers observed a major decline in insect pest populations. During the field monitoring of the seed production plots, the farmer group claimed that no serious sign or symptom of pest attack was observed. Thus no chemical pesticides were used from the time the frogs were released after young transplanted rice seedlings were established. The effectiveness of using frogs to control rice pests, and its later use as human food, encouraged farmers to continue to cooperate (see Box 4.1).

We do not use chemical pesticides in our rice fields any more. As a consequence, we have found that the numbers of snake and frog are increasing after rice harvesting (Farmer at DPL, 2004)**.**

We are not allowed to catch the tadpoles in the frog conservation area, but after rice harvesting, however, catching for household consumption is allowed (Man farmer, DPL).

We are collectively responsible to keep a close watch on people who trap the tadpoles, even our neighbours (Woman farmer, DPL).

These observations were confirmed by the regular field monitoring of rice seed production plots. No chemicals were used for pest control in the 2003-2004 rice seasons. The DPL farmers shared their pest management experience with neighbouring villagers through a community meeting. They then proposed to extend the frog conservation action plan to cover at least four villages sharing contiguous paddy fields. The target villages included Village No. 4 (Nong Khong), No.3 (Ban Dong Palan), No. 10 (Ban Thung Si Thong), and No.1 (Ban Buak Mue).

Tadpoles gathered from rice fields can be sold at *Baht* 200/kg. Adult frogs are raised and sold commercially in the daily market, ranging from 50 to 60 *Baht*/kg. However, farmers always took note of the costs and benefits associated with the practice (see Table 4.2). The criterion for the farmer's assessment of pesticide is to maximize the net return. Costs of pest control are referred to as the amount of farm resources used for every unit of crop loss prevented (Jungbluth, 1997). Therefore, reduction of production cost is an important driving force to motivate the community to practice pest control to achieve food security and income stability.

Box 4.1 Introduction of innovation from DOAE in 2003

During the farmer field school on community rice seed production, problems of rice pests and their possible solutions with biological control measures were discussed. Farmers were more interested in using biological control agents rather than chemical pesticides. In the training session, the DOAE Biological Pest Control Unit based in Chiang Mai was invited to present the use of biological pest control in rice.

It was one year after the CRSP in DPL that the principle of biological pest control was put into practice in rice production. The Biological Pest Control Unit released 1,500 tadpoles into seed production plots of 200 rai (32 ha). The results were so impressive that the CRSP group in DPL decided to continue the system in subsequent years by producing their own frog population to be released in rice fields.

Box 4.2 Farmer innovation on frog conservation as insect pest control strategy

In the CRSP group, there were five farmers who had accumulated experience in producing frogs for market since 1999. They had played leading roles in the frog conservation activity and its use as a biological control agent in rice.

Since the conservation of frog habitat in rice fields required collective action at the community level, the leading farmers in the CRSP group were concerned about the sustainability of the conservation practice. They decided to organize a farmer field day on the seed production site where frogs had been released, in order to motivate neighbouring farmers to see the effectiveness of the system and to provide support for future conservation activity.

The CRSP group approached the local administration organization (TAO) for financial support and for coordinating with other villages, and the chief monk, as the spiritual and religious leader, for moral support. In addition, the CRSP group invited local agricultural officials of DOAE including extension agents and plant protection specialists, and the Land Development Department [LDD] to observe the event. The key farmer leaders who were frog "specialists" provided practical knowledge to the audience. The 45 day old frogs were regarded as the appropriate stage to be released in rice fields. The amphibian was well adapted to the submerged conditions of rice field during the rainy season. It then reaches full size for the market after the rice harvest. The aim was to provide information on the multiple benefits of frog raising in rice fields, for controlling rice pests and for food and income after rice harvest. If the community coordinated to protect the amphibian, the community would harvest full benefits from frogs at the end of the rice season.

During the field day, other rice production technologies significant for cost reduction were introduced, such as use of bio-fertilizers, and bio-pesticide. The importance of community rice seed was also emphasized as a way to achieve self reliance in rice seed.

Individual practices in frog farming to supplement household income

Frogs are the most widespread amphibian to be associated with lowland rice ecosystems. Tadpoles are often gathered by local farmers for food and cash. In 1999, two farmers from DPL started-up a frog farming business to supplement income. They had learnt the technique from farmers in the nearby village, Village No. 10 (Tung Sri Thong). At present, six farmers have embarked on frog farming enterprises, five of them being members of the CRSP group. Within this frog farmer group, two were keen on hatching tadpoles through controlled mating. During the mating season, selected male and female adult frogs were borrowed from among frog farmers to procreate the initial frog population. Mating can be carried out 3-4 times in a year. The male and female parents can be used for mating for 3 to 4 years before they cease producing offspring.

Frog completes the full cycle of growth between 12-16 weeks. The adult frog aged 4 to 6 months old is sold at *Baht* 60/kg during September to November. Toward the cool season, beginning December, price can be *Baht* 80/kg or higher. Farmers claim there are several causes of frog mortality (Table 4.1). For instance, the young frogs (frog lets) were not eating during the first month because of disturbance by adult frogs, cats, etc. High population density also increases death rates. Excessive feeding can result in bursting of internal organs and death. The frog farmers in DPL village occasionally sought advice from and exchange information with frog farmers in Tung Sri Thong to find solutions to reduce death rate. Table 4.1 below summarizes farmers' experience in frog farming. The experiences varied, as described by the two farmers in Boxes 4.3 and 4.4.

Table4.1 Frog farming management data from mating to market

Life cycle	Mating	Spawn (egg)	Tadpole	Tadpole with legs	Young frog (frog let)	Frog	Fully-grown frog
Month			July	Aug	Sept	Oct	Nov
Duration	0ne night	2 days					
Management	Male: female, 1:3 or 3:5 removed after mating		3,000-5,000		300-500	Marketable size, stop feeding, frog begins hibernation	
Marketable price			200 Baht/kg	1-2 Baht/ tadpole	40 Baht/kg (8frogs/kg)	60Baht/kg (6 frogs/kg)	60-80 Baht/kg (4frogs/kg)

Pest incidence in rice farming (some farmer perspectives)

Our rice fields in DPL are connected to rice fields of other farmers in the neighbouring village. We have been cultivating rice on the rented land for over 30 years. Our parents had sold the land to a rich merchant in Chiang Mai city, who had resold the land to a rich person in Bangkok. We pay land rent every year either by rice or by cash. In the past, we grew local varieties, known as white rice (kaow kao), striped rice (kaow lai), and red rice (kaow daeng). We never used chemicals in our rice fields. But after 1970, we changed to high yielding varieties through the new extension program for the promotion of modern rice varieties. We began to have disease problems, which we learnt later were leaf blast, (bai mai), neck blast (tai kor luang) (Retired farmer, aged 72).

After the community rice seed production project was implemented in 2001, a new variety of rice, known as san pa tong 1, was introduced as high yielding variety, and [it was] supposed to be more tolerant to blast than the high quality rice, RD 6. It is also an early maturing variety. We adopted the variety after one year of testing. It can yield up to 6 t/ha (Rice group leader, aged 49).

Since we have introduced frogs into our rice fields, we never use chemicals for pest control any more. We can catch frog for food after rice harvest. My husband goes to catch fish and frogs in the night and we often find enough frogs for our family, and sometimes, we can sell frogs to our neighbours in the village (Wife of rice group member).

Box 4.3 Praphan Tatiang aged 47**:**

He began frog farming by purchasing five female and three male "golden" frogs (kob sri thong) at Baht 300 each to initiate his frog population. Praphan hired the frog farmer from Village no. 10, Tung Sri Thong, to help develop a breeding population. In 2004, Praphan had tried out a mating experiment by crossing a female "golden frog", which was fast growing, had an appealing skin colour, and good meat quality, with a male "black" frog, which possessed a firm, smaller body size, but was stronger. He raised his tadpoles in a 2x3x1.5 meters pond, and maintained the population at 500, using cooked egg yolk as feed. After one month, he used rice straw as feed supplement. He changed water once every seven days. The cost of feed accounted for about Baht 5,000-6,000 for 500 frogs. In 2004, during the first four months, Praphan managed to sell tadpoles for Baht 200, young frogs for Baht 300, and matured frogs for Baht 1,000. Praphan and his family consumed their own frogs and also supplied frog meat to village social functions over 30 times.

Box 4.4 Chaiwat Khumkao aged 50:

Chaiwat began raising "black frog" (kob dum) in 2000. He learnt the technique from farmers in Tung Sri Thong village. He had 5 frog ponds, each 3x5 m. The initial population density in each pond was 2,000 tadpoles. He decided to engage in the frog farming business because the system was easy to manage. The process consisted of good maintenance of water in the pond and use of commercial feed. The market price of fully-matured frog was relatively stable at Baht 60-80/kg. In 2001, he visited the commercial frog farm in san khamphaeng district (about one hour driving distance) operated by the CP conglomerate, the largest agri-business company in the country. He also raised pigs on contract with the CP Company. He decided to join the contract frog farming scheme of the CP Company by raising a commercial breed, known locally as "golden frog", bred by the company. The guaranteed price of golden frog was Baht 120/kg with body per frog of 0.25 kg. This frog was raised using commercial feed manufactured by the CP Company.

Chaiwat had joined the Northern Frog Farm Group. He began commercial production by developing his own breeding population with three male parents. He released one male parent in a 3x5 m. pond. After mating, he would obtain 3,000-4,000 progeny. The tadpoles were separated in different ponds (3x7 m.), each with a population density of 300 tadpoles. He sold his young frogs aged about 80 days to frog farmers. During the early growth period, the frog farmer had to change water once every 3-5 days. Frogs would not tolerate stagnant and unclean or contaminated water. Regular changing of water was essential for maintaining good growth and reducing the mortality rate. Tadpoles from "golden frog" parents, aged one month old, were priced at Baht 1-2 per tadpole. The mature frogs, from 4 to 6 months old, were sold at Baht 60-80/kg. He sold his frogs to a regular buyer, in amounts of about 20-30 kg each time. At present, he has stopped the frog farming business, but has turned to more integrated farming. He has given the "golden frog" parents to other members.

Community collaboration in frog conservation

We have opportunity to work with TAO and the district agricultural extension officer as a group. We have organized ourselves without difficulty since we all belong to the CRSP group. The extension officer helps us negotiate with the official from the Biological Pest Control Unit based in Chiang Mai to provide free tadpoles in the first year and to organize the training for us. There are four people who are most knowledgeable in this activity because they have experience in frog raising (Rice group leader, aged 49).

The rice group members attended the training in frog conservation for rice pest control. The farmers had been trained to understand the life cycle of key pests, and their relationships with natural enemies. A total of 48 farmers participated in frog conservation. The frog committee consists of 7 members, among who are the village headman and four experienced farmers. The committee works closely with the CRSP members. The role of the committee is to see that people in DPL follow the rules of frog conservation, and to convince other people in the neighbouring villages to follow suit, and not to catch tadpoles in the protected area.

Cultural beliefs, common rules and regulations

To have an effective frog conservation activity, the members suggested that rules and regulations should be written down and strictly followed. They were assisted by the agricultural extension officer and the Biological Pest Control Unit. They formulated the rules and regulations as a group. I had observed the first release of frog populations from the Biological Pest Control Unit in 2003. Contiguous rice fields to be assigned for frog conservation habitat were marked with stakes and flags so that the boundary was visible. The chief monk in the village has an immense influence on people's belief, especially through the concept of the Swearer[9] or *sa ban*. Scraps of the monk's old cloth were used as flags to indicate the boundaries of a sacred place. He carried out the *sa ban* ceremony which enhances shared belief in *bab* (sin) and *bun* (merit), which in effect prohibited the catching of frogs. The essence of pragmatic faith in Thai villages is the need to live a simple and satisfying life in harmony with nature as a counter-force to the inequities and injustices of modernization (Tayor, 1996).

Rice farmers in DPL then stopped using chemicals for pest control in their rice fields, for fear of harming the frog population in the conservation areas. The members were also asked to inform others not to hunt tadpoles or frogs during the rice growing season. The committee asked four farmers, experienced in raising frogs for the commercial market, to be responsible for each releasing 200 frogs in the 2004 season, to a total of 1,000 frogs, in rice fields where community rice seed was produced. The farmers experienced in frog farming showed a positive response to this request.

I asked them how they organized themselves to produce frog to be released in the protected areas in 2004 season, and whether 1,000 would be enough to provide effective insect control. Two farmers responded that each would produce 200-250 young frogs, and they would release the frog population after one week of rice transplanting. The released frogs together with the natural population would suffice to provide effective control as they had observed in the first year (2003) of operation.

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[9] The actions of the *Swearer* are based on three main principles: the principle of the good of the whole and the interdependence of society, cultural and nature; the principle of restraint (from personal greed), and need for social equity and generosity; and the principle of respect for the community and loving-kindness. The first informs all political, economic and social structures; the second governs individual behavior; and the third prescribes the correct attitude towards all forms of life.

Each person could easily provide 200-250 young frogs as requested by the committee. With one mating, the population could produce more than 5,000 tadpoles (statements by male farmers with experience of frog farming).

We have told other farmers that this area is a protected area and frog catching is not allowed during the rice growing season. We, the members, take turn to keep watch during the night. We have come across a few farmers from other villages catching frogs, so we have warned them and asked for their cooperation. If we see them catching frogs again, we will fine them according to our rules (Committee members, frog conservation group, DPL).

This initial protection work was undertaken to ensure that a there was a sufficiently large tadpole population at the community rice seed production site. In fact, farmers were all aware that the naturally occurring frog population would be sufficient to multiply and provide effective population size for pest control measure if the species was protected. Gathering or hunting tadpoles in the protected rice fields was prohibited only during the rice- growing season. Once rice is harvested, catching of adult frogs either for food or/and for cash is allowed. The rules and regulations were distributed in the adjacent villages, namely Village No. 10 (Tung Sri Thong) and Village No. 1 (BM). These two villages and DPL had connected paddy fields. The frog committee and its members also approached individual households, wherever possible, to inform them about the conservation activity, and ask for cooperation. So, it was found that a few people still caught frogs and tadpoles during the night. In addition, the frog conservation committee advised all members to refrain from using chemicals, such as *Endosulfan*, for crab control in rice field. The chemical is known to be toxic to tadpoles and frogs.

Collective strategies in reducing pesticide use

The community frog conservation proved effective in pest control. Farmers have needed to use no chemical pesticides in rice production since 2003, when the frog conservation practice was first implemented. A number of farmers said that the frog population had indeed increased and that an increased number of frogs had been caught at the end of rice season. They also noted an increase in numbers of (predatory) snakes and rodents in rice fields. The snakes found in rice fields are non-poisonous, and are eaten by local farmers.

The frog conservation committee decided to push further the acceptance of the community frog conservation scheme, aiming to reduce the amount of chemical use, especially with insecticides in rice pest management. However, convincing other neighbouring farmers to cooperate in this practice is a key to success. The effectiveness of rice pest management by introducing frogs as a biological control agent proved convincing because all members could observe its effect within one season. Such effectiveness provided strong supportive evidence for others to follow. The rice farmers in DPL indicated that the outcomes and shared benefits from frog conservation were many, such as benefits from biological pest control measures in rice production, gathering frogs for food and for cash, etc. This gradually increased other farmers' interest to cooperate and share responsibility in frog conservation.

Traditionally, farmers would walk over the field two weeks after transplanting to weed out aquatic weedy species. With intensive promotion of various kinds of herbicides as an effective and labour-saving weed control measure, use of herbicides had increased significantly. Farmers claimed that land preparation, through use of a rotary tiller, harrowing and flooding, as weed management practices for rice cultivation, could not provide complete weed suppression. Likewise, if farmers used pesticides that killed not only the pests but also their enemies, neighbouring farmers who encouraged the presence of predators might find that their predator populations would never reach a viable size. However, the best result often occurred when a majority of farmers in the area adopted integrated pest management practices. However, use of herbicide for weed control in rice field remains common. Since the group had successfully released frogs to control insect pest, application of herbicides had been carefully monitored by the group members for fear of killing the frog population. The results from 39 household interviews in DPL and 30 households in BM show that costs associated with pesticide and herbicides use was higher in BM than DPL according to frog conservation (Figure 4.1 and Table 4.2).

Table 4.2. Mean of input costs of rice in two villages, 2004

Village	Planted areas (ha)	No. of respondents	Cost (*Baht*/ha)			
			pesticides	herbicides	fungicides	Insecticides
DPL	18	39	320	7,847	400	1,285
BM	21	30	2,218	8,946	250	875

Source: Household interviews, rice group members, 2004

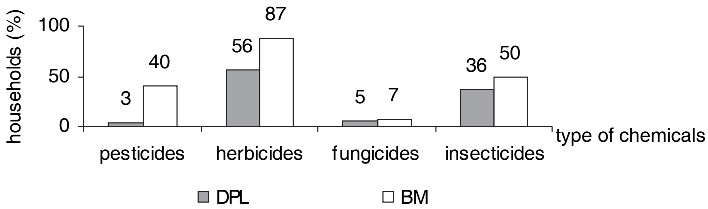


Figure 4.1 The percentage of households in two villages using chemicals
Source: Household interview, 2004Consequences of frog conservation

Near to the end of the rice growing season in 2004, I interviewed 62 farm households in DPL on the impact of frog conservation practices. The responses were arranged into 12 groups of observations and opinions. The practice had changed farmers' behaviour in relation to collective responsibility, by enforcing rules and regulations so that frog conservation was achievable. As a consequence, farmers reduced the use of pesticides in rice fields, and were more careful with herbicide use out of fear of killing the frog population. The outcome was that yield losses from insects were reduced. However, a few farmers could not see any changes during the season, and a few also complained that the conservation activity required more work. A small percentage of farmers began to appreciate the co-existence of other living organisms in rice ecosystems (Figure 4.2).

More than 80 households in DPL were aware of the frog conservation activity. Individuals have taken cooperative responsibility to protect frog populations in the designated areas, even though some of them are not the members of the CRSP group. In 2004, when the CRSP group decided to launch community-based frog conservation in rice production, the group included this activity in a field day where all village members were invited to participate in an event treated as the kick-off field day for community rice seed production. The CRSP group collectively transplanted rice seedlings in the seed production plot. The young frog population was released in the separate paddy field where rice had been planted for about 30 days. The field day was co-organized and supported by the TAO, and was witnessed by the chief monk of the village to provide moral and spiritual support for the success of the initiative. The field day was also attended by officials of the District government, and local administrative organisations, and farmers from other villages. DPL's frog conservation was recognized by the TAO as a success for community initiatives in natural resource management and environmental protection. The DPL farmers were proud of their collective effort and individuals took further steps to talk to other farmers in neighbouring villages, aiming to convince them to cooperate and adopt the practice at community level. Many had seen and accepted the concept, but there so far no action has been taken in their own villages.

The focus just described on sustainable agriculture and natural resource management challenges the large-scale transfer of finished technologies, the dominant model for a long time. Rather, it involves location-specific, informed practice, consensual decision-making and adaptive management. Rőling and Jiggins, (1998) point out that this requires collective farmer learning about technological and other innovations, and flexible options that can be adapted, enhancement of capacities for opportunity identification, problem solving, and decision making, platform building for resource use negotiation, and collective decision making at the larger ecosystem level. However, they do not talk about the two key factors mentioned by farmers of DPL, namely time and labour.

The key limitation in adopting the system on a wider scale, as indicated by farmers, was that the majority continued using herbicides for weed control. This was due to time and labour constraints. Many rice farmers could not afford to revert to the traditional practice of hand weeding in rice production. During the rice season, for instance, DPL rice farmers were also engaged in other farming and non-farming activities, planting non-rice crops such as corn and vegetables, in the island, under rain-fed conditions. A few had taken off-farm employment. The herbicides provided farmers with better opportunities to engage in other income generating activities. Obviously, many factors contribute to farmers' decision-making, and people adopt different strategies to improve their income, so a difficulty is apparent in finding the necessary time for collective action. Many farmers did not fully believe that frogs could reduce the pest problem, and feared that frog conservation might not be as effective as pesticides in rice pest control. Moreover, leadership in the neighbouring villages was not as strong as in DPL. Farmers knew that collective action requires genuine commitment by a key leader or coordinator, rather than Röling's platform, to assert community-based biological pest management. Many farmers are independent-minded, and see no reason to make decisions except in their own self interest.

This explains why DPL differed from BM. In the latter village the local institutions were not in place to stimulate coordination, and a majority of farmers had little or no interest to participate in coordinated pest management. But the door may not be shut. Rising prices for chemicals might yet convince skeptics that frog conservation is worth the effort due to its inherent low cost.

We went together with 3 people to see village leaders of Village 1 and 10 to try convince them that we had the same water canal for the rice field and that now we almost stopped using insecticide we had benefited from using frog as pest control agent in rice field. So, we would like to ask them to extend frog conservation to their Village No.1 and Village No.10. The leaders of both villages agreed in principle but indicated that their members were very difficult to organize for the purpose of cooperative pest management in rice production (Rice group leader and frog committee, DPL).

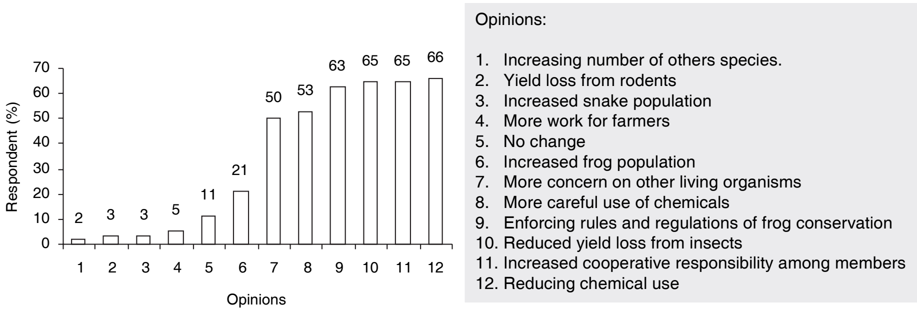


Figure 4.2 Farmers' responses to the impact of community frog conservation in DPL, 2004
Source: Household interview, 2004 (n = 69)

Key findings

Community frog protection is an example of a common pool resource management process that requires cooperation among villagers. It involves negotiation between the rice farmers who joined together as members of CRSP, other non-members in the community, and TAO. The farmers involved profit from sharing the benefits (Ostrom, 1990) received from reduced pesticide use in rice fields, as well as income and food earned from frog sales at the end of season. The groups adopted a simple structure and were self organizing, led by farmers skilled in the reproduction of tadpoles released during a collective field day. Other frog group members were involved in monitoring and reporting incidents, in order to limit taking of frogs during the rainy season. Over the last 2-3 years the number of farmers involved has gradually increased as a result of a shared interest, sense of belonging and ownership, to the point where individual farmers start to show collective responsibility. Many institutional actors were involved in building this sense of responsibility - TAO, the KT, the monk, the group leader. All can be deemed necessary support for localized technology adoption and transfer. The group leader was a keen supporter of frog production, while at the same time the village headman tried to have the frog habitat action plan accepted by TAO. It could be argued that DPL was lucky in being able to trade upon (and even increase) its levels of leadership and social cohesion. It remains a local solution. It is a fact that the practice did not spread to the neighbouring villages, despite the clear advantage in coordinating frog protection over a wider area. Leadership, and other circumstances, varied too much. Farmer individualism came to the fore.

Modification of a weed slashing machine for rice harvesting

Background

Under constraining conditions, farmers have always looked for alternatives to sustain their livelihoods. Many innovations have been developed and met with success where they fit a local need. Local experiences and practical knowledge co-evolve.

Farmers gain experience (*i.e.* adaptive rationality and co-learning skills) through 'reflection-in-action' (Stolzenbach, 1994). In order to consider an event or situation as farmer experimentation, certain conditions must be met, including (1) the creation or initial observation of conditions or treatments, and (2) the observation or monitoring of the subsequent result or effects. There are two types of farmer experimentation, namely (i) proactive - more or less systematic activities of individuals known within their communities as innovators or experimenters, and (ii) reactive - no systematically set-out objective, treatments of observation criteria. Reactive experimentation is also sometimes termed proto-experimentation (Okali *et.al.,* 1994). The knowledge gained through farmer experimentation plays a key role in disseminating the technology. The synergy of tacit knowledge (Nonaka, 1995) and explicit knowledge increases local creativity. The important thing is that farmers are encouraged to design their own technologies and test them for efficacy. It is often more relevant to individual action where farmers can develop whenever he/she wants and accumulate experience. Local innovation has challenged the conventional wisdom of a scientist-driven research agenda in technology development. It is through local innovation processes, for example, that many local plant species have been identified by for special uses, and this knowledge is sometimes eagerly seized upon by formal science and technology (as in pharmacology, for instance).

On the other hand, local knowledge is embedded in social relationships or practical usages that influence design of farmer technologies. For instance, a local technology developed by subsistence rice farmers for rice harvesting, such as a sickle made from light iron bent in a half circle with the blade on lower side for cutting rice stems, is more suitable when rice straw has multiple usage. Big bamboo baskets are used for hand threshing and grains are collected in basket; the materials are locally available and all the tools used are locally made. Subsistence farmers making their tools are practically self-reliant. But local innovativeness does not limit itself to traditional materials. Current materials and practices also play a part. Grain can be winnowed either with a hand or motor-driven fan for example,. The way a modern device is modified through local knowledge better to fit local usage and circumstances is described in the next case study.

Local innovation in modifying a hand-held weed slashing machine

The Northern rice farmers continue using sickles for harvesting rice by cutting a handful of rice stalks at a time. The harvested paddy is then threshed by buffalo or by people trampling the stalks to separate the grains from the panicles, and winnowed by throwing the grains into the air and catching them in a basket, letting the chaff and dust be blown away by the wind. The remaining unhusked paddy is stored in the rice barn. But it is sometimes found that farmers modify their own tools and methods to speed up processes or overcome production constraints. A simple instance is pictured opposite - the fitting of a fan to a weed slashing machine to blow dust and chaff from rice grains (Figure 4.3)

Figure 4.3. Blowing dust and chaff methods (a) Traditional (b) Modified weed slashing machine
Source: DPL, 2004

The hand-held weed slashing machine has also been modified, locally, for use as a rice harvesting tool. Labour constraint is a common problem during rice harvesting in late November to mid-December. Although two sizes of combine harvester (a harvesting and threshing machine) are available for hire on contract, the cost is high (800 *Baht/rai* and 500 *Baht/rai* compared to 350 *Baht/rai* for the weed slasher harvester). Only at times of extreme pressure would farmers call collectively for the services of a combine harvester.

In 2003, one farmer member of the CRSP group successfully modified a weed slashing machine to harvest rice. The design modification went through a number of field tests, until other members in the group were satisfied with its performance. The prototype was then multiplied by a local mechanic. The key feature developed was to fit a newly designed wire frame into the weed slashing machine. The wire frame was configured to hold rice plants in place after cutting, so that collecting the by hand would be easier. According to Scoones *et.al.,* (1996) and Rhoades and Bebbington (1991) experiments undertaken by farmers tend to be (1) curiosity experiments, to see what happens, (2) problem-solving experiments, to address a specific problem faced, (3) adaptation experiments, to adapt new technologies to known environments or known technologies to new environment, and (4) fortuitous experiments, or chance discoveries that lead to changes in practices, which in turn form the basis for a new learning experience. Farmers make the change according to condition and context. It was found that farmers practices in observation and experimentation is a key to the action learning process, and that they play a significant role in knowledge accumulation, adaptation and development (Winarto, 1994).

The use of the weed slasher as a rice harvester

The motor-driven hand-held weed slashing machine has become an important labour-saving tool in weed control in rice farming in northern Thailand. Farmers are willing to invest in such machines to make weeding easier and faster. The machine is used from sidewalks on paddy field bunds, or to manage weeds in fruit orchards and around the homestead. When a wire frame was fitted near the base of the rotating blade, the weed slasher could then function as a hand-held harvester. The wire frame holds rice plants in place after cutting. The height of the plant being cut is manually controlled without bending of the body. When harvesting with sickle, farmers have to bend their bodies and the process is laborious. Back pain is a common physical complaint of rice farmers. This is one reason why subsistence farmers in the North still prefer tall local rice varieties to modern high yielding varieties with short stalk.

When the combined harvester was introduced, it was readily accepted by commercial rice farmers in the Central Plain who plant modern high yielding varieties with short stalks. The hand-held weed slashing machine could cover one-metre (*i.e.* four rice hills) for each swing of operation. Rice plants would automatically lie in rows because of the support of the wire frame. The machine was suited to the new high yielding glutinous rice variety, SPT 1, which possesses a short stalk plant type (about 1 metre). Farmers would leave rice plants to dry for at least three days before the female farmers came as group to pile up the rice and prepare for threshing. In the 2004 season, about ten men were observed using machines to harvest rice at the same time. The group, familiar with the machine through actual practice, also offered harvesting services for other rice farmers. In group interviews with rice farmers in DPL, in 2004, I learnt that the machine and 10 men could finish one *rai* of rice in less than two hours. Farmers also recognized three additional advantages of the machine: 1.) It made collecting and piling of rice plants easier, 2.) It added value to rice straw by cutting the rice stem at the base, thus making the rice straw longer and unbroken (this straw was then used as mulch for garlic or onion production), and 3.) as a consequence of cutting at the base, farmers need not mow the rice stubble again, when soybean was planted under minimum or zero tillage systems.

Labour saving strategy is necessary for achieving sustainable livelihoods. In DPL and BM villages, small rice farmers have access to certain tools and methods that help make their rice farming sustainable. The small hand-held two-wheeled tractor used for puddling rice soils before planting, the newly developed hand-held weed slashing machine adapted for rice harvesting, hire of the small harvester or big combine, and labour exchange arrangements during transplanting, harvesting and piling of rice plants, and post harvest handling (threshing and transporting) are all instances of this labour saving strategy.

We had joined in the meeting with other villages in 2003 and found the wire frame joined with the weed slashing machine for harvesting rice. We told the group to modify and use it for our rice. In 2003 season, we were the only two persons who used the machine for harvesting rice. One year later there were 11 persons from our rice group using it for harvesting the variety SPT-1 (Male farmer, age 47).

What keeps people working together to make technology work?

The current success of the modified weed slashing machine was based on continued co-learning, experimentation and field testing by a small group of DPL farmers working with the machine until farmers had become familiar with it and thus able to adopt it to a specific high yield rice variety with a short stalk. The group process in DPL village inspired the TAO to provide support for group activity in other villages in *tambon* Kee Lek.

When I asked about what really keeps people working together and how group performance or behavioural factors eventually impacted on technology development DPL farmers came up with a range of cultural and organizational explanations.

Trust and reciprocity, social cohesion, and cultural relations among farming households were cited as key factors. The social solidarity and spirit of mutuality is rooted in village culture. A tradition of farmer cooperation is encountered in *muang fai, i.e. the* traditional communal irrigation system, where farmers sharing the same water resource co-manage the maintenance and distribution of water in a democratic spirit. When farming households face labour constraint they often seek to convince each other that only through cooperative effort is the problem of labour shortage likely to be solved. Reciprocal labour exchange is the method they most frequently deploy. This type of inter-household collaboration depends on a degree of trust that turns will be repaid. Such trust does not grow overnight, nor can it be conjured up by an outside institution, since it depends on intimate knowledge of character built up over a long time. In a way, the weed slasher is an interesting by-product of reciprocal labour exchange, since to make it work it needed to be tried out by members of a group in turn. Only a pre-existing group would have the necessary easy working relationship to make this seem feasible. It also involved a willingness to share practical knowledge freely across the group.

The farmers of DPL explain their spirit of solidarity as follows: when the extension officer came to ask farmers to participate in the training workshop on composting technology, farmers in other villages would wait till the result of meeting or until village headman said and decided who should participate, and many would ask about conditions of cost and who would be responsible for financial support. In DPL, the farmer group would organize itself and identify those members without commitments during the training period to participate voluntarily in the training. The issues of cost and financial support would be addressed later. There was some confidence that knowledge gained from training would disseminate through regular farmer meetings, since a confidence in sharing benefits was already well-established through labour cooperation.

But it needs to be emphasized that this was specific to DPL. In other villages, when the TAO requested for community work, the villagers would wait until the leader organized or distributed the responsibility to individuals. In DPL farmers say they will do the work that they can do first and organize themselves immediately. Here there is a well-established tradition of collective action that amounts to a local cultural trait. Self-organization is a well-honed practice, and part of group self-identity, with an expectation that output from group activity would be equally shared among members. The condition was self-maintaining. Since farmers could see the real benefits, both financially and socially, they kept widening the scope for cooperation. Group activity continued to provide low-cost solutions which worked under local conditions, and the approach extended to the cooperative way in which groups adapted technological options to local conditions.

Will local innovations spread?

In agriculture, the process requires farmers to become experts, instead of 'users' or 'receivers' of technology. They must learn to apply general ecological principle to their own locality and time-specific situations and be able to manage complex agro-ecosystem as businesses in competitive markets. But, as eco-systems do not stop at farm boundaries, local communities and wider consortia of interest groups and resource users also need to engage in learning how to manage landscapes and resources. (Rőling and Wagemakers, 1998: 10).

Developing locally adapted innovations for wider application is a challenge, however. A number of farmers in BM tried to uptake the slasher innovation, but failed, because they sought to use it on conventional rice varieties such as RD 6 and KDML105, which possess long stems and low tillering, compared to SPT1. The tall status of both varieties made the cutting by the machine less convenient. Farmers had to control the swinging of the machine and the wire frame did not work well to line up the rice plants in place. The machine worked better with short stalk rice varieties such as SPT1.

Farmer innovation during rice harvesting

Four processes associated with harvesting cutting rice, piling, threshing and transportation - were observed in the 2004 season, a year in which a number of innovations in the rice production system were introduced (Table 4.3).

Table 4.3 Rice harvesting systems

Systems	Harvesting	Piling	Threshing	Transporting
1.	Manual	Manual	Manual	Manual
2.	Manual	Manual	Thresher	Manual
3.	Modified weed slasher	Manual	Manual	Manual
4.	Modified weed slasher	Manual	Thresher	Manual
5.	4-row harvester	Manual	Manual	Manual
6.	4-row harvester	Manual	Thresher	Manual
7.	Small combine	-	-	Manual
8.	Big combine	-	-	-

Source: Farmer group discussion, 2004, 2005

System 1 The all manual system

Figure 4.4 Motor driven thresher
Source: DPL, 2004

This operation continues to be practiced by subsistence rice farming households, but its frequency is declining because labour becomes more of a constraint. Harvesting rice by hand collectively through labour exchange is a low cost approach, applicable to resource poor farmers in the subsistence farming. The host always pays for the meals after the day's work. In DPL, it always includes liquor, snacks, and light assortments, which can add up to *Baht* 1,000 when the group has over 20 members. It should also be noted that at least 4 days are required from harvest to threshing and carrying of the rice grain into the barn. After harvest, rice plants have to be allowed to sun-dry for three days before threshing.

System 2 Manual harvesting and motor driven thresher (Figure 4.5)

The practice is similar to the manual system 1, except during threshing where a motor-driven thresher is used to speed up the process, but there is a trade-off, since mechanization damages and therefore devalues the rice straw.

System 3 Use of modified weed slasher for harvesting.

This system is definitely faster than System 2. Farmers who cannot reciprocate manual services to others are likely to adopt the system. The modified weed slasher has become an important farm tool in rice production (Figure 4.6). The machine is handled by male farmers. For each swing, the machine can cut 4 hills of rice and puts the rice plants in proper alignment so that after drying for three days heaping for threshing can be done with ease. However, the modified slasher, with the frame currently fitted, cannot (as noted above) provide proper cutting. It still requires improvement to give greater versatility in terms of rice types it can tackle. In DPL, 10 modified slashers were made and operated by the seed producers group in 2004. Farmers consider the tool well suited to their rice production system, as well as fitting well with their own notions of collective action in rice production. The advent of this hand-held rice slasher modified from a motor-driven weed slashing machine has shortened the harvesting process.

System 4 Modified weed slasher for harvest and motor-machine thresher

This adds to system 3 the use of a motor driven thresher. The threshing cost is 180 *Baht*/15 kg of unmilled rice. The threshing machine came from lower north, where a large area produces rice the whole year round, allowing contractors to fully occupy themselves by moving around. The threshing machine is now very popular with rice farmers over a wider area because of labour shortages, and because it speeds up the harvesting process, so avoiding rain during December.

When rice has been dried in the open air for about three days grain quality is considered higher, having a lower moister content of about 14-15 percent and commanding a higher price than newly harvested paddy grain. However, farmers find the straw has a lower value and limited utility. The threshing machine, originally developed in the lower North, has now moved to the rice growing areas in the Upper North. Some thresher-owners are also rice traders.

Systems 5 & 6: The 4-row harvester (with or without thresher)

The 4-row harvester has certain advantage over the modified weed slashing machine, in that it is suitable for all rice varieties. A farmer able to hire a 4-row harvester is unlikely to adopt the manual threshing system (*i.e.* system 6 is more prevalent than system 5)

Systems 7 and 8: large and small combined harvesters

The systems are for those who do not engage in the labour exchange system. The machine combines harvesting and threshing processes. The charge for the big combine is lower than the small combine, but access to service is not always available. The contractor prefers large and contiguous paddy fields to allow the big combine to operate efficiently without wasting time on loading and uploading the machine and climbing over the rice bunds. Rice fields in BM and DPL are small and separated by the rice bunds, and thus not well-suited to combine harvester treatment.

