Impacts of Farmer-Based Training in Seed Production in Vietnam

Huynh Quang Tin

Thesis committee

Thesis supervisor

Prof. dr. ir. Paul C. Struik
Professor of Crop Physiology
Wageningen University

Thesis co-supervisors

Dr. Lisa M.L. Price
Associate professor, Sociology of Consumers and Households
Wageningen University

Dr. Tran Thanh Be
Director, Mekong Delta Development Research Institute
Can Tho University, Vietnam

Other members

Prof. dr. K.E. Giller	Wageningen University
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Dr. ir. H.A.C.P. Nuijten	Wageningen University
Dr. L. Bødker	National Centre - Crop Production, Denmark

This research was conducted under the C.T. de Wit Graduate School:

Production Ecology and Resource Conservation.

Impacts of Farmer-Based Training in Seed Production in Vietnam

Huynh Quang Tin

Thesis

submitted in partial fulfilment of the requirements for the degree of doctor

at Wageningen University

by the authority of the Rector Magnificus

Prof. dr. M.J. Kropff,

in the presence of the

Thesis Committee appointed by the Doctorate Board

to be defended in public

on Wednesday 18 November 2009

at 4 PM in the Aula.

Huynh Quang Tin

Impacts of farmer-based training in seed production in Vietnam, 175 pp

PhD Thesis, Wageningen University, Wageningen, the Netherlands (2009)

With summaries in English, Dutch and Vietnamese.

ISBN 978-90-8585-499-9

Abstract

Huynh Quang Tin, 2009. Impacts of farmer-based training in seed production in Vietnam. PhD thesis. Wageningen University, Wageningen, the Netherlands. With summaries in English, Dutch and Vietnamese, 175 pp.

Rice (*Oryza sativa*) is the most important food and cash crop of Vietnam. It is cultivated in all provinces of the country since ancient times. Farm-saved seed is the most important seed source covering more than 80% of the farmers' seed needs. However, farmers not always use the best techniques of producing and selecting seeds. Inadequate seed quality is an important yield limiting factor in rice production.

To improve the farmers' capacity to produce, process, store and use good rice seed, the farmer seed production school (FSPS) training programme was conducted in seven provinces of Vietnam during the period 2003−2007. The study reported in this thesis took place in four out of those seven provinces, i.e. Nam Dinh, Nghe An, Binh Dinh and Dong Thap. The objective was to assess to what extent farmers' knowledge in seed production practices and seed quality management had increased and whether that knowledge increase was reflected in an increase in potential rice yields and profits, and in diffusion of retained practices after training to other farmers in communities.

A long seed production training programme with the farmer field school approach was combined with field demonstrations including plots with either local practices or improved practices which were conducted in each FSPS. We recorded and analysed data on on-farm demonstrations at 429 FSPSs and on ex-ante and ex-post tests of knowledge at the FSPSs. Moreover, we carried out a survey among 240 rural households.

Results of the study indicate that some rice varieties were better adopted in the farming systems than other varieties: well adopted ones were KD18 in both Nam Dinh and Nghe An province and OM1490, Ai32 and MO2718 in Binh Dinh and Dong Thap. With local practices in the farm-saved seed system of the transplanted rice crop, farmers used old seedlings, planted many seedlings per hill, planted too many or too few plants per unit area and applied unbalanced quantities of fertilizers; for the directly sown crop farmers used high seed rates in the traditional system. Rice yields showed larger differences between local practices and improved practices in the dry season than in the wet season all across Vietnam. With improved practices at the FSPSs, rice yields were 8.5% higher in the wet season and 13.6% higher in the dry season; additional profits associated with the improved practice in both the dry and wet seasons averaged 212 US$ ha^{-1}. The majority of the FSPS-farmers moved from food production to seed production, reduced seed rates by about 50%, and used high quality seed to produce seeds with much better quality. More important is that the FSPS-farmers diffused improved practices (79%) and shared good seeds (57% of respondents) with other farmers in their communities to help other rice growers to improve their productivity. A large proportion of non-FSPS farmers learned and applied improved practices for rice production through neighbouring FSPS-farmers within the community. Besides, evaluation in acquired knowledge during training showed that FSPS-farmers with lower scores (<20%) in the ex-ante test realized an enormous improvement of 55.4% points in the ex-post test. There was a clear trend: the higher the scores in the ex-ante test, the smaller the increase in the score, suggesting that the tests provided insight into the knowledge gaps for improvement in training programmes.

The FSPS is considered as a good training model for farmers. The FSPS-farmers well retained the acquired knowledge and applied the improved practices to enhance the farm-saved seed system in the project provinces. The community capacity was strengthened through establishing seed clubs by FSPS-farmers. It created a seed supply and production network to ensure seed security for small farmer's seed needs in the rural areas. Thus, it promoted seed policies to strengthen the informal seed system in Vietnam.

Impacts of farmer-based training programme in seed production illustrate that in a country like Vietnam where more than seventy percent of the population live in rural areas and depend on agricultural production, farmer education is a very effective way for agricultural development.

Key words: *farmer seed production school, farm-saved seed, formal seed sector, impact assessment, improved practice, local practice, rice (Oryza sativa), seed production, seed quality, Vietnam*

Preface and acknowledgements

In September 2002, Dr. Ole Sparre Pedersen nominated me to be involved in Sub-Component 8 (Farm Saved Seed Production) of the Seed Component belonging to the Agricultural Sector Support Programme (ASPS), DANIDA – MARD when the ASPS was establishing a team to develop a training curriculum for farmers and a training of main trainers (ToMT) for the Farmer Seed Production School (FSPS) in Vietnam. I participated in the technical consultant team and organized a Training of Main Trainers (ToMT) for core staffs of Dong Thap and Binh Dinh provinces (Nov. 2002 – April 2003). During the period of running the training of Farmer Seed Production School, I was invited to revise and complete the curriculum of the FSPS and participated in workshops for annual training programme evaluation.

After two years of project implementation, results of on-farm experiments in the FSPS suggested that there were significant advantages in terms of higher yields and higher profits when improved practices were applied. In May 2004, dr. Lars Bødker (technical consultant of Sub-Component 8) proposed to assess the impact of the project as part of a PhD study. This idea was supported by Dr. Michael Turner (ASPS-Supervisor), Mr. Do Huu Thien (National Coordinator of ASPS); and Dr. Per Andersson (technical consultant); Mr. Le Hong Nhu (technical assistant); Mr. Phan Huy Thong (Vice Head of the Department of Crop Production) and they proposed it to the Danida-MARD and the Danish Embassy for funding. Lastly, I was awarded a Sandwich PhD Fellowship. First at all, I would like to express my thankfulness to all for their support.