The comparative advantage and disadvantage of different harvesting methods

1. Manual rice harvesting

The current practice for rice farmers, when labour is a constraint, is to share labour**.** Not all rice ripens at the same moment (depending on variety and date of planting). It is efficient to rotate labour to where it is needed. Traditionally, labourers use a sickle. This way, it required five person-days to complete one *rai* of rice (about 30 person-days for one ha). However, if compared the manual harvesting one man can operate one and a half *rai* per day with the weed slasher (see below). Conventional hand harvesting takes 4 to 5 man-days to harvest one *rai* of rice. Farmers with equipment provided the harvesting service at 300 *Baht/rai*, with additional charges for petrol of 50 *Baht/rai* (*i.e.* 350 *Baht/rai*). Based on 2004 wages for field work at harvest, it would cost *Baht* 600*/rai* to hire labourers for hand harvesting.

Figure 4.5 Manual harvesting systems (a) harvesting (b) threshing
Source: DPL, 2004

Figure 4.6. Modified weed slasher for harvest
Source: DPL, 2004

2. The weed slasher-rice harvester

The modified weed slasher was put into use on a larger scale in 2004. The cost of modifying by fitting the wire frame was about 100 *Baht*. As noted above, the simple machine reduces the labour requirement by three to four man-days. Additionally, it reduced risks from rain which can occur during rice harvesting in December. In the 2004 season, the almost every household owning a weed slasher modified it for harvesting. The equipment is used within the collective labour exchange system as well as being hired (see above). Male farmers operate the machine, while female farmers help tie up the rice into bundles, so that threshing is then done more easily, either manually or by machine.

Farmers considered the weed slasher-harvester well suited to their rice production system. As the system is controlled manually, farmers can cut rice at the base of the plant so that the straw yield is high and suitable for use as straw mulch. Straw obtained by modified weed slashing machine is of higher value than that produced by the harvester, which gives shorter straw. Meanwhile, cutting rice plants at the base reduces the cost of mowing the rice straw for soybean cultivation. The contractor would charge Baht 150/rai for mowing rice straw. Good straw (whether produced by modified weed slashing machine or hand harvesting) can be easily sold at Baht 560/rai. The long rice straw is always in high demand by vegetable farmers for mulching garlic, onion, etc. This is one reason why local tall rice varieties are still preferred by subsistence farmers. However, further development of the weed slasher is still necessary, so that it can be modified to accommodate different heights (of rice plant and user). The weed slasher is not practical for harvesting lodged rice plants. Then harvesting is done by hand.

3. The four-row rice harvester

The four-row rice combined harvester is connected to a two-wheel tractor. The machine costs about *Baht* 70,000, and can harvest 3 *rai*/day of rice. The cost for the service is *Baht* 300/*rai*. The machine can only perform the harvesting, and not threshing. The four-row harvester can be adjusted to cut the rice plants about 10 cm from the ground, thus providing longer and more usable straw than that harvested by small combined harvester. The service charge is lower than hiring labour. Farmers turn to the four-row harvester when they cannot arrange for exchange labour (which requires little or no cash outlay).

Figure 4.7 The four-row rice harvester
Source: DPL, 2004

4. The small combine harvester

The Japanese-made Kubota was designed for performing harvesting and threshing simultaneously in small paddy fields bordered with rice bunds. It was introduced by farmer who was formally a migrant worker in Taiwan. The farmer had observed the machine widely used by the Taiwanese farmers. When he returned to Chiang Mai, the farmer decided to invest in the machine to provide a renting service to the neighbouring rice villages. The machine cost *Baht* 500,000. He provides a service at *Baht* 800/*rai*. The farmer-owner carefully worked out the costing.

The average cost of combining harvesting and threshing was *Baht* 1,350/*rai*, using hand methods. So the small combined harvester provides a cheaper service than manual harvesting with hired labour, except that hired labour cuts better straw. The machine cuts short stature rice plants 10 cm above the ground. Hand harvesting also benefits soybean planting by removing the cost of rice stubble cutting. The machine was introduced for the first time in DPL. There were only three small combined harvesters in the entire Chiang Mai province. The machine harvests 6 *rai*/day, using 40 litres of diesel. The small combine is promises efficiency for farmers able to obtain cash but who do not engage in labour exchange system. The use of the small combine does not interfere with soybean cultivation after rice under the minimum tillage system. Thus it is a cost effective innovation within the rice-soybean system, when total expenditure for rice harvesting to soybean planting is taken into account (Table 4.4). But the high cash payment of *Baht* 800/*rai* for the basic harvesting-threshing service is not affordable by most farmers due to cash flow problems. Moreover the rice is immediately sold to the contractor after threshing at a lower price, since the moisture content of grain is still high (about 25 percent). The value of the straw is less than that produced by the modified weed slasher.

Figure 4.8 The small combine
Source: DPL, 2004

5. The heavy combine harvester

Figure 4.9 Big combine harvester
Source: DPL, 2004

The heavy combine has been introduced with modifications to fit Thai rice ecosystems, inclusive of both large, flat paddy fields, and small, fragmented paddy fields. The latest modifications enable the machine to harvest lodged rice plants. The combine has been widely used in the Lower North, the Central Plains, and the Northeast, where paddy fields are less bunded. In the Upper North, the big combine is commonly seen in the Chiang Rai and Phayao provinces, where paddy fields are of larger size than in Chiang Mai. However, the big combine is part of scenery during the rice harvest even in Chiang Mai. The cost of hiring the heavy combined harvester is almost the same as the modified weed slasher after threshing costs are taken into account (*Baht* 1,150/*rai*) but straw quality from the modified weed slasher is better (Table 4.4). It is perhaps surprising that hiring the big combine is less than the small combine for harvesting and threshing rice. But the heavy machine is in less demand since it produces soil compaction, and is thus unsuitable for the rice-soybean system, where soybean is managed under minimum tillage. Farmers who choose the big combine for rice harvest normally plant maize after rice, since irrigated lowland maize planted after rice requires tillage.

Table 4.4 The characteristics of and differences between rice harvesting methods

Elements	1.Manual	2.Modified weed slasher	3.4-row harvester	4.Small combine	5.Big combine
Cost: (*Baht/rai*)					
Harvesting	400	350	300	800	500
Piling	300	300	300	-	-
Threshing/carrying	500	500	500	50(carrying)	-
Days from harvest to threshing (days)	4	<4	<4	1	1
Variety specification	All	Best for SPT-1	All	All	All
Straw cut above ground (cm.)	Flexible	10	25	25	25
Row alignment	Pile	Proper alignment	Less good	Threshed	Threshed
Ease of piling	Easy	Moderately easy	Less easy	Not applicable	Not applicable
Straw Value (*Baht/rai*)	+560	+560	Less	Less	Less
Land preparation for soybean planting:					
Straw cutting (*Baht/rai*)	150	-	150	150	150
Ploughing (*Baht/rai*)	no	no	no	no	500
Total cost	1,350	1,150	1,250	1,000	1,150

Source: Group interview in DPL, 2004

Lessons of the rice slasher

According to Allen *et.al.,* (2001), learners function in a community by developing a shared language and acquiring the community's subjective viewpoint. This must be viewed as an accumulative process, which builds on existing practices and norms through interactive learning. Farmers' learning processes start from reflection on observations (Klob, 1984). Through learning by doing, knowledge is internalized and becomes the farmer's own. The BM case provides a negative instance, where individual farmers had tried to the slasher in their rice harvest but the performance was less satisfactory. The slasher was used without modification to farmers' circumstances, and there was little apparent opportunity for farmers to exchange experiences. In DPL, on the other hand, farmers continued testing and modifying when the machine was first developed. Group assessment helped speed up improvement, and within one season the machine was meeting individual needs in rice harvesting. The DPL farmers designed the wire frame to fit the harvesting of a short stem rice variety, SPT 1, which had become the main glutinous rice variety in the village, almost replacing the high quality RD 6 variety. They were aware that the modified weed slasher would not be suitable for harvesting tall-rice varieties, such as RD 6 and KDML 105. It can be concluded that collective knowledge, as exemplified by the modification of the weed slasher by farmers for harvesting short rice variety in DPL, is an important asset in the development process.

Double transplanting to overcome rice production constraints

Background

Transplanting rice requires the raising of seedlings in nursery beds, pulling from nursery beds, bundling young seedlings and transporting to the main production fields, where small clumps of seedlings (3 to 5) are planted in softened wet soil. A well managed transplanting operation involves seed selection, soaking clean seeds for 24 hours and allowing them to pre-germinate under dry conditions for two days in the basket before broadcasting in the prepared nursery. The normal seedling rate ranges from 30-40 kg/ha. Farmers often broadcast more seeds than needed as a precaution against seedling loss after transplanting. The process also requires proper control of water in the nursery and in the production field. Land preparation under wet rice culture consists of land levelling, soil puddling, and building levees or bunds to hold water. The irrigation system covers individual handling of water within own farm property, and at the community level, where the system is managed as a common resource. Wet rice culture can be considered an integration of people, plants, technology and environment. Higher productivity is generally reported using the transplanting method. Although it is labour intensive, with pre-harvest labour input ranging from 30 to 50 person-days/ha, this system is still the predominant method of producing rice. Transplanting provides definite advantages in terms of better use of available water, better weed control, higher grain yield under intensive management, lower risk, and more efficient use of land. Double transplanting is system in which young seedlings are replanted after about 15-20 days at a narrow spacing in a second nursery for a further 20-25 days. The seedlings are then separated into small bundles and transplanted in the production fields. The method of double transplanting is practised in the flood prone lowlands of Indochina and South Asia in anticipation of quick rising flood waters and a long rainy season (Grist, 1975).

Double transplanting is also practiced in selected place of the Upper North. The double transplanting has been developed by farmers to obtain rice plants with stiff straw and strong stem to cope with rapidly rising water levels, and to withstand damage caused by crab and pink snail. Relative to direct, broadcast, rice planting, the evenly spaced rows in the double transplanted rice system facilitate removal of off-types and speed up application of fertilizers and other field operations. In drought prone environments in rain-fed lowland, farmers also adopt double transplanting technique.

Farmer's knowledge about double transplanting

Farmers know which rice verieties are more suitable for double transplanting. The system is more suitable for photoperiod-sensitive rice varieties, which generally have a longer vegetative growth period. Most of the lowland rice varieties with photoperiod-sensitive characteristic flower in late October in the North when the day-length is about 11:30 hr. RD 6 starts to flower from October 21, and reaches full flowering within one to two weeks. In the 2004 season, the community rice seed production group of DPL used a double transplanting technique to produce RD 6 seed (Box 4.5), and single transplanting for SPT 1 seed production. Farmers were concerned about the yield obtained from each variety. RD 6 averaged 833 kg/*rai* or 5.2 t/ha, while SPT 1 yielded 640 kg/*rai* or 4.0 t/ha. Farmers discussed the significance of double transplanting for maintaining high rice yield in RD 6. Rice farmers in BM village also used double transplanting with RD 6 specifically in the low lying field with long duration flooding. Farmers claimed the method helped reduce the damage from crab and pink snail.

Farmers mentioned that they began to use the double transplanting practice with RD 6 (mostly for household consumption). The origin of double transplanting practice is unclear. There was a common practice after completion of transplanting. Farmers would thrust clumps of left over seedlings along the rice bunds. The seedlings would later be used to repair missing hills. The repair of missing hills by replanting with old seedlings still provides a reasonably good yield. Farmers noticed that this accidental "double transplanting" provided rice with stronger stems, more resistant to lodging under rising flood water levels. After incidence of pests such as crab and pink snail became more severe, farmers also found the double transplanting technique effective in keeping pest damage low. Thus it is through local experience that farmers identified certain features supporting a decision to use double transplanting. The photo-sensitive varieties, planted up until the first week of August, have over 70 days of vegetative growth after transplanting. Rice plants would then have enough storage of assimilates for seed growth. The practice is more applicable to varieties with weaker stems, such as RD 6. None of the strong-stemmed traditional rice varieties, such as *kao dor kao, kaow dor lai, kaow kham pai,* etc, ever needed double transplanting. In 2005 season, nine farmers of the CRSP group reported using the double transplanting technique with RD 6, with average rice yields of 3.84 tones per ha, as shown in Table 4.5. Under unfavourable conditions (flooding) in DPL, farmers maintained rice yields ranging from 1.82-6.3 tonnes per ha, while rice yields under the normal conditions of single transplanting for single planted RD 6 in BM averaged 4.37 tonnes per ha (yields ranging from 2.86-5.62 tonnes per ha). Kasem used double transplanting with photo-sensitive, non-glutinous rice variety KDML 105, and achieved an average of 670 kg/*rai* or 4.19 tonne/ha - not different from others using single transplanting and averaging 662 kg/*rai* (4.14 t/ha. Only one farmer obtained a low yield. The rice field was flooded by heavy rain four days after transplanting. Yields of over 5 t/ha from double transplanting indicates that the practice provides similar performance to single transplanting. Farmers indicated that with proper nutrient management, double transplanting could provide higher yield (Table 4.6.)

The double transplanting practice provides production stability under uncertainty and risk, in exchange for some additional investment in labour. After completion of rice transplanting, farmers maintain the water in the flooding field at such a level as to not affect seedling establishment. The field is then allowed to dry before it is flooded with irrigation water. Farmers do not keep the rice field flooded continuously. Essentially, farmers practice a wet and dry method of water management, perhaps a variant of the IRRI-recommended wise use of water program, or the System of Rice Intensification (SRI) documented by a group at Cornell University (Uphoff, 2002).

Table 4.5 Farmers planting RD 6 with double transplanting compared to average yields from single transplanting in 2005 season

Farmers	Planted area (ha)	Average yield from Double Transplanting (t/ha)*	Farmers	Planted area (ha)	Average yield from single Transplanting (t/ha)**
1. Sriduang	0.72	4.17	1. Tavin	0.64	2.86
2. Somruai	0.80	3.21	2. Som	0.64	3.98
3. Chumnong	0.64	5.34	3. Sompol	0.64	5.62
4. Sanit	0.72	6.34	4. Chumpol	0.42	4.81
5. Sangworn	0.96	1.83	5. Rawat	1.6	5.62
6. Viroj	0.48	5.25	6. Salee	0.56	3.42
7. Keow	0.96	6.30	7. Pankeow	0.32	3.75
8. Somdej	0.80	3.21	8. Sanit	0.8	4.87
9. Ta	0.24	5.40	9. Pakhon	0.64	4.45
Average (t/ha)	0.70	3.84	Average (t/ha)	0.70	4.37

Source: * interviews with DPL farmers working under unfavourable conditions, 2005
** interviews with BM farmers practicing single transplanting, 2005

Conditions required for double rice transplanting

Farmers in DPL and BM villages have realized that double transplanting is a labour-consuming operation (Table 4.6). They only carry out the practice with certain photo-sensitive rice varieties, notably RD 6 for consumption. Farmers know the optimal time for first and second transplanting. They prepare rice nurseries and broadcast pre-germinated rice seed in nursery plots in mid to late June. Clumps (10 plants) of rice seedlings of 15-20 days old are pulled up and transplanted in a second nursery in early July. The seedlings are allowed to grow for another 20-25 days until the main rainy season begins in early August. Farmers aim to complete all transplanting not later than August 15. Delayed transplanting of photo-sensitive rice varieties affects yield. At second transplanting total seedling age is 40-45 days. Farmers transplant 3-5 plants per hill at 25 x 25 cm or 30 x 30 cm spacing. The spacing varies slightly since it is carried out by exchange labour. Farmers realize

RD 6 does not produce high tiller numbers. However, through experience, they observe that with double transplanting seed filling is more uniform. So yield is not significantly different from single transplanting of RD 6. The extra labour requirement is met through farmer labour sharing, in order to secure good output from problem areas. Farmers facing similar land use problems appreciate the significance of collective action.

Table 4.6 Labour costs of different methods of rice planting

Methods	Seed rate (kg/ha)	Nursery preparation [1]	1st transplanting		2ndtransplanting	
			man-days[2]	Cost (*Baht*/ha) [3]	man-days	Cost (*Baht*/ha)
Single transplanting	31	bedding	30	3,125	-	-
Double transplanting	31	bedding	30	3,125	30	3,125

Source: Interview DPL farmers, 2005

Note: 1 Land preparation for single transplanting and double transplanting is normally the same, but broadcasting is used in flooded areas, which requires good land preparation, 2 one man-days equal to 8 hours 3 Standard cost of transplanting for Chiang Mai is 3,125 *Baht*/ha.

Box4.5 Double transplanting of photo-sensitive, glutinous rice variety, RD 6

In the 2004 season, the CRSP group of DPL decided to produce seeds of photosensitive rice variety, RD 6, and a non-photosensitive rice variety, SPT 1. The RD 6 was all produced by the double transplanting technique. When the seedlings reached 22 days old, the work was done collectively, by both women and men from the work group. The group had selected land on the upper terrace for a nursery site. The soil was kept moist at all times and was not flooded. Loosely structured soil of loamy sand made pulling of young seedlings easier. The process of transplanting involved several steps in an organized system. Everyone in the group knew his or her own task. .

- *Pulling of rice seedling from semi-dry seed bed and tying rice seedlings into small bundles, carried out by male farmers*
- *Chopping-off the top of rice seedlings to ease transplanting, and stabilizing plant stand after transplanting in flooded field, carried out by male farmers.*
- *Carrying rice bundles with chopped-off tops to the second nursery for transplanting, by both male and female farmers*
- *Transplanting: clumps of young rice seedlings, consisting of about 10-12 plants, are inserted into flooded mud soils at close spacing of 10 x 10 to 15 x 15 cm. Farmers leave some space between 6-8 rows of transplanted seedlings to ease the pulling of rice seedlings during the second transplanting period in early August.*
- *In 2004 season, farmers spread red algae in second rice nursery as a source of nitrogen.*

During the second transplanting of rice seedlings into the main production fields lines were marked to ensure proper plant spacing (25 x 25 cm, as recommended by DOAE). Seedling clumps were divided into smaller bunches and three to four seedlings were transplanted along the marked line. Pulling of rice seedlings was carried out by assigning responsibility to different groups; only some were doing the pulling. A few were tying rice seedlings into small bundles. Others were carrying bundles of rice seedlings to chop-off the tops. Chopping-off the tips of the leaves helps stabilize plant stands during transplanting. Bundles of rice seedlings were placed in a bag to be carried to the field from the nursery (SPT 1 variety). Transplanting takes place in August. Farmers spread bundles of rice seedlings over the field. Lines are marked to guide transplanting. Wider row spacings (1.0 to 1.2 m) are marked, and rice seedlings planted at 15 x 15 cm within these wider rows. Crab was the major pest of young rice seedlings after tranplanting. Red algae are allowed to grow for 25 days before the second transplanting was taking

4.3 Conclusions

This chapter looked at three cases where farmers have been involved in local development of simple but effective rice technologies – frog protection as a form of integrated pest management, modification of a weed slasher to help work groups partially mechanize labour-demanding and expensive harvesting operations, and a double-transplanting technique that strengthens rice plants to withstand flooding and pest attack on land subject to rapid and unpredictable flooding.

Community frog protection is an example of a common pool resource management process that requires cooperation among villagers. It involved sharing of benefits received from reduced pesticide use in rice fields, as well as income and food earned from frog sales at the end of season. The number of farmers gradually increased as a result of a shared interest, sense of belonging and ownership, to the point where individual farmers start to show collective responsibility. Other institutional actors were involved in building this sense of responsibility - TAO, the KT, the monk, the group leader, which enabled the group to trade upon (and even increase) its levels of leadership and social cohesion. It is a fact that the practice did not spread to the neighbouring villages, despite the clear advantage in coordinating frog protection over a wider area.

The case of the rice slasher, originally developed by an individual farmer, emphasizes the practice of learning by doing for internalizing and sharing knowledge. The BM case provides a negative instance, where individual farmers tried the slasher in their rice harvest but the performance was less satisfactory. The slasher was used without modification to farmers' circumstances, and there was little apparent opportunity for farmers to exchange experiences. In DPL, on the other hand, farmers continued testing and modifying when the machine was first developed. Group assessment helped speed up improvement, and within one season the machine was meeting individual needs in rice harvesting.

Also the case of double transplanting shows a collective learning process where farmers have long developed their own knowledge to overcome certain production constraints and to stabilize rice production. This method is inefficient if labour costs are the main concern for individual households. However, it works when labour exchange is a common practice in rice farming community, and thus under social conditions with strong human relationships, trust and reciprocity that provide resilience for community to cope with uncertainties. The practice is variety-specific, and works well with photo-sensitive rice varieties, specifically those varieties with weaker stems. It provides stronger stems during the time of risks, from flooding and crab-snail attack in the early stage of seedling establishment. The practice also reflects that small subsistence farmers working under uncertain conditions search for practical solutions that lead to production stability. This might be in conflict with the common rice research program which is emphasizing high productivity and high efficiency of resource use.

The main points to draw to attention are that farmers are inventive, and work continuously to adapt technology to their needs and circumstances, and that this type of local technology development seems to work best where a group is engaged with prior experience of collective action (Table 4.7). Farmers have a tradition of sharing labour to overcome labour bottlenecks, and there are savings to be made by introducing a degree of mechanization into existing labour sharing arrangements. The government of Thailand now hopes to promote "indigenous knowledge" as an aspect of a more internally self-reliant agricultural development strategy. But how far the cooperative technology solutions documented in this chapter can be scaled out is unclear. A second village study referred to in this chapter for comparative purposes shows that not all communities, and not all farmers, are as cohesive as the ones protecting frogs, developing a modified slasher for harvesting, and double-transplanting rice. At best, scope in Thailand for an "indigenous agricultural revolution" (Richards, 1985) through participatory means is partial, and should be considered a potentially valuable element in a strategy mix.

Table 4.7 Local technological innovations and collective action

Technology	Collective action	Outcome
1. Frog conservation	Management of common property	Controlling rice pest
2. Modified weed slasher for rice harvest	Sharing knowledge and learning from experience	Improving harvesting efficiency
3. Double transplanting	Management of labour	Maintaining rice productivity in the problem area

Chapter 5

Green manure: does it work, can it be scaled up?

5.1 Introduction

The use of participatory approaches has gained popularity among development practitioners as a source of better agricultural technological practices for farming smallholders. It is also recognized that the benefits of a centralized research process, supported by extension systems, to disseminate "proven" technologies to farmers have been uneven, very often bypassing socially disadvantaged groups, which for some reasons are unable to benefit from the new high-input high-yielding technologies.

The best-known approaches put forward as alternatives to the institutional forms of research/extension relations include Farming Systems Research (FSR) in the early 80s (Collinson *et al*. 2000), the Farmer-First-and-Last (FFL) model (Chambers and Ghildyal, 1985), Agro-ecosystems Analysis for Research and Development (Conway, 1985), etc. One of the key features of these kinds of approach is to include on-farm research, as an essential process consisting of diagnosis of farmers' circumstances and problems, farmer design and experimentation, farmer appraisal and feedback. Success is based on farmer adoption, as stressed by the FFL model.

The emerging issue concerning farmer participatory technology generation is that if it works whether and how it can work on a mass scale. The FSR model has been criticized because its very features of empowering farmers make the approach difficult to integrate into main-stream agricultural research (Biggs, 1989; Hall and Clark, 1995). Participatory approaches, relying on facilitation of collective learning and action, with emphasis on interaction and feedback, are thought to be not in line with the institutional configurations within which they have to be applied, and this might hamper the up-scaling process.

The use of green manure crop as soil improving technology for rice cultivation in Thailand offers a good case in point, because there has been a lot of localized effort in the past, and some knowledge about what works has been built up, but more recently government, and other actors, notably the Land Development Department of Ministry of Agriculture and Cooperatives, and a non-governmental organization (the Sustainable Agriculture Foundation), have tried to scale up green manure technology on a national scale.

Farmers have their own knowledge systems for soil management, and they are capable of integrating external technology recommendations with their own local knowledge (Hall and Clark, 1995). In fact, farmer practices often evolve in parallel with changes of their own production environment. The practice of green manure technology requires additional investment in terms of labour and opportunity cost. Its on-farm performance has been found to be quite variable and even unpredictable. This lack of predictable outcomes tends to affect farmers' adoption decisions. Thus to make progress with a green manure approach more needs to be known about the learning environments in which such technologies are introduced.

The present chapter seeks to contribute to this knowledge by considering how the participatory approach in green manure technology development actually works among farmers engaged in collective action, and in terms of relations between farmers and research institutions, such as the Multiple Cropping Centre [MCC] and the Land Development Department [LDD]. Specifically, the case study concerns the initiation and adaptation, and the changing nature of farmer adoption, of a green manure and cover crop (GMCC), *Sesbania rostrata*, intended to improve rice productivity in the irrigated lowlands of Chiang Mai province and other rice growing areas of Northern Thailand. The chapter traces how technology changes in use, mainly through adaptation. This also involves adjustments in the relationship between research institution and farmers. The chapter is interested in whether agricultural systems could be made more sustainable through the right kind of interaction between the various actors linked by feedback mechanisms associated with the participatory approach. It explores ways to conceptualise this relationship and makes some use of grid-group cultural theory in assessing the viability of requisite hybrid institutional forms.

Collective action is seen as important social asset for scaling up of farming innovations. Through collective action, group members interact, reflect performance, exchange information and experience, create new knowledge and propose new initiatives. Collective action is found not only at the farmer level, but also in the interaction between farmers and the research institution, MCC, where technology development through the participatory approach is concerned. The chapter seeks to assess the contribution of collective action. Forms of collective action are described using the framework of grid-group cultural theory (Douglas, 1978; Thompson *et al.,* 1990) to throw light on effective forms hybridity involving farmers and research institutions. It is observed that the participatory approach (linking learning and action) emphasizes interaction and feedback as tools in developing appropriate technology. To be sustainable reproduced these forms of collective action require new institutional forms covering linkage between farmers and researcher in formal research institutions. The chapter also considers how to integrate mobilization of farmer knowledge, complementary to that of formal research organizations. Brief attention is also paid to initiatives to scale up green manure technology on a national scale.

5.2 Localized initiatives in soil improvement

Agricultural production is characterized by complexity and heterogeneity where scientifically derived technologies cannot cope alone with the scale of the problem and the reality of the farmers' complex social worlds. Several approaches treat farmers as human resources (Chambers and Ghildyal, 1985; Chambers, Peacey and Thrupp, 1989; Hall and Clark, 1995) and recognize the farmer's importance as a source of innovation with equal status to that of scientific professional, because of the intimate understanding farmers develop of their own physical environments and socio-economically determined requirements. Farmer knowledge is often based on local experimentation, which at times results in technologies directly addressing local problems (Richards 1985). Therefore, an implication is that local initiatives should be more fully integrated into both the scientific research process and the technology development process. The following argument provides some support for this view, through showing how local initiative has been able to overcome some typical production problems encountered by smallholder farmers.

Although farmer knowledge has evolved over a long period during which rural people built up understanding their environment, some critics have found it unclear how this system might handle a novel agricultural problem or technique. In other words, it is not certain how well farmers' indigenous knowledge can cope with complex agricultural technologies and changes. In considering the literature on the dynamics of knowledge systems involving farmers as innovators and experimenters, Farrington (1993) reports some confusion about farmer knowledge systems. Some see farmer knowledge not as a "living" process of exploration and adaptation but mainly as a body of information which can be 'mined' by agricultural scientists and slotted into the agricultural research process.

One way to resolve this dispute is to consider some actual cases. Attempts have been made to explore farmers' practices in relations to localized initiatives and knowledge in soil improvement, with emphasis on farmers' alternative management of chemical fertilizer applications. In this regard, I organized farmer workshops in rice growing areas of two provinces, Chiang Mai and Phayao, to provide better understanding of localized management of rice soils. These results can now be briefly reported.

Exploring farmers' practices to reduce rice production cost in irrigated lowlands, Chiang Mai province

I approached the local organization, the TAO of the *tambon* Kee Lek, Mae Teang district, Chiang Mai province, to help organize a one-day farmer workshop in early 2003. We had agreed on a broad topic, covering practical approaches to reduce costs of rice production would be appropriate and interesting for farmers. I had anticipated that from the farmers' perspectives, they might have generated several relevant approaches, including soil fertility management, and pest control techniques. Through facilitating this process, the forum would provide opportunity for farmers from different villages of *tambon* Kee Lek to share their experiences and knowledge, and collectively to identify combined good agricultural practices for rice production that are locally relevant, particularly on the issue of soil fertility management.

Sixty farmers from seven villages of *tambon* Kee Lek, representing a rice group, soybean group, a women's group, a fruit tree group, a vegetables group, a cattle group, and a poultry group, participated in a one-day workshop in the village temple. A majority of farmers cultivate rice-soybean as their major cropping system in the irrigated lowland, and plant maize and vegetables either after rice or on the upper terraces and non-rice plots in the lowland. Farmers produce rice for household consumption and sell the surplus. Therefore household rice sufficiency is the first objective of smallholder rice farmers, and consequently, they are little interested in high input cost technologies to achieve maximum rice yield. Table 5.1 summarizes the key production practices contributing to stable rice yield in *tambon* Kee Lek.

The village no.1 or Buak Mue village, where the MCC had long collaboration in the GMCC testing, was the only village with experience of *Sesbania rostrata*. Soybean is another soil improving legume mentioned by farmers. One farmer, Vichit, who produced foundation rice seed, was also keen on producing compost - bio-extracts from pink snail and crab collected from rice paddy - for use as a plant nutrient supplement. One farmer from Dong Palan village, who had previously worked as farm worker in the northern district, learned from other farmers the use of bergamot extract to control pink snail in the flooded field. Farmers have increasingly learnt and tried fertilizer management alternatives to reduce chemical fertilizer use.

Table 5.1 Production practices in rice across villages in *tambon* Kee Lek used to maintain high rice yield with reduced cost

Methods	Village							Remarks
	1	3	5	7	8	9	10	
Bergamot extract for pink snail control		*						The practice works well in the flooded field
Bio-extracts as fertilizer	*							Extraction of pink snail and crab with molasses through anaerobic fermentation process
Use green manure crop	*	*				*	*	*Sesbania rostrata*, soybean, soybean thrashings
Mixed use of chemical fertilizers and biofertilizers							*	Farmers broadcast chemical fertilizers on spots where rice plants show sign of N deficiency (yellowing).
Compost	*	*						Not widely use

Source: Farmer meeting in Chiang Mai, 2003

Use of green manure cover crop by rice farmers in Phayao province

Green manure cover crop (GMCC) has been widely used with some success in rainfed areas. Therefore a survey was undertaken of Phayao province, and its neighbouring province, Chiang Rai, which are the main rice producing areas in the Upper North. Rice is grown in these areas as a cash crop, based on high quality non-glutinous rice, such as KDML 105 and RD 15 varieties, for local commercial mills. These two rice varieties are well known for their fragrant grain quality. The interest lay in discovering how GMCC was being used. What made farmers successful in using GMCC and what differentiates these rainfed lowland from the irrigated lowlands? The rice farmers in these two provinces own larger areas of rice land than farmers in Chiang Mai province, averaging more than 3 ha, but the majority of rice farms are rain-fed. Only recently have farmers invested in tube-wells or farm ponds to provide supplementary on-farm water through diesel pumps for rice nursery preparation.

In 2005, I explored the use of GMCCs in rice farming in Chun district of Phayao province. In 2004-5 farmers had received GMCC seed from the LDD, particularly

Crotalaria juncea (commonly known as sunn hemp). It was found that rice farmers in Chun district have adopted sunn hemp as the main GMCC to improve soil fertility in their rice fields. Conversations with farmers and field visits established that farmers typically owned more than one plot of rice, with a total holding per farmer of 3 ha. These farmers had tried several species of GMCCs introduced by the LDD since 2004, and had discovered that sunn hemp is the most suitable GMCC in the elevated (*i.e.* dryland) fields.

Farmers who adopted sunn hemp identified a number of key features making the species useful in their rice farming system (Table 5.2). Of five species of GMCCs, farmers in Jun district found *Sesbania rostrata* and sunn hemp-incorporated plots provided higher rice yields than plots treated with other GMCCs. Both species, because of their rapid growth and tall plant type, are able to suppress weed growth one month after sowing (Table 5.4). Farmers stated that they would not use herbicides on plots treated with sunn hemp.

Farmers had experienced difficulty in producing *Sesbania* seed in the area because of heavy infestation of *Mylabris phalerata* (Blister beetle) at flowering stage. *Sesbania* seed from the LDD was not always available, so farmers stopped using *Sesbania.* Farmers turned to sunn hemp because they had observed its suppression of weeds and impact on increasing rice yield. As a consequence, farmers reduced or stopped using herbicides and chemical fertilizers. All farmers adopting the GMCC indicated that they would use sunn hemp on the same plots for not more than three years in succession, for otherwise rice plants would lodge. But instead, farmers would grow sunn hemp in rotation; usually a plot incorporated with sunn hemp in one year would not be treated again the next year. Farmers' decisions to use sunn hemp would depend on plot yield.

An understanding of these knowledge processes is assisted by adopting an actor-oriented perspective. This seeks to clarify how actors attempt to create space for their own initiatives. An example concerns a farmer volunteer "soil doctor" seen as a change agent for diffusion of GMCC technology developed by LDD. In Chun district, the Chief Councillor of TAO (Chai Wannasorn) was the "soil doctor volunteer" *or mor din ar-sa* at the village level (see below), but because of his competence and services to the farming community, the farmers in Chun district nominated him to represent the entire district. His actions improved collective action in farming in Ban Sroisri, *tambon* Chun district. Specifically, he organized community rice seed production in which 30 farmers participated in the 2006 season. According to Long (1992) knowledge processes can be properly understood only if one recognizes their socially constructed and emergent character.

"*Agency - which we recognize when particular actions make a difference to pre-existing state of affairs or course of events - is composed of social relations and can only become effective through them*" (Long, 1992: 23).

"*The notion of agency attributes to the individual actor the capacity to process social experience and to devise ways of coping with life, even under the most extreme forms of coercion*" (Long, 1992: 22).

"Within the limits of information, uncertainty and other constraints [...] that exist, social actors are 'knowledgeable' and 'capable"(Long,1992: 23).

Given the fact that different social actors are likely to have different, if not conflicting, interests and values, agency is most clearly seen in the struggles that take place over strategic resources and in the attempts to create space for furthering their own cherished schemes or "designs for living" (Leeuwis and Long 1990). All members using sunn hemp as GMCC in rice farming had such a scheme. For example, seven farmers produced sunn hemp seed for sale at *Baht* 15/kg, and thus saw GMCC as an income-generating livelihood opportunity. Others produced the seed in order to offer it on loan.

In addition to its effectiveness in enhancing soil organic matter and soil structure, and increasing rice yield, sunn hemp is well adapted to rainfed lowland rice ecosystems of Phayao province because there is an abundance of flood-free terrace land. Over 80 percent of rainfed lowland rice ecosystems are classified by farmers as upper terrace and middle terrace, where long periods of flooding hardly occur. About 20 percent are under lower terrace (*i.e.* are flood prone areas). These areas are not suitable for sowing sunn hemp.

In Phayao province, where the LDD introduced soil improving technology to rice farmers, rice farmers were exposed to a range of options, such as different species of GMCCs, and bio-fertilizers developed from extraction of plant and animal wastes with the LDD bacterial cultures. Farmer volunteers, as *mor din ar-sa,* were given practical training by the LDD and provided financial support as compensation to carry out demonstrations in the village. Farmers who thereby improve their farming practices gain good practical experience and are expected to apply the system in their own farms, as reported and observed in Ban Sroisri, *tambon* Chun, district, Phayao province. Adoption of GMCCs in rice farming depends on individual farmer decisions. According to discussions with farmers (Box 5.1), the Ban Sroisri case shows that, by building on farmer experience, dissemination of GMCC technology can be effectively attained on a farmer-to-farmer basis. Farmers describe how a combination of good leadership and effective innovation slowly built-up a group where the membership wanted to achieve the shared objective of reducing production costs and improving soil fertility and rice yield. The social process of learning through doing, granted enough critical mass, transformed farming practices from a chemically-based system into an ecologically based system.

Box 5.1 Successful application of GMCC in rice farming in Ban Sroisri, Chun sub-district, Chun district, Phayao province

In discussion with farmers, it transpired that several factors in combination led to the success of GMCC in rice farming. These can be summarized as follows:

1. *Competent and service-minded group leader. He himself a rice farmer, a mor din ar-sa at the village, tambon and district representative, and also the Chief Councillor of the TAO of tambon Chun promoting the use of GMCCs and other soil improving technologies introduced by the LDD. He is the chairperson the community rice seed production group, and the Tambon Agricultural Technology Transfer and Service Centre (TTC). He is an innovative farmer, experimenting new farming practices on his own farm and using it as demonstration, thus being respected and trusted by the local community through his long experience in farming. With his many active roles as a local organizer, administrator, farmer leader, and innovator, he is able to mobilize local resources to push forward agricultural development in the village and other communities within the tambon administration.*

   Other key farmer representatives in the village are also practicing GMCC with success, providing convincing evidence to other farmers interested to try and use the GMCC in rice farming. In addition, farmers are able to identify physical conditions favoring the adaptability of sunn hemp. With such success, a few farmers have taken the initiative to produce sunn hemp seed and distribute it to others, either on a loan basis, or by selling it, thus becoming less dependent on free supply from the LDD. Farmers who produce sunn hemp seed will sow the seed in October in the upland fields after harvesting rainy season crops such as maize, taro, etc. The sunn hemp crop will thrive under residual soil moisture, and will be harvested for seed in late February to early March. Yield from 600-1200 kg/ha (Interview Chai Wannasorn, 2006).

2. *Farmers have large farm sizes and use all the lowland fields for cultivation of high quality rice in the rainy season. Three quality rice varieties with premium price are KDML 105, RD 15 (both non-glutinous, for market), and RD 6 (glutinous, for home consumption). Reduction of chemical fertilizer use will have greater impact for commercial rice farmers with larger farm size. The effect will have less impact for small rice farmers, as observed in the Chiang Mai province. Farmers also stop applying herbicides in rice fields when sunn hemp is being used as GMCC, so the system enables farmers to save the cost of weed control. Many claimed that using sunn hemp as GMCC can reduce production costs by one-third to half. All farmers engaging in commercial rice production in the village use broadcasting technique, thus sowing can be done by family labour.*

3. *To obtain good seedling establishment and uniform growth of sunn hemp, the rice farmers in Ban Sroisri, tambon Chun are willing to plough the land before sowing. All farmers own two-wheel tractors. Two farmers in the village who own big tractors provide ploughing services, charging about Baht 200 for the members of the village, which is much cheaper than in Chiang Mai (Baht 500-600/rai).*

4. *Reliable rainfall and its even distribution from mid-April to mid-May provide sufficient moisture for germination and establishment of sunn hemp seedlings. The rice growing area in Ban Sroisri, tambon Chun also has good access to ground water. Many farmers have invested in tube-wells with diesel pumps, or dig farm ponds to supplement water for agricultural intensification.*

Understanding farmers' perceptions of soil fertility

Farmers use visual criteria to categorize good soil and poor soil, through observation and working the soil with the hand. It is important to understand how farmers in each region define good soil (*din dee*) and poor soil (*din liel*). The common features of good soil are black colour, and ease of working (loamy soil). The tradition soil improvement technique for farmers is to use chicken manure, cattle manure, and crop residues. In the rain-fed lowlands of Phayao province, where farmers raise cattle as a second farming enterprise, lowland rice farmers often contract the cattle owner to put the cattle overnight in the allocated plot for fertilizing services. The payment depends on cattle numbers. With over 50 cattle, rice farmers pay cattle owner *Baht* 500/month to have cattle stay overnight in a designated plot. The rice farmers have to locate the plot and fence the area; the cattle owner will then herd the cattle in the early evening into the designated plots. The farmers have indicated that with an area of 20 *rai*, they prefer to use the "fertilizing" service from the cattle herd to chemical fertilizers, which they would pay *Baht* 500, while the cost the urea is over *Baht* 650/50kg bag, and fertilizer 16-20-0 is *Baht* 550/50 kg bag or more. The cattle have become an important element in rice farming in the rain-fed lowland ecosystem.

Farmers "mind" their rice soil when they observe growth of rice plants to be retarded, and soils become difficult to work (Table 5.2). Soil colour, soil texture, and rice growth are indicative of soil fertility status as perceived by farmers. The impact of GMCCs on the quality of rice soil can be observed within two years. All claimed that both *Sesbania rostrata* and sunn hemp improve soil structure, making soil easier to work with when ploughing.

Table 5.2 Farmers' perception on poor soil and when they want to improve it

Poor soils and need for improvement as perceived by farmers	Proportion of farmers (%)			
	Mae Teang, Chiang Mai (n=43)	San Sai, Chiang Mai (n=24)	Sunkamphang, Chiang Mai (n=22)	Chun, Phayao (n=16)
1. solid soil clump, and difficult to break	35	56	50	50
2. heavy soil, difficult to plough	21	-	17	24
3. rice: stunted growth, poor yield	36	44	28	20
4. soil becomes sandy, poor water holding capacity	8	-	-	
5. soil become whiter, acid soil (low pH)	-	-	5	6

Source: Year of interview, 2005 , n=number of farmer respondents

Local farmer initiatives in soil-plant nutrient technology

Based on evolving knowledge and experimentation, farmers are able, through learning by doing to develop some technologies which address their problems. The development of bio-fertilizers is an example of this village level knowledge creation process. The key aspect is that farmers formulate their own ingredients, and test the efficacy of bio-fertilizers. It is important that farmers can develop these solutions whenever he/she wants, and effective knowledge accumulates with experience. This local movement sometimes usefully challenges the conventional wisdom as embodied in a scientist-driven research agenda for soil technology development. Through local innovation processes, many available plant species have been identified by farmers for particular uses.

Local technology development is a buffer against price rises of external inputs. It can be seen that when chemical fertilizer is affordable and cost effective farmers prefer the use of agricultural chemicals for rapid results. But recent increase in the world oil price has increased costs of inputs, especially affecting intensive cropping enterprises such as sweet corn, hybrid corn seed production, vegetable soybean, chilli, and vegetables which depend on heavy use of agro-chemicals for maintaining high crop yields. Thus there has been a recent change in attitude at all levels. Since 2003 alternative fertilizer management, such as use of bio-fertilizers from plant and animal extracts, has been promoted by both governmental and non-governmental organizations. For instance, the use of a culture consisting of antagonistic micro-organisms, such as *Trichoderma* and *Bacillus species*, for controlling soil-borne diseases such as crown rot, and root rot in crop plants caused by *Sclerotium rolfsii* has been promoted by the LDD under the brand name of LD 3, and by the Chiang Mai Biological control Unit (BCU). Farmer modified ingredients find a place in this new approach, since locally available resources can often be substituted in bio-fertilizers. This is now happening in many area of Chiang Mai province.

Local initiative in Buak Mue village, *tambon* Kee Lek, Mae Teang district

At Buak Mue village, one farmer began to develop his own bio-fertilizer extracts from fermentation of golden apple or pink snail with molasses. The farmer had applied bio-extract in addition to *Sesbania*, to maintain his high rice yield. He produced his own materials and also offered these for sale in the village. At present, the bio-extracts, prepared from pink snail, has been widely used in Buak Mue village. More than 20 households are using bio-extract from pink snail. Some make the material by themselves and others buy from neighbours in the same village.

The fertilizer is expensive and I would like to try the bio-extract. I prepare the material for the first time about a month ago and if the smell is very bad I put in more molasses. When it is ready to use, the colour turns to brown and gives off the sweet smell of molasses. The bottles of extracts are placed in rice fields to allow slow release of liquid when irrigation water is applied (Male farmer, age 48).

Many people in village talked about the innovation that I had made. I actually had chances to attend a workshop a few years ago on how to make bio-extract. I also heard the story from the radio about the mixture of various plants. Then I tried to do it. I used the pink snails that have been available in the field since 2003 (Male farmer, BM).

Nowadays people say if you want to get the pink snail from the field you are allowed to catch it within your field. The process of making bio-extract begins by crushing the snail, and the content is mixed with molasses filled up with water. The anaerobic fermentation process is about one month. The extract is then diluted before use. The practice has been seen by farmers as a direct and effective control of pink snail population in the rice field (Male farmer, BM).

Development and use of bio-extracts in Buak Mue (BM) and Dong Palan (DPL) villages

Farmers in BM and DPL indicated that the process of making bio-extract is not difficult but it takes about one month for the fermentation process to be effective and the aqueous materials ready for use. Pink snail is available in rice field, and it becomes a key pest if we do not get rid of it. Farmers only pay for *Baht* 50 worth of molasses to provide energy for micro-organisms during the anaerobic fermentation process. Formerly, farmers would apply chemical pesticides to control pink snail in rice field. With recent increased use of pink snail as raw material for making bio-extracts for use as plant nutrient, the pest is now under good control. In 2005, farmers in both areas used bio-extract on rice (totaling 5 ha), on soybean field (16 ha) and on fruit trees (12 ha). Farmers indicated that the local bio-extract was more widely used from 2004-2005 because the price of chemical fertilizers and pesticides increased (*e.g.* Urea (46-0-0) went from *Baht* 480 per 50kg bag in 2002 to *Baht* 600 in 2005). Examples of pink snail based bio-extract used as plant nutrients prepared by farmers in BM village are given in Table 5.3.

Table 5.3 Farmers' innovation on bio-extracts as plant nutrient

Farmers	Ingredients	Uses
1	Pink snail + vegetable waste + water + molasses	As liquid fertilizer for rice and soybean: applied 14 days after planting (dap) and 30 dap on rice and 30 dap on soybean
2	Plant hormone + pink snail + water + molasses	Applied 2 times 7 dap and 30 dap on soybean to increase growth
3	Plant hormone + pink snail + water	Applied on soybean 30 (dap)
4	Pink snail + corn leaf + molasses	Applied on soybean and vegetables

Source: Survey in BM and DPL village, 2004

The initial development of bio-extract can be described as an individual initiative, based on a continuous process of trials, observations and modification. Collective adaptation, and modification by others, occurs after the practice has been shown to be effective. Once the practice is shown to be effective, then farmers in the neighbourhood will follow. Lipsey (2001) argued that the rate and direction of technological change is normally specific to the context (*i.e.* it is context specific). It has been observed that the DPL farmers use bio-extract from pink snail as fertilizer on corn and vegetables, unlike BM farmers who use bio-extract from pink snail and vegetables on rice and soybean. The actual use depends on other inputs available at the relevant time in the field and on the specifics of household management. The success of bio-extract enables a few farmers to produce the materials for sale in the village. For instance, in BM, a litre of bio-extract was sold at *Baht* 15.

However, farmers in DPL still depend on chemical fertilizers for improving rice yield. Their intensive cropping enterprises such as sweet corn, hybrid corn seed production, vegetable soybean, chili, and vegetables require chemical fertilizers to maintain and improve crop yields. Their continuous sequential cropping systems do not easily permit the inclusion of bio-extract as a nutrient management practice. The use of bio-extract mixed with chemical fertilizers to reduce chemical fertilizer use and cost is found in corn and vegetables. Farmers in DPL began to experiment with the use of bio-fertilizer in vegetable production with promising results. About 10 farmers reported that they used bio-extracts together with chemical fertilizers on corn and vegetables. Farmers also made comparisons between their own practices and practices of other farmers.

I observed from 2002 that he used bio-extract with corn, I saw nothing change in his corn. So, I think the bio-extract is not useful and I don't want to waste my time (Female farmer, corn grower).

We know that he used bio-extract in hybrid corn production. Corn grows faster and the leaves are greener than other fields. I think I will use it next year (Male farmer, Rice group Leader).

A representation of what farmers knew about nutrient management practices and what they actually used, over the past decade, in DPL is presented in Figure 5.1. The diagram represents a combination of what farmers discovered and what they learnt from others.

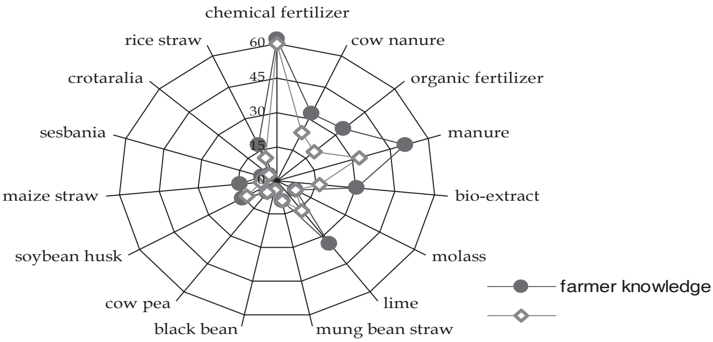


Figure 5.1 DPL farmer practices in soil management for period 1995-2005

From interviews, it was found that all 62 farmers know about the use of chemical fertilizer as a nutrient management practice on rice (Figure 5.2). When chemical fertilizers are affordable and cost effective, farmers prefer chemical fertilizers to other alternatives. Two kinds of knowledge make up farmer knowledge - knowledge that something is the case, and knowledge of how to do something. A majority of the sample know how to use nutrients on rice - especially with cow manure, organic fertilizer, manure, bio-extract and lime. A smaller proportion of the sample claims to know about green manure crops. The local practice in DPL in relation to five crops or crop complexes is indicated in Figure 5.3. Some practices are no longer adopted, such as cow manure, manure, molasses and bean. The *Sesbania, Crotalaria* and organic fertilizer are rather new, and have been known for not more than three years. Rice straw, maize straw and soybean husk have long been used for soil improvement.

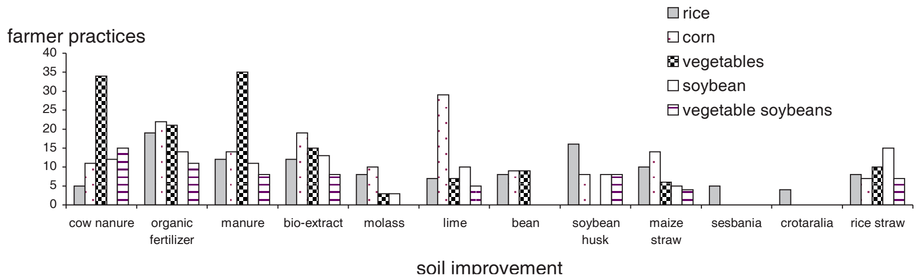


Figure 5.2 Different soil improvement practices as used by farmers in DPL for crop production (1995-2005)

The farmer assessment of GMCCs is summarized in Table 5.4. The majority is interested in fast growing GMCC species that fit the farming systems. Farmers prefer edible to non-edible and easy to manage items with low production costs. Farmer assessment can be used as a baseline against which future selection criteria for GMCCs in rice farming can be assessed.

Table 5.4 Farmer assessment of GMCCs in relation to rice farming

GMCC	Advantages	Disadvantages
sunn hemp (*Crotalaria juncea*)	- fast growing - adapted to drier conditions - unbranching and easily breakable with two wheel tractor - provides sufficiency of nutrient to rice plant and subsequent yield equivalent to chemical fertilizer - no evidence of pest problems when produced as seed	- susceptible to flooded conditions or under long period of submergence - Threshing mature pods for seed causes itching
Cowpea (*Vigna unguiculata*)	- Short maturity - edible grain	- slow growth in early vegetative stage plants lodge and creep, make ploughing difficult
Mungbean (*Phaseolus aureus*)	- Short maturity - edible grain	- slow growth [ditto]
Sword bean (*Canavalia gladiata*)	- suppresses weed	- difficult to incorporate into soil
Sesbania rostrata	- high biomass yield - fast growing and suppress weed growth - flood tolerant	- not easy to plough - *Mylabris phalerata* (Blister beetle) attacks flowers, lowering seed yield

Source: Farmer interviews in Chiang Mai, Phayao, 2005

5.3 Participatory research in GMCCs in rice farming

Farmer participatory research in technology generation has emerged as a promising approach to the problem of limited adoption of cropping systems technologies by farmers (Ashby, 2003), and there is increasing evidence to support its effectiveness (Van der Fliert *et al.*, 2001; Johnson *et al.*, 2003). The inclusion of farmers in the process of designing and developing technologies has been shown to increase the probability that the technologies so developed are relevant and appropriate to local conditions. This functional approach, as noted by Ashby (1996) and Pretty (1994), has improved the efficiency of conventional research processes. The following sections attempt to explore how participatory approach has been put into practice in relation to GMCCs by MCC and LDD in rice farming, and to debate what kinds of participatory approaches are necessary for GMCC technology development and application.

The case study on GMCC initiatives aim to explores the outcome of a participatory process and approach in promoting the use of GMCCs in two broad rice farming ecosystems in the Upper North: the irrigated lowlands of Chiang Mai province where the Multiple Cropping Centre [MCC] has actively collaborated with farmers of Mae Teang district, developing the use of *Sesbania rostrata*, and the rainfed lowlands in Chun District of Phayao province, where farmers have successfully adapted *Crotalaria juncea* (sunn hemp) in rice farming through interactive learning experiences among farmers based on initial introduction by LDD.

In the GMCC case study, it is observed that through deploying the participatory research approach the process of learning and knowledge sharing has improved farmer capacity for innovation. Such "empowering" processes, as noted by (Okali *et al*.,1994), are a further benefit of the participatory approach. Through collective learning, each farmer comes to understand the nature and properties of GMCC, and then is better able to adapt it to his or her own farming system and socio-economic circumstances.

The early study of GMCC in Chiang Mai province and recent observation of the Phayao cases reveal that farmer exposure to GMCCs comes from various sources:

- The LDD: through its *mor din ar-sa* network, including farmer training and demonstration plots in farmers' fields. The system is implemented nation wide.
- The DOAE: through its community rice seed production project, introduction of GMCCs in rice seed production is being added, based on interaction between local extension agents and the Provincial LDD staff.
- The MCC: through its on-farm research in the Chiang Mai valley, before the active promotion of GMCCs by the LDD in the areas studied.
- Dissemination farmer-to-farmer.

The technology development approaches consist of transfer of technology (TOT) (Chambers, 1990), with scientists generating technology and passing it to farmers, either via or by-passing local extension agents. The first approach is taken by a governmental organization (the Land Development Department) where the participatory approach is linked with LDD's *mor din ar-sa* system; farmer volunteers nominated by the village headman, receive intensive short-term training by the LDD on various aspects of soil conservation and improvement. The LDD provides substantial support in terms of materials and funds for setting up demonstration plots, and offers an honorarium for training services given to farmer volunteers. The system provides farmer volunteers, who are supposed to be future trainers, an opportunity to learn by experimenting and assessing the technology in their own villages. The approach depends on the capability of *mor din ar-sa* in technology dissemination. The system benefits and works best for innovative farmers who want to learn and seek new options. This is seen in the case mentioned above (Chai Wannasorn in Chun district, Phayao province).

The second approach is that taken by non-governmental organizations, where the main focus on the MCC approach combines on-station and on-farm based studies concerning best-bet solution to improve soil fertility on rice land. The options are specific, and decided by researchers. But a participatory approach is also used, in which farmers gain knowledge through communication and interaction with a researcher serving as facilitator. This is a group-based interactive approach. Such social learning has been recognized as the most effective way of approaching adult education, as applied in the farmer field school (FFS) approach. When farmers begin to practice GMCCs (in this case the farmers in Buak Mue) they go through sequential adjustment to unpredictable conditions (Richards, 1989), until they finally decide that the system is compatible. Then they will continue to use it, or stop when it is clear it is not compatible. This kind of participatory approach seems to help farmers make better decisions on technology adoption.

The governmental organisation

Land Development Department [LDD]'s soil conservation and soil improvement services

The Land Development Department [LDD] is a leading agency in the MOAC that has a mandate to develop and transfer technology that conserves and improves soil fertility for sustainable agriculture and food security, especially for smallholder farmers. The LDD initially worked on rain-fed uplands, designing legume-based cropping systems and developing soil and water conservation farming practices to increase land productivity. In recent years, the LDD actively participated in collaborative development work on highland agriculture under the coordination of the Royal Project Foundation; the LDD provides technical support in sustaining highland land use systems. The main technological innovations to rehabilitate the rain-fed uplands and highlands are hedgerow intercropping, legume-based rotational cropping systems, use of green manure and cover crops to improve soil fertility, minimum tillage in combination with legume-cover crops such as cowpea (*Vigna unguiculata*), mung bean (*Vigna radiata*), sword bean (*Canavalia gladiata*), lablab bean (*Dolichos lablab*), sunn hemp *(Crotalaria juncea*), etc., and the most recent widespread promotion (use of *vetevier grass* as soil erosion control measure on hill slopes). For the lowland rice ecosystems the LDD promotes the use of cow pea, mungbean, sunn hemp, and *Sesbania rostrata* as green manure crops. In addition, the LDD has developed many culture media for catalyzing the decomposition of composting materials. These are known as "effective microorganisms" (EM). EM is also recommended for making bio-fertilizers from plant and animal extracts through anaerobic fermentation. The diluted solution is used as foliar fertilizers or for direct application to rice fields. The soil and water conservation practices aim to capitalize available soil and water resources for improving soil conditions in marginalized rain-fed environments.

The LDD does not have a formal organizational structure for extension work at the *tambon* and village level, providing land conservation and development services to farmers. Instead, the LDD new policy is to provide farmers' access to information and services via village farmer volunteers or *mor din ar-sa* (volunteer soil doctors) nationwide. The plan is to have about 70,000 *mor din ar-sa* representing each village for the whole country. The provincial Office of Land Development Station (PO-LDS) selects village farmer volunteers with the assistance of the *tambon* extension official, the *kaset tambon,* (KT), who nominates potential farmer representatives. The PO-LDS provide annual training for the *mor din ar-sa*. Specifically the *mor din ar-sa* has been trained on diagnostic techniques for soil chemical properties, such as soil pH, lime requirement, P_2O_5 and K_2O, with the use of a test kit. Other services for soil improvement technologies include composting technology, liquid organic fertilizers, and use of GMCCs. At the *tambon* level, the PO-LDS set up the land development service centres (LDSC). In many cases, it has been observed that the LDSC is located close to the residence of the *mor din ar-sa*.

In 2004, the PO-LDS in Northern Thailand began active recruitment of *mor din ar-sa* throughout the region. The numbers of *mor din ar-sa* recruited in the selected three provinces of Chiang Mai, Chiang Rai and Phayao are given in Table 5.5.

The registered numbers of *mor din ar-sa* at the village and at the *tambon* levels are excessive. In each village, the village headman has often nominated more then one farmer volunteer. During the annual meeting of the *mor din ar-sa* organized by the PO-LDS, *mor din ar-sa* at the *tambon* will be elected from the village farmer volunteers. The scaling down policy of land conservation and development services to village level is supposed to take its effect within a short time. It remains to be seen whether this institutional approach and its implementation will provide effective services to farmers. Field visits to selected villages in the three provinces of Chiang Mai, Chiang Rai and Phayao revealed that many farmer volunteers are not so keen to take a pro-active role in providing services to the community. The effort takes time, unless farmers bring their own soil samples to *mor din ar-sa* for diagnosis. Many have distributed seed of recommended green manure varieties among their relatives and friends. But a few have shown outstanding performance. The LDD organizes annual national awards to outstanding *mor din ar-sa* to encourage voluntary service to farming communities.

Regarding the lowland rice ecosystem, the *mor din ar-sa* is required to set up a demonstration plot for GMCCs during May-June as an information service to farmers. A few will keep some seed and broadcast it in late September-October on the upper terrace for seed multiplication. Considering the present institutional organization at the village and *tambon* level, if the TAO could take an active role in coordinating and supporting the governmental implementing agencies, farmers would have better access to agricultural services, as depicted in Figure 5.5.

The TAO, through its administrative and functional roles in TTC, can collaborate with the district and provincial office for agricultural extension concerning crop production activities, *i.e.* the Office of Agricultural Research and Development (OARD) Region 1 for agricultural technological services, and through its farmer volunteer service have access to land conservation and development services from the Provincial Office of Land Development Station (PO-LDS). The TAO, with its own budget, can determine its own agenda when approaching the above governmental agencies for services. So far, very few TAO Committees have played any active role in working together with the above mentioned agencies for development and delivery of improved farming interventions. One case was observed in Phayao province, where the TAO chairperson is farmer who successfully promoted the use of sunn hemp as a green manure crop in rice farming from 2005.

Table 5.5 Farmer volunteers (*mor din ar-sa*) for land conservation and development services in three provinces in the Upper North, 2006

Province	***mor din ar-sa* at sub-district level**			***mor din ar-sa* at village level**		
	Target	**Recruited**	**In excess**	**Target**	**Recruited**	**In excess**
Chiang Mai	199	838	+639	965	2437	+1472
Chiang Rai	123	486	+363	861	989	+128
Phayao	68	202	+134	484	551	+67

Source: LDD, 2004

Non-governmental organization (NGO) initiatives

Various non-governmental organizations have been involved in participatory approaches to promoting soil improvement technology. The list includes Thai NGOs, universities, and an international agency such as ICRAF. The following section describes the approach used by the Sustainable Agriculture Thailand Foundation [SATHAI].

In recent year, Thai NGOs working towards sustainable agriculture over the country have been coordinated by a centralized organization, the Sustainable Agriculture Thailand Foundation [SATHAI]. During the 8th National Economic and Social Development Plan (1997-2001), SATHAI received financial support from the Ministry of Agriculture and Cooperative [MOAC] to coordinate sustainable agriculture and natural resource management projects among local NGOs nationwide. The common approach in technology development is participatory action research, with emphasis on participatory learning and action. SATHAI, like its network of NGO allies, advocates on behalf of local knowledge and wisdom, and takes an initiative to organize farmer forums as social platforms for exchanging local experience and knowledge. Participation is considered an empowering process for socially disadvantaged rural communities.

The SATHAI and its NGO allies are against the use of agro-chemicals in agriculture, and are main critics of a Green Revolution approach in Thai farming. They strongly believe that organic agriculture is the only production system that can benefit small farmers. Such a system could relieve farmers of their dependency on external inputs, and thus reduce indebtedness. Sustainable farming practices – their view - would include reviving the use of local varieties, for which farmers can produce their own seed, replacing chemical fertilizers with bio-fertilizers, and replacing pesticides with plant or herbal extracts or micro-organisms that have an antagonistic function to pests. The approach is termed (Richards 1990) “supply side populism”.

In rice farming, SATHAI and allies, work with farmers to develop liquid extracts derived from anaerobic fermentation of herbal materials, plant and animal materials for use as bio-pesticides, and bio-fertilizers. The technology provides the basis of organic farming, SATHAI’s main objective. Successful organic farmers throughout the country are invited by the SATHAI as resource persons to promote non-agro-chemical localized technology in crop production. The widespread use of organic materials has prompted the private chemical companies to manufacture commercial “bio-fertilizers”, promoted as “green technology” and environmentally friendly materials. Few products give details of nutrient compositions, and quality is unchecked.

SATHAI and allies are more interested in up-scaling of the organic process than testing and further improving the technology as such. As with populism more generally, the aim is farmer empowerment. The participatory approach is seen as a central element in that process. Exploration and utilization of local knowledge is facilitated by local NGOs in farmer forums to create practical knowledge and break dependency ties on commercial suppliers. Therefore many localized initiatives in bio-fertilizers have been developed by NGO-farmer partnerships. However, the use of GMCCs is regarded as an alternative, depending on its availability.

SATHAI and allies do not directly involve or promote the use of GMCCs, especially where introduced alien species are involved. They consider introduced species promoted by the LDD to be less adapted to local conditions and thus put farmers at higher risk. Farmers have a tendency to request seed support from the LDD every year. The common GMCC recommended by NGOs is mungbean. It is a common edible local pulse crop and widely adapted, and has dual purpose, being a harvestable N-fixing grain legume with crop residues useful in soil improvement. This is seen as providing a better alternative than other introduced species

Organically produced bio-fertilizers, made from locally available materials, are easily accessible. Their perceived advantage is that farmers will not have to depend on external sources for material inputs. Utilization of bio-fertilizers and GMCCs in crop production is thus in line with SATHAI policy of promoting the development of organic agriculture as an alternative for smallholder farmers.

Box 5.2 *Sesbania rostrata* technology

S. rostrata grew taller in the long-day period (April to September) than in the short-day period (October to February) (Becker et. al, 1990). Dreyfus and Dommergues (1981) found that S. rostrata - a tropical legume colonizing waterlogged soils in the Senegal Valley, forms N-fixing nodules with Rhizobiurn (Azorhizobium caulinodans) on both the roots and the stem. Due to its profuse stem nodulation, this plant has 5-10 times more nodules than most nodulated crop plants. Moreover, stem-nodulating ability provides additional opportunities to fix N_2 *under flooded conditions (Becker et al.,1986; Ladha et al., 1989b, Dreyfus and Dommergues.1981), and appears as a probable adaptive response to waterlogging this ability confers on this legume an advantage assimilating both soil and atmospheric nitrogen (Moudiongui and Rinaudo, 1987)*

These characteristics make the species a promising green manure option for lowland rice. S. rostrata accumulates 25-30 t ha-1 fresh biomass after 45 days and 7.0 t ha-1dry weight of biomass after 60 days (Kalidurai and Kannaiyan, 1989, Kalidurai and Kannaiyan, 1991). Evaluation of 50 green manure crops in different seasons showed that Sesbania accumulates nitrogen to a maximum of 4.8 percent at the age of 50 days (Vacchani and Murty, 1964). In India 36 Sesbania species incorporated in the wet rice growing season, (October-February) showed an average contribution of 63 kg N ha-1 after 30-45 days (Ghai et al.,1988). Presently Aescheynomene spp. and Sesbania rostrata growing naturally under dry or waterlogged conditions, develop nodules on both roots and stems, and produce about 25 ton fresh biomass ha-1 after 45 days in a rice field (Dreyfus and Dommergues, 1981). Nitrogen fixation by Sesbania rostrata has been shown to be 270 kg N a in 50 days (Manguiat et al., 1987). Similar results reported by Rinaudo, et.al., (1983) show that the application of chemical N fertilizer; at 60 kg N ha-1, increased the rice grain yield by 1.69 t ha- I, whereas incorporating S. rostrata as green manure resulted in a grain yield of rice increase of 3.72 t ha N, fixed by S. rostrata as estimated to be at least 267 kg N ha, one third being transferred to the crop and two thirds to the soil.

The MCC initiatives

The MCC research for developing and disseminating green manure crops technology for sustaining rice production in the lowland ecosystems began in 1993. The initial on-station research agenda derived from a researcher who was motivated to improve rice productivity through alternative soil management practices. GMCCs were considered the best bet solution. The on-station research provided technical competence to researcher on how GMCC works in rice farming. The knowledge on GMCCs generated through on-station experimentation provided technical backing for the researcher to disseminate the practice to rice farmers. This was then followed by a shift to a farming systems approach with emphasis on on-farm participatory research. The preparatory phase included researcher-farmer dialogue to identify opportunities for incorporating GMCCs in farmers' rice production systems. The process consisted of a number of integrated activities, such as reviewing existing farmers' rice production systems, explaining the possible roles and functions of GMCC, specifically *Sesbania rostrata* in rice farming with evidence-based on-station studies, and inviting farmers to observe *Sesbania* growth on demonstration plots at the research station. Participation of farmers in the learning process was voluntary. A farmer committee was formed by farmer participants. Its main function was to coordinate all activities among farmer members, and to act on behalf of the group for liaison with MCC researchers. The

MCC provided rice seed and *Sesbania* seed for test plots for all farmer participants. Farmers-researcher meetings were held regularly during the cropping season. Not all farmer participants were present at all times. The most important learning session was during participatory monitoring and evaluation of crop performance on individual plots, both during the *Sesbania* and the rice growing seasons. Individual farmers had opportunity to present their ideas and reflections on *Sesbania* management and rice yield performance. Causes of variation in *Sesbania* growth across farmers' fields were identified and discussed in situ. The process of monitoring, evaluation, and reflection between farmers and researchers was recognized by farmer participants as a most rewarding exercise. This attitude is indicative of farmers' interest in cooperation with research institutions to provide technical advice and develop localized farming technology. The historical profile of GMCC work is outlined in Table 5.6. The later phase of researcher-farmer interaction goes beyond GMCC activity, extending to all aspects of rice-based livelihood systems in the Chiang Mai Valley. Two villages, Buak Mue and Dong Palan, of *tambon* Kee Lek, Mae Teang district, Chiang Mai province have been selected for detailed studies.

Table 5.6 Development of GMCC work in rice farming at the Multiple Cropping Centre

Period	Developmental process
1993-1998	On-station research, researchers learnt about and developed Sesbania rostrata as a "best bet" GMCC technology in rice farming. They used station-based study as demonstration and for farmer training.
1997-2000	On-farm research with farmer participation in three rice growing districts of Chiang Mai province. Close collaboration between farmers and the MCC researchers improved social relations and inter-cultural learning that extended beyond GMCC testing.
2000-2002	Continued interaction with farmers through field visits and farmer meetings. The researchers played an advisory role, providing information and connection to external sources.
2003	Collaborative work with local institutions *to develop cost effective cultural practices for rice farming, specifically in tambon* Kee Lek, with subsequent emphasis in two villages, Buak Mue and Dong Palan
2004-present	Exploring farmers' use of GMCCs in two main rice growing provinces in the Upper North, Chiang Rai and Phayao, and the work of LDD in promoting the use of soil improvement technology in rice farming. The GMCC work has been extended to community rice seed production.

Farmer traditional practices

The long existing rice-soybean cropping system has provided farmers with food security and relatively stable income from selling of rice surplus and soybean grain. Rice farmers use soybean threshing as soil improvement material, broadcast over paddy fields. Farmers with access to cow dung also broadcast manure to improve rice yields.

Farmers have no experience in using green manure and cover crops (GMCCs) to enrich soil fertility. The local extension agent or *kaset tambon* (KT), whose mandate is mainly extension of cash crop production technology, does not deal with GMCCs, and has also no access to seed materials. Farmers have realized the importance of soybean as a soil improving legume, and so have adopted soybean to stabilize rice yields. The rice-soybean system, which requires a growing period for about nine months, from August to April, also provides a fallow period of three months. Farmers consider weeds and other vegetation in the fallow field provide soil nutrients when they are incorporated into rice field before rice transplanting.

Use of chemical fertilizers in rice fields is increasing, partly as a consequence of an extension programme to increase rice yield run by the Department of Agricultural Extension (DOAE). The Good Agricultural Practice (GAP) for rice, as formulated by the Department of Agriculture (DOA), recommends fertilization of rice soil throughout the country using 156.25 kg/ha of compound fertilizer 16-20-0 as basal fertilizer, and 62.5 kg/ha of urea (46-0-0) as top dress at heading stage. The three months fallow period in the rice-soybean cropping system provides a window for incorporating GMCCs. If the practice were to prove compatible with farmers' circumstances and economically viable it would have a good opportunity to be adopted.

Farmer experimentation on *Sesbania rostrata*

In 2000 over twenty farmers in Buak Mue village participated in the field testing of *Sesbania rostrata.* Seed was provided by the MCC. A small amount of foundation seed for selected rice cultivars, such as the high quality non-glutinous rice KDML 105, and the glutinous rice RD 6, were also given to participating farmers. It is commonly observed that farmers join testing programmes because of material incentives. In this case, the incentive was the quality rice seed.

During the *Sesbania* season, regular field monitoring was conducted together with farmers. However, not all farmers were present at all times. The growth and biomass yield of *Sesbania* was different from farmer to farmer. Variations were due to many factors, including different planting times by farmers, site heterogeneity, variation in soil moisture status at planting time and thereafter, vegetation conditions before planting (weedy or less weedy), land preparation (plough and non-plough), and farmer commitment.

In the 2001 season a reduced number of farmers in Buak Mue continued to use *Sesbania* as a green manure crop, and continued to set aside small plots for production of *Sesbania* seed. Nearly all-participating farmers selected rice variety RD 6 for planting. The variety was considered less risky, since it was preferred by local communities for household consumption, and was thus always in high demand.

Those continuing to use green manuring in rice farming had produced their own *S. rostrata* seed. These farmers could be considering being true adopters. The farmers who discontinued the use of *Sesbania* fell into two categories. One group was those not successful with the GMCC, either because the field environments during the test period were not favourable to good growth and high biomass yield, or because the farmers themselves did not manage well. The other group was those whose fields showed good performance, but were not willing to invest in own seed production, expecting instead to have continued free supply of seed from the project. It seems likely that the agronomic and economic benefits from *Sesbania,* as reflected in the rice yield, were not attractive enough for these farmers to invest.

In the 2002 season, the District Extension Office sought to build on group activities in producing community rice seed and applying GMCC in rice farming. The Office approached the group as well as other members within the same village to join the community seed development project, which would be supported by the DOAE. Farmers would receive supplies of certified seed of KDML 105, and compound chemical fertilizers (16-20-0) and urea (46-0-0). Small quantities (5 kg/farm) of GMCC seed (for cowpea and *Sesbania*) were again given without charge. The cost of rice seed was 10 *Baht*/kg ($0.24), and 7.2 *Baht*/kg ($0.17) for fertilizer. The full cost of the fertilizers and 10 percent of the seed cost were to be returned to the group and used as revolving fund, being managed by the group committee. A farmer field school (FFS) approach was adopted to develop the farmer-learning process in seed production. The FFS was organized and run by the staff of the DOAE Seed Multiplication Centre, based in Chiang Mai. About thirty farmers joined the DOAE community seed project. However, at harvest, due to severe rain damage, only one farmer with 3,000 kg of seed passed the seed testing standards set by the Chiang Mai Seed Multiplication Centre. This lot was procured by the Centre at 20 percent premium over the normal grain price. The majority of farmers were not satisfied with the outcome. They considered themselves ill treated, since they considered this was all group activity, not a matter of individual effort, but they were reluctant to complain, and instead, withdrew from the project in the 2003 season The project was thus very short-lived (lasting one year). The DOE decided it would work with a new farmer group at a new site in future. Whether the agency learnt the lesson of trying to build activity around group dynamics, only to undermine group cohesion by rewarding the performance of an individual remains in doubt.

What had farmers learnt since the GMCC initiative?

Farmers in Buak Mue wanted to reduce the use of artificial fertilizers. After the introduction of *Sesbania* by the MCC in 2000, a few successful farmers continued to believe in its contribution to soil organic matter and plant nutrients, as manifested in increased rice yield, and persevered with *Sesbania.* Those who were less successful did not necessarily give up the search for organic fertilizer sources, even though they discontinued the application of *Sesbania*

As already noted, the years 2000-2003 witnessed increasing use of bio-fertilizers in agricultural production. This was partly due to the sustainable agriculture movement organized and promoted by the non-governmental organizations [NGOs]. An additional element was the Sustainable Agriculture Development Project (SADP) of the Department of Agriculture [DOA], funded by Danish Cooperation for Environment and Development [DANCED]. In 2001, the SADP conducted the first national workshop on bio-fertilizers in Chanthaburi province, an important fruit-growing province in the East where farmers had developed their own bio-fertilizers for their fruit orchards, and these were claimed to be effective. The workshop was well attended by agricultural scientists and farmers from all over the country. The bio-fertilizers (BF), as well as plant extracts (PE), came with many forms, with different combinations of ingredients, mainly derived from local source materials. It thus became evident that there was vibrant local activity and knowledge in the area of soil fertilization, based on use of locally available raw materials. This was seen by both the DOA and NGOs as a source of environmentally friendly technology, to be promoted by both institutions.