My study started by sending a short proposal (concept note) to Wageningen University and that proposal was accepted by Prof. dr. Paul C. Struik. This study could not have been completed without the advice of Prof. dr. Paul C. Struik, my promotor working in the Centre for Crop Systems Analysis, Wageningen UR; Dr. Lisa L. Price, my co-promotor of the Sociology of Consumers and Households group, Wageningen UR; and Dr. Tran Thanh Be, my local supervisor of the Mekong Delta Development Research Institute, Cantho University, who advised through different stages of field work and commented on draft papers until completion. I am deeply grateful for their guidance.

I am also most grateful to Dr. Bert L. Visser (CGN) for his introduction and facilitation of visiting the Gene-bank of the WUR; Dr. Claudius van de Vijver of the PE&RC office for his advice and assistance, and also to the Central Student Administration (CSA). I want to thank all the staffs of Crop and Weed Ecology/Centre for Crop Systems Analysis, Plant Production Systems, PROSEA/PROTA and TUPEA for creating a convenient environment for my work.

My specific thanks to Jenny Elwood, Wampie van Schouwenburg, Gijsbertje Berkhout (the Administration Office), Tine Ruijsch, Geurtje Janse-Van Velsen and Ton Minnebreuker (the Finance and Control) who have been so kind and helpful in arranging the air tickets, visas, accommodation and reimbursement-payments.

I also thank the technical team: Dr. Heleen Bos, Mr. Nguyen Phung Hoan, Dr. Hung, Dr. Vien, Toan, Hanh, Khiem, Ms. Sau, Thuy for designing the training model and applying the FSPS in this study.

I am also grateful to Ms. Dong Thi Phuong, Nguyen Thi Thu Hang, Nguyen Thu Huyen, Quach Thi Que, Hoang Anh Nga, Pho Thanh Van, and Mr. Ai, Mr. Duong, Mr. Nguyen Ngoc Hung (ASPS staffs) for their help in financial affairs, field work planning and for providing data and project documents.

All the work implemented and presented in this thesis was done in close collaboration with and with major contributions from the local institutions/authorities and local technicians in conducting the FSPSs, on-farm experiments, surveys and interviews; and in collecting data on the FSPSs in the provinces and other information related to this study. Special thanks to you all:

- In Nam Dinh province: Mr. Khanh, Tung, Tham, Hoan, Huu,
- In Nghe An province: Mr. Sinh, Tan, Hieu, Dung and Ms. Ha Lan, Liem, Tram, Huong, Hoa, Chau, Lien, Mai,
- In Binh Dinh province: Mr. Hung, Thu, Truc, Tranh, Khiem, Pha, Suong, Thien; Ms. Hoa, Vinh, Sanh,
- In Dong Thap province: Mr. Duong, Phong, Tuyen, Phuoc, Phong, Nam, Kien,

Phung Hoa Thao and Ms. Nguyet, Ty, Hue.

A special acknowledgment to all farmers who directly and indirectly contributed to on-farm activities, provided information during the survey and during the self-evaluation by doing the training tests of this study.

During most of my time spent in Vietnam, Dr. Tran Thanh Be, Dr. Nguyen Van Sanh and Dr. Nguyen Duy Can (the Mekong Delta Development Research Institute) facilitated me in implementing on-farm experiments, provided staff for survey work and means for local transportation. I am truly grateful for their support. In addition, I worked together with staffs of the Department of Crop Resources and the CBDC Project; they assisted in data analysis and shared my work load in the office. My thanks to Dr. Vu Anh Phap, Mr. Le Xuan Thai, Mr. Huynh Nhu Dien, Ms. Ong Huynh Nguyet Anh, and Nguyen Thi My Phuong.

I wish to thank Dr. Dang Kieu Nhan, Dr. Le Thanh Phong, Dr. Duong Ngoc Thanh and Mr. Vo Duc Hoang Vu who guided me with data analysis. Mr. Nguyen Minh Hoang, Mr. Tin, Mr. Vu, Ms. Phuong, Mieng helped me with raw data input.

My thanks go to:

- My neighbours in Cantho: Uyen-Dung, Nam-Hung, Thuy-Kham, Huong-Dam, Truong, Dinh, Sang for taking care of my house during my absence.
- The Vietnamese families in Ede-Wageningen: Nguyen Quang Ke - Nguyen Thi Mai Quyen, Chu Le Thanh Minh – Co Minh, Chu Liem – Co Oanh, Anh Chi Thanh-Thuy, Le Thi Xuan Huong, Little Ha-Khoa. They gave me a warm Vietnamese welcome and environment in Wageningen.
- The colleagues in the UN Room in the Haarweg Building: Dr. Alice Laborte, Dr. Mel Revilla-Molina, Dr. Mulugeta Taye, Dr. David Kamau, Dr. Hassan, Gisella Cruz Garcia, and Joyce Challe for sharing experiences in data analysis and writing.
- My friends in Bornsesteeg: Nam Anh, Thang, Yen, Khoi, Tin, Dung, Dieu, Ha, Loan, Huong, Trang, Ai, Phuong, Duyen, Van, Quyen, Linh and other Vietnamese students for their help in sharing accommodation and Vietnamese foods.

My study took a long time; I may have neglected to acknowledge other people who have helped me along the way. If so, please accept my apologies, and know that you are appreciated.

I am really grateful to my family: Nguyen Thi Bich (my Mother in law), Nguyen Thi Hong Diep – Nguyen Van Nam, Nguyen Thanh Long - Ha, Nguyen Thanh Hai - Thuy, Nguyen Thi Hong Loan – Ngo Son Tung for bringing up and taking care of my son during times my wife and I studied abroad and conducted field works; and Nguyen Thi Thoi (my Mother), Huynh Thanh Hau – Le Thi Trang, Huynh Van Hoang – Duong Thi Bong, Huynh Viet Tuyet, Huynh Thanh Thuy – Lam Van Ky, Huynh Quang Nhiem for their encouragements to complete my study.

Lastly, I thank very much my wife Nguyen Hong Cuc, and my sons Huynh Nguyen Vu Lam and Huynh Nguyen Bao Lam for all the love, support and understanding, and encouragement to overcome some difficult times. I could not have done this thesis without them!

Huynh Quang Tin

List of Abbreviations

AR	Applying Roguing
ASPS	Agricultural Sector Programme Support
BNN	Bo Nong Nghiep
BS	Basic Seed
BUCAP	Biodiversity Use and Conservation in Asia Programme
CBDC	Community Biodiversity Development and Conservation
COWI	International consulting group, specialising in engineering, environmental science and economics, based in Lyngby, Denmark
CP	Cultural Practices
CP-TTg	Chinh Phu - Thu Tuong
CS	Certified Seed
Danida	Danish International Development Assistance
DARD	Department of Agriculture and Rural Development
DCP	Department of Crop Production
FFS	Farmer Field School
FSPS	Farmer Seed Production School
GSO	General Statistic Office
IP	Improved practices
IPM	Integrated Pest Management
KD	Khang dan rice variety
LCC	Leaf Colour Chart
LP	Local practices
MARD	Ministry of Agriculture and Rural Development
MET	Ministry of Education and Training
NCVESC	National Center of Variety Evaluation and Seed Certification
OM	O Mon (rice variety released by Cuu Long Rice Research Institute)
OPV	Ordinance of Plant Varieties
PH	Post Harvest
PP	Plant Protection
PPB	Participatory Plant Breeding
PPD	Plant Protection Department
PS	Pre-basic Seed
PVP	Plant Variety Protection
SC	Seed Component
SC-8	Sub-Component 8
SQP	Seed Quality and Policy
SS	Seed Selection
ToFT	Training of Farmer Trainers
ToMT	Training of Main Trainers
ToT	Training of Trainers
UPOV	The International Union for the Protection of New Varieties of Plants
VNFU	Vietnam Farmers Union

Contents

CHAPTER 1

General introduction

General introduction

This introductory chapter contains general information on Vietnam, its rice production, seed systems, agricultural extension and training, a problem statement and outlines of the research programme of this thesis and of the thesis itself.