As noted above, the private chemical companies, sensing possible loss of income, were not slow to come up with various forms of bio-fertilizers of their own, in a number of formulations (for instance, granular, powder, concentrated solution, etc.) but all without specifications. The DOA was asked by the farming community to regulate and standardize the quality control of all bio-fertilizers, but to date, there is no clear indication about standardization of products. Farmers in Buak Mue were increasingly interested in granular forms of bio-fertilizer in rice farming, and one in particular marketed by the trade name of "Tiger". The material was first made available by the Bank for Agriculture and Agricultural Cooperatives [BAAC]. Farmers who were members (*i.e.* clients) of BAAC could buy the granular bio-fertilizer at 360 *Baht*/50 kg bag ($8.50/50 kg or $0.17/kg). The price was comparable to chemical fertilizer, so commercially available granular bio-fertilizers did not come cheap. Farmers, who used a granular form of bio-fertilizer for the first time in the 2002 season, claimed that rice plants grew vigorously when the bio-fertilizer was applied one week after transplanting. Unfortunately, grain yield could not be properly assessed, because the rain damaged part of the grain harvest. About half the farmers indicated that they would also use the bio-fertilizer in the rainy rice season in 2003. The main features of this bio-fertilizer attracting farmers' interest was:

- Rice plants showed positive response (visual effect)
- The granular form made application easier (learning by doing)
- Price was comparable to chemical fertilizer (economic rationale)
- The bio-fertilizer would not have a negative effect on the soil (farmers' own perception)

The farmers did recognize the effectiveness of *Sesbania* in increasing rice yield, but under their field conditions, ploughing was required to achieve good stand establishment of *Sesbania*. The practice was not economically viable. From the information available, bio-fertilizers seemed more attractive. They could be made from local raw materials. A question then arises why these farmers did not try to produce their own bio-fertilizers. The answer seems to be that the manufactured type was convenient, and its price comparable to chemical fertilizers used on rice. Farmers considered the aqueous form of bio-fertilizers (of the kind made locally) to be less effective and the results unreliable.

One farmer who first participated in the *Sesbania* testing with the MCC had developed a bio-fertilizer concentrate. He also continued to use *Sesbania* in subsequent rice farming by producing his own seed. He had applied his own prepared bio-fertilizer in the *Sesbania* treated rice fields. With consistently good rice yields, he eventually stopped using chemical fertilizers in rice production.

Although the picture is mixed, we can summarize as follows. Since the first GMCC work was launched by the MCC in 2000 in Buak Mue, rice farmers in the study area have modified their nutrient management in rice farming can be grouped as:

1. True adopters of *Sesbania*, developing new organic-based integrated nutrient management practices
2. Those who changed from chemical fertilizers to use of commercial bio-fertilizers in granular form
3. Those mixing chemical fertilizers and various forms of bio-fertilizers
4. Those using other soil improving legumes than *Sesbania*, such as rice bean
5. Users of chemical fertilizers

The farmer who was successful with the use of *Sesbania* had managed to broadcast the seed without ploughing, thus reducing the land preparation cost. The technique was to properly treat the seed, either with sulphuric acid or boiling water. Enough initial soil moisture was essential for uniform germination. Those who terminated the use of *Sesbania* did not make any attempt to modify or adjust the system to fit their own field conditions. They claimed that the added cost was higher than the added benefit, so the farmers abandoned the system. However, a few then searched for other soil improving legumes. Rice bean (as noted above) was considered suitable by some, since it did not need seed treatment, or extra land preparation.

The use of a green manure crop in the 2003 rice planting season

Farmers who had earlier experimented with green manure crops in rice–based farming systems then undertook to apply the technique on the rice crop during the 2003 rainy season. Most of these farmers continued with *Sesbania rostrata*. One farmer, who had earlier tried out with cowpea and bush bean (in the 2002 season, where the Chiang Mai Land Development Station supplied the seed), explained he was satisfied with the legume growth and consequent rice yield, and so continued with these crops to support the 2003 application farmers in Buak Mue were exposed to information on green manure crops in rice farming, and were helped to access sources of seed. Hands on experience led them to observe increased yield on subsequent rice crops.

The Chiang Mai Land Development Station implemented the Department's policy to improve rice productivity through the use of green manure crops in 2003. The Station made use of its village "soil doctor" network, a farmer volunteer network for delivery soil improving technology at the grass-root level. The "soil doctor" volunteers worked closely with the Station, each was supplied with a soil test kit. Assessment of soil chemical properties was carried out on-farm and the test kit gave an instantaneous result. Request for green manure seed could then be made through the "soil doctor" volunteers.

- At the planning stage for the 2003 rice season, farmers discussed about the tillage system to be used for planting green manure crops in the May-June period. The tillage practices varied according to farmers' preference and past experience, as outlined below:
- Without tillage, broadcasting seed after the first rain and soil moisture was sufficient for seed germination.

- Without tillage, spraying herbicide for weed control, and broadcasting seed after the first rain and soil moisture was sufficient for seed germination.
- Without tillage, slashing the weed to ground level to facilitate seedling establishment; broadcasting seed after the first rain and soil moisture was sufficient for seed germination.

Ploughing with two-wheel tractor and broadcasting seed after the first rain and soil moisture was sufficient

Farmers were all concerned with the added cost of ploughing for green manure crop planting. Unless the added return from such practice can be sustainable realised it is clear that use of green manure crops, particularly *Sesbania rostrata*, will be limited.

It was observed that during the farmer planning discussion, the tillage practice for green manure crops was left to individual farmers' circumstances; there was no single solution or best practice proposed to fit all farmers. The main bio-physical determinants for adopting tillage practice in green manure crop planting seemed to rest on:

- Soil texture; no tillage with clayey soils.
- Weed density; with densely populated weed, tillage or weed control either with chemical or hand weeding.

Those who decided to use green manure crops selected *Sesbania rostrata* simply because they could produce their own seed, and the other legumes, either cowpea or rice bean, were not readily available in the 2003 season. Farmers broadcast *Sesbania* in mid-May to early June when the first rains arrived. Unfortunately, only one farmer (Nai Mee) succeeded in obtaining good crop establishment; the rest was not so successful with the crop. The observed crop failure, as identified by farmers, included poor germination, and poor stand establishment and growth. The main causes were insufficient soil moisture, weed infestation due to no tillage or weed control, and seedling damage by insect pests. One farmer had to re-seed twice to get the *Sesbania* established, but the final growth and biomass yield were poor. Plant height was only about 30 cm when the crop was incorporated into the soil.

Those who did not use a green manure crop to improve soil fertility stated that they were tied up with wage labour activity. Since there was high demand for wage labour in the village and within the sub-district during the dry season, many rice farmers in Buak Mue chose to work off-farm, as a better income generating opportunity, than to manage their rice land with green manure crops.

The utilization of a green manure crop, and the overall performance in Buak Mue 2003 season, were not outstanding, as compared with the first year of farmer experimentation. The success of green manure depends not only on its realized benefits in terms of improving soil conditions and increasing subsequent rice yield, but also on farmers' opportunity costs (*e.g.* foregoing engagement in more rewarding income generating off-farm employment within the sub-district). The instability of *Sesbania* performance was also an important factor in discouraging farmers from adopting the GMCC system.

5.4 The main arguments against chemical fertilizers in rice farming

During farmer meeting, workshop and field visits, and discussion with staff members of the LDD, DOAE, and local NGOs, as part of this research, local views strongly reiterating arguments against the use of agro-chemicals in rice farming, and advancing strong arguments for the use of GMCCs and other organic materials in rice production, were frequently encountered. Populist agencies may not have been able to fully establish green manures, but they have definitely managed to swing the pendulum of local opinion towards the view that external inputs are in some sense negative. This thesis reports these attitudes in terms of the perspectives of farmers, government agency and local NGOs.

Farmers' perspective

Farmers have concerns over the continued application of chemical fertilizers in seasonal rice farming, and fear that its benefits cannot be sustained. This is because many farmers have observed evidence in their fields that soil has been "hardened" and is not easy to work with. Increasing fertilizer price relative to farm gate price of rice is another key factor forcing farmers to seek alternatives to chemical fertilizer. The ratio of rice price to fertilizer price (*Baht*/kg) is deteriorating (Figure 5.3, Table 5.7). This is evidenced in the case of Phayao province, where farmers with larger farms producing rice as a main cash crop, are increasingly adopting *Crotalaria juncea*, while reducing or replacing chemical fertilizers. But the picture is significantly different in Chiang Mai province, where rice farming is more for subsistence and farm sizes are much smaller (And off-farm livelihood opportunities more readily available) *i.e.* there is much less dis-adoption of fertilizer. Here, small farmers still find chemical fertilizers are labour saving and more convenient to use.

Farmers with better access to farm machinery, such as the two-wheel tractor or heavy tractor for land preparation, more readily opted for GMCCs over chemical fertilizer use. This is also clearly shown in the adoption of *Crotalaria juncea* in Phayao province, where more commercial rice farmers tend to have more equipment. Farmers who have used *Sesbania rostrata* (Gypmantasiri *et al*., 2004) and *Crotalaria juncea* agree about the agronomic benefits of GMCC (that it improves soil conditions, resulting in greater ease of transplanting and increase in rice yield).

Many farmers who have better results with GMCCs have tended to reduce the use of chemical fertilizers. But few depend on GMCCs alone. In field work farmers were observed applying chemical fertilizers on the patches where rice growth was not uniform or showing "unhealthy" symptoms with yellowish leaf colour during tillering and flowering stages. Chemical fertilizers provide a rescue strategy of last resort. Farmers also broadcast chemical fertilizers to regenerate rice growth damaged by insects (*e.g.* gall-midge) or affected by flooding. In Chiang Mai the widespread use of bio-fertilizers in combination with *Sesbania rostrata* reinforces the obvious point that farmers like to combine strategies. Few are likely to depend on a single soil improving technology to stabilize and to increase rice yield (whether chemical or organic).

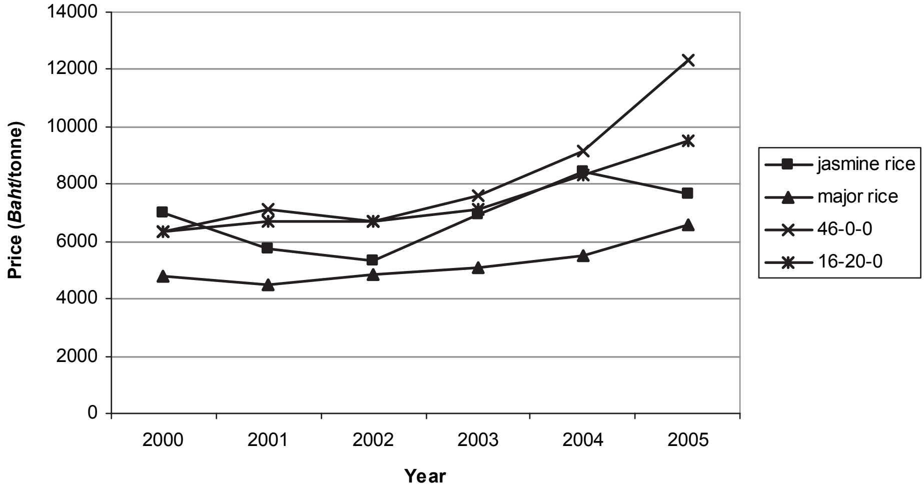


Figure 5.3 Average farm gate price of rice and average retail price of chemical fertilizers (2000-2005)

Source: Office of Agricultural Economics, MOAC, 2006.

Table 5.7 Rice and fertilizer price ratio (*Baht*/kg)

	Ratio/Year	2000	2001	2002	2003	2004	2005
jasmine rice	rice:46-0-0	1.1	0.8	0.8	0.9	0.9	0.6
	rice:16-20-0	1.1	0.9	0.8	1.0	1.0	0.8
major rice	rice:46-0-0	0.8	0.6	0.7	0.7	0.6	0.5
	rice:16-20-0	0.8	0.7	0.7	0.7	0.7	0.7

Source: Calculate from Figure 5.3.

The LDD perspective

During the 9th National Economic and Social Development Plan period (2002-2006), organic agriculture was considered by the MOAC to be a key production practice to serve the national policy of developing the country to become the "World's Kitchen", and so is part of a national agenda. The LDD, because of its mandates in improving soil and water management in agriculture, has been assigned by the MOAC to take the leading role in organizing collaborative programmes linking various departments within the ministry and across ministries. While the Department of Agriculture [DOA] is responsible for developing Good Agriculture Practice (GAP) for each crop commodity targeted for export, the National Bureau of Agricultural Commodities and Food Standards [ACFS] takes responsibility for setting up standards, monitoring, and accrediting certification of all types of exported food and agricultural commodities to boost consumers' confidence on safety and quality of Thai exported agricultural commodities.

The GMCCs and other bio-technology products derived from "effective micro-organisms" (EM), and composting technology developed by the LDD, are meant to support "green technology" for production of quality agricultural commodities. GMCCs have been strongly promoted for soil improvement in organic agriculture, particularly in the production of organic rice. The LDD has the policy to reduce the use of agricultural chemicals by 30 percent among 2 million farm households throughout the country by using bio-technology in soil improvement. The policy assumes that the change would enable farmers to reduce production costs by 10 percent, while crop productivity will increase by 10 percent.

The LDD recently announced that since the campaign for reduction of agro-chemical use began in 2004 numbers of farm households, reducing and/or replacing chemical fertilizers with bio-fertilizers through the network of *mor din ar-sa*, has grown to 8540,385 (by December 2006). This is 20,000 households more than targeted. On average, LDD claims that farmers have reduced chemical fertilizers used by 9.70 kg/*rai* (60.60 kg/ha) or about 22.5 percent (*http:wwwnaewna.com/news).* The Department also claimed that at the end of 2006, 17 million *rai* of farm lands (2.72 million ha) - or about 13 percent of the total farming area - had come within the scope of reduction of chemical fertilizer use.

The annual use of chemical fertilizers in rice production is estimated to be1.7 million tonnes. With retail price averaging *Baht* 10,000 per tonne (US$ 278), (OAE, 2006), this is a huge market. Rice farming alone generates demand for US$ 470 millions worth of chemical fertilizers. This figure is seen as the basic justification for the LDD to develop and promote the use of bio-fertilizers and GMCCs in rice farming. Reducing the market share of chemical fertilizer is not, however, the same thing as replacing it altogether. Total replacement seems unlikely, for reasons already analysed above, so one can take the view that government strategy is primarily to push green manure as a strategy for diversification.

The NGO perspective

SATHAI and its NGO allies advocate organic agriculture and promote total replacement of chemical fertilizers with organic forms of home-made bio-fertilizers, including compost, animal manure, and GMCCs. Success stories of organic rice farming promoted by the NGOs and operated by local farmers have been used as model farms for others to learn through networking. There are many groups and networks involved in sustainable agriculture, such as the network on chemical free agriculture, the network on health assembly, the network on the self-sufficiency economy, the network under the coordination of the Village Foundation (Phongpit, 2005), and a farmer network under the supervision of the BAAC (Verakan, 2004). Each group or network within this national NGO world tends to share similar goals and ideology, based on Buddhist teaching and practice, stressing the dignity of the farmer and importance of self-reliance and freedom.

NGOs have played a significant role in promoting the organic agriculture movement, in facilitating conversion to organic farming practice, in organizing farmer groups, in providing training and marketing support for smallholder farmers, and in assisting in certification (Ellis *et al*., 2006). Basically, Thai NGOs consider that there is no future for Thai farmers if the smallholder continues to follow the path of Green Revolution technology. The NGO network has clearly positioned itself as the advocacy arm of alternative agriculture opposed to chemically-based agricultural production systems. The network in effect campaigns for the complete withdrawal of agro-chemicals in farming. Organic agriculture has been promoted by the NGOs as an environmentally safe production practice with great potential for both domestic and overseas markets, notably European markets (Ellis *et al*., 2006). This is now part of Thai government development policy, as discussed in the following section.

5.5 Scaling up the GMCC approach

The scaling up of the GMCC approach and other bio-fertilizer initiatives is closely linked to government policy support for organic agriculture. Thailand's National Agenda on Organic Agriculture was launched in October 2005. The 5-year programme is aimed at supporting 4.25 million farmers to use organic inputs instead of agro-chemicals over an area of 13.6 million ha, reducing total import of agrochemicals by 50 percent and boosting organic exports by 100 percent annually. There are 26 agencies from 6 ministries involved in the programme, coordinated by the LDD.

Prior to the Thai Cabinet's endorsement of organic agriculture as a national agenda, the National Bureau of Food and Agricultural Commodity Standards was established in 2002. National organic standards were defined and a certification system set up. The DOA established the Organic Crop Institute and approved "Organic Thailand" as a national logo. Specific actions in support of the National Organic Agenda were taken by the LDD to strengthen on-going GMCCs and bio-fertilizer initiatives by working in close collaboration with farmers and local communities.

The LDD has promoted the use of "green production technology", consisting of organic fertilizers, GMCCs, and EM cultures, to produce low-cost materials for biological pest management and plant nutrient management, in order to reduce the use of agricultural chemicals. As described, the technology delivery system is itself also transformed, no longer depending on conventional extension agents, but organized through the network of farmer volunteers (or *mor din ar-sa*) at village and sub-district level (Figure 5.4).

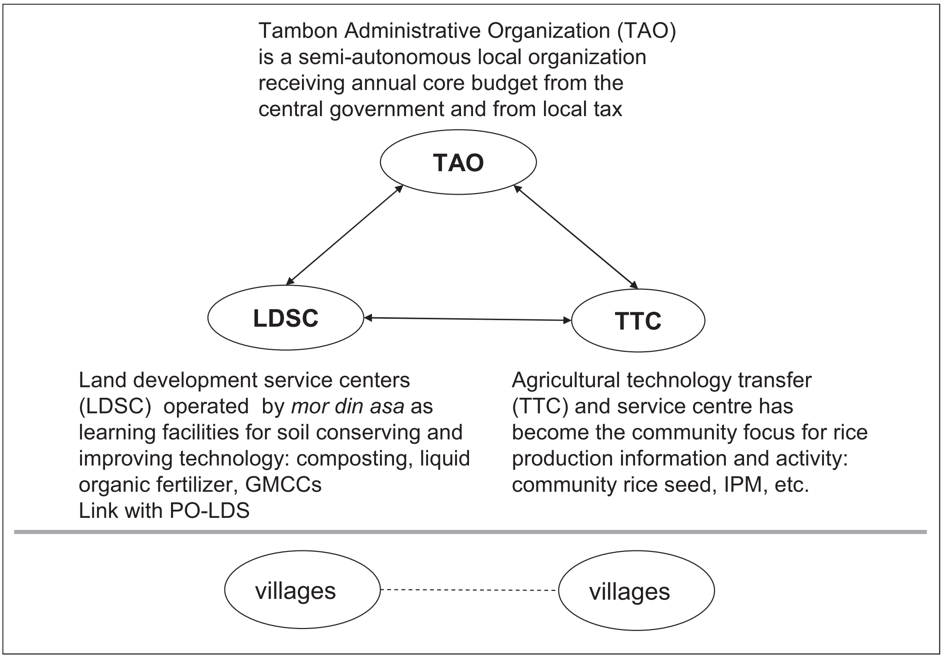


Figure 5.4 Institutional service arrangements for extending soil improving technologies to farmers in villages at *tambon* (sub-district) level.

In recent years, the governmental institutions have recognized the increasing contributions of farmers-to-farmer knowledge transfer as an effective approach to agricultural technology development and adoption. Participatory approaches and farmer networks have been adapted to shift technology transfer from the top-down model. The LDD has recruited and trained farmer volunteers to carry out delivery of soil improvement services in the villages.

In 2004, The LDD set the target to increase crop productivity by 10 percent, to reduce agricultural chemicals use by 30 percent, and to reduce production costs by 10 percent for 2 million farm households throughout the country. The strategy is to work closely with *mor din ar-sa*, who help organize the participating farmers in the delivery of SIT projects supported by the LDD. There were 7,122 *mor din ar-sa* at the sub-district level, and 52,878 *mor din ar-sa* at the village level, totaling 60,000 such agents in 2004. The *mor din ar-sa,* making use of local social dynamics, are supposed to assist the spread of locally generated soil improvement technologies. But this is more than just a purely lateral extension approach. The LDD makes use of a pyramidal process, by setting certain screening criteria for qualified village *mor din ar-sa* to be nominated and elected as *tambon mor din ar-sa*. The structure of the system is summarized in Table 5.8 and Figure 5.5 below.

The qualification for nomination includes being *mor din ar-sa* representing the village, being trained by the LDD, being literate, having good human relationships and ability to communicate with both farmers and the LDD, and having at least four years working experience as *mor din ar-sa*. The LDD also appoints competent village *mor din ar-sa* to be *tambon* representatives. The LDD will inform the TAO and the TTC about the appointment, to ensure services to farmers are coordinated.

As already noted, the LDD provides soil diagnostic techniques based on use of simple soil test kits and colour charts to estimate soil pH, P_2O_5, and K_2O levels (low, adequate and excessive). Each farmer volunteer receives one such test kit. Some *tambon* volunteers become trainers and provide training for the village farmer volunteers. The LDD has 12 regional offices throughout the country, coordinating and conducting research and providing technical advice to its provincial land development stations. There are 75 provincial land development stations. In the eight provinces of the Upper North, two regional offices (Regions 6 and 7) oversee eight provincial land development stations. The Region 6 Office coordinates programme activities with land development stations in Chiang Mai, Lamphun, Lampang and Mae Hong Son provinces.

The *mor din ar-sa* also receive financial support when giving lectures during the training sessions. A few *mor din ar-sa* have developed themselves into resource persons providing training to farmers at national level. These competent *mor din ar-sa* possessing good communication skill and practical experience are able to deliver explanations that prove convincing to farmers. Such development is indicative of hidden talent among volunteer farmers. With opportunity, these farmers are in the process of becoming useful partners for the LDD in disseminating soil improvement technologies. In effect, an entirely new – parallel - extension cadre, recruited from among the farming population, is being trained "on the job".

Once the Department has set up a target for extending soil improvement technologies, the Regional Office and its affiliated stations select target areas, usually in collaboration with formally trained extension agents, KT, who are still part of the process, and in fact often have vital access to local information about "who is who" in the village. The provincial stations, responsible for production of GMCC seed, carry out training programs for farmer volunteers, and conduct site selection to demonstrate the effectiveness of GMCCs under local conditions. Each farmer volunteer selects 4 *rai* (0.64 ha) of village land, to be used as a demonstration plot. The LDD provides daily wages to the *mor din ar-sa* responsible for setting up and managing the demonstration plot during the seasonal growing period. Very often, farmer volunteers participating in testing and demonstrations would prefer some other GMCCs than those provided by the stations. This is an important weakness in the system, since it represents a survival of a "top down" technology mentality, with the LDD, in effect, failing to "listen to farmers". This is a general weakness of bureaucratic centralized systems of technology transfer as deployed by state agencies.

The LDD contracts private companies to produce GMCC seed for distribution, and the private company in return sub-contracts to farmers to produce seed. Given the existing institutional linkage between the LDD at the provincial level and the local TAO and TTC, there is evidence to indicate that local farmers are capable of producing GMCC seed on contract directly with the LDD. One case was observed in *tambon* Na Pang, *amphur* Pong, Phayao province, where the LDD made direct contractual arrangement with farmers to produce *Crotalaria* seed, with only the *mor* *din ar-sa* as intermediary. Local farmer-produced *Crotalaria* seed has the advantage that it is easily accessible to neighbouring farmers, who observe how it is grown and its usefulness and effectiveness in improving soil properties and increasing rice yields without need for business intervention and packaging.

The requirement of GMCC seed varies from years to years. The rice farmers in the irrigated lowlands prefer edible and marketable legumes, such as black cowpea, and mungbean. The short maturing growth habit of these two species produces harvestable grain before rice planting. Farmers will plough over the biomass after grain harvest. The main objective of planting these two species is for grain, and biomass is a by-product readily incorporated as organic material. The provincial LDD staff working directly with farmers indicated that farmers became interested when they found out rice yields declining, or when the soil structure becomes hard and forms large clumps, not easily broken by ploughing. Farmers also identify poor soil showing pale colour, and good soil having black colour. Rice plants growing under soil with "pale" colour will show stunted growth. It is at this point that farmers look for methods of soil improvement, but are often frustrated by not being able to access a preferred type of GMCC. It can be argued that a quality "chain" for eco-innovation works best when it remains local and informal. The intervention of businesses, "packaging" solutions, and turning GMCC solutions into commodities, may not in fact be helpful.

Table 5.8 Hierarchical organization of *mor din ar-sa* working with the LDD

mor din ar-sa	**Who**	**Responsibility**
At the village or *ban* level	Farmer who is interested working as volunteer for soil improvement with the LDD, and appointed to be the LDD representation in the village. Assistant volunteer can be appointed by the LDD upon request by the village headman.	Diagnosing soil chemical properties, advising farmers on soil conservation and improvement, organizing farmer training, gathering information with questionnaires for the LDD.
At the sub-district or *tambon* level	*mor din ar-sa* nominated by the village farmer volunteers, and appointed by the LDD, representing LDD at the *tambon* level, and coordinating farmer volunteer network within *tambon.*	Provides technical support to the TTC, helps conduct training for farmers, participates with the Agricultural Mobile Unit for soil diagnosis, sets up demonstration plots, and keeps records on the material support to farmers from the LDD.
At the district or *amphur* level	Nominated by the *tambon* farmer volunteers and appointed by the LDD, representing the LDD at the district level, and coordinating *tambon* farmer volunteers network.	Coordinating activities of the LDD at the *tambon* level, disseminating information about the LDD to all farmer volunteers.
At the provincial or *chang wat* level	Nominated by the *amphur* farmer volunteers and appointed by the LDD, representing the LDD at the provincial level, and coordinating *amphur* farmer volunteers network.	Representing *mor din ar-sa* at the provincial level, and participating in formulation of agricultural development plan of the TAO

Source: Interview LDD researchers at the Chiang Mai Land Development Station, 2004

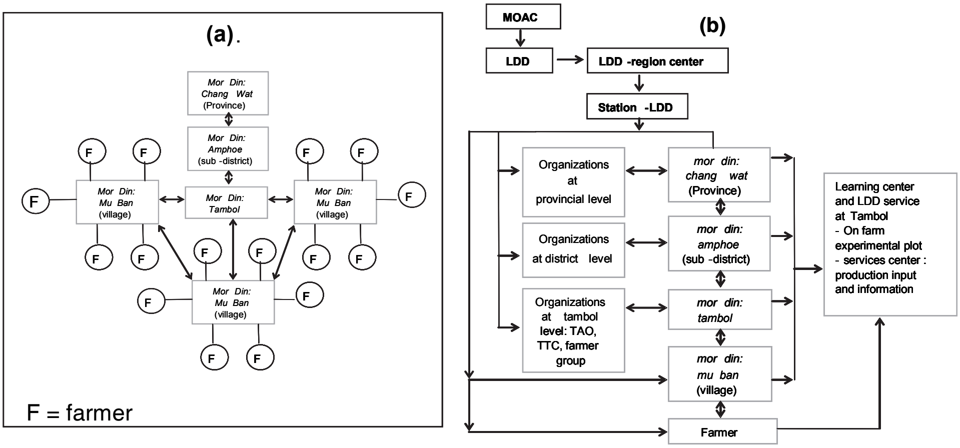


Figure 5.5 (a) Structure of *mor din ar-sa* at different levels and their network (b). Networking of *mor din ar-sa*

Source: Modified from LDD, 2004 (Roles of *mor din ar-sa* in collaboration with LDD

5.6 Conclusions

Debate continues on the role of green manuring in small-farmer agro-technology development. Much of this debate concerns a variety of small-scale experiments, and whether techniques can be implemented on a larger scale. Thailand is a different case. Government has firmly embraced a policy objective of reducing chemical dependence in agriculture, including dependence on chemical fertilizer, and aiming (at the same time) at potentially lucrative overseas markets for organic produce. This chapter has offered a picture of a recently scaled-up system. The conclusion reviews evidence about what works, and why, and what might need to be modified or improved.

The concept of GMCCs is broad, with different individuals emphasizing different aspects. For the LDD and the MCC, GMCCs are leguminous crops producing high N content and biomass yield. In use, their purpose is to improve availability and recycling of N, other nutrients, soil moisture and water infiltration, and weed suppression and pest control. Improvement of human and/or animal diet and income are seen as possible additional goals (Eilitta, *et al.*, 2004). However, from the farmers' perspective, GMCCs are often primarily edible grain legumes, of which crop residues incorporated into the soils are of secondary importance. The common grain legumes adopted by farmers in irrigated rice-based cropping systems are soybean, mungbean and peanut. In rainfed lowland, farmers expect naturally occurring vegetation emergent during rice fallow periods to serve both as livestock feed and for soil fertility improvement. But such traditional practice does not build up enough soil fertility to maintain rice yields. Farmers then mainly supplement plant nutrients with chemical fertilizers to maintain and increase rice yields.

The introduction of non-edible leguminous species, with specific utilization for soil improvement and weed suppression, to smallholder rice farmers by external institutions somewhat clashes with the farmers' perspective as sketched in the last paragraph. Change agents thus need to identify their niches, and develop a specific strategy based on interactive learning and appropriate forms of collective action between key actors and community if adaptability to local conditions is to be guaranteed. The empirical evidence from case studies in Northern Thailand here reviewed suggests that adaptability of GMCCs in rice farming is a product of technological fit, actor interaction, and the dynamism of farmer knowledge systems, which together produce individual and collective understandings and new and adequate performance. The value of a participatory approach, based on encouraging non-linear technology modification and dissemination in situ, enabling farmers and researchers to contextualize and redesign production technology, has been demonstrated. The case study focused on the relationship between institution and farmers. Through adoption of a participatory approach, various interesting forms of collective action between research institutions (MCC and LDD) and farmers emerged during the process of technology development. But whether there is full alignment between the objectives of formal institutions and farmer groups can still be doubted.

The GMCC technology and its adaptability

Green manure is being promoted in Thailand as fertilizer replacement strategy. It has certain potentials as well as inherent limitations. GMCCs are a well-tested and proven technology (Eilitta *et al*., 2004), but their utilization has hitherto been influenced by the ready availability and low price of inorganic fertilizers during the early period of Green Revolution in rice farming. With global energy shortages prices are set to rise. Pressure from the sustainable agriculture movement in Thailand since the 8^{th} National Economic and Social Development Plan and the recent Government policy on National Organic Agenda have converged with global energy prices to make the conditions for utilization of GMCC more favourable, particularly given the institutional support now available to farming communities from both government sources and non-governmental organizations (NGOs).

Among selected species of GMCCs being introduced by GOs and NGOs in rice farming, two non-edible species are prominent, namely *Sesbania rostrata*, more suited to irrigated and wetter lowland rice ecosystems, and *Crotalaria juncea* , adapted to rainfed and drier lowland rice ecosystems. Both are selected for their high biomass yield and high nitrogen content. Agronomically, both species are easily incorporated into rice based cropping systems by broadcasting in early rainy season and ploughing over within 50-55 days before the cultivation of rainy season rice. *Sesbania* requires seed treatment, either with hot water or with sulphuric acid, to break its hard seed coat before planting. Farmers are often unfamiliar with this process. Poor or delayed germination results in uneven plant establishment. This discourages farmer use of *Sesbania*. *Crotalaria* is more easily managed, with the exception that the species is less tolerant to flooding.

When using these two species as GMCCs, farmers have to plan for seed production. During the early period of farmer experimentation with *Sesbania* in Buak Mue village, Chiang Mai province, farmers planted *Sesbania* seed along the levee. The species is perennial and it can grow into a tree-like structure, producing seed annually. *Crotalaria* is annual, and farmers have to set aside plots for seed production. Farmers in Phayao province who have adopted the *Crotalaria* system sow the seed in October to make use of residual soil moisture and harvest in January.

The key determining factor for crop performance is to get seed to germinate and achieve uniform plant establishment. The process requires land preparation. In Chiang Mai, with increasingly high costs of tractor service, farmers are unlikely to invest in land preparation for a non-marketable crop. In Phayao province, where tractor services are readily available, the cost is about half the price paid by the Chiang Mai farmers. Commercial rice farmers with larger farms than those in Chiang Mai can afford land preparation, and have better profit margins from *Crotalaria* than from chemical fertilizers, given that the price of fertilizers is currently increasing relatively to price increase in paddy rice.

Sesbania - still highly variable and uncertain compared to *Crotalaria* - is planted after soybean in rice-soybean cropping systems, where the land condition is less favourable (covered with weeds and soil compacted). *Crotalaria, by contrast,* is sown under a rainfed rice-fallow system with less weed infestation, and conditions are more favourable to land preparation. The key management feature is to capitalize the interaction of soil and water, which is site-specific, for stabilizing plant establishment of GMCCs in the early rainy season.

Farmers use GMCCs until they have achieved desirable rice yields, averaging 3.75-4.35 t/ha. They will stop using the green manure for a year or two years where lodging of tall local rice varieties occurs. Other organic materials used to supplement plant nutrients by farmers are compost, animal manure, bio-fertilizers, and organic fertilizers. All these materials can replace or reduce chemical fertilizer use, as well as increase the efficiency of use of chemical fertilizer. It seems unlikely that *Sesbania*, in particular, will progress at the expense of these locally-devised "mixed" solutions. More research attention should probably be paid to the role of composts, bio-fertilizer and green manure in increasing the efficiency of use of smaller (but essential) amounts of chemical fertilizer. This is where farmers themselves seem to be heading. The all-or-nothing replacement of chemicals by green manures espoused by some of the campaigning NGOs may prove to be in competition with farmer indigenous knowledge.

Incorporating farmer knowledge and initiative

Farmer knowledge is the product of a dynamic knowledge system which co-evolves with the dynamics of complex biological systems underpinning agricultural technology and production (Hall and Clark, 1995). The traditional use of various forms of GMCCs is closely related to farmers' land use and cropping systems. For instance, the system includes natural vegetation in the rice-fallow system, soybean crop residues in the rice-soybean system, and a rice–mungbean-mungbean system in which the second mungbean crop is ploughed over at the vegetative stage to incorporate plant residues as green manure for the rainy season crop. Thus the aim with GMCC research should be to support activity that integrates well with actually existing farming systems, and enable farmers to contextualize production technology choices. GMCC needs "situated action" not "plans" (to use the terminology of Suchman, 1987).

Most introduced GMCCs are non-edible and non-cash crops, requiring certain initial investment and accruing certain risks before farmers see the benefits. Such interventions should be accompanied with detailed and frank information on weaknesses as well as advantages. There is need for an adaptable approach, in which local initiative combines with introduced knowledge, with adjustment and modification following to fit individual circumstances. The final decision of farmers on technological use is governed by overall performance and output. The development of bio-fertilizers and their widespread use among farmers in Thailand, for instance, is an outcome of local initiative and based on opportunities for farmers to share experience. It has been shown that the Chiang Mai farmers who participated in the *Sesbania* testing went through a cycle of learning, doing, reflecting, and modifying, with emphasis on scope to redesign the system. For instance, farmers first followed the researcher recommendation, but then attempted to further reduce production costs by broadcasting seed directly without land preparation. Farmers temporarily withdrew the use of GMCC, whether *Sesbania* or *Crotalaria*, when its effects on soil improvement and subsequent rice yield reached desirable levels. This is one way of reducing production costs (by passing certain management practices). The phenomenon is site specific. This means that even where farmers have been exposed to new information and technology, they have to validate it via their own "situated" practices, before such new knowledge becomes accepted and internalized.

A participatory approach is necessary

Many studies in the late 80s and early 90s indicated that the true situation with respect to many agricultural technologies for smallholder farmers in developing countries had been oversimplified (Richards, 1985; Farrington and Martin, 1991; Okali *et al.*, 1994). The GMCC case is an illustration of a complex system evolution, in which technology develops through interaction and participatory learning between actors, initially facilitated by researchers. Participation is seen as an empowering process, helping build up farmer competence in developing local relevant technology. The *Sesbania* case In Chiang Mai did not result in widespread use as compared to the *Crotalaria* case in Phayao province, and yet through interactive participatory learning between farmers and the MCC researcher, farmers have usefully modified management practices to fit their own circumstances. The participatory approach, based on joint-activities between farmers and researcher in reviewing the suitability of technology, testing and monitoring it, and reflecting on results, has slowly strengthened farmers' capacity to discern alternatives for improvement. However, with limited GMCC choices, even the participatory approach reached a limit.