1.1. GENERAL INFORMATION

Geographical location: According to GSO (2007a), the Socialist Republic of Vietnam is an S-shaped land covering an area of 331,212 km^2 with 3,260 km of coastline. The geographic coordinates of Vietnam are: longitude 102º 08' – 109º 28' east and latitude 8º 02' – 23º 23' north. It has borders with China in the north, Laos and Cambodia in the west and the South China Sea in the east and the Gulf of Thailand in the south.

Climate of Vietnam: Vietnam's climate is of the tropical monsoon type with a high humidity throughout the year. Due to differences in latitude the climate of Vietnam varies from place to place. There are only two seasons in North Vietnam: a cool and humid winter (November to April) with a mean winter temperature of about 17°C and a hot and wet summer with a mean summer temperature of about 29°C. The summers are frequented by typhoons. In South Vietnam, on the whole, it is hot with temperatures soaring to 30°C in the months of March – May. Summers are dry there. Monsoons follow from April to October (VO 2007; MW 2008; Louise et al. 2007). For coastal areas and the parts of the central highlands facing northeast, the season of maximum rainfall is during the south monsoon, from September – January. These regions receive torrential rain from typhoons which move in from the South China Sea at this time of the year. The weather at this time is cloudy with frequent drizzles (EV 2007).

Population: The population in Vietnam was approximately 85.1 million people in 2007 of which 63% was living in the rural areas (GSO 2007a). The population consists of 54 different ethnic groups of which the Kinh (Viet) people constitute 90% of the population and the remaining 53 ethnic groups form the remaining 10% (MW 2008).

The population of Vietnam is unevenly distributed and the population density varies for the different geographical-economic regions. The population is concentrated in the deltas of the Red River and the Mekong River, where 42% of the country's population live. However, these deltas constitute only nearly 17% of the total land area in the country (GSO 2008).

1.2. RICE PRODUCTION

Vietnam is basically an agricultural country with about 24.7 million ha of agricultural land and forest land (occupying 74% of the total land area); the area of land used for agricultural production is about 9.4 million ha occupying 28% of the country's natural land. Agriculture contributed 27% of the GDP and 30% of the export value (GSO 2006).

Rice (*Oryza sativa*) is a major food crop and is cultivated in all provinces covering around 4.1 million ha in the 1980s. Almost all rice area in the Red River delta and the Mekong River delta is cropped with two or three rice crops per year. Thanks to the development of irrigation systems in the last decades, the harvested area of rice increased considerably in Vietnam (Fig. 1.1).

In parallel, the Vietnamese Government issued the Resolution-10/1988/NQ-TW - *DOI MOI*, meaning literally "change and newness", in 1986 to reform and renovate the economy of Vietnam. This Resolution recognized the State, the collective and the private sectors as legally equal components in the economy. Under this policy line the governmental agricultural land ownership was abolished. Lands were allocated to farm households for long-term (10 to 15 years) use. Besides, the Government Decree-10/1998/CP-TTg stipulated and further confirmed the full rights of land use to farmers. In 1999, 5.7 million hectares (78% of the land area) were allocated to farmers, and 10.2 million households (87%) received the official land title certificates. As a result, farmers were permitted to buy, own and sell inputs such as machines, tools and animals. Furthermore, farmers were no longer required to sell a contracted amount of their rice to the State. A tremendous growth in agriculture, especially in the rice sector, began, and rice production increased quickly (UNEP 2005).

Although the area cropped to rice has gone down since 2001 because of replacement by aqua-culture, development of infrastructure and urbanization, rice production has increased annually over the last decades (Fig. 1.1). The area of rice production reached 7.2 million ha and the production was 35.8 million metric tons (GSO 2008). With such a production, Vietnam has a surplus of food and can export a large amount of rice.

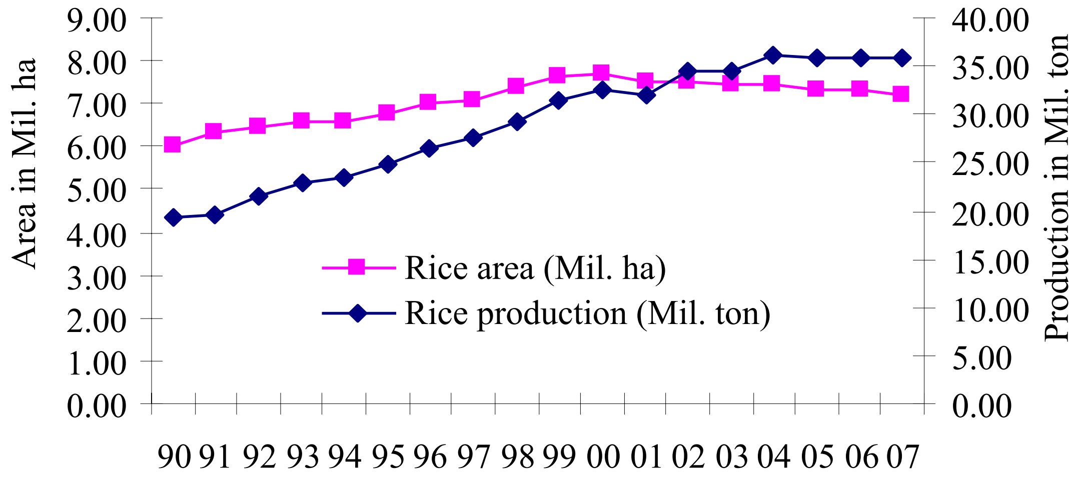

Fig. 1.1: Total grown rice area and rice production of Vietnam throughout 1990-2007
Data source: (GSO 2007b)

1.3. SEED SYSTEMS

Seed systems are defined as the total of physical, organizational and institutional components, their actions and interactions that determine seed supply and use, in quantitative and qualitative terms (van Amstel et al. 1995). Seed systems are often characterized as "formal" versus "informal" or "local", although the meanings assigned to these terms may vary. Usually, the term "formal seed system" refers to a seed supply system which has been set up since the 1950s to improve the quality of seeds and deliver improved and modern varieties to farmers (Almekinders and Louette 2000). The local or informal seed (supply) systems still function in all or most developing countries. Up to now, farmers are basically self sufficient for seed. These local seed systems developed naturally over time in response to farmers' seed demands without formal quality control and are not subject to seed trade regulation (van Amstel et al. 1995).