Improving soil conditions and fertility is a site specific fine-tuning approach to technology, despite the fact that the GMCCs in the case study showed benefits on rice yield within one season. Other correlated responses to GMCC use remain yet to be unexplored. Participatory learning and collective action through carefully designed activity would open up new opportunities for farmer innovations. It was observed that through the participatory research approach, the process of learning and knowledge sharing improved farmer capacity for innovation, as noted by (Okali *et al*., 1994). Moreover, Douthwaite *et. al,* (2001) concluded that successful technology represents a synthesis of research and key stakeholder knowledge and creating this synthesis requires more iteration and negotiation as complexity increases, instead of assuming a new technology is ''finished'' when it leaves the research institute. Through collective learning, each farmer comes to understand the nature and properties of GMCC, and to adapt it to his or her own farming systems and socio-economic circumstances. The LDD's farmer volunteer *or mor din ar-sa* system, operating on the basis of having farmer volunteers work as change agents for soil improvement, uses training as a key technological development tool to convince farmers of the beneficial effect of GMCCs. LDD delegates disseminate activity to farmer volunteers to interact with local communities with the expectation that farmer-to-farmer diffusion is a cost effective means to boost GMCCs in rice farming. But the system of delegation disconnected farmers and LDD field staff, and with weakened feedback, the LDD had less opportunity to understand farmers' real problems or to incorporate local initiative into technological design for long-term viability It was concluded that both the MCC and the LDD approaches reviewed in the present chapter showed some weaknesses even when trying to function in participatory mode (Table 5.8). An "organic" model of rural technology transfer (Clark and Clay, 1986; Biggs, 1989) with state agencies acting as interdisciplinary "nodes" of development has yet to emerge, at least in the GMCC case in Thailand.

Forms of collective action

Two forms of collective action could be identified from interaction between farmers and external institutions (MCC and LDD). In the MCC approach, involving farmer group participation in technology validation and modification, led the agency and farmers towards some collective appreciation and mutual learning about intrinsic problems associated with GMCC utilization under local conditions. The aggregated information and knowledge derived from collective feedback has been picked up by individual farmers for their own use. The decision to adopt GMCC in each season depended on individual circumstances and initiative. Such forms of collective action are common in participatory technology development, when farmers are often organized into groups to encourage interaction and reflective learning between members, and yet the decision to adopt is individualistic. Flow of information and knowledge continues to evolve, and is more effective when the facilitation process is included. The facilitation can be carried out either by the external actor or by experienced farmers. In the case study, the MCC played an active role in facilitation.

The LDD approach showed a stronger hierarchical organization, with less social integration in extending the use of GMCCs. The LDD provides training and materials to farmer volunteers. It adopted a linear relationship with clients, with less feedback, resulting in a certain degree of disconnection between farmers and the agency. The success of GMCC adoption mainly depended on the ability of individual farmer volunteers, as observed in Chun district, Phayao province. However, regulating collective action by having the LDD act as host agency, playing a key coordinative and supporting roles, while encouraging farmer volunteers (*mor din ar-sa)* and their respective groups to act as nodes for local adaptation, would help scale up GMCC technologies that actually worked.

Further opportunity for up-scaling

The best way to approach the further development of the GMCC approach, it is concluded, is to seek ways of linking a national framework for green manure usage with farmer action at a local level in adapting technology to site specific aspects. There are various factors for non-adoption of green manure technology. Reynolds (2005) stresses that non-adoption of pasture and forage crop at farmer level is undoubtedly complex and variable, twelve possible reasons for non-adopting are identified. There is a need to understand the context which embraces the physical, social-cultural and economic conditions and not to try to solve problems or find solutions in complete isolation from the local contexts. The overall impact of the GMCC approach is in the long-term, a dimension often overlooked by a majority of hard-pressed farmers. Use is related to other input costs and farming opportunities, and trends look broadly favourable (assuming increase in energy prices and a continued expansion of overseas markets for organic produce).

The present National Organic Agenda provides policy conducive to the up-scaling of various forms of “green technology” in farming, including GMCC technology. The up-scaling process requires changes in institutional configurations. The concept of farmer volunteer or *mor din ar-sa,* with subsequent network configurations, is innovative, and yet the LDD should not simply delegate responsibility to farmer volunteers and farmer members as the means of inducing self-reliance. Instead, the LDD should continue actively to build a basis for its own interaction with the farming community to make more technological choices available to local users, and in such a way that local users are encouraged actively to transform and adapt these introductions. LDD should continue to maintain its coordinating role, providing technical support and material resources as needed.

Up-scaling presents its own organizational challenges. The present GMCC approach is still limited. The MCC participatory approach (too few technological choices), and the LDD hierarchical approach (handing over too much responsibility to peasants) reflect these limitations. Participatory approaches need to enhance capacity for innovation at the local level. An approach combining hierarchical organizational with networking features is perhaps required for managing the up-scaling process. Hybridity between various organizational features is needed if up-scaling is to bring about technological change through the fine tuning of technologies as well as empowerment of the poor and marginalized.

Table 5.9 Strengths and weaknesses of the MCC and the LDD working on GMCCs in rice farming

Key features	MCC		LDD	
	Strength	Weakness	Strength	Weakness
1. Participatory approach	- Key approach to empower farmers. - Interactive and collective learning with farmer feedback on farming innovation	Number of farmer participants were not diverse enough to cover key rice agro-ecosystems	Network of key farmer leaders who collaborated with LDD as "soil doctor"	Disconnection between hierarchies. Only indirect contact between farmer-soil doctor and LDD.
2. Technology	- Evidence-based on station medium term research results and demonstration plot. - On-farm experimentation	Limited choice of GMCC	More varieties of GMCCs	GMCC test result is based on demonstration plot of "soil doctors" who differ in competence, commitment, and services
3. Farmer initiative	Inclusion of local initiative through participatory approach and feedback mechanism	Exclusion of farmer knowledge on technology development	Knowledge sharing among soil-doctors in the network	Exclusion of localized initiative
4. Opportunity for up-scaling	Use of farmer participatory research and collective action	Limited linkage and partnership with implementing agencies	Hierarchical organization to implement large scale adoption of GMCC	Process based on soil doctor network with fewer local participatory and collective initiatives

Chapter 6

Contract farming and collective action: opportunities for smallholder farmers in Northern Thailand?

6.1 Introduction

Contract farming is an agreement between farmer and a firm, either a simple verbal commitment or one based on written documents, which arranges that the contract grower produces a fresh or processed product that the company is committed to buy under stipulated conditions (Roy, 1972; Glover and Kunsterer, 1990; Glover, 1984; Grosh, 1994). Contract farming is a dominant form of incorporating family or household production into capitalist forms of agricultural trade and production (Watts, 1990; Little and Watts, 1994). Contract farming involves a variety of social and organizational forms, and is not only aimed at peasants. Nor is it the monopoly of agribusiness alone but is increasingly a country strategy, often in alliance with local and foreign capital.

In Thai agriculture, the emergence of contract farming as an institutional arrangement for facilitating market access and implementing supply chain management is not new. Technological innovations in input supply, agro-processing, and marketing, have been integrally linked with agri-business as the country's economy expanded. The agri-business component of Thai agriculture has fuelled national economic growth over the past five decades. Since the implementation of the Sixth National Economic and Social Development Plan (1987-1991), the agricultural development policy has included the guidelines for development of agro-industries. The state's objectives were to promote export oriented agri-business and import substitution commodities through improvement of quality and management systems, the development and transfer of appropriate technology to farmers, and assistance of farmers in production planning so that consistent supply of high quality raw materials could be timely delivered and met requirements of agro-industrial plants.

Contract farming has been shown to be an effective institutional mechanism to increase profitability and to reduce transaction costs faced by small scale farmers in the North and Northeast of Thailand (Setboonsang *et al.,* 2006). Under the favourable growing conditions of the North, contract farming dominates in the horticultural sector (*i.e.* sweet corn, vegetable soybean, etc), organic rice, and hybrid maize seed. A wide range of contract agreements can be observed, varying from oral or written contract concluded between farmer producers and purchasing agents, such as wholesalers, processors, retailers, packers, farmer cooperatives, public sector enterprises, private exporters, and multi-national corporations. These agents directly or indirectly regulate and control production process and influence decisions taken by farmers without having to obtain land resource. The unique factor in contract farming is that it commits land and labour of households to the production of commodities that are ultimately controlled by agri-business firms (Raynolds, 2000).

This chapter presents a case study in Dong Palan (DPL) village of Mae Teang district, Chiang Mai province (the same village study on CRSP at DPL in Chapter 3), where the individual smallholder rice farmer undertake different types of contract farming arrangement as livelihood security strategy. The production site focuses on the island (Figure 6.1) of DPL where soil and water conditions are more favourable than the rice – growing lowland of the village. The island has become production niche for crops under contract farming. The research aims to explore forms of collective action and their principal conditions in order to provide opportunities for technology development and to assess potential links between farmers, contract companies, and external organizations.

Farmers of DPL participating in contract farming are independent growers and make their own decision on types of contract to join. But they organize themselves into groups, working collectively in certain activities producing common benefits, such as sharing labour in the production process, negotiating and bargaining with company through broker or field technician for better price, crop loss compensation, and fair arrangements. The contract farmers make use of collective action to improve farming performance through sharing of labour and knowledge, and the companies gain from farmers' collective action by achieving their production targets cost-effectively. The collective action leads to joint benefits between farmers and the companies. Accordingly, the study perceived contract farming as an hybrid organizational form, including different institutional modalities as described by the Douglasian scheme of grid-group typology such as collective action by a egalitarian or self-regulated group in the community, individual negotiations in the marketing arrangement with company, participation in the corporate hierarchy (Vellema, 2002, 2005).

Two private companies use contract farming arrangements with DPL farmers, covering four crops *i.e.* sweet corn, vegetable soybean, hybrid maize seed and inbred maize parental lines. The first is the Chiang Mai Frozen Foods Plc. Ltd. (the CM Frozen Food), a major food processing ago-industry in the North, contracting farmers to grow sweet corn and vegetable soybean. The second is the Pioneer Hi-Bred Co. Ltd. the first multinational seed company establishing a hybrid maize seed production plant in Chiang Mai, contracting farmers to produce seed of hybrid maize and inbred maize parental lines. Both companies have selected DPL specifically for island plots with its efficient logistics, favourable soil and water conditions, and reliable and knowledgeable farmer groups. The diversification and intensification of production systems are possible at the end of rainy season beginning October until July, after which rainfall becomes more intense, causing annual flood in August-September. The 10-month growing periods encompass dry season and early rainy season (Table 2.7). The use of diesel pumps, either drawing water from tube wells or from the Ping River, has supported dry season contract farming in the island. The production site is located about 30 km from the CM Frozen Food processing plant and about 70 km from the Pioneer Hi-Bred seed processing plant (Figure 6.1).

The companies have different contractual arrangements with farmer producers in terms of guaranteed pricing system, input credits, financial support, technical services and field supervision. Social relations between farmers and two companies are also different. The CM Frozen Food employs a brokerage system to link with farmers, while Pioneer Hi-Bred deals directly with farmers through its own field technician. The CM Frozen Food does not make written contract with farmers, but uses verbal contract facilitated by a local broker. Pioneer Hi-Bred on the other hand, utilizes legal contract agreements directly with individual farmers, despite the fact that farmers have formed themselves into production group (Table 6.1).

The chapter will explore nature of different contract farming arrangements and their effects on technological performance, and how farmers manage social mechanisms and collective action so that to maximize the benefits of contract farming. Forms and conditions of collective action will be distinguished. Within different contract farming arrangements, the chapter also looks into the possibilities of improving the interdependent relationships between farmers and contracting companies through participatory technology development, which would lead to improved contract farming performance, and achieving both farmers and corporate goals.

The farming community in DPL village has been able to combine rice planting in the rainy season with contract farming for CM Frozen Food and Pioneer Hi-Bred in the dry season. Both companies first chose DPL as the production site for its physical and natural assets, but were also attracted by human assets of DPL farmers, well known for their close social relations. The operations of both private companies, CM Frozen Food and Pioneer Hi-Bred, depend on farmer cooperation supporting agricultural performance, *i.e.* yield and quality. Collective action is observed in various stages of crop production process, such as crop choices, planning planting schedules, weeding, detasselling (in hybrid maize seed production), harvesting plan and operation, and grading (in vegetable soybean). The companies value such human and social assets that constitute farming community of DPL. The site has been used as demonstration by the companies for other communities who are joining contract farming schemes for the first time. The CM Frozen Food has used the site to impress the Japanese buyers about the quality of product produced by farmer groups.

The following account will describe and discuss in detail about contractual arrangement of CM Frozen food and Pioneer Hi-Bred and its performance in relation to collective action. It also explains production systems and farmer management of different crops.

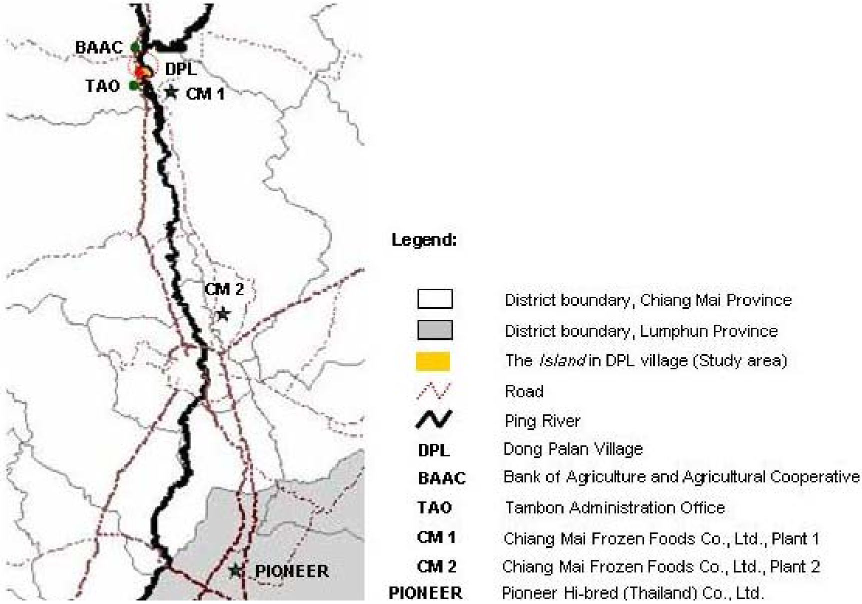


Figure 6.1 Location of two contract companies (CM1, CM2, and Pioneer)
Source: Map modified from Land Development Department and Multiple Cropping Centre, 2000

6.2 Arrangement and relationships in contract farming

Contract farming as part of livelihood strategies in DPL village The rice farmers of DPL village have taken up various contractual arrangements of contract farming as their livelihood diversification strategies. Two private agri-business companies dominate the contract farming systems, namely the Chiang Mai Frozen Food Company, which is specializing in processing of sweet corn and vegetable soybean, and the Pioneer Hi-bred International (Thailand), which is specializing in hybrid maize seed production. The basic contractual arrangements that are thought to be major incentives for farmer producers are: market security, price guarantee, the financial credit, and technical services (Table 6.1). The access to credit was a major motive for farmers in signing production contracts with agribusiness firms, especially who are facing high cost of input and low access to financial institutions (Fernando, 2006; Vellema, 2002; Simmonsa, *et.al.*, 2005. Moreover the certainty of selling all production at a fixed price is the second important advantage of a contract, as price in the open market fluctuates considerably (Glover and Kusterer, 1990). In some cases, the contract itself includes provisions for credit from the firm, with repayments often deducted from the product price. Contract farming also involves another external agent, the credit institution, which proved to be an important motive for farmers to engage in contract farming with agri-business firms. Both Pioneer and CM Frozen Food provide credit in kind, in the form of inputs, payment for which is deducted from crop payments. Given that the price of agricultural chemicals is increasing, availability of different credit schemes help farmers to ease financial burden at planting time. Cheaper material inputs than the market retail price and timely delivery by the firms are also important favouring conditions of contract farming in the village.

Table 6.1 The contractual arrangements between farmers of DPL and the companies

Items	The CM Frozen Food	The Pioneer Hi-Bred
Commodity	Vegetable soybean, sweet corn	Hybrid maize seed, maize inbred line seed
Contractual arrangement	Verbal	Written
Key actors in contract farming:	Farmers, secondary broker primary broker, field technician, marketing staff of company	Farmers Field technician
Financial institution	BAAC, Primary broker and TAO	BAAC and TAO
Seed source	Vegetable soybean seed from the CM Frozen Food; sweet corn seed from the Pacific Seeds	Seed of parental inbred lines are property of the Pioneer. The company provides free supply of seed to farmers.
Input credit	Chemical fertilizers, pesticides	Chemical fertilizers, Pesticides
Field subsidy	None	Labour cost for detasseling Labour cost for weeding
Crop insurance	No compensation for crop failure, but it is negotiable through primary broker	Compensation for crop failure based on crop loss assessment by field technician
Technical service	Field technician makes planting schedule with farmers and provides advice on chemical use and agronomic practice	Field technician monitors production process to make sure that farmers strictly follow instruction: plot selection, weeding, fertilization, detasseling
Guaranteed price incentive	Vegetable soybean: *Baht* 12/*kg* of fresh pods, but varies according to pod quality. Sweet corn: flat rate at *Baht 3/*kg	Income (*Baht/rai*) based on yield range (kg*/rai*)

Source: Summary of discussion, 2004-2005

Although all material inputs are provided by the company on credit, farmers still need financial capital during the planting season for land preparation, hired labour cost, expense on food and drink for the working crews during planting. Farmers have access to several sources of financial capital for contract farming. The Bank for Agriculture and Agricultural Cooperatives (BAAC) provides short term (one year), medium term (3-5 years) and long term (10 year) loans to farmer members. All farmers are members of the BAAC. Farmers would take short term loan to support farming operation. Normally, the Pioneer transfers the payment for farmers to the BAAC, so that farmers have to be members of the BAAC. Farmers may seek short term loans from the local organization, the Tambon Administrative Organization (TAO) by organizing into production group with at least five members. The short term loan, a maximum of *Baht* 50,000, supported by the TAO is interest-free.

The dependence of small farmers on production credits may lead to disaster, as a year or two of bad crops could result in the transfer of small farmers' land to their creditors (Glover and Kusterer, 1990). But such phenomenon has not been found in the case of contract farming of sweet corn and maize, where availability of financial credit mainly provided by the BAAC makes the contract farming arrangement between farmers and the companies more solid. From the financial institutional perspective, contract farming is highly stable for farmers, with market security, price guarantee, input supply on credit, and technical advice. In addition, farmers in DPL are cooperative and their livelihoods are based on farming, so the chance of success is high. Farmers have indicated that the BAAC is willing to provide financial support and approve short and medium term loans to farmers. The remainder of this section discusses in detail the nature of the relationships between contract farmers and companies for the two cases in DPL village.

Chiang Mai Frozen Food Company: sweet corn and vegetable soybean

Sweet corn and vegetable soybean

The adoption of modern sweet corn production system in DPL dated back since early 1990s, when one farmer, contracted to grow modern sweet corn to supply to the broker of the River Kwai Food Processing Company (River Kwai) in southern district of Chiang Mai. In later years, new agri-food processing companies had approached the farmers. In 2002, the CM Frozen Food, known locally as CM, is the agro-food processing company contractor, had begun contracting the farmers to produce sweet corn and vegetable soybean. Today, farmers have contract arrangement with two companies, the River Kwai, and the CM Frozen Food to produce sweet corn. Recently, the demand for sweet corn as canned sweet corn and frozen sweet corn for export has increased significantly and Northern Thailand has become major producing areas. The planted areas in Mae Teang district and Chiang Mai province have been increased. The food processing and food exporting company has expanded the cultivation areas from Kanchanaburi province in the Western Central region to Northern Thailand. However, this study focuses on sweet corn contract farming from CM Company.

CM Frozen Food is the first processing company introducing vegetable soybean for commercial production in the North. Initially the company was based in Chiang Mai and later it expanded to production sites in Chiang Rai and Phayao provinces. The company also sells sweet corn as a new processed food. The vegetable soybean seed was first imported from the Republic of China (Taiwan), where farmers produce mainly for the Japanese market. At first, the CM Frozen Food invested in technology development, conducting on-farm testing of production technology imported from Taiwan or Japan. The promising variety from Taiwan is introduced and directly used for commercial production. The quality vegetable soybean, processed as frozen product, is exported to Japan. CM Frozen Food had subsequently collaborated with the Chiang Mai Field Crop Research Centre, Department of Agriculture, to develop quality vegetable soybean seed in order to reduce importation of seed from Taiwan. The company has contracted seed growers to produce seed in the dry season so that the newly harvested seed can be used for early rainy season planting, which is considered to be the optimal growing season for vegetable soybean. The crop is vulnerable to pests and diseases, and production depends on chemical pest control. But for export processed product, strict quality control at pre-harvest by the company is being carried out to ascertain that no chemical residues are detected on green pod.

CM Frozen Food, a major agro-food processing company in Chiang Mai, introduced sweet corn as contract crop to rice farmers in the irrigated lowlands. Sweet corn is grown for processing as canned sweet corn and frozen sweet corn. In recent years, Northern Thailand has become a major whole year round supplier of sweet corn to canned sweet corn packers in the Central on region, due to favourable growing conditions in the North. The production is forecasted to increase in response to continued strong export potential. The canned sweet corn production is reaching 118,000 metric tonnes, and its exports are catching up to the U.S. canned sweet corn exports (GAIN Report, 2004). As for frozen sweet corn, production is also expected to increase significantly. The frozen sweet corn packers are reportedly sourcing more fresh sweet corn, amounting to about 15 percent of total fresh sweet corn production, in response to strong market demand. The key technological innovation in sweet corn production is variety and seed availability. Today, all sweet corn varieties used for processing are hybrids, and are produced by multinational corporation seed companies in Thailand. CM Frozen Food does not develop its own variety, but uses the seed produced by the Pacific Seeds Company for planting, and will not accept other varieties from the contract farmers. The sweet corn varieties are susceptible to pests and diseases, notably downy mildew, and farmers use chemical pest control to minimize production risks. Moreover, the quality of sweet corn in fluenced management of soil fertility and appropriate harvesting time of sweet corn, which both depend on labour input. The five major factors influencing farmers' decision to engage in sweet corn contract farming were: crop price was guaranteed, market was secure, the crop was easy to grow as compare to other crops, input credit was available, and farmers could not find other more suitable crops.

Arrangement and relationships

The arrangement of contract by the Chiang Mai Frozen Food Company making verbal contracts with farmers in DPL to produce sweet corn and vegetable soybean for processing for export market. The company provided similar arrangement between sweet corn and vegetable soybean in input credit, field technician staff and farmer broker to act as liaison between farmers and the company. The brokerage systems and key actors involved are the same. The roles of key actors and institutions during the course of contract farming of sweet corn and vegetable soybean as depicted in Figures 6.2, 6.3 are described below.

Primary broker: was formally a farmer producing sweet corn and vegetable soybean for the CM Frozen Food Company, but at present has become a liaison between contract farmers and the Company. The primary broker handles all the material inputs, such as seed, fertilizers, and chemicals on behalf of the Company and delivers to the farmers. The material inputs will be stored at the secondary farmer broker, who is also a contract farmer in DPL village. The secondary farmer broker helps the primary broker organizing planting schedules, delivering seed, fertilizers, and chemicals to farmer members. In return, the secondary broker will receive *Baht* 0.10/kg of sweet corn or vegetable soybean upon delivery from the primary broker as compensation for organizing farmers into production group. The primary broker also provides short term loan without interest to farmers. The loan is for small amounts and is used to support expenditures for land preparation and petrol during planting, ranging from *Baht* 2,000-3,000 per person. The loan will be repaid after crop harvest. Upon request of farmers, the primary broker will support negotiations on the guarantee price with the Company. However, in essence, the primary broker works out the logistics between farmers and the Company, and in return receives payment for this service from the Company.

When the crop fails, due to uncontrollable circumstances such as pest outbreak, or flood damage, the primary broker would share half of the cost with farmers on the material costs, while the Company bears no responsibility. For the brokerage service, the primary broker will receive *Baht* 0.50/kg of sweet corn or vegetable soybean upon delivery to the Company. In addition, the primary broker will receive a net value of *Baht* 0.40 */kg* of product. So the income earning from brokerage service is a promising incentive for the primary broker. There exists a long and good relationship between the primary broker and the secondary farmer broker in DPL. The secondary farmer broker is also a well recognized and respectable individual in the village and is elected by farmers as leader in sweet corn and hybrid maize production. So the social space between the primary broker and farmers is established through the secondary farmer broker, creating a close relationship and trust among them.

In Mae Teang district, formally there were a number of primary brokers working for the Company, but at present, only primary broker, who is a resident in a neighbouring village, becomes the sole agent for farmers of DPL and from the neighbouring villages to organize farmers producing sweet corn and vegetable soybean on contract with the CM Frozen Food Company.

Farmer broker for DPL farmers said "I have grown corn before, so know the problems and if farmers' crop fails, I also loose the money. So, I have to be close with them and be friend with them if there is any problem in the contract; I am willing to help and discuss the matter with farmers openly. The important thing for farmers with a contract is advanced money, input credit and market guarantee. Frankly, I prefer to work with group of farmers as in DPL, rather than individuals at random. With a group, farmers already cooperate, which makes planning and monitoring easier, and will also save time. So I appreciate working in DPL through the assistance of my secondary broker, since I have several places to deal with" (Primary broker for DPL, aged 50).

Secondary farmer broker is a farmer member of the contract farming group, who helps the primary broker to manage logistics in crop production under contracting farming. He also gathers farmers' suggestions and problems and discusses these with the primary broker. His main responsibility is to see whether the crop, either sweet corn or vegetable soybean, is planted according to agreed schedules, so that the projected production could be delivered to the processing plant on time. He helps to deliver the material inputs to individual farmers. But above all, farmers appreciate his commitment and devotion to the group. The strong social relations between individuals and the secondary farmer broker, through collective decision making and action in contract farming, make the production of labour-intensive cropping systems possible. Occasionally, the secondary farmer broker would contact and consult the company's field technician about pest control measures, and the proper use of new chemicals, particularly on vegetable soybean. The crop is specifically screened for chemical residues after harvest and before processing. The secondary farmer broker will inform growers about proper usage of chemicals on vegetable soybean. Crop spraying has to be stopped one month prior to harvest to avoid contamination with chemical residues. The product could be completely rejected if chemical residues were found. The secondary farmer broker will receive compensation for his service directly from the primary broker at *Baht* 0.10/kg of product.

The Company's field technician monitors farmers' production process. He will provide information about the amount of volume required from the group for processing. Early in the season, the field technician will help to work out a production plan with the farmers. For instance, for sweet corn production, about 5 *rai* (0.8 ha) of crop should be planted (about 10 tonnes of production) every day during early May to early July, so that the Company will have constant supply from DPL. Normally, the Company will assign one field technician to a number of key production sites. So planning production with farmers to have continuing supply of product is important. When farmers work as group and have good social relationships, the Company will gain more benefit and production planning is more efficient. This is the main reason why the Company continued contract farming with the DPL farmers, apart from the short distance from the Company's processing plant (about 30 km). The role of the field technician in technological service is concentrating on regulation of chemical use in vegetable soybean production, due to strict regulation imposed on chemical residues on crop for export by the Japanese importing firm, which also control the types of pesticides used in vegetable soybean production. The visit from the field technician is less often once the crop has been established, unless there are urgent calls from the farmers.

The working relationship between field technician and farmers is not as close as between farmers and primary broker. All policy decisions are made by the Company, and the field technician simply implements it. There is no field testing of new pesticides conducted jointly by field technician and farmers. The technological information is based on published materials prepared by the Company, and the experience of the field technician who might learn it through field observations from various production sites. The Company's main concern is pesticide contamination in the harvest products. The company has to use chemicals as specified by the overseas buyers, which will be reviewed from time to time. The Company pays less attention on the development of new sweet corn varieties, because the hybrids produced by the Pacific Seeds are of good quality and acceptable by the buyers.

The marketing unit of the Company is handling the incoming crop product from the field and assessing product quality. Pricing is based on crop quality control. In vegetable soybean, there are 13 indicators for vegetable soybean pod quality. All these quality indicators are not presented to farmers before planting. In practice, farmers perform grading soybean in the field before delivering product to the Company. A few farmers encountered complete rejection of their products due to chemical residues detected in the product. There are fewer problems with sweet corn quality control. At harvest, farmers have to screen only for cob damage by insects. There are few direct contacts between farmers and the marketing unit of the company. Farmers' complaints about unfair treatment on crop quality assessment are usually channelled through to the primary broker and then to the company.

The BAAC is available at the district town, located less than 2 km from DPL (see Figure 6.1). So farmers have easy access to financial services. The BAAC provides financial credit to farmers in DPL. The loan for farming activities is usually for one year. Individual farmers can get access to credit from BAAC. The normal amount for one-year loan is ranging from *Baht* 50,000 to 80,000. Loans are also used to support other household expenses. The interest rate depends on farmers' payment performance. The lowest interest rate is 5 percent for farmers with good repayment record. The highest is 9 percent. The payment for the sweet corn and vegetable soybean systems is about two weeks after product delivery. Payment is based on a grading system of quality performance of product, which very few farmers understand, particularly for vegetable soybean. Farmers understand that if they manage well, they would receive good product, and so does the quality. But the grading system for export quality of vegetable soybean has not been explained thoroughly to farmers before planting, so resulting in farmer dissatisfaction.

The TAO is another source for farmers to seek short term financial loans without interest. But it is a group loan. For loan application farmers have to organize themselves into a group with a minimum of 5 members. The loan is restricted to a one year period and has a maximum of *Baht* 50,000. The amount depends on the income of the TAO which is derived from tax collection and government support. In the 2005 season, farmers had experienced poor crop performance of vegetable soybean, particularly during the January planting. Poor seed germination and viability had been observed in several plots. Farmers asked for compensation since the seed was only produced by the Company. But the company refused to comply with the farmers' request, arguing that seedling establishment was highly variable across plots, and that poor establishment was due to farmer mismanagement. Majority of farmers lost the crop, and those who managed to get their crop harvested did not make good return, so all had decided to stop growing vegetable soybean. But farmers continued to have sweet corn contract farming with the company.

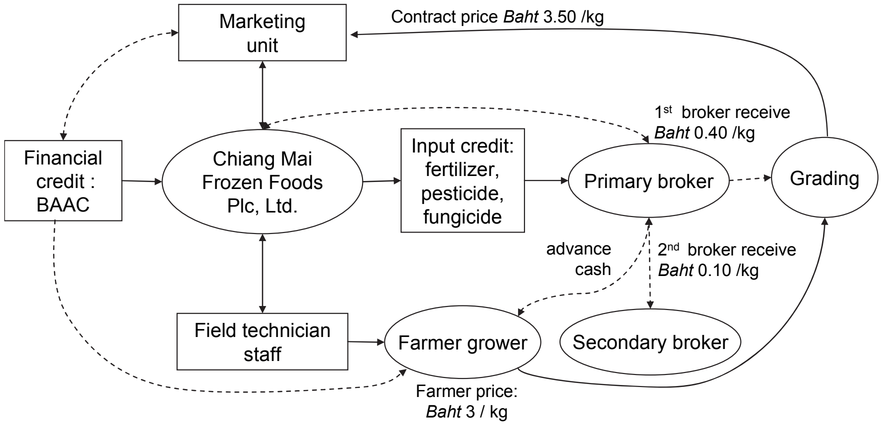


Figure 6.2 The sweet corn contract farming between DPL farmers and the Chiang Mai Frozen Foods Public Co. Ltd. (CM), 2004

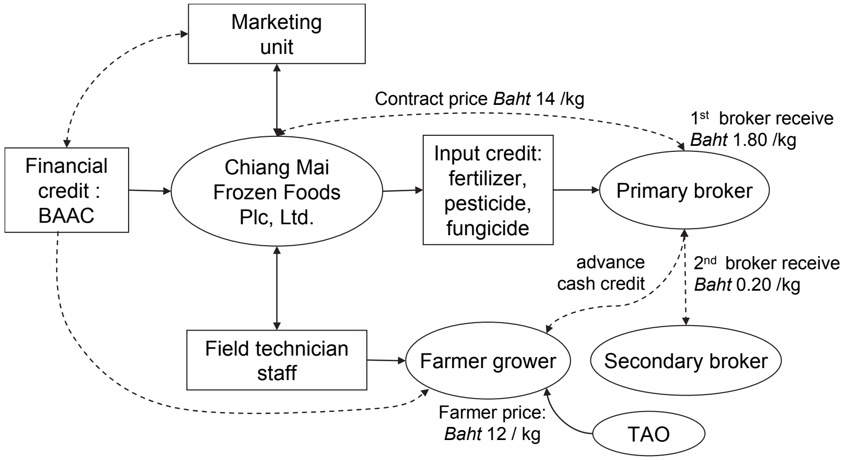


Figure 6.3 The vegetable soybean contract farming between DPL farmers and the Chiang Mai Frozen Foods Public Co. Ltd. (CM), 2004

Pioneer Hi-bred International (Thailand): hybrid and inbred line maize seed

The second contracting company in the village is Pioneer Hi-Bred (Thailand) Co. Ltd. The company collaborates closely with public research institutes in Thailand, most notably Kasetsart University in Bangkok, for developing maize varieties suitable for production under Thai conditions and competitive in the seed markets. The Pioneer Hi-Bred International (Thailand) is the major private seed company producing hybrid maize seed contract farming in the Upper North. Pioneer's seed production plant is in Lamphun province. Since the demand for hybrid maize seed in increasing, the company has to search for favourable agro-ecological environments for producing hybrid seed during the dry season. The company is extending maize seed contract farming to favourable production sites in selected provinces of Northern Thailand. In areas where farmers provide good cooperation and achieve outstanding performance, Pioneer Hi-Bred also contracts farmers to produce inbred line seed, which are much sensitive to agro-ecological conditions and farm management, and to test yield performance of new hybrids. Pioneer is the only private seed company making direct contract farming arrangement with farmers of DPL for maize seed production.

Arrangement and relationships

The company contracts farmers to produce one crop of seed per year: the optimal planting date for the crop ranges from late October to early November. Farmers pointed out that during the initial phase of contract farming, Pioneer's seed production manager had personally approached farmers to produce hybrid maize seed on a contractual basis, by proposing several incentives, including price guarantee, market security, input credit and technical services. In addition, the Company would provide crop management subsidy such as labour cost compensation for weeding and detasseling. The Company emphasized the importance of good agricultural practice for seed production and asked farmers to follow the farm management practices as designed by the Company, particularly removing of off-types and timely detasseling.

The Company has one field technician who works closely with farmers, handles all logistics on behalf on the Company, and arranges delivery of parental seeds for planting, fertilizers and chemicals to individual farmers, and supervises the overall seed production process (Figure 6.5). As farmers became acquainted with the system, the relationship between farmers and the production manager has becomes distant. Instead, farmers have more contact with Pioneer's field technician. Farmers have noticed that they do not receive the "warm" treatment as compared to the beginning of the contract. For instance, Pioneer Hi-Bred delivers contract document after farmers have planted the crop, and sometimes makes changes without prior notice or agreeable by farmers. There is no explanation from the Company over such practice. In the 2005 season, the document for formal agreement was given to farmers after the crop had been planted. The field technician basically handled the contractual arrangement between farmers and the Company. Very often, the contract document arrived after planting, and farmers took for granted that the conditions would be the same as previous year, but it turned out the price determination for product had changed.

According to the arrangement, the Company transfers the payment directly to individual farmer's account at the BAAC, usually a few days later than two-weeks as stated in the contract. The guaranteed price remained the same for two years (2004-2005) while cost of production increased, particularly fertilizers, chemicals, and petrol. In the case of hybrid maize seed production, the price guarantee for seed had changed from weight basis (*Baht/kg*) to yield range without informing farmers before planting or signing the contract. According to the contract, the Company had made arrangements for compensation (see the Rights and Obligations of farmers Annexes 6.4 – 6.5). The Company does not use any form of brokerage in the process. In comparison with the arrangement with Chiang Mai Frozen Food, the role of the Company's field technician is more prominent; the technician works with farmers, gives technical advice, and monitors farmers' production practices. One question relevant for this study is to what extent the field technician uses farmer feedback to further improve production technology and crop yield. The relations with different actors involved in contributing to the operation of contract farming of maize systems are given in the Figure 6.4.

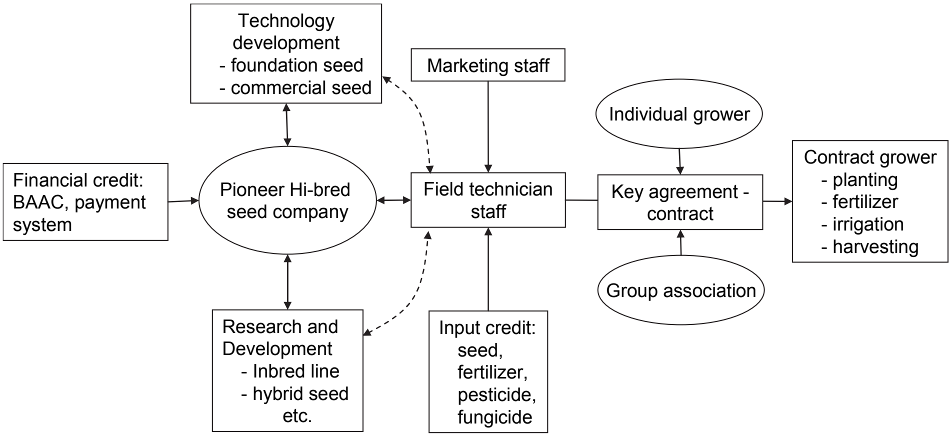


Figure 6.4 The contract seed production of hybrid maize and maize inbred lines between DPL farmers and the Pioneer Hi-Bred International (Thailand)

The field technician is the key agent for managing the production of hybrid maize seed. Before planting, the field technician and farmers survey the field plots to be used for seed production; to make sure that no cross pollination with sweet corn occurs during production. Plot size was measured individually so that the right amount of seed of parental lines was prepared for farmers: to prevent 'seed escape' from farmer fields. It was reported among seed companies that extra seed of parental lines of one company had been secretly taken away and used to produce a commercial hybrid under a different name. Hybrid seed production requires close monitoring. Any leakage of genetic materials or genetic contamination of hybrid seed affects the Company's competitiveness or damages the Company's reputation.

The main task of the field technician is to maintain social and working relationships with farmers, by supervising farming practices, monitoring farmers' detasseling process and removing off-types. The field technician would pay regular visits to farmers' fields to make sure that farmers strictly followed the seed production procedures. At first sight, the relationship between the field technician and the farmers appears to be purely technical and professional without personal attachment or preference. The field technician would communicate with farmers about the day for her visit to monitor management of seed plot. Farmers were asked to have weed-free plots, and to remove any doubtful plants or off-types. The Company maintained strict rules to make sure that seed purity is absolutely 100 percent. If one off-type plant was found after detasseling plants showing late flowering - the field technician and her crew ensured that 4m^2 of maize plants surrounding the off-type was removed, even without the farmers' permission. The field technician also hired additional labour to help complete the detasseling operation if she considered the farmer could not complete the task on schedule. The Company considered all materials planted belong to the company. The field technician would also assess field performance, and in case of crop failure, the field technician, based on her field monitoring data and information, would explain to farmers the possible causes. By using such an evidence-based strategy, the Company claimed that they were able to mitigate the conflict and defuse farmers' dissatisfaction (Interview with the Pioneer Hi-Bred Production Manager). Any compensation was based on a result of negotiations between field technician and farmers on the case to case basis. The field technician personally selected farmer leaders who were considered to be more committed to seed production than the others for further training by visiting other successful sites. This was meant to arrange effective farmer-to-farmer exchange of information and experience. In addition, a few farmers were selected to participate in the yield evaluation of certain new maize hybrids, which was accompanied by close supervision of the field technician. But there is no other participatory development of improved technology, such as efficient use of fertilizers, selection of hybrids to fit local conditions based on farmer criteria, etc. Nevertheless, the field technician of the Pioneer Hi-Bred works more closely with farmers than the CM Frozen Food to see that field and crop management was properly carried out. Hence, some closer relationship between technical field staff and farmer leader occurred, but this was rarely the case of the CM Frozen Food.

6.3 Production systems in contract farming

Sweet corn

Farmers own more than one plot of land for all year round farming. So the decision of crop selection as well as planting time would depend on the availability of plots. For cultivation of sweet corn, some farmers produce three crops of sweet corn per year and the majority produces two crops. Farmers identified three planting seasons for sweet corn to be cultivated on the island. The first season is in early October, when the rainfall declines. The crop will be harvested in late December, maturing within 90-95 days after planting. The maturity is longer due to lower temperature during crop growth. The second season is during the dry season in mid-January to late February. The crop will be harvested in April to May. It matures within 78 days after planting. The third season is during the early rainy season in mid-May. The crop will be harvested in late July having similar maturity as the second season crop of 78 days. Majority of farmers would not cultivate the third season crop because of higher risk of pest and disease incidence. Yield is relatively low. Nevertheless, some farmers reasoned that cultivation of a third season crop serves as partial weed control. Farmers also realize that during the third season, production is at risk, yield and profitability are less promising, so farmers would be satisfied if they could maintain reasonable economic return. The selected features of sweet corn performance over three planting seasons are shown in Table 6.2. It can be seen that farmers capitalize the October planting to maximize the productivity (yield and profit). The only additional cost incurred is cost for pumping water. Farmers normally plant the second crop in the same plot for the second season planting.

Table 6.2 Features of sweet corn performance in three planting seasons at DPL

Features	**1st season October - December**	**2nd season January – April**	**3rd season May – July**
Farmers	60%	30-40 %	10-15%
Labour constraints	No	Compete with soybean harvest	No
Yield (t/*rai*)	2.8-3.5	2.0	1.5
Maturity (days)	90-95	78	78
Pest incidence	No	Not serious	Serious
Disease incidence	No	Not serious	Serious
Relative pumping cost	100	60	30-40

Source: Group interview, 2004

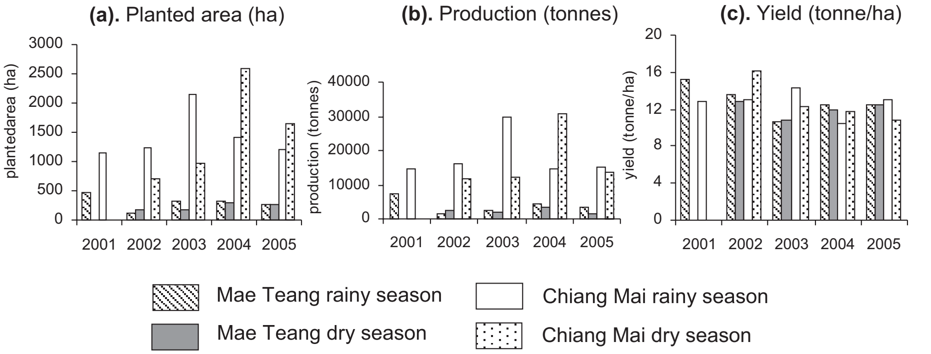


Figure 6.5 Sweet corn in Mae Teang district compared to the whole Chiang Mai province in rainy season, 2001-2005 (a). Planted area (ha) (b). Production (tonnes) (c). Yield (tonne/ha)

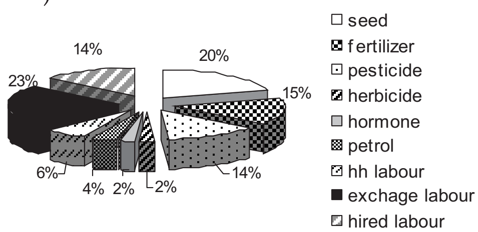
Vegetable soybean

The vegetable soybean was re-introduced by the CM Frozen Food Company in DPL in January 2005. It served as crop rotation to sweet corn which was infested by downy mildew disease. Few farmers changed to production of hybrid maize in response to economic incentives given by Pioneer. CM Frozen Food Company negotiated with the primary broker to introduce vegetable soybean for late January planting, which is not the main growing season, because it received an order from an overseas buyer. The optimal planting dates for vegetable soybean in the Upper North produced for green pod market are in the early rainy season planting from late April to mid May. During these planting periods, night temperature lies between 20 to 30 °C, promoting good vegetative growth. The crop would normally be ready for harvest after about 62-65 days with the existing commercial varieties, AGS 292 and Kaori. Several attempts to grow the crop in cool season, similar to grain soybean in December, were agronomically not feasible. Pod yield in December-January planting was 40 to 50 percent less productive than the early rainy season planting. Pod maturation also lasted longer, over three months, which made the planting vulnerable to rainstorm damage. In the December planting, the Company clearly marked an ultimate dateline for seeding. In December 2004, the last planting date to be accepted was 29 December. The Company demanded that all the harvest had to complete and the product delivered to the processing plant by

April 10. One reason for this is also the celebration of the Thai New Year, from April 13 to 15. In the rural areas, this festival can last for two weeks and farm work practically ceases.

High temperatures, over 30 °C during summer months (February-April), did not provide good growing conditions for vegetable soybean despite the long growing duration. The summer planting required additional irrigation water. The supply was furnished by pumping from tube wells or from the Ping River. Frequent irrigation was required during early stage of crop establishment, after which weekly irrigation was provided. The cost of petrol used for diesel pumps could be as high as 6 percent of total production costs. When information on possible risks and additional costs, as well as potential farm yields, was outlined in the group discussion during the decision process, farmers would still consider the chances of failure to success were 50:50. The important determining factors that provided the incentive for cultivation of vegetable soybean seemed to rest on price guarantees and credit support. In addition, the Company would use a combined harvester to help ease labour constraint during harvest. Farmers viewed the set cost of machine harvest agreeable: *Baht* 2 per *kg*. Farmers did not need to use own cash investment in the production process: seed, fertilizers, and chemicals would be provided on credit by the company. The contract arrangement had outweighed the potential risks that seemed to be unseen by the farmers.

The group of 12 farmers arranged their planting dates based on individual farming activities. Some farmers delayed their vegetable soybean planting dates until they had finished harvesting their sweet corn crop. The group of 12 would have a total of at least 24 combined family labourers. This amount of labour was sufficient to plant 4 *rai* (0.64 ha) of vegetable soybean in one day. Each farmer would try to complete his/her own field in one day. The Company would allow one farmer to plant a maximum of 2 *rai* (0.32 ha) of vegetable soybean, since experience suggested that two family labourers could manage not more than two *rai* (0.32 ha) of vegetable soybean. It was found that the non-cash costs of family labour and exchanged labour was reduced by 29 percent or about 15,000 *Baht* per ha of total production cost (Figure 6.6, Table 6.3).



Labour costs =43 %: Material input costs =57%

Figure 6.6 The shared of material costs and labour costs in vegetable soybean
Source: Interview growers n=8, 2005

Table 6.3 Cost benefit return of vegetable soybean

Production cost (*Baht*/ha)	**cash**	**non-cash**
Material cost		
seed	10906	
fertilizer	8378	
pesticide-insecticide -fungicide	7323	
plant hormone	1078	
herbicide	1194	
petrol	2325	
Labour cost		
land preparation	3741	0
planting	0	7875
fertilizer - weeding	2729	3089
irrigation	0	750
harvesting	4156	5100
Average total cash cost (*Baht*/ha)		46126
Average total non-cash cost (*Baht*/ha)		15013
Average total income after grading (*Baht*/ha)		37626
Average total return after cash cost		-8500
Average total net return (*Baht*/ha)		23513

Source: Individual interview grower n=6
Note: January planting, 2005

Hybrid maize seed and maize inbred seed production

Farmers have produced maize seed on contract with the private seed company for almost a decade. Pioneer is the sole private seed company working with farmers producing hybrid maize seed and inbred lines. Farmers gained certain advantages from entering into a growing contract seed with the Pioneer, such as secure market, input credit, guaranteed price, free seed supply, substantial compensation for crop failure due to climatic factors or poor seed quality (See Annex 6.1). Farmers produced maize seed in three planting seasons continuously throughout the year in the island and in paddy fields after rainy season rice. The main production site remains on the island. The first season is in October, toward the end of rainy season. Farmers will adjust the planting dates so that hybrid seed production does not interfere with sweet corn production. This is a strict rule observed by the Pioneer Hi-Bred field technician for fear of cross pollination with sweet corn. Since farmers in DPL work in groups, collective decision on planting schedules are easily managed. The second season of planting is in the dry season after rice harvest. The hybrid seed production would be carried out in the paddy field. Hybrid maize seed production and soybean would be the major commodities planted after rice in the irrigated paddy field. The third season for hybrid maize seed production begins in late May to early June when farmers select farm land on the island for cultivation. Crop growth is more vigorous than during the other two seasons because of warmer temperature and good soil moisture conditions. However, the hybrid seed production in the third season is vulnerable to diseases. The key features of hybrid maize seed production over three seasons as noted by farmers are shown in Table 6.2.

The first season planting also incurs additional cost of water pumping, which is necessary as there is no irrigation service from the Mae Teang Irrigation Project. Farmers have less production problems from pests and diseases in the first two seasons (from cool to dry planting seasons) as compared to the third season. Recently, the Pioneer Hi-Bred also contracted farmers with land on the island to produce inbred lines during the first season as this is considered to be the most reliable growing season to produce the vulnerable inbred lines. Farmers are able to cultivate the farming areas on island beginning early October after the annual flood. The maize production system, which includes sweet corn, hybrid maize seed, and inbred line production, will have different planting dates from October to December in order to avoid pollen contamination. During the rainy season, especially during August-September, larger proportion of farming areas on island would be flooded from the inundation of the Ping River. The month-long flooding has eliminated certain soil borne diseases and replenished soil fertility to a certain extent. Another common crop is chili pepper, which is long maturing, and would cover the whole growing season in dry season

Labour management appears to be crucial for dealing with various biological and physical conditions in production under contract farming, especially with the high value crops that have to meet export quality standard. General practice in contract farming of hybrid maize seed or inbred lines necessitates intensive labour use, in particular during the phase of detasseling (see box 6.1), to reduce risks and production losses in hybrid maize production. The manual work on detasseling is made possible through exchange labour arrangement. The Pioneer Hi-Bred has its own field technician to closely monitor the detasselling process. In the hybrid maize seed contract farming, there is no brokerage to facilitate the production process. It is strictly between the company, through field technician, and the farmers. The field technician works on behalf of the Company, to provide field supervision and technical advice, and to maintain close relationship with farmers throughout the production process until harvesting.

Box 6.1 Open-pollinated maize, Inbred lines and types of maize hybrid

Open-pollinated variety. *Natural cross pollinated maize variety. In Thailand, through population improvement, the improved open-pollinated maize variety or synthetic variety (produced by intermating selected genotypes) is Suwan variety, developed jointly by Kasetsart University and Department of Agriculture in early 1970s with support from the Rockefeller Foundation. The variety has gone several cycles of population improvement, and continued to contribute to inbred line extraction.*

Inbred lines. *Lines produced by inbreeding or self pollination of open-pollinated maize variety for several generations are homogeneous and homozygous. The lines are genetically uniform. Inbreeding of cross-pollinated maize usually results in inbreeding depression, or less vigorous. Today, due to advancement of population improvement, extraction of inbred lines from improved population has provided high seed yield.*

Hybrid. *Progeny derived from crossing between genetically different parents or inbred lines. In early maize hybrid development in Thailand, the commercial hybrid maize developed from three ways cross hybrid, double cross hybrid, and single cross.*

- *three way cross hybrid: crossing between single cross and inbred (A x B) x C*
- *double cross hybrid: crossing between two single cross hybrids (A x B)x (C x D)*
- *single cross hybrid: crossing between two inbred lines*

The demand of maize hybrids increases, reaching 20,000 tonne annually. All hybrid maize seed produced and used commercially in Thailand is derived from single cross hybrid. Today, better inbred lines have been developed by the multinational seed companies based in Thailand and the national research institutions, notably the Kasetsart University and the Department of Agriculture. Hybridization of two parental inbred lines is carried out by hand, by detasseling female plants. Removing of male plants will be carried out about five days after complete pollination is assured. The normal planting arrangement is one row of male to four rows of female plants, but occasionally different male to female plant ratios, such as 1:3, 1:5, etc. are experimented in farmer fields and carried out by farmers with contractual arrangement. Therefore, there are certain requirements that related to performance where farmers must follow (Table 6.2). First, the farmers have to isolate the area to grow hybrid seed or inbred lines in order to prevent pollen contamination from uncontrolled cross pollination. Second, the process of detasseling female plants in the hybrid maize seed production requires labours to carry out the activity on schedule, hence seed produced is the result of hybridization of two parental inbred lines.

6.4 Interdependent performance and collective action

The DPL farmers decided to take up contract farming with CM Frozen Food and Pioneer simultaneously into their farming strategy in order to stabilize their farm incomes. The farmers considered the incentives provided by the companies, such as price guarantee, market security, input credit, and technical service, to be reasonable and to provide a better alternative than non-contract farming. In the production process, the farmers' activities were interdependent on the action of the company and required co-management between the company's technician starting from planning, field monitoring, harvesting, and delivery. Hence, during each stage of the production process, there are certain interdependent performance tasks distributed between the different partners and at different layers or levels of the chain, such as between individual household members at farm household level, between individual farmers and group of exchanged labour, between farmers and secondary broker and primary broker, between farmers, primary broker and field technician (in the case of sweet corn and vegetable soybean), and between farmers and field technician (in the case of hybrid maize seed). In the production process, interactions between farmers and the companies through field technicians or broker, resulted in achievable performance, expressed in yield and product quality. But certain production risks remained, which farmers had to face. For instance, vegetable soybean is found to be vulnerable starting from quality of planting material, seedling establishment and susceptible to pest and disease. The production is unstable that eventually farmers have decided to withdraw the crop from contract farming with the CM Frozen Food Company. This section describes the various interdependencies observed in the production of contracted crops that impact on performance in the production process. In part, these interdependencies are managed through existing patterns of collective action, such as labour exchange and planning of cropping patterns (Table 6.8).

In both contract farming schemes, there were certain critical stages of the production process that required managing interdependent relationships between different actors to accomplish the tasks. From the Company's perspective, planning is very crucial. Since the farmers of DPL are simultaneously planting contract crops from CM Frozen Food (sweet corn and vegetable soybean) and Pioneer (hybrid maize and maize inbred lines), planting schedules to avoid cross pollination between sweet corn and parental maize inbred lines were essential for quality control. During planning stage, in the case of the CM Frozen Food, all key actors were present; including farmers, primary broker, and field technician to draw out the planting plans.

In the case of hybrid maize seed production, farmers and field technician jointly determined suitable planting dates for individual farmers within the optimal planting dates of hybrid maize seed production. The field technician determined the range of optimal planting dates (first and last dates), and each farmer then made adjustment to fit exchange labour arrangements as well as avoiding cross pollination. This was a complex process of coordination because each individual farmer has his or her own farming plan, and not all have the same cropping patterns. Where the plots of sweet corn and hybrid maize seed are adjacent to each other, the planting of sweet corn and parental lines for maize hybrid production had to be separated by 10 days to avoid cross pollination between hybrid maize and sweet corn. Farmers and field technicians made use of different flowering times of sweet corn and maize inbred lines to adjust planting time so that crops were isolated, and there was no risk of pollen contamination. The joint-planning of planting schedules appeared to be so effective that the small farming areas in the island were almost fully utilized for contract farming of sweet corn and hybrid maize seed.

In the sweet corn production, farmers were trained to remove the second ear from the corn plant, so that only one ear per plant was allowed to grow until maturity. This is to maintain uniform cob size and to enhance the growth of first ear. The removal of second ear provides additional income for farmers. The young ears are sold as baby corn, which is popularly consumed as vegetables. With timely fertilizer application, and timely harvest, farmers would produce a quality product with large cob size and high sugar content. The field technician monitored and worked closely with farmers during fertilization application, ear removal and harvesting time. The primary broker was informed to prepare for delivery of sweet corn on time for processing. The labour viability is important in various processes of contract farming. Little and Watts (1994) indicated that internal configuration of household labour dynamics and production is highly labour-intensive.

The important processes in sweet corn production were weeding and fertilizer application not later than 60 days after planting. Mismanagement at this stage would result in slow crop growth and small cob performance, which would lead to 50 percent of yield reduction. Similarly, seed yield reduction of about 30 percent of hybrid maize production had been observed under mismanagement practices. Farmers indicated that mobilization of family labour and exchange labour was able to reduce total labour cost about *Baht* 33,199 per ha and *Baht* 35,040 per ha in sweet corn and hybrid maize production (Table 6.6). The arrangement of exchange labour, on average, had reduced the production cost (material cost and labour cost) by 24 percent in both sweet corn and hybrid maize seed production. While family labour, on average, constituted 19 percent of production cost in sweet corn, and 22 percent in hybrid maize seed production (Tables 6.4, 6.5). The non-cash cost of production, which included exchanged labour and family labour, constituted 60 percent of the production cost in sweet corn and hybrid maize seed production. Farmers paid cash cost which included material and hired labour costs, on average, constituted 55 percent of the production cost in both crops (Tables 6.4, 6.5). Without family and exchanged labour, the contract farming in sweet corn and hybrid maize seed systems would not be economically viable for smallholder farmers.

Vegetable soybean is susceptible to water-logging conditions. This is one reason why the DPL farmers allocated their land on the island, which is sandier, for cultivation of vegetable soybean, and allocated paddy land, which is more clayey, for cultivation of grain soybean. During planting, exchange labour of experienced farmers, who are also growing vegetable soybean on contract, helped speed up the process with precision planting. In the vegetable soybean production, farmers are trained to plant soybean on raised bed to achieve better drainage. To achieve good germination, farmers pre-irrigate the bedding field one day prior to planting, during planting, farmers walked and worked on wet soil and at the same time tried not to damage the raised beds. In the production of vegetable soybean, farmers hardly hired unskilled labour to do the planting. Vegetable soybean is processed as frozen cooked product and consumers are concerned about chemical residues. CM Frozen Food Company did not expect the product to be an organic or pesticide-free product. Safe chemicals use was practiced in the current production system. This meant that there were no chemical sprays one month before harvest, and all chemicals and fertilizers used in vegetable soybean production were strictly monitored by the field technician. Traces of alien chemicals detected at the processing plant would result in total rejection.

At harvest, farmers would inform primary broker and field technician for timely delivery to the processing plant. Vegetable soybean is harvested in the morning, and field grading by removing single-seeded pods is carried out by women members. Harvesting and field grading has to be completed within one day. The graded pod is then delivered by primary broker in the late afternoon to the processing plant. The CM Frozen Food Company will normally allow each farmer to plant not more than 2 *rai* (0.32 ha) of vegetable soybean. This is the limit where each farm household, with exchanged labour arrangement, can manage to achieve quality product on time.

Grading of vegetable soybean is emphasized on pod size, number of seeds per pod (2 to 3 seeds), and chemical residues. The grading is first done by farmers with exchanged labour and /or hired labour in the field after crop harvest and the second grading is carried out by the marketing staff of the company after pod delivery. Farmers would receive additional payment as incentive if the product reached the quality standards. The marketing would randomly take pod samples of one kg sampling from 25 bags (each weighed about 30 kg) and assess pod quality. The 13 quality standard indicators would use to assess pod quality. Each indicator should not exceed 15 percent of the one kg sample. It was found that higher percentage of pods was below processing quality for export (Table 6.7).

Table 6.4 The percentage of material costs and labour costs per ha in sweet corn production

Table 6.5 The percentage of material costs and labour costs per ha of hybrid maize seed production

Contract Grower (ha)	Material cost* (%)	Labour cost (%)			Total Labour cost (%)*	Contract Grower (ha)	Material cost** (%)	Labour cost (%)			Total Labour cost (%)*
		HH	Ex*	Hired				HH	Ex*	Hire	
1. 0.3	53	13	34	1	47	1. 0.3	36	22	42	0	64
2. 1.1	59	21	12	7	41	2. 0.6	34	18	32	16	66
3. 0.8	65	24	10	1	35	3. 0.2	59	34	7	0	41
4. 0.4	50	13	36	1	50	4. 0.6	37	10	51	3	63
5. 0.5	44	19	34	3	56	5. 1.0	20	39	0	41	80
6. 1.4	68	26	6	0	32	6. 0.6	26	42	0	32	74
7. 0.8	45	17	38	0	55	7. 1.0	37	3	41	19	63
8. 0.9	60	19	19	2	40	8. 1.4	39	11	19	31	61
Average 0.78	55	19	24	2	45	0.7	36	22	24	18	64

Source: Interview, 2004; Note: * exchange labour, **the cost as percentage of total, HH=household labour

Table 6.6 The shared cost of cash cost and non-cash cost of sweet corn and maize production

planting	yield (kg/ha)	income (*Baht*/ha)	Cost (*Baht*/ha)				Percent (%)			Percent (%)	
			Material	Hired labour	Non-cash labour	Total cost	Material	Hired labour	Non-cash	cash	Non-cash
Sweet production											
October	13,773	39,043	17,713	5,357	33,629	56,699	31	9	59	41	59
January	15,217	40,018	13,164	5,842	28,167	47,173	28	12	60	40	60
May	11,481	32,123	19,787	6,045	37,801	63,633	31	9	59	41	59
average	13,490	37,061	16,888	5,748	33,199	55,835	30	10	59	41	59
Maize seed production											
October	8,630	48,604	18,220	5,816	40,744	64,780	28	9	63	37	63
January	4,591	29,762	12,117	10,906	30,821	53,844	23	20	57	43	57
May	6,384	23,960	14,623	7,043	33,555	55,221	26	13	61	39	61
average	6,535	34,109	14,987	7,922	35,040	57,948	26	14	60	40	60

Source: Interview contract sweet corn farmers (30) and hybrid maize farmers (31), 2005

Note: Cash cost = total cost of material cost and hired labour; non-cash = total family labour and exchanged labour (calculation of cost of labour based on the daily wage of *Baht* 120, about 8 hours per day)

In maize hybrid seed and inbred line production, genetic isolation of planting materials is crucial for production of genetically pure seed. Close collaboration between Pioneer's field technician and farmers during plot selection, planning and determining planting schedules for individual farms enabled the Company to estimate hybrid seed to be produced in the DPL site. Product quality was importantly determined by close supervision during anthesis of female plants, when the male flowers are removed so that cross pollination in the hybrid plot comes from male parental line. At harvest, the field technician helped with delivery of hybrid cobs to the Pioneer's seed processing plant in Lamphun.

In summary, in the contract arrangement, the companies need not to invest in land for gaining access to suitable farming areas with well-equipped irrigation systems. The land use situation in these suitable areas required close coordination between various farmers and crop production systems. In the cases described here, the collaboration between farmers and field technicians from both companies results in agreeable planting schedules. The farmers followed the production procedures, and the companies, through their respective field technicians, expected to benefit from close working relationship between farmers and field technicians, or between farmers and primary broker. The presence of field technicians, especially in the case of the Pioneer, provided space and opportunity for hybrid maize seed farmers to negotiate, and complain about poor adaptation of inbred lines, although there were few direct contacts between farmers and the company's production manager. Moreover, the connectedness between technician and farmers in vegetable soybean contract farming was effective for disseminating new knowledge and new inputs, particularly on chemical use. This is perhaps one important contribution of contract farming to dissemination of new knowledge (Glover and Kusterer, 1990).

Table 6.7 The grading result from vegetable soybean growers in 2004 (n=6)

Criteria	**Reduction (%)**	**Farm1 0.32 ha**	**Farm2 0.32 ha**	**Farm 3 0.12 ha**	**Farm 4 0.32 ha**	**Farm 5 0.32 ha**	**Farm 6 0.32 ha**
1. pod shorter than 4.5 cm	5	0.2	1.2	0.4	1.6	0.4	0.1
2. insect damage	3	1.6	0.8	1.6	1.2	4.8	3.3
3. worm damage	2	0	0	0	0.4	3.3	1.1
4. one seeded pod	5	1.2	5.6	2.4	6.4	0	0
5. disease; anthracnose	10	0.6	2.4	3.2	4.4	4.1	3.1
6. bruised pod, damage pod	10	0	0	0.4	0	0.5	0
7. misshapen pod	5	5.8	2.4	8.4	2	0	0
8. yellow pod, purple pod	10	1.4	0.8	0.4	1.6	1.6	1.3
9. broken pod	10	0.6	0	3.6	0	0	0
10. seedless, shrunken seeded pod	10	16.6**	10.8	7.6	13.6	0	0
11. pod with stem attached	10	1.2	1.6	1.2	1.2	0	0
12. pod with clay, muddy pod	3*	0	0	0	0	0	0
13. pod with worm	2	0	0.2	0.8	0.2	0.3	0.1
A: Total		29.2	25.8	30	32.6	15	9
B: Net weigh (kg); before grading		1360	730	480	270	790	1080
C: Reduction cost (%)		0	20	15	15	15	9
D: Weight loss from grading*** (Kg)		397.1	42.3	72	47.5	118.5	97.2
E: Income loss from grading (12 *Baht*/kg)		4765	508	864	570	1422	1166
F: Net weight (kg); after grading		963	688	408	222	672	983

Source: Compile from receipt received by contract grower

Note: Each criteria value ≤ 15 % except, *criteria value ≤ 5 %, ** reject=no reduction cost,
*** calculated from B x (A –C)/100

Table 6.8 Interdependent performance and collective action in contract farming of Chiang Mai Frozen Foods Co., Ltd

Process	Layer/interlayer	Performance	Return to farmer	Risk to farmer	Return to company	Risk to company
Sweet corn						
Land	Farmers and land owners	Access to land use with agreeable rent	Access to lane use	Owner decision to stop leasing	Free access to irrigated land	No control over land use
Production						
Planning	Technician/ broker/farmers	Planting schedules to fit individual farmers	Optimal planting date	-	Optimal planting date achieved	-
Planting	Farmers/farmers	Planting on schedule resulted from labour exchange	Planting on schedule without labour constraint	Poor seed germination	Control over range of planting dates	Compensation on poor germination
pest management	Farm household	Good crop growth and yield	productivity	Crop loss	productivity	Not achieving production target
fertilization	Farmers/farmers	Tillage and fertilization on schedule with exchanged labour	Product quality	Excessive use of fertilizers increases production cost	Product quality	-
discarding second ear	Farm household	Better growth of first ear	Product quality, second ears sold as baby corn	-	Product quality	-
irrigation	Farm household	productivity	productivity	Increasing petrol price increases irrigation cost	productivity	-
harvesting	Farmers /broker	Achieving timely harvest with exchanged labour	Productivity and quality	Delayed harvest would lower product quality	Product quality	Low quality product from delayed harvest
delivering	broker	Timely delivery	Economic incentive for timely delivery	-	Constant supply of quality product to be processed on schedule	-
Marketing						
grading	Company marketing staff	Quality control	Income based on product quality	Product being rejected	Quality product being processed	Quality product is below target
Financial	BAAC/farmers	Loan	Support farming operation	Low farm return could delay repayment	No financial credit commitment to farmers	Delayed farmer payment on input credit if crop failure

Table 6.8 (continued)

Process	Layer/interlayer	Performance	Return to farmer	Risk to farmer	Return to company	Risk to company
Institution						
contract	Farmers/broker/company	verbal	Market and price guarantee	No legal protection	Broker worked on behalf of company	-
input credit	Farmers/broker/company	Access to input supply on credit	Easy access to cheaper input supply	Quality of input supply (chemicals)	Benefit from sale of chemical inputs	-
Technical service	Technician/broker/farmers	Technical advice	Technical service improves crop productivity and quality	Inappropriate technology, esp. variety, pesticides	Farmer competence leads to improvement of product	-
Monitoring	Technician/farmers	Crop performance and time of harvesting	Productivity and quality	-	Product quality	-
Vegetable Soybean						
Land	Farmers and land owners	Access to land use with agreeable rent	Access to land use	Owner decision to stop leasing	Free access to irrigated land	No control over land use
Production						
planning	Technician/ broker/farmers	Cool season planting not later than January 29	Optimal planting date	Beyond dateline of January 29 not accepted by the company	Optimal planting date achieved	-
land preparation	Technician/farmers	Planting soybean on raised bed	Good plant establishment	Poor plant establishment	Achieve production target with good practice	-
planting	Farmers/farmers	Planting on schedule with exchanged labour	Planting on schedule without labour constraint	Poor seed germination	Control over range of planting dates	-
weeding	Farm household	Weed-free plot	Good crop growth	Crop growth affected by weed	Achieve production target with good practice	-
pest management	Farm household	Good crop growth and yield	Productivity and quality	Crop loss and rejected products due to chemical residues	productivity	Not achieving production target

Table 6.8 (continued)

Process	Layer/interlayer	Performance	Return to farmer	Risk to farmer	Return to company	Risk to company
fertilization	Farmers/farmers	Tillage and fertilization on schedule with exchanged labour	Product quality	Excessive use of fertilizers increases production cost	Product quality	-
irrigation	Farm household	productivity	productivity	Increasing petrol price increases irrigation cost	productivity	-
harvesting	Farmers /broker	Achieving timely harvest with exchanged labour	Productivity and quality	Delayed harvest would lower product quality	Product quality	Low quality product from delayed harvest
grading	Farmers/farmers	On-site grading by exchanged labour	Product differentiation with quality product goes to processing plant	Farmers' products do not meet grading scale at the processing plant	On-site grading by farmers reduces grading time at processing plant	-
Marketing						
delivering	broker	Timely delivery	Economic incentive for timely delivery	-	Quality product to be processed on schedule	-
Financial	BAAC/farmers	Loan	Support farming operation	Low farm return could delay repayment	No financial credit commitment to farmers	Delayed repayment on input credit if crop failure
Institution						
contract	Farmers/broker/company	verbal	Market and price guarantee	No legal protection	Broker worked on behalf of company	-
input credit	Farmers/broker/company	Access to input supply on credit	Easy access to cheaper input supply	Quality of input supply (chemicals and seed)	Benefit from sale of chemical inputs and seed	-
Technical service	Technician/broker/farmers	Technical advice	Technical service improves crop productivity and quality	Inappropriate technology, esp. variety, pesticides	Farmer competence leads to improvement of product	-

Sources: Summary from farmer group discussion, 2004-2005

Note: Adapted from Vellema, 2002

Table 6.9 Interdependent performance and collective action in contract farming of Pioneer Hi-bred (Thailand) Public Co., Ltd.

Process	Layer/interlayer	Performance	Return to farmer	Risk to farmer	Return to company	Risk to company
Hybrid maize seed and maize inbred line						
Land	Farmers and land owners	Access to land use with agreeable rent	Access to lane use	Owner decision to stop leasing	Free access to irrigated land	No control over land use
Production						
Planning	Technician/farmers	Planting schedules to avoid cross pollination	suitable planting date	-	Optimal planting date achieved	-
Planting	Farmers/farmers	Scheduled planting due to labour exchange	Planting on schedule without labour constraint	Poor seed germination	Control over range of planting dates	-
pest management	Farm household	Good crop growth and yield	productivity	Crop loss	productivity	Not achieving production target
weeding	Farm household	Good crop growth and yield	productivity	Yield affected by weed	productivity	Not achieving production target
fertilization	Farmers/farmers	Tillage and fertilization on schedule with exchanged labour	Productivity	Excessive use of fertilizers increases production cost	Productivity	-
detasseling and removal off-types (hybrid seed)	Farmers/farmers	Farmers complete operation with exchanged labour	Productivity and quality	Mixture of off-types in seed plot leads to rejection	Productivity and quality	Seed impurity
irrigation	Farm household	productivity	productivity	Increasing petrol price increases irrigation cost	productivity	-
harvesting	Technician/farmers	Achieving timely harvest with exchanged labour	Productivity and quality	Yield variation with parental lines or inbred	Productivity	-

Table 6.9 (continued)

Process	Layer/interlayer	Performance	Return to farmer	Risk to farmer	Return to company	Risk to company
Marketing						
delivering	Technician	Timely delivery	Economic incentive for timely delivery	-	Timely delivery of quality seed for processing	-
Financial	BAAC/farmers	Loan	Support farming operation	Low farm return could delay repayment	No financial credit commitment to farmers	Delayed repayment on input credit if crop failure
Institution						
contract	Farmers/technician/company	Written	Market and price guarantee	-	Supply of seed is being secure	-
input credit	Farmers/technician/company	Access to input supply on credit	Easy access to cheaper input supply	Quality of input supply (chemicals)	Benefit from sale of chemical inputs	-
Technical service	Technician /farmers	Technical advice	Technical service for productivity and quality	Technology failure, parental and inbred lines	Farmer competence for product improvement	-

Sources: Summary from farmer group discussion, 2004-2005

Note: Adapted from Vellema, 2002

6.5 Conclusions

This chapter describes how smallholder rice farmers in DPL village included contract farming arrangement in their livelihood strategies. They invested in land improvement, irrigation, and labour to develop their farming enterprise in the island, where land with its sandy texture is suitable for cultivation of vegetable soybean, sweet corn and hybrid maize seed production. Two companies offered contracts for the production of these high value crops and provided inputs, credit, technological services, and a secure market with a guaranteed price. The study on contract farming informs us on the nature of an interdependent relationship of smallholder rice farmers with external agencies that is based on performance in crop production. Additionally, the study shows how the companies built on collective action in the village for achieving corporate goals.

The nature of contractual arrangements

The different types of contract arrangements, either verbal or written, do not deter farmers to enter the relationship with a company. Neither are they concerned about legal aspects. Farmers are more interested in credit, market security and guaranteed price. Once the farmers are satisfied with the terms of contract, particularly with provision of credit system, they are willing to produce crops that meet the companies' requirement of productivity and quality. In this sense, the contract farming arrangement is based on mutual interests and benefit sharing, which also entails a level of interdependency between farmers and companies.

The study also shows that the relationship between farmers and company is social in nature. There are different layers of working and social relationships between farmers and contracting companies in the production process that could affect overall performance. The brokerage system, as adopted by the CM Frozen Food, which consists of primary and secondary brokers, has played important supporting and negotiating roles, linking between farmers and the company. Relationships between farmers and brokers, particularly on trust, reciprocity, and fairness, contribute significantly to the successful management of contract farming. However, contract farming performance also depends on the ability of broker to manage technological information and knowledge and to work it out with farmers to improve production capacity. The technical staff, employed by the companies, and worked closely with farmers on behalf of the companies, could help stabilize productivity and reconcile any disputes between farmers and the companies. Pioneer Hi-Bred, without using brokerage system, depends on its field technician to disseminate production technology, to act as public relations for the company in answering farmers' quarries about contract arrangement, so that farmers could have good impression about the company, leading to long term working relations.

The brokerage system, which is a common practice in contract farming for production of quality farm products, has been adopted by the CM Frozen Food Company to help facilitate the linkage and communication between farmers and the company. The company benefits greatly from the collective action between primary broker and farmers without investing additional field staff. The primary broker, in return, receives commission from his service. The primary broker, who is caretaker and mediator in the negotiation between farmers and the CM Frozen Food Company, also offers farmers with interest-free short-term financial assistance. The interdependent relationship between farmers and primary broker, which is built upon trust and reciprocity, has created mutual benefits that are recognized and appreciated by both parties. The DPL farmers who are engaged in contract farming also have made certain organizational change, from individualistic to egalitarian, and forming themselves into sub-groups of production systems. The close and equal social relation among members within group has propelled the system to move forward. When the group works with the primary broker, who is considerate and receptive, it leads to productive performance. Collective action through trust and reciprocity between farmers and primary broker contributes to the successful performance of contract farming.