1.3.1. Formal seed system

The formal seed system generally consists of a research institution (mainly public), private seed production and marketing agencies and seed quality control organizations (Larinde 1997). It is set up and organized with the principal goal of diffusing quality seed of improved varieties developed by formal breeding programmes (Almekinders 2000), and with planned seed production, mechanical processing, organized marketing and distribution in sealed, labelled units which meet specified quality standards and may have the force of law (Bishaw and Turner 2008).

In Vietnam, this system has been established based on a management system by three levels of authorities (ASPS 2000): at the national level there is the Ministry of Agriculture and Rural Development (MARD), at the provincial level, the Department of Agricultural and Rural Development (DARD) and at the district level the Sub-MARD. The national crop variety evaluation and seed certification programme is conducted by the Department of Crop Production (DCP) which is responsible for seed quality control of commercial seeds (public and private). In this, the DCP is assisted by the National Centre for Variety Evaluation and Seed Certification (NCVESC) which organizes testing of new varieties and conducts seed quality certification of crop seeds. Besides that, the Department of Plant Protection (PPD) is also responsible for managing pests and diseases of crops, monitoring the health of imported seeds, and seed pathology issues.

Development of new varieties is conducted by the crop research institutes under the MARD. However, agricultural and plant breeding departments of agricultural universities under the Ministry of Education and Training (MET), and private seed companies are also submitting new varieties for release (Fig. 1.2). Nowadays, many promising farmers who do rice breeding themselves are registering their new varieties to NCVESC for testing. The good varieties evaluated from that test are suggested to the MARD for issuing the national certification. These varieties are then allowed officially for seed production and commercial seed supply in the market.

Giao (2007) reports that the seed industry in Vietnam is really young compared with the seed industry in other, developed countries. The history can be summarized as follows:

1. In the 1960s some seed related institutions were established (National Seed Co., Research Institutes, and Agricultural Universities), with rice being the most important commodity;
2. In the period 1970-1985, the National Maize Research Institute and other specialized institutes were established. Corn and vegetables were bred, seeds tested and seeds supplied mainly in Vietnam;
3. In the period 1986-1995, hybrid corn and hybrid rice were introduced into Vietnam. Hybrid vegetable seed were also imported and used. Some domestic hybrid corn, watermelon, and cotton varieties were released successfully at the end of this period. Private seed sector first appeared and then played a rather important role;
4. In the period 1996-2006, the seed industry developed rapidly. Hybrid variety breeding and research was promoted by both public and private seed sectors. Many state seed companies or seed centres, private/joint-venture/foreign seed companies were established. In 2006, there were 260 seed business units in total, consisting of 2 central level companies, 99 centres, 54 provincial seed companies, 92 private companies, 8 foreign companies or joint-ventures with foreign partners and 5 companies belonging to research institutes.

1.3.2. Informal seed system

The informal system is described by several authors (e.g. Sperling et al. 2006). The informal seed system is basically what the formal system is not. Seed-related activities tend to be integrated and locally organized, and the informal system embraces most of the other ways in which farmers themselves produce, disseminate and procure seed: directly from their own harvest, through barter among friends, neighbours and relatives, and through local grain markets or traders. Bishaw (2004) states that this informal system comprises a multitude of private farmers who select and save their

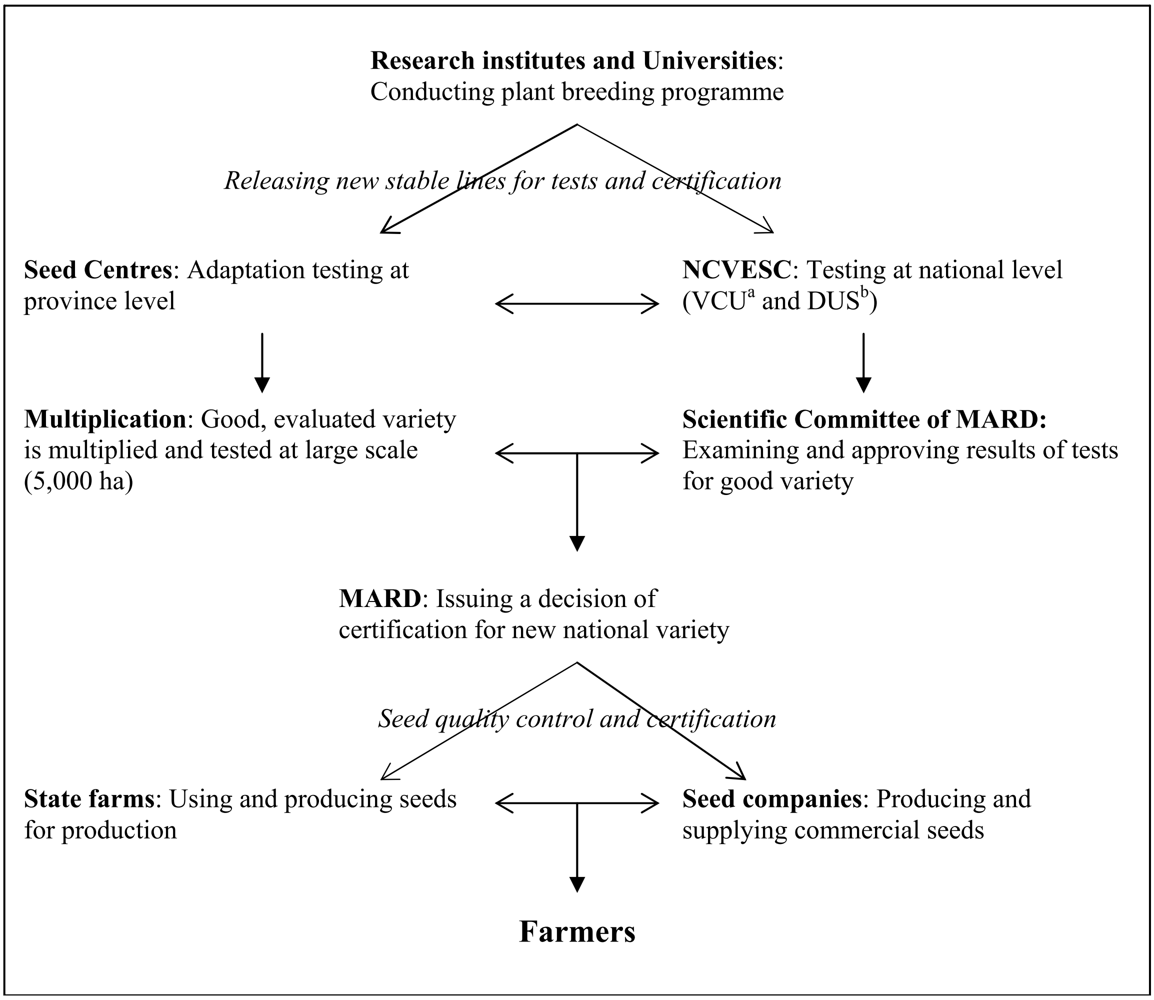

Fig. 1.2: The framework of formal seed production system in Vietnam

[a] Value, Cultivation and Use; [b] Distinctness, Uniformity and Stability
→ flow of progress,
↔ complement of evaluated results on adaptation and grown area of new varieties in provinces

own seed or exchange seed with others through traditional means such as gift, barter, labour exchange, cash transactions or social obligations as well as a diversity of local level seed production initiatives organized by farmers' groups and under no legal norms and certification schemes of the organized seed sector.

In Vietnam, the informal seed system is called "Farm saved seed system" (in Vietnamese: Giong Nong Ho) by the Decision-35/2008 (MARD 2008). This Decision was to legalize and stimulate any farmer individuals, farmers' groups, clubs and co-operatives who and which can do breeding, selection, seed production for household use and seed exchange and supply in the market. In this decision it was also stipulated that the local government at the province level must have a responsibility to support (or fund) farmers who participate in on-farm studies and activities on plant genetic resource conservation, development and utilization (PGR-CDU), crop improvement (plant breeding), seed production and supply at low seed prices to farmers in communities. In parallel to the recognition of the informal seed system in Vietnam, capacity building for farmers in participatory plant breeding (PPB) and seed supply networks has developed through NGOs projects, e.g. Community Biodiversity Development and Conservation (CBDC) in the South and Biodiversity Use and Conservation in Asia Programme (BUCAP) in the North, from which farmers not only rehabilitate many adapted or local varieties for re-use, but also develop new rice varieties by making crosses and carrying out selection for their cultivation conditions, e.g. the varieties HD1 and NV1 (Tin 2008). These activities have contributed to ensuring local seed supply systems.

1.4. AGRICULTURAL EXTENSION AND TRAINING

In Vietnam, previous extension projects usually stopped at the stage of introducing new and appropriate techniques to farmers through demonstration plots. This approach does not include a proper follow-up programme or service to facilitate and support farmers in expanding such adopted or improved techniques (De 2006). Farmers make their own decisions on how and to what extent they will apply the new practices in their crop production. To improve the efficiency of the extension, agricultural research and development should be carried out stepwise through a large multipurpose hierarchy of actions. The agricultural extension model has developed from the Training and Visit Extension System in the 1980s to the new training approach based on a change in the roles of farmers in their own training in which farmers can better reflect on the development of agricultural practices called “Farmer First”. Under this model, farmers, extension agencies, and researchers work together as equal partners, each having specialized skills and knowledge to contribute (Matterson 2000). Currently, farmer’s participatory research and farmer field school (FFS) approaches have been applied widely in training farmers, especially in integrated pest management (IPM) and crop improvement.

1.4.1. Concepts of the Farmer Field School approach

Farmer participatory research has received particular attention and recognition since the “Farmer First” and “Participatory Technology Development” concepts were first introduced in the late 1980s (van de Fliert and Braun 2002). Acceptance of the important role that farmers can play in agricultural research, development, and extension has grown considerably. The Farmer Field School (FFS) approach for training farmers in Asia started when plant protection officers started to test and develop field training methods as part of their Integrated Pest Management (IPM) (Gallagher 1999). The IPM-FFS participatory education format includes both information and knowledge (Price 2001), and the approach is a system where observations are made, facts highlighted and ecological theory is offered through the learning by doing principle. Through “agro-ecosystem analysis” farmers learn about the probability of severe pest infestations and then determine if any intervention is needed (Mangan and Mangan 1998).

1.4.2. Farmer Seed Production Schools in Vietnam

In comparison with grain production for food, seed production requires better care, more precision in procedures and more technical skills to ensure quality of seed during the process of multiplication, post-harvest management, and storage, until sowing the next crop. To help farmers in improving basic practices in seed production, a curriculum of Farmer Seed Production Schools (FSPS) in Vietnam was developed. Normally, in farmer field schools as well as in our recent project, the experiential learning exercises are to develop new management skills (Fleischer et al. 2002). The FSPS-curriculum included a string of technical topics and facilitated in an interactive manner in seed production with “study fields” for practices. Farmers suggested adding some locally optional topics. The FSPS training programme was to improve farmer’s capacities in production, processing, storage and use of seed. At the same time, the purpose was to strengthen the capacity of the Department of Agriculture and Rural

Development and of the Seed Centres to manage and train farmers using participatory methods. The training programme targeted farmers, farmer-groups/seed clubs and co-operatives for strengthening their capacity in seed production, seed processing, use of good seed and sale/exchange produced seeds to other farmers in the local areas.

The main activity of the Farm Saved Seed Project (SC-8) was training farmers to improve quality in farm saved seed production. The training was implemented by three levels:

1) Training of Main Trainers (ToMT/ToT) for extension workers and local technicians;

2) Training of Farmer Trainers (ToFT) for advanced farmers from FSPSs; and

3) Both ToT and ToFT combined to train farmers of farmer seed production schools (FSPS).

The training programme was started in 2003 in four provinces: Nam Dinh, Nghe An, Binh Dinh and Dong Thap. After one year of implementation, the SC-8 expanded to three more provinces, i.e. in Thanh Hoa, Phu Yen and Soc Trang. The expected output of the training programme was about 19,000 trained farmers. However, the total number of trained farmers reached a considerably higher number at the end of the project.

1.5. STATEMENT OF THE PROBLEM

In developing countries, 50-80% of the households are dependent on agricultural employment. The majority of them are poor and illiterate. Private commercial suppliers of seeds, agricultural chemicals, tools and spare parts are absent (Adams 1988). For seed supply, the existence of even a relatively developed formal sector at the national level certainly can not yet guarantee farmers seed security at community and household level (Bishaw and Turner 1998). Thus, the development of an efficient seed production system is essential, particularly in the coming periods of regional and international integration of economies. The Government of Vietnam has launched seed programmes at a national and local level to promote breeding activities, seed production and distribution, making good seeds available to most farmers. Therefore, demand for high-quality seeds[1] and planting materials for production is enormous, but the formal seed supply capacity is very limited (AGROVIET 2001). Despite the fact that there is a surplus of rice and that there is even export of rice, farmers who produce rice grain and seed still face some technical limitations that could bring about unstable yields, low income and negative environmental impacts. The following specific problems could arise:

In seed supply and demands: The formal seed sector is instrumental in developing and supplying new varieties and in maintaining the genetic purity and stability of existing ones. Quality seed control through certification is undertaken by the Ministry of Agriculture and Rural Development in the whole country. This system will control and supply certification to the state seed companies, foreign private companies and seed production units at provincial level. Seed production and supply of the formal sector could not meet households' seed demands, and not have enough high-quality seeds to supply all farmers. In practice, total seed demand for rice seed was estimated to be about 1.1 million tonnes in 2007, of which the provincial seed agencies provided 2.6% (ASPS 2000). Separately, in the Mekong River delta, the formal seed system produced and only supplied about 3.5% of total seed requirement in 2008 (Tin et al. 2008). This implies (COWI 1999) that more than 90% of all rice seed used is farm-saved seed, and the production of seed on farm thus must be organized as being the most important seed source in Vietnam.