The working relationships between farmers and field technicians of two companies have different features. Farmers were closer to Pioneer's field technician than to CM Frozen Food staff, partly because of the nature of contract and the production system. In the case of Pioneer Hi-Bred, the company considered inbred lines and hybrid seed as its intellectual property. Therefore, control over production through close monitoring and written contracts intended to prevent misconduct. From the company's perspective, legal and property rights are difficult to police and enforce in many local settings. It is not unusual for a company to suspend the faith in formal legal institutions and rely instead on relations on trust, patronage and traditional reciprocities rather than the word of law (Watts, 1990).

The perspectives of small farmers to contract company in contract farming are close to patron-client relations as observed by Glover and Kusterer (1990) that the traditional pattern relations between the rural elite and the rural poor typically have a patron-client quality to them where attempted mutual manipulation, subordinate clients profess loyalty to patrons in the hope of receiving personal economic benefits and favours. Patrons provide these favours with arbitrary paternalism, effectively reinforcing client behaviour with such occasional rewards. The system is manipulative in the sense that there is never an open expression of conflicting interests. Patron pretends to have mothering but the clients, best interest at heart, profess nothing but devoted gratitude for the patron's attention. This study observed that features of patron-client relationships are embedded and influencing contract farming performance. The study also suggests how performance in the contracted crop production systems strongly depends on this social embeddedness and thus on the types of social relationships and collective actions apparent in the specific location.

Interdependent performance

The study underlined the importance of social cohesion for contract farming by looking at the various tasks requiring concerted action. There is considerable interdependency in a contracting relationships and much implicit over risk allocation (Glover and Kusterer (1990). The DPL farmers have worked with CM

Frozen Food Company to produce sweet corn and vegetable soybean and with Pioneer Hi-Bred (Thailand) International to produce hybrid maize seed and inbred lines for several years. Farmers acquired new production technology through contract farming, and experienced the process of producing quality products for a specific demand. There are several layers of interdependence with respective process of collective action and their performances in contract farming such as farmers - farmer, farmers - broker, and farmers - field technician as shown in Table 6.10.

The contract farming requires intensive and timely management to meet production schedules. Farmers would not be able to comply with these time settings if each farm household worked independently. Farmers cooperated (farmer – farmer) in a number of processes, such as planning, land preparation, planting, removing second ear of sweet corn, detasseling male flower on female plants in hybrid maize seed production, and grading vegetable soybean pods before delivering to the company. Farmers have organized themselves into group to manage production system so that the required technical performance in contract farming could be realized.

All contracting crops encounter production risk when the production process requires high labour input. The production process is intensive and some farmers are not able both to manage the rigid time schedule and to participate in all labour exchange activities. In all forms of contract farming in DPL, both man and woman household members participated in the production process. Labour availability from cooperative exchange arrangement also provides quality labour supply. In a sense, the private contractor exploits non-wage labour to fulfil high valued seed crop or processed product (Watts, 1990). The farmers provide labour power, land and tools, while the contractor provides inputs and production decisions, and holds title to the product. However, the land tenure systems which do not provide leases of security to safeguard tenants' investments are not conducive to some of farmers who withdrawn from contract faming because land use depends on landlord.

Socially, farmers seem to have transformed from individualistic to egalitarian behaviour by exercising collective action in contract farming. Through cooperative behaviour and practices, farmers shared working experience, and in the process, accumulated new knowledge on contract farming technology. This could be seen in the production of high quality sweet corn by proper fertilizer management and pruning of newly emerged second ear, of vegetable soybean by integrated pest management through timely and safe-use of chemicals, and of hybrid maize seed production through careful and coordinated planning of planting scheduled. All these practices were introduced by the companies through their respective field technicians. However, they strongly rely on the forms of collective action present in the production location.

Table 6.10 Layer of interdependence with respective process of collective action and their performances in contract farming

Interlayer	Collective action process	Performance
Farmers-farmers	labour exchange arrangement, knowledge and resource sharing	equal benefit sharing, collective consciousness, community egalitarianism
Farmers-broker	Planning, information sharing,	benefit sharing through trust and reciprocity, negotiating with company for fair treatment for farmers
Farmers-field technician (the CM Frozen Food)	Planning, monitoring, field technician as technical service provider	improved product quality and yield of sweet corn, heterogeneous performance on vegetable soybean
Farmers-field technician (the Pioneer)	Planning, monitoring, field technician as technical service provider	improved seed production, testing of new inbred lines and hybrids

Forms of collective action and conditions

Using the grid-group scheme, we can distinguish three distinct sets of social relations and organizational forms in contract farming, which have a hybrid character (see Figure 6.7). The first form of egalitarian cooperation is best described by labour sharing, which is the coping strategy of small farm holders to fulfill labour requirements in intensive contract farming system. The second form is a hybrid, drawing on some coordinative aspects of individual market initiatives and some aspects associated with hierarchy. There is a certain degree of cooperation based on interdependent relationships between farmers and primary broker, and between farmers and field technician to improve the negotiation with the companies. However, the hierarchical structure and administration of the companies do not offer space for two-way dialogue between farmers and the administrators.

The third and less distinct form is represented by a fatalistic relation between farmers and the companies. It is transitional with an opportunity of improving the relationship when farmers are more capable of forming collective bargaining with the company. At present, farmers work collectively in many activities, but they are still less capable in handling the contract or creating bargaining power. Farmers still behave in a patron-client mentality with the company, seeing company as the market provider and would not likely negotiate to change the terms of contracts. They are also limited by the scale of their operations, which is not large enough to strike for bargain with the contracting company. In other words, the farmers are concerned that the company might withdraw or leave the production site and this would disrupt their chance of contract farming.

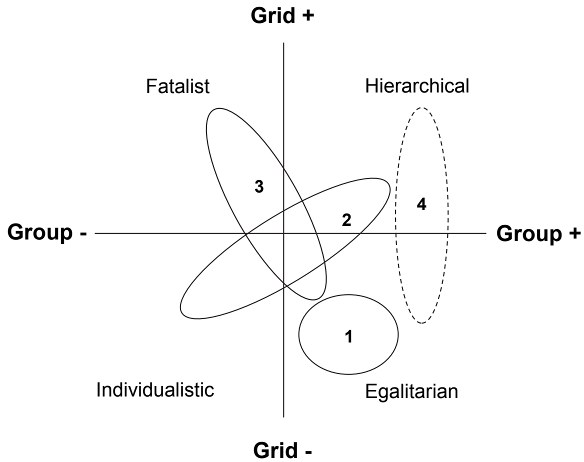


Figure 6.7 Forms of collective action in contract farming based on Douglasian schematic; 1. Labour sharing within farmer group, 2. Hybridity: farmer market initiative and negotiation with contract company 3. Fatalistic relation between farmers and the companies, 4. Hybridity: true partnerships between farmers and company.

The DPL farmers are dealing with monopolistic corporations, either in seed production or agro-food processing. There is no competition, where the company exercises strong control over the production processes of vegetable soybean, sweet corn, maize hybrid and inbred lines, and over the accompanying resource flows. The delay of the contract documents and complicated grading systems, product specification, and rule-based prohibitions give the impression that the company has close control over all operations. Finally, other actors that supposed to help oversee the overall performance and benefit sharing of the contractual arrangement are not present. This includes the local agricultural extension agents, staff of the TAO and the BAAC, etc. The interrelationships among contracting parties, for instance, between the company management and local extension agent, TAO, and BAAC are quite distant. The farmers are working alone with their contractors without any legal advice or technical support from local institutions.

So to improve the bargaining power, farmers may need another intermediary body, such as KT or TAO that can leverage collective action and act as mediator to improve the negotiation for equal benefit sharing and risk management. Such a form of collective bargaining will, most likely, include aspects of a more hierarchical modality. This kind of modality seems to be particularly relevant because the contracted crops in the case studies have little marketing risks, but show significant production risks, especially in vegetable soybean production with uncertainty of seed quality and less alternative of chemical use in pest management. Yet, the contracting company avoids all the consequences by transferring responsibility to farmers. Compensation is possible only through persistent negotiation with the help of primary broker. Also in the seed production of hybrid maize and inbred lines, the rules appear to be changed in favour of the contractor. Pioneer changed the contractual arrangement when farmers had already planted their crops, by revising the rewarding system which was formerly based on

Baht/kg into *Bah*t/ yield range in kg. As a consequence, farmers received less financial return in the new system.

Disconnection between farmers and companies in performance improvement

The study also points at a missing link between collective actions for technology development, specifically with local relevance, and the contract farming arrangements. The companies did not make use of the social connectedness of DPL farmers groups to initiate participatory technology development, linking on-farm farmer experimentation with their on-station studies. Such a process could strengthen research and development programmes and also benefit farmers. It would require shifting the form of collective action of type 3 to new type 4 associated with hybridity of egalitarian and hierarchical relations, representing farmers-company partnerships.

However, according to Little and Watts (1994) concluded that one of the key unifying themes that underlie in the range of case studies in Africa is intuitional linkages between state and private capital, and the primacy of labour dynamics and production relations. Result from the chapter show, there is a clear disconnection between layers or hierarchies in contract farming and the installation of feedback mechanisms from farmers to company. Farmers have no information on the attainable yield of hybrids or inbred lines in relation to input use. Such agronomic information is essential for farmers' decisions on efficient use of resources. Another related point concerns the participatory assessment of the internal performance of the contract scheme, *i.e.* farmers' yields and incomes, and product quality, by farmers, field technician and production manager of the company. In such an exchange causes of failure can be identified and discussed between the partners. So far the companies seem to be more interested in their product quality and not so much on the farmers' benefits and welfare. Moreover, the vertical hierarchical relationship; the production manager, the field technician and the overall company policy, toward improving farmers' benefit is not well understood. From the '*no response and no comment*' attitude of the field technician to the unfair treatment of the contract, it gives the impression that the field technician has to follow the production manager's instruction, and feedback mechanism from field operation is not fully effective.

The companies designed their own production technologies, derived from various sources and introduced to farmers. There is no evidence that the DOAE extension agents were involved in disseminating the technology. The companies employed their field technicians to work directly with farmers, so that the companies can control over production processes and ultimate products of which the quality has significant impact on the companies' name and reputation. The field technician thus becomes the key actor working closely with farmers on behalf on his or her host company, to help develop products of required quality.

CM Frozen Food Company field technician did not initiate any new farming innovations to improve production efficiency. The field technician's mandate was to ensure that farmers follow the production protocol, particularly on the appropriate use of chemicals. Product will be rejected if it is found to be contaminated with pesticide residues above the stated level. Also Pioneer Hi-Bred controls its R&D activities in plant breeding and makes field testing of new genetic materials, either hybrids or inbred lines, by contracting experienced farmers to grow with guaranteed minimum income based on yield performance. Essentially, farmers use technology that is determined and designed by the company. There is no evidence of farmer participatory technology development in the contract farming system.

The companies consider their production technologies to have general adaptability; any variations across farms are due to farmers' different competence. But so far, heterogeneity of performance has been observed across farms, and the technicians are unable to identify best-bet solution that works for farmers. For instance, the causes of variability of seed germination and seedling establishment across farms were not fully understood by both farmers and the CM Frozen Food field technician. The company claimed that seeds with the uniform quality were provided to the group members. So the company would conclude that any variability in seed germination across farms would be due to variability in farmer management practices.

This behaviour prohibits farmers from joining problem solving in contract farming. An alternative would be to consider improvements in production technologies as manifestations of will shaped by task group (Richards, 2000), consisting of farmers and field technicians. A change in the institutional modalities present in contract farming may help to foster better relationships between two parties, creating mutual benefits. Unfortunately, such joint effort in technology development has not been observed in the case study.

The agribusiness will be most beneficial when it opens rather than closes options, when the farming system is such that the new crop can be added to existing activities rather than requiring specialization. However, this does introduce a bias away from the participation of the poorest farmers. The benefits of agribusiness can also be increased by involving a growers' organization and thus to incorporate existing forms of collective action into its operations. Such organizations increase the farmers bargaining power to improve coordination between firms and growers. In the short run, these organizations can make it more feasible for company to deal with a multitude of small growers, thus extending the benefits of the scheme. In the longer run, they can take over some functions performed by the company, even including ownership of the enterprise. The case of contract farming between the DPL farmers and two companies shows that good contract farming performances have been achieved as a result of good social relationships between farmers and the companies, through field technicians and primary broker with various forms of collective action in the process. The system could be improved and result in more equitable benefits to farmers if there were collective action through direct connection between farmers and the company administration.

Chapter 7

Conclusions

This book covers the description and analysis of local practices of collective action and benefit sharing in two villages in Northern Thailand. The different case studies provide an overall understanding of the conditions for successful and effective cooperation in mobilizing resources and labour, and in participatory agro-technical innovation for sustainable agriculture development. This concluding chapter will reflect on our four research questions and their answers, starting from the forms and conditions of collective action and moving towards the management of collective action for technology development. The research questions were:

1. What are the forms and conditions for collective action among the rural poor in Northern Thailand?
2. How do farmers in Northern Thailand manage collective action for technology development in different cases?
3. What makes collective action work for technology development and agro-technological innovation?
4. How can collective action for technology development by small-scale farmers in Northern Thailand be improved, and what can it contribute to the improved sustainability of village agriculture?

7.1 Forms and conditions of collective action

There are various forms of collective action, and the forms suitable for technology development depends on social and material circumstances in the local context. We have analysed how rice farmers were organized in collective rice seed production groups, and how their successful collaboration triggered new forms of collective action in pest management by means of frog protection during the rice growing season. The results are varying organisational forms of collective action that reveal a hybridity of institutional modalities, which is further described, using grid-group theory, by the level of regulation of individual behaviour and the level of absorption of individuals in group memberships (Table 7.1). The case studies in the villages of Dong Palan (DPL) and Buak Mue (BM) further lead to the conclusion that the integration of ago-ecological and social-economic conditions has an effect on the organisational forms and levels of collective action (Chapter 2). For example, BM farmers have chosen rice-soybean cropping systems which are less capital and labour intensive, to better fit their off-farm employment opportunities whereas the DPL farmers have selected farming-based livelihoods, and are practising collective management for year round cropping in both rice growing areas and the area in the loop of the river, called ‘the Island’.

Table 7.1 Forms, management and outcomes of collective action in the different case studies

Technology	Forms of collective action	Management of collective action	Technology performance and development	Areas for improvement
1. Participatory seed multiplication (CRSP)	- individualistic and hierarchical - egalitarian and hierarchical	- arranges collective benefit sharing - requires quality rice seed - develops market access - requires strong leadership	- developing communal seed plot for effective seed production - produces own rice seed - develops seed market with support from TAO	- to integrate individual innovation to improve cost effective technology - to develop improved certification schemes for farmer seed production
2 local initiative				
2.1 community frog conservation for biological pest management	- egalitarian and hierarchical	- installs common interest sharing - develops regulatory system to be observed by all members	- establishes low cost biological pest control technique	- to create knowledge sharing system to improve farmers' understanding of biological pest management - to develop community conservation action plan
2.2 rice harvester	- egalitarian	- develops cost effective technology - manages knowledge sharing through farmer experimentation and feedback	- develops labour saving, and non-destructive straw harvesting equipment	- to support individual innovation by supporting knowledge exchange among farmers to improve technology
2.3 Double transplanting	- egalitarian	- develops cost effective technology - overcoming local specific production constraints	- maintains productivity under unfavourable conditions	
3. Learning and diffusion in green manure technology	- individualistic - hierarchical and individualistic	- participates in developing soil improving technology - arranges knowledge exchange - receives initial material support from governmental agency as incentive	- reduces chemical fertilizers use - makes better use of chemical fertilizers	- to embed R&D function within farmer organizations through collaboration with research institutes - to link existing vertical knowledge transfer to learning within and among farmer networks
4. Joint problem solving under contractual farming arrangement	- egalitarian - fatalist and egalitarian - hierarchical and individualistic	- arranges benefit sharing through mobilizing resources and labour - creates access to market with guaranteed price	- improves performance of contracting crops - establishes intensive cropping systems as livelihood strategy	- to introduce benefit sharing system with active roles of mediators in negotiation - to improve linkages between company, R&D, and farmers through participatory technology development

7.2 The management of collective action

The management of collective action has a clear impact on technology development (Table 7.1). The most important institutional and individual mechanisms are flexible forms of benefit sharing recognising and managing common interests, trust building, and, finally, joint problem solving and knowledge exchange about agro-technology among farmers themselves and between farmers and external agencies such as companies or research institutes.

Firstly, benefit sharing was particularly strong in the inter-household labour exchange of CRSP (Chapter 3), technology innovation (Chapter 4) and contract farming (Chapter 6) where collective action helped to overcome labour constraints as well as to arrange concerted land and water management. Chapter 2 shows that the solidarity of DPL enhances the organization of up to19 group activities. Some of them helped solve financial problems in farming such as the agriculture production revolving funds of the rice, maize, and soybean groups. The culture of sharing is rooted in subsistence rice production and lives on to some extent in both villages, but in varying degrees. For example, farmers create safety nets to mitigate hardships by mobilizing funds from various sources such as monthly savings from the housewife group, village fund, agricultural production fund, and welfare in case of death. Since the number of household members is decreasing, and the proportion of older people in the villages increases, social relations between households and kin groups, as seen in community rice seed production, are increasingly important to help overcome labour constraints, and in fostering solidarity between land-owning and landless farmers. Intra-family labour sharing works best where the tasks, as in rice farming, are common to the group and similar from member to member. Labour sharing arrangements among smallholder farmers is an important social relation that enables farmers to maintain their production. The viability of such collective management is partly dependent on the flexibility and responsiveness to the needs of both parties, *i.e.* between the host and the service provider, signifying a help-and-care community in rice farming.

The case in Chapter 3 shows that the labour exchange arrangement can be reciprocated in the forms of labour, cash, and rice, depending on individual needs. In the socially cohesive community, as depicted by the DPL village, the sharing of labour has been extended to other non-rice production activities, such as maize production, soybean production, house building, etc. The contextual changes described in Chapter 2 suggest that collective action and solidarity are not stable and may erode due to changing social-economic conditions. The existent solidarities are important in supporting farm labour requirements as well as in village activities, which have been shown to set the conditions for a range of technological innovations or interventions.

The mutual benefits between farmers and local brokers in the case of contract farming (Chapter 6) are indicative of an organisational form that manages the interdependent tasks and functions in order to regulate agricultural performance, *i.e.* yield and product quality. Improved technology performances are shown in contract farming (Chapter 6) where company and farmers learned to trust each other. The shared interest between companies and farmers is rooted in a principle of co-existence. The companies need to make good social relationships in order to achieve good performance and farmers depend on market access and guaranteed price. Collective action is being observed in planning between farmers and companies and in land use planning by the sub-group leader and farmer members. However, the collaboration requires a mediator in the persons of the local broker and the field technician, who help bride the communication gap, and are able to relieve tensions between farmers and the company. These are the two important key actors negotiating and building trust between the two parties. Certain lessons for participation led by NGOs can be learnt from a careful examination of the business approach. But equally the business approach will only sustain farmer interest over the longer term if sufficient attention is paid to social dynamics and technological adaptation. The development of contract farming builds on trust and reciprocity between farmers, the local broker, the field technician and the companies. But its future improvement rests on the ability to make socio-technical change, by participating farmers in refining farming technology to fit the production sites.

Secondly, success and failure of cooperative activities and concerted actions in farming communities are related to the degree of trust and reciprocity among farmer members. Trust and reciprocity arise when participants equally share benefits or equally need labour during transplanting and harvesting of rice. Trust building has tangible results in cost-effective technology development and, likewise, feasible technologies build trust (Chapters 3, 4). This was the case in DPL community rice seed production where farmers seek to reduce the cost of production and improve seed production performance by creating communal rice seed plots where farmer members collectively engage in a seed production process. Other cases are the implementation of low-cost technologies such as community frog protection for biological pest management, and the invention and introduction of a weed slasher machine for improving rice harvest. The communal seed plot is an indicator of social cohesion when participating farmer members have established social relations built on trust and reciprocity leading to mutual benefits. Support from local institutions helps catalyse and promote group activities. BM village, on the other hand, displays weak co-operation with less structure and more individualism, with greater emphasis on non-farm activities. There is less co-operation and slower group development than in DPL village.

Finally, results from the case studies stress that knowledge sharing is important for sustaining collective action in technology development. The three local innovations analysed in Chapter 4 (community frog protection, double transplanting, and adoption and modification of a weed slasher machine for harvesting rice) show strong cooperation in knowledge sharing for development of low-cost technology. Although double rice transplanting is labour intensive, it could maintain productivity in areas where farmers have good cooperation. The case of green manure (Chapter 5) shows that farmers with an interest in reducing chemical fertiliser use include learning practices and knowledge distribution in existing forms of collective action. However, the case also shows that effective technology performance depends on contextual factors such as ecological conditions, soil properties, seed quality, social-economic conditions, and the technology itself. The challenge is how to involve farmers' organizations in new opportunities through collaboration with research and development institutions, based upon individual innovation in farmer's practice, and how to link existing vertical knowledge transfer to learning within and among farmer networks.

The joint problem solving under contractual farming arrangement (Chapter 6) emerged from the social organization of trust building and benefit sharing, in the sense of mobilizing labour and arranging market access with a guaranteed price. The inclusion of existing forms of collective action into contract farming arrangements resulted in performance improvement in the cultivation of cash crops and the planning and implementation of agricultural activities from planting to harvesting. Brokerage and service supervision further ensured improved linkages between the company's R&D and the farmers through participatory technology development, thus securing performance improvement, as contract farming requires intensive and timely management to meet production deadlines. However, in order to improve collective action and technological performance of contract farming, benefit sharing system has to be reviewed and the social coherence between farmers and companies can be improved through giving an active role to a mediator in negotiations and finding institutional modalities for including farmers in company R&D technology development.

7.3 The role of collective action in making technology work

The thesis shows that for specific technologies to work collective action is a pre-condition. The CRSP case (Chapter 3) clearly shows that collective action is essential for creating a communal seed plot for effective seed production in DPL. As a result, farmers can have access to quality rice seed for next season's planting, and specially selected materials are used to propagate as seed for sustainable seed production. The process of collective action in seed production has built up farmer confidence to negotiate with the local government organization (TAO) for supporting the development of a seed market. Integration of individual innovation to develop cost-effective production technology, and institutional support on seed certification schemes, would help to improve the configuration of rice seed production in DPL village.

Cost-effective technology (Chapter 4) emerged from a common interest and farmer-regulated management systems, such as biological pest management through implementing community frog protection. In the case of community-based biological pest management, it was essential that farmers jointly recognized pest management problems and the key success factors of collective management to legitimize community-based management practices. The involvement of the monk was significant in legitimizing collective protection of rice fields through shared beliefs. Sharing knowledge was also essential in further developing and adapting the weed slasher machine into a labour saving and non-destructive straw harvesting method. It is necessary to support individual innovation by creating knowledge sharing among farmers to improve technology. Local innovation on the double transplanting method in rice production, which helped farmers to maintain productivity under unfavourable conditions, was highly dependent on the practice of labour exchange. The farmer field day, as illustrated in the case studies, provides farmers with the opportunity to have interactive discussions among farmers and mutual learning from real cases. It is an effective method in scaling out the learning process and information. Collective learning and action was shown to be an effective approach in technology diffusion among members of farming communities.

Farmers and the Multiple Cropping Centre [MCC] collectively worked on introducing green manure, using *Sesbania rostrata* as a soil improving technology in rice farming, and jointly introduced this low-cost, input-saving technology suited to the needs of small rice farmers. This participatory initiative included farmer-researcher interaction, a continuous process of trial-observation-modification, farmer feedback and redesign of technology. In the green manure case, collective action became an important social asset for scaling up of farming innovations. Through collective action, group members interact, reflect on performance, exchange information and experience, create new knowledge and propose new initiatives. Then, collective action is found not only at the farmer level, but also in the interaction between farmers and the research institution, MCC.

Performance in the contracted production of sweet corn, vegetable soybean and hybrid maize seed depended on concerted action between farmers and between farmers and companies (Chapter 6). Different cropping and water use patterns needed to be managed collectively in order to regulate the natural conditions of crop production. However, the study also observed a clear disconnection between layers in the supply chain: feedback from farmers did not reach the managerial and R&D levels in the company. The contract crops show production risks especially in vegetable soybean production with uncertainty of seed quality and less alternative of chemical use in pest management. Compensation is possible only through negotiation with the primary broker. A stronger emphasis on joint problem solving could reinforce the commitment of collective action to the contract farming schemes and, consequently, avoid potential conflicts related to performance and remuneration.

This thesis evidently shows that effective technology development and agro-technological innovation depend on social relationships and, more specifically, on the capacity to link to existing forms of collective action. Technology that works is constituted by both the technology itself and social conditions and contexts. In other words, it is concluded that technology-that-works is a configuration (Rip and Kemp, 1998) resulting from a combination of agro-ecological conditions, technological artefacts and social arrangements, including collective action.

The incentive for people to participate in technology development as well as the management and development of resources is a major enabling factor for sustainable collective action. In addition, collective knowledge can make an important contribution to technology development and innovation so that people with long experiential learning from trial and error in rice farming are able to integrate their own knowledge with outside knowledge in developing technology.

This raises the question on how to link technology development and adaptation grounded in collective action in rice farming communities with technological innovation in public or private R&D organisation.

7.4 Up-scaling

This thesis approaches up-scaling from a horizontal and vertical perspective. Most insights have been generated on horizontal up-scaling (*i.e.* out-scaling), considered as a form of social networking among farmers with similar problems. This thesis shows that horizontal up-scaling worked in the context of DPL, but not in BM. In DPL, the community rice seed system was a technological configuration that also enabled both other innovations such as the frog protection schemes and intensive interaction and learning between farmers. The technological outcomes in return reinforced existing forms of collective action. Potentially, this provides a viable basis for expanding the outreach of the community rice seed development, for example by adding seed certification schemes. The village could then be promoted as a seed production centre, producing quality rice seed for neighbouring villages. On the other hand, in BM where farmers are more interested in off-farm employment and producing rice mainly to meet household needs, the production of a green manure cover crop assumes the same conditions to be present. This evidently was not the case. Therefore, this study suggests that it is necessary to understand the technological configuration within a given context.

Analysis of the case studies shows that certain paths of technology development, such as the rice seed system or the frog protection scheme, assume and require specific forms of collective action that may be absent in other contexts: the differences between DPL and BM are revealing in this sense. Social leadership in combination with access to a specific agro-ecological area – the 'island' - proved to be essential for maintaining the conditions for collective action in DPL; in BM rural households adopted livelihood strategies reliant on off-farm employment and with a weaker rooting in farming. The observed variety in organisational forms and social coherence leads to an important lesson for the practice of participatory technology development, namely that attractive technologies, assuming certain social conditions, may be incommensurable with realities in rural economies. Yet, numerous NGOs and research organisations tend to select small-scale technologies that strongly rely on a high level of collective action and they may therefore fail to work on technological innovations tailored to less favourable social-economic conditions. Hence, an insight from this thesis is that constructing a fit-for-all model of collective action for small scale and sustainable technologies may not be desirable because of the different social and material conditionalities in the field.

The thesis underlines that a specific form of collective action is the outcome of social relationships and farmers' choices in a specific locality. The implication for government and market agencies is to build on autonomous decision making in the village and to tailor their technology and up-scaling strategies to local conditions. Building on existing capacities and constraints in villages may eventually lead to a variety of models that recognise the specific social institutions and organisational forms needed to make the technology work. The results therefore also imply that, for example, the implementation of community rice seed production nation-wide will be inappropriate if the technological configurations in particular local contexts are not taken into account.

Hence, the mode and form of vertical up-scaling appears to be an important issue for effective technology development. The thesis looked at vertical up scaling by examining the feedback between users of technology and research organizations, by examining the roles of local government institutes, with more executive powers due to decentralisation propagated by the Thai government, and by investigating the vertical linkages in contract farming schemes.

The case study emphasizes the relevance of continuous interaction and feedback between users and researchers as tools in developing appropriate technology. This is considered more effective than the delegation of dissemination tasks to farmer groups and conventional instruction. Institutional actors should not be allowed to "plan" and then delegate everything to farmers, under the banner of self-reliance, but should continue to interact with community groups to make technology work. The approach advocated is that of working on technology as "situated action" (Suchman, 1987). Moreover, the feedback mechanism from farmer practice is necessary to link existing vertical knowledge transfer to learning within and among farmer networks into current research and development.

At several points, the thesis introduces the various roles of local government institutes, and it anticipates that these institutes will continue to have increasing roles in overall area-based agricultural development. The support of the local actors, seen in leadership of the monk, village leaders, group leader, as in the case of Thai context, the Tambon Administration Organisation [TAO], and the local agricultural extension office who are in close contact with farming communities, is essential for vital community cooperative activity and collective learning. These local brokers also play an important role in negotiations between local farmer groups and TAO, for example for accessing financing schemes or for decision-making on locally controlled public funds. Linking local governing institutions to the process of up-scaling innovation is still a largely uncharted terrain but has promising perspectives. For instance, the expansion of frog conservation in rice growing areas would work best at the Tambon Council level, where representatives of all villages are members.

The thesis emphasises the facilitating roles of the local governing institutions to develop and promote self-learning and self-assessment for the community. The support provided by the TAO should be based on collective performance of the groups or sub-groups. For instance, the provision of free interest loans to the group, both short and medium term, is based on group performance. The success is at present based on financial criteria alone, particularly the ability to pay back on time. The challenge for up-scaling is to provide local organizations, such as TAO, with new incentives and opportunities so that its key actors are committed to new functions. As mentioned in Chapters 1 and 2, TAO is a small unit but has executive power to oversee welfare of local community within its administrative boundary. The new role could include providing enabling environment, brokerage with companies and trading cooperatives, scanning innovations, setting the research and development agenda building on collective action. In practice, TAO has the potential and opportunity to carry out up-scaling on its own initiative.

The thesis also observed a growing role for the private sector in making technology development effective for the rice farming communities. However, the study also observed a missing link in collective action for technology development specifically with local relevance. Linking on-farm farmer experimentation with the company's on-station studies would strengthen the research and development programme. This is not an easy endeavour because the managerial styles adopted by the contracting companies do not easily accommodate representation and participation by producers associated through collective action. However, the shared interest in improved performance may be better served by including socially viable arrangements.

Finally, the discussion on horizontal and vertical up-scaling opens a debate on how to include new functional roles within existing organizational forms of collective action, and how to link local brokers and local government organisations within configurations that make technologies work. This discussion may shed light on how to arrange the processes of up-scaling by reinforcing socially embedded forms of cooperation and negotiation.

Annexes

Annex A. Rights and obligations of farmers and the Pioneer Hi-bred (Thailand) Ltd. in hybrid maize seed production.

Farmers obligations	**Company obligations**
1. use land and follow production regulations specified in contract as follows: 1.1 plant the crop and maintain weed-free and pest-free plot; manage field plots and surrounding to suit the company's field operation; harvest crop by strictly followed the recommendation of the company and the field staff. 1.2 must help the company's staff remove off-types in the production plot and its surrounding by strictly followed staff's recommendation. 1.3 complete detasseling female plants before flowering, and remove all male plants after pollination is complete by following staff's recommendation.	1. supply seed as necessary according to the company's decision 2. supply fertilizers and chemicals as necessary on credit 3. purchase all production based on moisture content on the day of delivery 4. pay farmers according to the agreed formula as follows:(cob weight equal or more than 0.5 kg will be rounded up to 1 kg) 4.1 target yield (kg/*rai*) 750-834 pay 5,500 *Baht/rai* 4.2 above target yield (kg/*rai*) 835-919 pay 6,500 *Baht/rai* 920-1,004 pay 7,500 *Baht/rai* 1,005-1,019 pay 8,500 *Baht/rai* 1,200 pay 10,700 *Baht/rai* above 1,200 kg pay 5 *Baht*/kg 4.3 below target yield (kg/*rai*) 660-749 pay 4,500 *Baht/rai* 570-659 pay 3,500 *Baht/rai* below 570 pay 2,500 *Baht/rai* Payments will be deducted from advanced credits on fertilizers and chemicals provided by the company. 5. pay farmers within two weeks after product delivery
Farmers rights	**Company rights**
1. receive special payment when farmers 1.1 complete detasseling all female plants on time following staff's recommendation 500 *Baht/rai* 1.2 carry out good agricultural practice: weed-free, pest-free, remove off-types, within plot and its surrounding following staff's recommendation 200 *Baht/rai* 1.3 strictly follow staff's recommendation on preventing cross-pollination by having seed plot at a distance from others, or separating seed plot through proper planting date 200 *Baht/rai*	1. have the rights to make final decision on special payment 2. withdraw special payment in the event of default, particularly 1.1 on detasseling process and 1.3 on preventing cross-pollination measures 3. impose penalties on seed plot which is doubtful on its genetic purity, due to farmers' negligence. The company will pay 1.20 *Baht*/kg of cobs at moisture content on the day of delivery

Source: Contract grower, 2005

Annex B. Rights and obligations of farmers and the Pioneer Hi-bred (Thailand) Ltd. in yield testing of hybrid maize contract

Farmers obligations	Company obligations
1. use land and follow production regulations specified in contract as follows: 1.1 plant the crop and maintain weed-free and pest-free plot; manage field plots and surrounding to suit the company's field operation; harvest crop by strictly followed the recommendation of the company and the field staff. 1.2 must help the company's staff remove off-types in the production plot and its surrounding by strictly followed staff's recommendation. 2. take full responsibility if seeds of parental lines or hybrid are escaped from farmers' plots and are being found elsewhere 3. keep information on inbred lines and hybrid, as well as their parental materials confidential 4. must not produce seed for other companies or individuals at the same time unless receiving approval from the company	1. supply seed as necessary according to the company's decision 2. supply fertilizers and chemicals as necessary on credit 3. detassel in female rows under the company's responsibility 4. purchase all production based on moisture content on the day of delivery 5. pay farmers according to the agreed formula as follows:(cob weight equal or more than 0.5 kg will be rounded up to 1 kg) 5.1 yield (kg/*rai*) 975-1,174 pay 7,100 *Baht/rai* 5.2 yield(kg/*rai*) 1,174-1,449 pay 8,600 *Baht/rai* 5.3 yield (kg/*rai*) 1,450 pay 10,600 *Baht/rai* 5.4 In case the company cannot supply seed for planting to the area as agreed on contract, the company will pay compensation on the unused land at 5,000 *Baht/rai*. Payments will be deducted from advanced credits on fertilizers and chemicals provided by the company. 6. pay farmers within two weeks after product delivery
Farmers rights	**Company rights**
1. receive special payment when farmers 1.1. carry out good agricultural practice: weed-free, pest-free, remove off-types, within plot and its surrounding following staff's recommendation 200 *Baht/rai* 1.2. strictly follow staff's recommendation on preventing cross-pollination by having seed plot at a distance from others, or separating seed plot through proper planting date 200 *Baht/rai* 2. receive minimum guaranteed income of *Baht* 5,000 if strictly follow staff's recommendation	1. have the rights to make final decision on special payment 2. withdraw special payment in the event of default, particularly 1.1 not carrying out good agricultural practice, and 1.2 on not preventing cross-pollination measures 3. pay 2,500 *Baht*/*rai* to farmers whose cob yields are lower than 975 kg/*rai* due to farmers' negligence 4. request repayment from farmers whose negligence has caused damage to the company's investment in inputs and seed supply 5. all seed produced and harvested remains the property of the company

Source: Contract grower, 2005

Annex C. The Chiang Mai Frozen Food Company's recommendations of vegetable soybean production practices to its contracting farmers

Days after planting	**dd/mm/yr**	**Practices**
Planting		Inoculate seed with Mencozep 40g/10kg seed Inoculate seed with rhizobium
5-6 days		Spray Dimethoate 20 cc/ 20 liters of water
11-12 days		Apply fertilizer 15-15-15 at 50 kg/*rai* Spray Dimethoate at 20cc/ 20 liters of water Spray Mencozep at 40g/20 liters of water Spray Imidacopic 50cc/ 20 liters of water
17-18 days		Apply fertilizer 14-14-21 at 50 kg/*rai* Spray Lannate 15-20 g/20 liters of water + Mencozep 40g/20 liters of water + hormone
23-24 days		Spray Lannate 15-20 g/ 20 liters of water + Mencozep 40g/ 20 liters of water + hormone Spray Imidacopic 50cc/ 20 liters of water Spray copper hydroxide 10-20g/20 liters of water
29-30 days		Spray Lannate 15-20 g/20 liters of water + Mencozep 40g/20 liters of water + hormone
35-36 days		Spray Lannate 15-20 g/20 liters of water Spray Bennomil 10g/20 liters of water + hormone Spray copper hydroxide 10-20g/20 liters of water
41-42 days		Spray Lannate 15-20 g/20 liters of water Spray Bennomil 10g/20 liters of water + hormone
60-65 days		Harvest

Source: Contract grower, 2005

Annex D. Questionnaire of farmer perception on participation in Community Rice Seed Production (CRSP)

Questionnaires

Buak Mue (BM) / Dong Palan (DPL) village

Kee Lek sub-district, Mae Teang district, Chiang Mai province

Part I: Households information

Name ....

Address ....

Telephone number ....