In agricultural extension: Improving farmer's technical knowledge in seed production can increase the amounts of high-quality seed significantly and presumably increase the quality of rice for export as well. Although this is recognized, farmers still produce seed by multiplying their own seed and apply inadequate practices. Technical assistance from local institutions and extension agencies has not yet attached strongly to local extension programmes. The extension system is organized from the central to local levels with a central department, 61 extension centres in 65 provinces, 470 extension stations in 615 districts, 3,750 extension workers in 10,000 villages. Besides,

[1] *High quality seed* can be broadly defined as "seed of an adapted variety with high genetic, varietal, species, and physical purity; high germination and vigour; free from seed-borne pests (fungi, bacteria, viruses, insects, nematodes, parasitic weeds); and properly cleaned, treated, tested and labelled" (Bishaw 2007).

other extension volunteer organizations also are established by institutes (AGROVIET 2001). In addition, the "top-down" approach in agricultural extension was still prevailing. Linkage and collaboration between the professional extension systems with other related organization within agricultural sector and supporting institutions were loose (De 2005).

Expected strategy: Improvement of seed quality for farm-saved seed production systems could have a positive impact on farm saved and locally sold seed, and then farmer as buyers and users of seed could also increase the awareness and the benefits of using high quality seed, the ability to select their right variety, determine the seed quality, and apply suitably improved practices. This, in turn, will increase demand for and use of high quality seed supplied by the formal sector and reduce the supply of low-quality seed, or seed which is not truthfully labelled. The question is then how to improve the quality of farm saved seed and farmer's technical knowledge in Vietnam. The training of farmers could be a high priority because Muhamed (1999) experienced in Pakistan that the quality of farmer seeds was significantly improved if farmers were given basic training in production, cleaning and storage of seeds. Thus, the Farm Saved Seed Production Project (Sub-component No. 8) of the Seed Component belonging to Agricultural Sector Programme Support (ASPS) in Vietnam was conducted for the period 2003-2007.

1.6. THE STUDY ON FARMER SEED PRODUCTION SCHOOLS

1.6.1. Sites

The study described in this thesis four of the seven provinces included in the programme were selected (Fig. 1.3): Nam Dinh (in the Red River Delta) and Nghe An (in the North Coastal Delta) in the north and Binh Dinh (in the Central Delta) and Dong Thap (in the Mekong Delta) in the south. In each province, 16 villages from four districts where the FSPS started in 2003 were selected for this study.

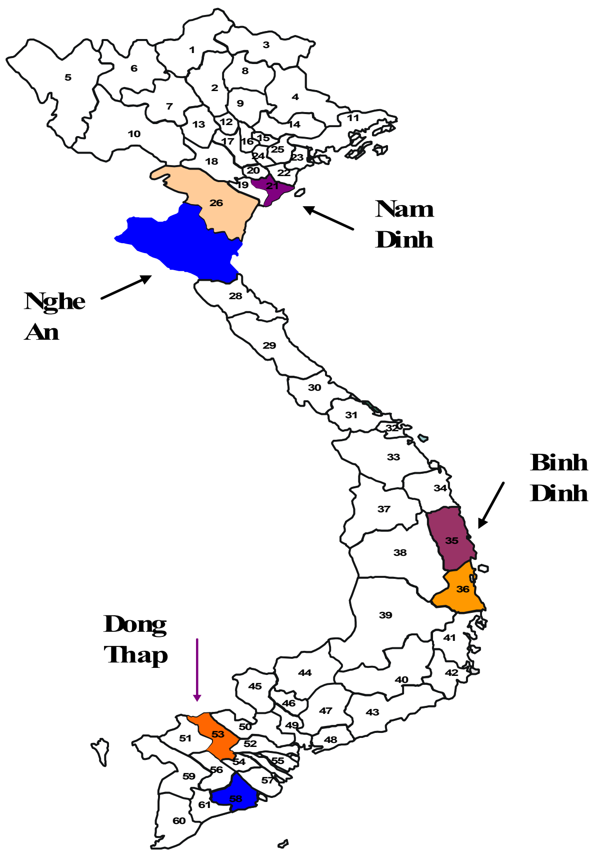

Fig. 1.3: Location of four research provinces of the Farm saved seed project in Vietnam

1.6.2. Objectives

The research activities undertaken in the period 2005–2006 were to assess impacts of the farmer-based seed production training programme in Vietnam. The specific aims were to:

1) Assess how traditional cultural practices and inputs affect rice yields and profits and to evaluate the status of seed demands and use of high-quality seeds in rice production of four provinces: Nam Dinh, Nghe An, Binh Dinh and Dong Thap;

2) Compare local and improved practices used by farmer seed production schools in Vietnam;

3) Assess impacts of farmer seed production schools (FSPS) on seed production and technical diffusion in the project provinces of Vietnam; and

4) Study the increase of farmer's knowledge through farmer seed production schools (FSPS) in Vietnam.

1.6.3. Methods

The methods were based on participatory on-farm demonstration plots that were laid out by farmers at sites in the provinces Nam Dinh, Nghe An, Binh Dinh and Dong Thap (Chapter 2). Unreplicated on-farm experiments were carried out in four different provinces and analyzed by the farmer seed production schools (FSPS) where these experiments consisted of two adjacent seed production plots: one with common local practice and one with improved practice. Differences between the two plots in yield and profit were assessed (Chapter 3). A study to assess whether farmers applied improved practices (Chapter 4) after being trained was executed by interviewing 30 FSPS farmers and 30 non-FSPS farmers in each of four villages of the research provinces. To assess improvement in knowledge as a consequence of the training, the project used ex-ante and ex-post tests including a set of 25 questions covering all basic elements of the seed production process (Chapter 5).

1.7. OUTLINE OF THE THESIS

The thesis is organized into six main chapters. The introductory chapter (Chapter 1) gives an overview of the information about Vietnam's agriculture and the Farm Saved Seed Production Project belonging to the Agriculture Sector Programme Support (ASPS) funded by the Danish Government and the Royal Danish Embassy and Danish International Development Assistance (Danida) took responsibility for assisting in the execution of this programme. Following this introduction the main part of the thesis consists of the four research chapters (Chapters 2−5 identified above). Chapter 6 will provide a general discussion and synthesis of the study. The thesis framework and outline are described in Fig. 1.4.

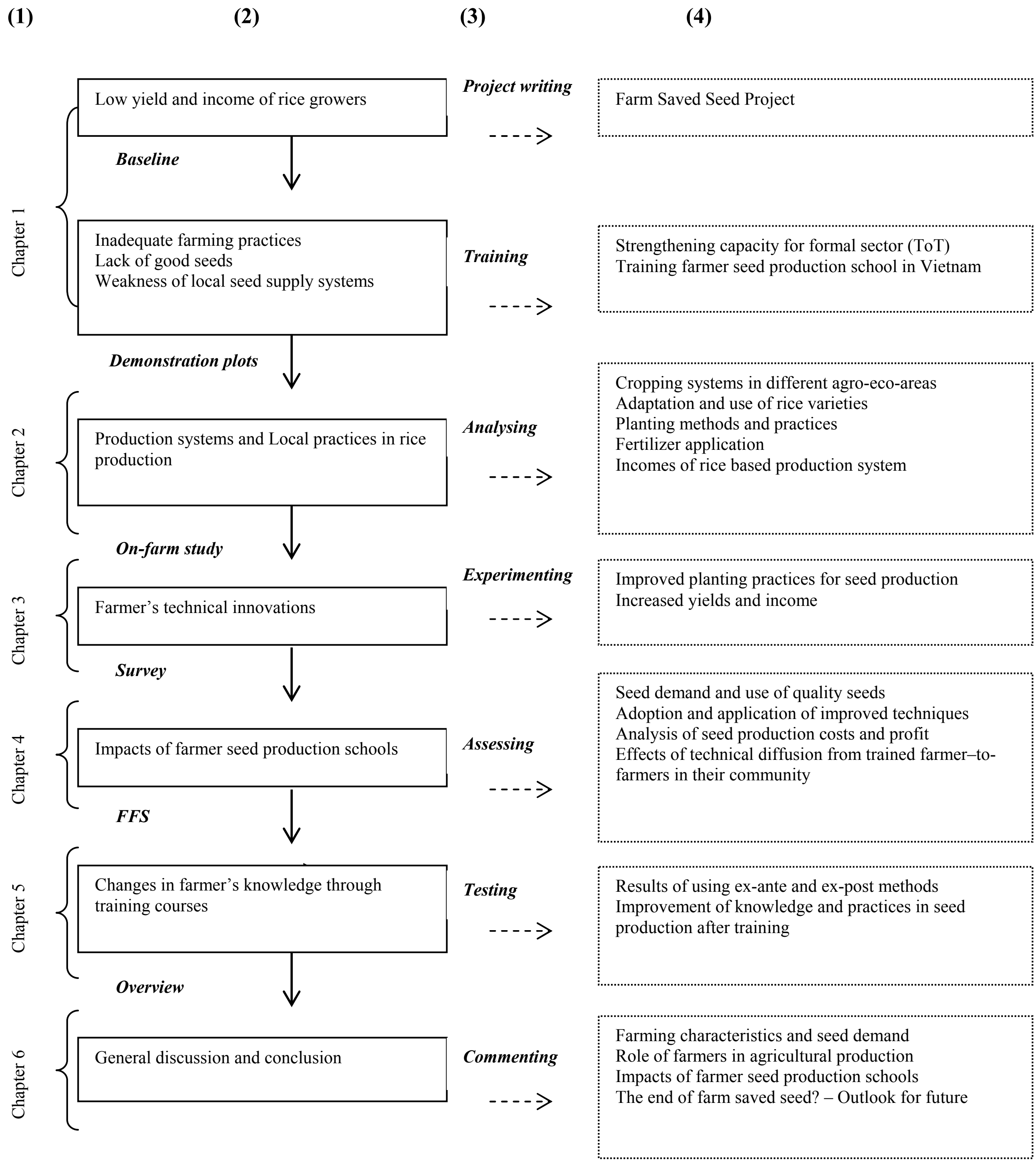

Fig. 1.4: Thesis outline and brief descriptions:
(1) chapters in thesis, (2) study areas, (3) execution and (4) main findings, with:
Methods *Activities*

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CHAPTER 2

Evaluation of rice cropping systems across Vietnam based on a large set of on-farm demonstration plots and household surveys

This chapter has been submitted for publication to *Experimental Agriculture* as:

Huynh Quang Tin, Paul C. Struik, Lisa L. Price. Evaluation of rice cropping systems across Vietnam based on a large set of on-farm demonstration plots and household surveys.

Evaluation of rice cropping systems across Vietnam based on a large set of on-farm demonstration plots and household surveys

Huynh Quang Tin[a,b], Paul C. Struik[b], Lisa L. Price[c]

[a] Mekong Delta Development Research Institute, Cantho University, Cantho City, Vietnam
[b] Centre for Crop Systems Analysis, Wageningen University, P.O. Box 430, 6700 AK Wageningen, The Netherlands
[c] Sociology of Consumers and Households, Wageningen University, P.O. Box 8060, 6700 DA Wageningen, The Netherlands

Abstract

Traditionally, rice is the major source of food and cash for Vietnamese farmers. It is grown in the whole country, both during the wet and the dry season. Rice farmers have learned to use varieties and apply cultivation techniques that are adapted to their local conditions. Whereas rice yields have increased over time, inputs increased but profits went down. This research aimed 1) to describe how rice is grown and used in the farming systems of four contrasting provinces in Vietnam, 2) to evaluate adoption of rice varieties in the different farming systems, and 3) to assess to what extent cultural practices and inputs affect rice yields and profits. Participatory on-farm demonstration plots were laid out at 429 sites across the provinces Nam Dinh (ND), Nghe An (NA), Binh Dinh (BD) and Dong Thap (DT). Household surveys were conducted on 60 representative households of one characteristic village per province: Yen Phuong (ND), Dong Thanh (NA), Phuoc Thuan (BD) and Tan Hoi Trung (DT). In the first three villages farm size was small and rice was mainly produced for home consumption. In the fourth village farm size was large and rice was produced for the market. Farmers selected varieties based on yielding potential and response to traditional cultivation techniques. Varieties differed amongst provinces and seasons. However, variety KD18 was dominant in Yen Phuong and Dong Thanh in both seasons. Crop establishment was through transplanting in ND and NA, and through direct seeding in BD and DT. Averaged across provinces rice yields were lower during the wet season than during the dry season. Highest yields were obtained in DT and lowest ones in NA. Yields were increased by higher seed rates in ND and BD, by more muck but less nitrogen fertilizer in NA, and by more K fertilizer in DT. The profits in rice production were on average much higher in the dry than in the wet season and higher in DT than in NA. To increase the profit for rice growers, improved practices to reduce production costs and/or increase yields need to be tailor-made.