1. Education level

☐ Not educated ☐ Primary school

☐ Secondary school ☐ Higher than secondary school

2. Status

☐ Single ☐ Married ☐ Widow/Divorced

3. Member of family household

3.1 Total ....

3.2 Number of male ....

3.3 Number of female ....

3.4 Number of children ....

3.5 Number of the elder ....

4. Age

4.1 Age of answerer .... years

4.3 Age of husband/wife .... years

4.4 Age of children

First child .... years

Second child .... years

Third child .... years

5. Number of on-farm labour in household

	Total	Male	Female
Full time			
Part time			

6. The person who makes decision on production

☐ Husband ☐ Housewife ☐ Both

7. Farmers experiences

7.1 Experience on agricultural sector ……………….. years

7.2 Experience on rice production ……………….. years

8. Participation in group or organization

Group/Organization	(years)
8.1 Agricultural cooperation	
8.2 Bank for Agriculture and Agricultural Cooperatives	
8.3 Community Rice Seed Production group	
8.4 Maize production group	
8.5 Soybean production group	
8.6 Pesticide-free vegetables production group	
8.7 Housewife group	
8.8 etc. --	

9. Land tenure

Unit: *rai*

Cultivated area	Total area	Own land	Rented land	Free-of-charge	Remark (*i.e.* rental fee)
Rice					
Maize					
etc.					

Part II. Participation in Community Rice Seed Production (CRSP) group *(if the answerer didn't participate in this group, skip to 2.2)*

2.1 CRSP group

1. The reason for participating in CRSP group *(Please, rank priority)*

☐ subsidizing rice seed

☐ subsidizing chemicals

☐ requiring to develop higher rice seed quality

☐ interested in loan

☐ …………………………………………………

2. How long have you been in CRSP group? ……………… (years), since
   Who did persuade you to get into group?
   ……………………………………………………………………………………………………....
3. What are your supports to CRSP group, apart from participating in group?
   ……………………………………………………………………………………………………....
4. What are you gaining from participating in CRSP group?

4.1 ………………………………………………………………………………………....

4.2 ………………………………………………………………………………………....

4.3 ………………………………………………………………………………………....

4.4 ………………………………………………………………………………………....

4.5 ………………………………………………………………………………………....

5. Does the modified weed slasher take an advantage for CRSP group?

☐ Yes ☐ No

Because of

………………………………………………………………………………………………....

6. Have you ever develop technology for reducing rice production cost?

☐ Yes ………………………………………………………………………………………

☐ No

7. How do you assess your cooperation in the CRSP group activities?

		What did you assess from?
☐	Most	
☐	More	
☐	Moderate	
☐	Less	
☐	Least	

8. What are your roles in the community frog conservation?

………………………………………………………………………………………………....
………………………………………………………………………………………………....
………………………………………………………………………………………………....
………………………………………………………………………………………………....

2.2 Non-CRSP group

1. Have you ever known about CRSP group in your village?

☐ Yes ☐ No

2. Have you ever participated in the CRSP group's activities or Farmer Filed School?

☐ Yes ☐ No

3. Why you do not participate in CRSP group?

☐ No land for rice production

☐ Have more activities

☐ No time

4. Do you participate in another group in the village or community?

☐ Yes, that is/are

…………………………………………………………………………………………………

The reason for participating in this/these group(s)

…………………………………………………………………………………………………

☐ No, because of

…………………………………………………………………………………………………

5. When will you be ready to join the CRSP group?

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

6. Have you ever participated in the community frog conservation?

☐ Yes ☐ No

(give the reason)

…………………………………………………………………………………………………..

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

Part III. Production costs year 2004 (November 03- December 04).

3.1 Production costs

	Plantation			
	Rice	Rice	Other cash crop	Other cash crop
Plant variety				
1. Farmer's experience (years)				
2. Planted area (*rai*)				
3. Seed rate (kg/*rai*)				
4. Planting duration				
- Planting date				
- Harvesting date				
5. Fertilization				
No. of fertilization				
1st time				
Type				
Amount of use				
Price (per unit)				
2nd time				
Type				
Amount of use				
Price (per unit)				
3rd time				
Type				
Amount used				
Price (per unit)				
6. Herbicides				
No. of spraying/broadcasting				
1st time				
Type				
Amount of use				
Price (per unit)				
2nd time				
Type				
Amount used				
Price (per unit)				
7. Fungicides				
No. of spraying/broadcasting				
Type				
Amount used				
Price (per unit)				
8. Insecticides				
Type I. for				
Amount uses				
Price (per unit)				

	Plantation			
	Rice	Rice	Other cash crop	Other cash crop
Type II. for				
Amount used				
Price (per unit)				
9. Pesticides				
Type I. for				
Amount used				
Price (per unit)				
Type II. for				
Amount used				
Price (per unit)				
Type III. for				
Amount used				
Price (per unit)				
10. Growth hormone				
No. of spraying				
Type				
Amount of use				
Price (per unit)				
11. Fuel and transportation costs				
12. Cost of food and drinks (Planting and harvesting)				
13. Threshing cost				
14. Total yield (kg)				
15. Amount of distribution (kg)				
16. Return from distribution (*Baht*)				
17. Fertilization trend (compare with the last year)				
The reason for less or more fertilization				
18. Currently yield compare with the last year				
The reason for gaining less or more yield				

Plantation period in 1 year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Remark: including off-farm activities, identify type of off-farm;

3.2 Labour costs

Activities	Rice									Sweet corn									Maize								
	Household labour			Exchange labour			Hired labour			Household labour			Exchange labour			Hired labour			Household labour			Exchange labour			Hired labour		
	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.
Variety																											
Planted area Rai																											
1. Land preparation																											
- 1st plough																											
- 2nd plough																											
- trenching																											
- putting lime																											
2. Transplanting																											
- 1st transplanting																											
- 2nd transplanting																											
3. Fertilization																											
- 1st dap																											
- 2nd dap																											
- 3rd dap																											
4. Herbicides time(s)																											
5. Fungicides time(s)																											

3.2 Labour costs (Continued)

Activities	Rice									Sweet corn									Maize								
	Household labour			Exchange labour			Hired labour			Household labour			Exchange labour			Hired labour			Household labour			Exchange labour			Hired labour		
	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.	No.	Day	Hr.
6. Insecticides time(s)																											
7. Pestiicides time(s)																											
8. Growth hormone time(s)																											
9. Watering time(s)																											
10. Harvesting																											
- manual																											
- modified weed slasher machine																											
- 4-row harvester																											
- Small combine																											
11. Piling																											
12. Threshing																											
- manual																											
- motor driven thresher																											
13. detasselling																											
14. carrying																											

Part IV. Farmer's perception on green manure crop

4.1 Which are your methods for reducing production costs?

	Method	Timing (years)	Frequency per year	Production		
				rice	maize	etc.
☐	Manure					
☐	Green manure crop					
☐	releasing frogs in the rice field					
☐	Bio-extract					
☐	Modified weed slasher for harvesting					
☐	Herbicide utilization					
☐	etc.					

4.2 Where are your major sources of information?

……………………………………………………………………………………………………...

……………………………………………………………………………………………………...

4.3 Are you interested to participate in green manure crop project, if there is only seed subsidizing?

☐ Yes, (give the reason)

…………………………………………………………………………………………….

…………………………………………………………………………………………….

☐ No, (give the reason)

…………………………………………………………………………………………….

…………………………………………………………………………………………….

4.4 What are the factors influencing on the decision of utilizing green manure crop?

5.4.1 ……………………………………………………………………………………………

5.4.2 ……………………………………………………………………………………………

5.4.3 ……………………………………………………………………………………………

4.5 How do you assess the fertility in your rice fields, and why?

……………………………………………………………………………………………………...

……………………………………………………………………………………………………...

……………………………………………………………………………………………………...

……………………………………………………………………………………………………...

……………………………………………………………………………………………………...

Part V. Source of income, capital and credit

5.1 Total household income of the last year (2004) ……………………………. *Baht*

5.1.1 Income from plantation ………………………………………….*Baht*/year

Please identify type of plantation ………………………………..……………………

5.1.2 Income from livestock …………………………………………*Baht*/year

Please identify type of livestock …………………………………………………………

5.1.3 Income from wages in agricultural sector ……………………. *Baht*/year

Please identify activities ………………………………………………………………….

5.1.4 Income from off-farm activities ………………………………… *B*aht/year

Please identify activities ………………………………………………………………….

5.2 Sources of capital for agricultural investment

☐ solely from own budget

☐ solely from loan

☐ partially from loan

In case of lending, the regular source(s) is/are ……………………………………………………

and amount of loan is …………………………… *Baht*/year

5.3 Indebtedness, classify by sources of credit.

………..

5.4 Do you have any role in village or sub-district level?

☐ Yes. That is/are …………………………………….. for ………………………….. year (s).

☐ No.

5.5 How many times did you see the extension officer in one month or year?

………..

5.6 Farmers' household assets

6.6.1 <u>Agricultural assets</u>

☐ Two-wheel ☐ Tractor ☐ Weed slasher

☐ Water-pump ☐ Sprayer ☐ Mower

☐ etc. (Please, identify) ……………………………………………………………………….

6.6.2 <u>Household assets</u>

☐ Truck ☐ Motorcycle ☐ Refrigerator

☐ Television ☐ etc. (Please, identify) ………………………………….

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Summary

Many farming communities, through collective action, are able to improve, protect, and sustain resources for their lives. Collective action is assessed as an organisational form that brings people together and generates and redistributes benefits associated with improved farming livelihoods. The thesis seeks to build an understanding of farmer capacity in cooperation, as well as to identify crucial enabling factors that stimulate collective action to enhance continued learning and adaptation for sustainable development, via analysis of group attributes in relation to four sets of elements: agro-ecological conditions, socio-economic variables, cultural context and the role of government intervention. The study focuses on small-scale rice farming in Northern Thailand, with the aim to understand the social and technical relations involved in rice based farming systems, and to illuminate scope for participatory technology development more generally. This thesis targets rice farmers because of their important contribution to the country's food security and social economic development.

The main research questions were:

1. What are the forms and conditions for collective action among the rural poor in Northern Thailand?
2. How do farmers in Northern Thailand manage collective action for technology development in different cases?
3. What makes collective action work for technology development and agro-technological innovation?
4. How can collective action for technology development by small-scale farmers in Northern Thailand be improved, and what can it contribute to the improved sustainability of village agriculture?

The research was carried out in a village with viable forms of collective action (Dong Palan, DPL) and in another village (Buak Mue, BM), included for comparative purposes, where off-farm employment affects labour use and household composition in such a way that collective action eroded or has a different orientation. The research is based on several case studies in the villages of BM and DPL, which are serviced by the same irrigation scheme in Mae Teang district, Chiang Mai province, Northern Thailand. Both qualitative and quantitative methods were used for data collection. The methods and techniques used depended on specific or prevailing circumstances at each phase of research process. Semi-structured interviews of key informants, group meetings, focus group discussion, farmer workshops and participant observation were all employed. The case-study analysis is based on fieldwork in which participant observation of farming activities throughout an agricultural season was combined with farming systems data collection procedures.

Chapter 1 introduces the context of agricultural development in Thailand, especially in the North, to outline the historical background of collective action, mentioning in particular self organized groups in irrigation management and community forests, and governmental initiatives in establishing civil groups for

social and economic development at village level. The evolution of participatory technology development research and transformation of extension systems is also explained. The thesis also has an interest in up-scaling local initiatives. Hence, the context is followed with a brief overview of development and agricultural policy in Thailand which emphasizes institutional development: decentralisation and empowerment and, a shift to agro-industrial and business development. The overview of agricultural policy is complemented by a brief history of technological change in Thai rice farming, such as adoption of modern rice varieties, changing cultivation practices, introduction of cash cropping and integrated farming.

Chapter 2 provides local setting of two studied villages, showing difference in five key contextual conditions as described by agro-ecological, land tenure, socio-economic, livelihood strategies and social –organisational and cultural. The physical context and historical and social cultural background influence the different forms of cooperation encountered in the case-study villages. The practices of farmers in BM are more individualistic, in both farm and non-farm activities, as observed in the low number of group organizations, including groups for agricultural credit.

Chapter 3 explores collective action in community rice seed production (CRSP) scheme, which has been introduced in rice farming areas throughout the country. The DPL rice community meets all elements in technological configuration including agro-ecosystem determinants, social mechanisms and collective action. The inclusion of key actors such as village headman, village group leader, monk, TAO, and local extension agent, has helped motivated the success of CRSP in DPL village. On the contrary, the CRSP performance of BM village is less satisfactory. The BM village can still receive benefit by using seed produced from the DPL village, but its competent individual farmer can supply foundation seed for the DPL CRSP group. Thus we see the sustainability of CRSP needs hybrid form of collective action, individualistic for innovation, and egalitarian for group cohesiveness. So in practice, BM and DPL can form partnership in rice seed production, where a key farmer in BM produces foundation seed with his pure line selection technique, and supplies it to the DPL CRSP group for production of certified rice seed. Other relevance of the CRSP groups as form of collective action is to provide access to services for the landless, gender equity for woman and man in remuneration in rice.

Chapter 4 looks at three cases where farmers have been involved in local development of simple but effective rice technologies – frog protection as a form of integrated pest management, modification of a weed slasher to help work groups partially mechanized labour-demanding and expensive harvesting operations, and a double-transplanting technique that strengthens rice plants to withstand flooding and pest attack on land subject to rapid and unpredictable flooding. The technological innovation of three case studies stresses that farmers are inventive, and work continuously to adapt technology to their needs and circumstances, and that this type of local technology development seems to work best where a group is engaged with prior experience of collective action.

Chapter 5 investigates two institutional approaches, the MCC's participatory, and the LDD's hierarchical, in dissemination of green manure technology in rice farming. The chapter is interested in whether agricultural systems could be made more sustainable through the right kind of interaction between the various actors linked by feedback mechanisms associated with the participatory approach. The chapter also considers how to integrate mobilization of farmer knowledge, complementary to that of formal research organizations. Brief attention is also paid to initiatives to scale up green manure technology on a national scale. The empirical evidence from case studies suggests that adaptability of GMCCs in rice farming is a product of technological fit, actor interaction, and the dynamism of farmer knowledge systems, which together produce individual and collective understandings and new and adequate performance. The MCC approach involving farmer group participation in technology validation and modification, has led both parties towards some collective appreciation and mutual learning about intrinsic problems associated with GMCC utilization under local conditions. The LDD approach with a stronger hierarchical organization, results in less social integration and a certain degree of disconnection between farmers and agency. The participatory approach is seen as an empowering process; its value based on encouraging non-linear technology modification and dissemination in situ, enables farmers and researchers to contextualize and redesign production technology. The up-scaling process requires changes in institutional configurations.

Chapter 6 describes how smallholder rice farmers in DPL village included contract farming arrangement in their livelihood strategies. They invested in land improvement, irrigation, and labour to develop their farming enterprise in the island, where land with its sandy texture is suitable for cultivation of vegetable soybean, sweet corn and hybrid maize seed production. Two companies offered contracts for the production of these high value crops and provided inputs, credit, technological services, and a secure market with a guaranteed price. The study underlines the importance of social cohesion for contract farming by looking at the various tasks requiring concerted action. There are several layers of interdependence with respective process of collective action and their performances in contract farming such as farmers-farmers, farmers-broker, and farmers-field technician. The study informs us on the nature of an interdependent relationship of smallholder rice farmers with external agencies that is based on performance in crop production. The case of contract farming between the DPL farmers and two companies shows that good contract farming performances have been achieved as a result of good social relationships between farmers and the companies, through field technicians and primary broker with various forms of collection action in the process. However, the study shows a missing link between collective action for technology development, specifically with local relevance, and contract farming arrangements. The companies did not make use of the social connectedness of DPL farmer groups to initiate participatory technology development, linking on-farm farmer experimentation with their own research studies. The system could be improved and resulted in more equitable benefits to farmers if there were collective action through direct connection between farmers and the company administration.

The concluding chapter reflects on our four research questions and their answers, starting from the forms and conditions of collective action and moving towards the management of collective action for technology development. There are various forms of collective action, and the forms suitable for technology development depend on social and material circumstances in the local context. The varying organisational forms of collective action reveal a hybridity of institutional modalities, which is further described, using grid-group theory, by the level of regulation of individual behaviour and the level of absorption of individuals in group memberships.

The management of collective action has a clear impact on technology development. The most important institutional and individual mechanisms are flexible forms of benefit sharing recognising and managing common interests, trust building, and, finally, joint problem solving and knowledge exchange about agro-technology among farmers themselves and between farmers and external agencies such as companies or research institutes.

This thesis evidently shows that effective technology development and agro-technological innovation depend on social relationships and, more specifically, on the capacity to link to existing forms of collective action. Technology that works is a configuration resulting from a combination of agro-ecological conditions, technological artefacts and social arrangements, including collective action.

The incentive for people to participate in technology development as well as the management and development of resources is a major enabling factor for sustainable collective action. In addition, collective knowledge can make an important contribution to technology development and innovation so that people with long experiential learning from trial and error in rice farming are able to integrate their own knowledge with outside knowledge in developing technology.

This thesis approaches up-scaling from a horizontal and vertical perspective. Most insights have been generated on horizontal up-scaling or out-scaling, considered as a form of social networking among farmers with similar problems. This thesis shows that horizontal up-scaling worked in the context of DPL, but not in BM. In DPL, the community rice seed system was a technological configuration that also enabled both other innovations such as the frog protection schemes and intensive interaction and learning between farmers. The technological outcomes in return reinforced existing forms of collective action

The observed variety in organisational forms and social coherence leads to an important lesson for the practice of participatory technology development, namely that attractive technologies, assuming certain social conditions, may be incommensurable with realities in rural economies. Hence, an insight from this thesis is that constructing a fit-for-all model of collective action for small scale and sustainable technologies may not be desirable because of the different social and material conditionalities in the field.

Samenvatting

In veel boerengemeenschappen is collectieve actie een belangrijk element bij het verbeteren, beschermen en onderhouden van de bronnen van levensonderhoud. Collectieve actie is een organisatievorm die mensen samenbrengt en voordelen oplevert door op een betere manier boer te zijn. Deze dissertatie laat het vermogen van boeren tot samenwerking zien en onderscheidt tevens enkele cruciale factoren die collectieve actie bevorderen en een continu proces van leren en aanpassen ten behoeve van duurzame ontwikkeling versterken. Dit gebeurt via de analyse van groepskenmerken met betrekking tot vier soorten elementen: agro-ecologische omstandigheden, sociaaleconomische variabelen, culturele context en de rol van overheidsinterventie.

Het onderzoek gaat over kleinschalige rijstteelt in Noord Thailand en heeft tot doel de sociale en technologische relaties te begrijpen die van belang zijn in op rijst gebaseerde *boerenbedrijfssystemen*. De inzichten laten de ruimte zien die er is voor participatieve technologieontwikkeling. Deze dissertatie richt zich op rijstboeren vanwege hun belangrijke bijdrage aan Thailands voedselzekerheid en sociaaleconomische ontwikkeling.

De belangrijkste onderzoeksvragen zijn:

1. Welke vormen en omstandigheden gelden voor collectieve actie van arme dorpelingen in Noord Thailand?
2. Hoe gaan boeren in Noord Thailand om met collectieve actie ten behoeve van technologische verbetering in de verschillende cases?
3. Wat maakt dat collectieve actie werkt voor technologieontwikkeling en agro-technologische vernieuwing?
4. Hoe kan collectieve actie voor technologieontwikkeling door kleinschalige boeren in Noord Thailand worden verbeterd, en hoe kan deze bijdragen aan grotere duurzaamheid van de dorpslandbouw?

Het onderzoek werd uitgevoerd in een dorp met levensvatbare vormen van collectieve actie, Dong Palan (DPL) en een nabijgelegen dorp, Buak Mue (BM), dat ter vergelijking werd onderzocht, waar arbeid buiten het boerenbedrijf zodanig van invloed was op het gebruik van arbeidskracht en de samenstelling van het huishouden, dat collectieve actie verslapte of een andere richting kreeg.

Het onderzoek is gebaseerd op case studies van verschillende technologische interventies in de dorpen DPL en BM. Beide dorpen zijn onderdeel van hetzelfde irrigatiestelsel in het subdistrict Mae teang, provincie Chiang Mai, in Noord Thailand. Zowel kwalitatieve als kwantitatieve methoden zijn gebruikt voor het verzamelen van de gegevens. Tijdens verschillende fasen van het onderzoek is gekozen om met bepaalde methoden en technieken te werken, afhakelijk van de omstandigheden, bijvoorbeeld halfgestructureerde interviews met sleutelinformanten, groepsbijeenkomsten met gerichte discussie onderwerpen, workshops met boeren en participatieve observatie. In de case studies is observatie

van de landbouwactiviteiten gedurende een heel seizoen gecombineerd met het verzamelen van data over boerenbedrijfssystemen.

Hoofdstuk 1 stelt de omgeving van de landbouwontwikkelingen in Thailand aan ons voor vooral in het Noorden, geeft de historische achtergrond van collectieve actie door te verwijzen naar zichzelf organiserende groepen in irrigatie beheer en gemeenschapsbossen, en bespreekt de overheidsinitiatieven om burgergroepen op te richten ten behoeve van de sociale en economische ontwikkeling op dorpsniveau. Ik licht ook de evolutie van participatieve technologieontwikkeling en de transformatie van voorlichtingssystemen toe. In mijn onderzoek ben ik in het bijzonder geïnteresseerd in de opschaling van lokale initiatieven. Hoofdstuk 1 plaatst dit in de ontwikkeling en het landbouwbeleid in Thailand, met de nadruk op institutionele ontwikkeling: decentralisatie en *empowerment* en een verschuiving naar agro-industriële en boerenbedrijfsontwikkeling. Het overzicht van het landbouwbeleid wordt aangevuld met een korte beschouwing over technologische veranderingen in de rijstteelt in Thailand, zoals de invoering van moderne rijstvariëteiten, veranderde teeltwijzen, de introductie van handelsgewassen en geïntegreerde landbouw.

Hoofdstuk 2 beschrijft de lokale situatie van de beide onderzoeksdorpen en geeft de kern van de verschillen weer door middel van vijf variabele omstandigheden die worden omschreven als agro-ecologische verschillen, verschillen in landgebruik, sociaaleconomische omstandigheden, strategieën voor levensonderhoud, strategieën van sociale organisatie, en culturele aspecten. De fysieke omgeving en de historische, sociale en culturele achtergrond van de boeren beïnvloeden de verschillende vormen van samenwerking in de dorpen van onderzoek. De landbouwpraktijken zowel als de activiteiten buiten de landbouw van de boeren in BM zijn meer individualistisch, wat we zien terugkomen in het geringe aantal groepsgewijze organisaties, inclusief landbouwkredietorganisaties.

Hoofdstuk 3 onderzoekt collectieve actie in het Gemeenschaps Rijstzaad Productie Project (CRSP) dat in het hele land is ingevoerd in de rijstteelt. De rijsttelers gemeenschap van DPL voldoet aan alle technologische voorwaarden inclusief de bepalingen van het agro-ecosysteem en de sociale voorwaarden voor collectieve actie. De deelname van centrale actoren, zoals het dorpshoofd, de groepsleider van het dorp, de monnik, het bestuur van het subdistrict (TAO) en de lokale landbouw-voorlichter heeft er mede het succes van CRSP bepaald. Maar in BM deed het project het minder goed. Gelukkig kunnen boeren in BM gebruik maken van rijstzaad dat in DPL wordt geproduceerd. Ook is er één boer in BM die zaad produceert voor CRSP in DPL. Het CRSP beklijft en beide dorpen zijn partners in de productie van gecertificeerd rijstzaad, zowel op het gebied van individuele innovatie als op het gemeenschappelijke vlak door egalitaire samenhang van de groep. Andere belangrijke kwaliteiten van de CRSP groepen als vormen van collectieve actie zijn dat landloze boeren ervan deel kunnen uitmaken en dat vrouwen en mannen gelijkwaardig zijn en gelijke beloning ontvangen in natura (rijst).

Hoofdstuk 4 beschouwt drie gevallen van lokale technologieontwikkeling in de rijstteelt. Ten eerste, de bescherming van kikkers als vorm van geïntegreerde ongediertebestrijding. Ten tweede, het veranderen van een dorsvlegel om arbeidsgroepen die slechts gedeeltelijk gemechaniseerd waren en dus duur waren in hun oogstwerkzaamheden, te helpen efficiënter te werken. Tenslotte, de invoer van een dubbele overplantingtechniek die de rijstplanten sterker maakt om overstroming en aanvallen van slakken te weerstaan op het land in de bocht van de rivier ('het eiland') dat regelmatig, maar op onvoorspelbare momenten, gevaar loopt onder te lopen. Het succes van de technologische vernieuwingen in deze case studies toont aan dat boeren niet alleen inventief zijn, maar dat zij voortdurend zoeken naar mogelijkheden de technologie aan te passen aan hun behoeften. Dit proces van technologieontwikkeling lijkt het beste te werken als de groep eerder ervaring heeft opgedaan met collectieve actie.

Hoofdstuk 5 bestudeert twee institutionele benaderingen in de verspreiding van groenbemestingstechnologie in de rijstteelt, de participatieve benadering van het Multiple Cropping Centre in Chiang Mai (MCC) en de hiërarchische benadering van het Landontwikkelings Departement (LDD). Ik ben geïnteresseerd in de vraag of landbouwsystemen duurzamer gemaakt kunnen worden door de juiste soort wisselwerking en terugkoppeling tussen verschillende actoren betrokken in rijstteelt. Het hoofdstuk behandelt ook de vragen hoe boerenkennis is gemobiliseerd en hoe deze geïntegreerd kan worden met de formele kennis van de onderzoeksinstituten. Er wordt kort aandacht besteed aan initiatieven om de groenbemestingstechnologie toe te passen op nationale schaal. Volgens empirisch bewijs uit de case studies lijkt aanpassing van groenbemesters en grondbedekkers (GMCCs) in de rijstteelt voort te komen uit technologische geschiktheid, de interacties tussen actoren en de dynamiek van boerenkennis systemen, die tezamen zowel individueel als collectief begrip en nieuwe, meer adequate prestaties bewerkstelligen. De benadering van het Multiple Cropping Centre met participatie van boerengroepen in de validatie en verandering van de technologie heeft bij de partners geleid tot meer waardering en lering over en weer met betrekking tot de intrinsieke problemen die gepaard gaan met het gebruik van groenbemesters en grondbedekkers onder lokale omstandigheden. De benadering van het Landontwikkelings Departement daarentegen, dat een strakke hiërarchie kent, leidt tot minder sociale integratie en zelfs tot een zekere verwijdering tussen de boeren en de instelling. De participatieve benadering wordt gezien als een proces dat de boeren sterker maakt; de waarde ervan is gelegen in de non-lineaire technologie verandering en de verspreiding ervan ter plaatse, wat de boeren en de onderzoekers in staat stelt de productie technologie beter te contextualiseren en aan te passen. Immers, het proces van opschaling vereist veranderingen in de institutionele configuraties.

Hoofdstuk 6 beschrijft hoe kleinschalige rijstboeren in DPL contractteelt voor voedsel- en zaadbedrijven inbouwen in hun ondernemingsstrategieën. Zij investeerden in grondverbetering, irrigatie en arbeid om hun boerenonderneming te verbeteren op 'het eiland' (in de bocht van de rivier), waar de zandige grond geschikt is voor de teelt van soyabonen, zoete maïs en de productie van hybride maiszaden. Twee bedrijven boden contracten aan voor de productie van deze hoogwaardige producten, verschaften zaaigoed, krediet, technologische ondersteuning en creëerden een verzekerde afzetmarkt met een gegarandeerde prijs. Deze studie onderschrijft het belang van sociale cohesie voor contractteelt door te kijken naar de taken die vervuld moeten worden en om gerichte, gezamenlijke actie vragen. Er zijn verschillende niveaus van afhankelijkheid in de betreffende processen van collectieve actie en hun uitvoering in contractteelt, zoals de wederzijdse afhankelijkheid tussen boeren onderling, tussen boeren en middelaar, en tussen boeren en veldtechnicus. Het onderzoek toont de aard van deze onderlinge afhankelijkheidsrelaties tussen kleinschalige rijstboeren en externe instellingen en geeft aan dat de continuïteit nauw samenhangt met de verwezenlijking van bepaalde productiedoelstellingen. Het voorbeeld van de contractrelaties tussen de boeren in DPL en de twee bedrijven laat zien dat positieve resultaten kunnen worden bereikt als gevolg van goede sociale relaties tussen boeren en bedrijven, onder andere door inzet van veldtechnici en de voornaamste middelaar in verschillende vormen van collectieve actie gedurende het hele productieproces. Maar de studie toont ook aan dat er een schakel mist tussen collectieve actie ten behoeve van lokaal relevante technologieontwikkeling en de (algemene) contractafspraken: de bedrijven hebben geen gebruik gemaakt van de sociale verbondenheid van de boerengroepen in DPL om participatieve technologieontwikkeling toe te passen. Dit zou bijvoorbeeld kunnen door experimenten op de boerenbedrijven te koppelen aan onderzoeksactiviteiten binnen de bedrijven. Het systeem van contractteelt zou verbeteren en tot meer gelijkwaardig voordeel voor de boeren kunnen leiden, indien er een directer verband tussen boeren en contractbedrijven zou bestaan.

Het concluderende hoofdstuk geeft een terugblik op de vier onderzoeksvragen en hun antwoorden, te beginnen bij de vormen van en voorwaarden voor collectieve actie en vervolgens het benutten van collectieve actie ten behoeve van technologieontwikkeling. Het blijkt dat er geen algemeen model kan worden gegeven, maar dat er verschillende vormen zijn en dat de vormen van collectieve actie die geschikt zijn voor technologieontwikkeling sterk afhangen van de lokale sociale en materiële omstandigheden. De diverse organisatievormen van collectieve actie onthullen een hybride karakter, dat beschreven is met behulp van institutionele modaliteiten uit *grid-group* theorie van M. Douglas (1978). Het gaat hierbij om de mate van regulering van individueel gedrag en de mate van absorptie van individuen als lid van een groep.

Management van collectieve actie is duidelijk van invloed op technologieontwikkeling. De belangrijkste institutionele en individuele mechanismen zijn flexibele vormen van verdeling van de baten met inachtneming van gemeenschappelijke belangen, het opbouwen van vertrouwensrelaties en tenslotte, het gemeenschappelijk oplossen van problemen en uitwisselen van kennis over agro-technologie, zowel tussen de boeren zelf als tussen boeren en externe instellingen, zoals de contract bedrijven en onderzoeksinstituten.

Deze dissertatie toont overtuigend aan dat agro-technologische ontwikkeling sterk afhankelijk is van het bestaan van goede sociale relaties en, meer specifiek, van het vermogen om bestaande vormen van collectieve actie te benutten. Technologie-die-werkt is een configuratie die voortkomt uit een combinatie van agro-ecologische condities, technologische artefacten en vormen van sociale organisatie, inclusief collectieve actie.

Belangrijke factoren die duurzame collectieve actie mogelijk maakt zijn de aansporing voor mensen om zelf deel te nemen in de ontwikkeling van technologie en het beheer en de ontwikkeling van de hulpbronnen. Bovendien kan collectieve actie een belangrijke bijdrage leveren aan technologieontwikkeling en vernieuwing, zodat boeren met een lange geschiedenis van kennisontwikkeling in de rijstteelt, meestal opgedaan door vallen en opstaan, in staat zijn hun verworven kennis te integreren met de kennis van buiten.

In dit boek heb ik opschaling benaderd vanuit een horizontaal en een verticaal perspectief. De meeste inzichten zijn verworven over horizontale opschaling, ook wel bechreven als *out-scaling*, dat gezien kan worden als het opbouwen van sociale netwerken tussen boeren met vergelijkbare problemen. Mijn onderzoek laat zien dat horizontale schaalvergroting wel werkte in Dong Palan (DPL), maar niet in Buak Mue (BM). In het eerste dorp was namelijk het Gemeenschaps Rijstzaad Productie systeem (CRSP) een technologisch-sociale configuratie die ook andere innovaties mogelijk maakte, zoals de bescherming van kikkers en intensieve interacties en kennisoverdracht tussen boeren in de verandering van een dorsvlegel. Op hun beurt versterkten de technologische vondsten weer de bestaande vormen van collectieve actie.

De variëteit aan organisatievormen en sociale cohesie die wij vonden leidt tot een belangrijke les voor de praktijk van participatieve technologieontwikkeling. Het blijkt namelijk dat ogenschijnlijk aantrekkelijke technologieën alleen werken als bepaalde sociale voorwaarden aanwezig zijn. Deze sociale aannames kunnen in de praktijk onverenigbaar zijn met de realiteiten van de verschillende landbouweconomieën, zoals blijkt uit de vergelijking tussen de twee dorpen in deze studie. Met andere woorden, dit onderzoek geeft ons het inzicht dat de constructie van een eenvormig model van collectieve actie voor kleinschalige en duurzame technologieontwikkeling niet wenselijk is vanwege de verschillende sociale en materiële omstandigheden in het veld.

About the author

Budsara Limnirankul (born in Khon Kaen, Thailand, in February 15th,1970) began her BSc studies in Agriculture in 1989 at the Bansomdej Bhaophaya Rajchabhat University, Bangkok, Thailand. Her undergraduate research was on optimum level of nitrogen fertilizer application in vegetable soybean. Immediately after her BSc in 1993, she continued her MS degree in Agricultural Systems at Faculty of Agriculture, Chiang Mai University in 1997. Her dissertation research was assessing nitrogen fertilizer management for red kidney bean (*Phaseolus vulgaris* L.) in highland. During her studies for MS degree, she worked at the Multiple Cropping Centre, Chiang Mai University as research assistant for developing sustainable livelihoods systems for ethnic minorities in the highland of Northern Thailand, focusing on conservation and utilization of rice biodiversity by the Karen community, and participatory development of integrated land use systems for food security for the highland communities.

In 1998 she joined the Multiple Cropping Centre as research staff and worked at Sustainable Agriculture Unit of the Centre. She initiated participatory technology development in lowland rice-based farming systems, integrating variety and soil improvement technology to improve productivity for smallholder farmers. She was interested in community action research, working with farmers to co-develop appropriate technologies and land use systems. Later she was involved in farmer capacity building in rice seed production, incorporating alternative soil management with green manure and cover crops to improve productivity.

Beginning of 2002, she joined Participatory Approach and Up-scaling (PAU) Program of the Technology and Agrarian Development (TAD) Group of Social Science Department at Wageningen University and Research as the first PhD cohort with financial support from the Rockefeller Foundation. During the time of her field work in Chiang Mai from late 2002 to 2005, she was a local advisor to the Sustainable Agriculture for Environment (SAFE) project of the Ministry of Agriculture and Cooperatives supported by the DANIDA, specifically advising staff members of DOA and DOAE on participatory technology development and biodiversity resource management in Northern Thailand. She also involved in a joint research project with the Rice Research Institute, DOA and Khon Kaen University on Farmer Participatory Plant Breeding in Rainfed Lowland Rice Improvement: community seed production and distribution in the Upper North and Northeast Thailand, supported by the Rockefeller Foundation. At the Multiple Cropping Centre, she headed the community-based natural resource management for food security of smallholder farmers in Northern Thailand, with emphasis on biodiversity in the forest areas during 2003-2005, in which the research results were used to help facilitate local community to develop community action plan for forest biodiversity conservation and utilization. The work is to become the basis for present research on farmland biodiversity supported by the Thailand Biodiversity Research and Training Program.

Her current research interests include collective action in biodiversity management, community plant genetic resource management, and improving farmer rice seed production and distribution.

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CERES PhD Education statement form

Completed Training and Supervision Plan B. Limnirankul

Description	Department/Institute	Month/year	Credits
I. Orientation			
Literature review and proposal writing	Wageningen University	February - December 2002	4
CERES orientation program	Utrecht University	March-May 2002	3
II. Research Methods and Techniques			
CERES presentation tutorials	De Hoorneboeg, Hilversum	May 2002	2
CERES a practical course on the methodology of fieldwork	Utrecht University, Nijmegen University, The Netherlands	June 2002	1
Social science concept part of training for multi-agent modeling: by Prof. Niels Röling	CIRAD/MCC, Chiang Mai university, Thailand	October 2003	1
PAU 6th learning workshop “Support to analysis and write up of PhD research”	Jinja, Uganda	January 2006	2
Master class: Realistic explanation account linking explanatory and interpretive accounts in applied social research	Utrecht and Wageningen University	June 2006	2
III Seminar Presentations			
Presentation: ” Up-scaling resource regenerating innovations in rice based production system in Northern Thailand”	Wageningen University	December 2002	1
Presentation: “Understanding farmers participation in generation and diffusion of *Sesbania rostrata* technology in rice farming in Northern Thailand”	Wageningen University	August 2002	1
CERES Summer School 2002 ”Farmers participation in generation and diffusion of *Sesbania rostrata* technology in rice farming system’’	Utrecht University	June 2002	1
CERES Summer School 2004 ”How farmer participation in technology development: Cases of individual action and collective action in rice farming“	Nijmegen University	July 2004	1
Seminar” Collective action and technology development in rice farming of Northern Thailand’’	TAD, Department of Social Sciences, Wageningen University	2002-2006	4
CAPRi Research Workshop “Collective action on community rice seed production (CRSP)”	Siam Commercial Bank Training Centre, Chiang Mai, Thailand	October 2005	1
CERES Summer School 2006 “Analysis of factors underlined the collective cooperation in CRSP in Northern Thailand”	Wageningen University	June 2006	1
IV Academic skills			
Tutorial for End Note program	Wageningen UR library	February 2002	1
Techniques for writing and presenting a scientific paper	Mansholt Graduate School, Wageningen University	November 2002	1
Total			**27**

Funding

The main financial support for this PhD thesis was received from the Rockefeller Foundation through the Participatory Approaches and Up-scaling (PAU) Programme at TAD Chairgroup, Wageningen University and for research support through the Multiple Cropping Centre, Chiang Mai University. The author is grateful to these institutions for the kind support.

Cover design by Author, Almekinders, C. and Pansompong, P.