Key words: Oryza sativa*, profit, rice yield, improved practice, variety adoption*

2.1. INTRODUCTION

Vietnam is basically an agricultural country. The agricultural sector accounts for 25% of the GDP (FAO, 2002), while more than 70% of the rural population depends on food production as the main source of income (Hai, 2003). Vietnam's agriculture occupies 28.4% of the country's natural land area of 33.1 million hectares. The total rice growing area in the country is about 7.3 million hectares. Rice production is 35.8 million tons (GSO, 2006); the two main granaries are the Mekong River Delta in the South and the Red River Delta in the North. These figures illustrate that rice is Vietnam's main crop and that it plays a central role in the livelihoods of the people of Vietnam. It is the main staple accounting for three-quarters of its population's caloric intake, and it is grown by more than two-thirds of the households on more than 60% of the cropped area (Minot and Goletti, 2000). Rice is also the most important cash crop for the Vietnamese farmer.

In Vietnam, rice is cultivated in diverse environments under different cultural practices and farming systems and therefore there are many different varieties. It is estimated that about 12,000 varieties of rice exist in the world (Khush, 1997) and many of them are grown in Vietnam. About 5,000 traditional rice cultivars are conserved in the National Gene Bank (Bo, 2004) and 1,552 accessions of the local rice of the Mekong Delta of Vietnam are preserved in the Cantho University Gene Bank (Tin, 2001).

Rice production in Vietnam has greatly changed over time in terms of varieties grown and cultural practices applied. The high-yielding rice variety IR8 was first introduced into South Vietnam in May 1966. The adoption rate of modern rice varieties increased from 1% of the total area planted with rice in 1968 to 33% in 1975 and 48% in 1980. In northern Vietnam, IR8 was introduced in 1968 and the adoption rate of modern rice varieties already exceeded 50% in 1980 in the rice area of the Red River Delta (Ut and Kajisa, 2006). During 1977–2002, 143 improved rice varieties were released by the Ministry of Agriculture and Rural Development (Bo, 2004). Those varieties replaced almost all photoperiod-sensitive, local rice varieties with a long growth cycle and low yields. At present, the area planted to traditional rice varieties is very small, accounting for 6.2 and 8.9% of the total rice growing area of the winter-spring crop and summer-autumn crop, respectively (Tuyen, 2003).

In the rice cultivation of northern Vietnam, transplanting was always common. When IR8 variety was introduced in northern Vietnam in 1968, the traditional cultivation techniques for local rice varieties were adapted to fit modern rice varieties. Since this time, different direct seeding techniques, including dry seeding, wet seeding, no tillage seeding, and submerged direct seeding, have been introduced and applied. Direct seeding is now applied widely in South Vietnam. Also other aspects of seeding technology have been improved (Paris and Chi, 2005). The change in seeding was combined with a change in nitrogen fertilizer management from high-rate blanket applications to need-based nitrogen fertilizer management using the leaf colour chart method. Farmers in some parts of the Mekong Delta have adapted this method to their own needs since 2000.

Given the importance of rice as a source of food, income, and export earnings, it is not surprising that issues related to rice have received considerable attention from the government. Agricultural reforms have had a large beneficial impact on the well-being of rural households throughout Vietnam (Benjamin and Brandt, 2002). For example, rice production increased at an annual average growth rate of 5% since 1980, and rice yield and area harvested increased from 1980 to 2000 at annual rates of 3.5 and 1.5%, respectively. Such rapid expansion of rice production has made it possible for Vietnam to become a major rice exporter since 1989 (Ut and Kajisa, 2006). However, rice yields and profits of individual rice growers can still be low and variable.

This research aims to describe how rice is grown and used in the farming systems of four contrasting provinces in Vietnam, to evaluate adoption of rice varieties in the different farming systems and to assess to what extent cultural practices and inputs affect rice yields and profits. We hypothesize that the concurrent changes in variety choice, intensification and changes in cultural practices of the last decades have created a dynamic situation in which the best agricultural practice has not yet been adopted to the full extent.

2.2. MATERIALS AND METHODS

2.2.1. Background

The Danish International Development Assistance (DANIDA) funded a programme on Farm Saved Seed Production in Vietnam, with the objective to improve the capacity of the farmers to produce, process, store, and use seed. The programme mainly consisted of training of farmers in seed production through so-called Farmer Seed Production Schools (FSPSs) which applied both the farmer field school approach and on-farm participatory demonstrations to transfer knowledge on improved practices. While the FSPSs provided the basic training, the demonstrations were supposed to be instrumental in the adoption of the new practices by the participating farmers but also in the diffusion to other farmers in the community. This paper analyses and interprets the results of the on-farm participatory demonstrations. It also analyses the use of the rice and farmers' criteria of selecting varieties based on household surveys.

Participatory on-farm demonstrations were carried out on plots throughout four different provinces in Vietnam, both in the wet and in the dry seasons of 2004. In each province, demonstration sites were identified in 16 villages located in four different districts. The number of sites in each of these 16 villages was variable and these sites were selected randomly. At each site, a FSPS was active, with participation of 20–25 farmers. With these FSPSs, the demonstration plots were planned, designed and implemented. Through weekly practices with the participating farmers in the demonstration plots the plots were monitored, data on agronomic practices, input costs and profits were collected, data were interpreted and evaluated throughout a season.

In each province, one characteristic village was selected to carry out 60 household surveys per village in 2006. These were conducted to assess the use of the rice, farmers' criteria of selecting varieties and rate of replacement of old seed.

Seeds of widely grown, adapted rice varieties and training materials were donated by the Farm Saved Seed Production Project of DANIDA.

2.2.2. Research sites

Vietnam's climate is favourable for tropical agricultural development but impedes economic development in general and agriculture in particular by regular threats of storms, tropical low pressure, flood, and other disasters. Vietnam is divided into two weather zones: monsoonal in the north and tropical in the south. Four provinces of Vietnam with major rice production areas were included in this study (Table 2.1), Nam Dinh (in the Red River Delta) and Nghe An (in the North Coastal Delta) in the north and Binh Dinh (in the Central Delta) and Dong Thap (in the Mekong Delta) in the south. The northern provinces Nam Dinh and Nghe An have similar weather conditions with four seasons per year including a cold winter and a hot summer; also the two southern provinces Binh Dinh and Dong Thap have similar weather patterns with a hot and a rainy season. Characteristics of rice production in the four provinces are:

1. In Nam Dinh, rice is the main crop, grown under good irrigation in a large proportion of the rice area. Total annual area cropped to rice is about 161,017 ha (PSO, 2005). Total agricultural land area is 106,593 ha, illustrating the multiple cropping of rice. Farm size at the survey village (Yen Phuong) was small. The farm size distribution (including landless households) was: 70% <0.05 ha, 25% between 0.05 and 0.10 ha and 5% between 0.10 and 1.0 ha. The average land-owning household had 0.31 ha of rice.
2. In Nghe An, rice comprises about 40% of total agricultural land area: 408,119 ha (PSO, 2005). In general, agricultural production is rainfed, but rice is irrigated. Farm size at the survey village (Dong Thanh) was small, with 90% of the households having less than 0.1 ha and 10% having 0.10–1.0 ha (including landless households). The average land-owning household had 0.25 ha of rice.
3. In Binh Dinh, rice production is rainfed, affected by salinity and by annual floods from typhoons in the wet season. The annual rice growing area is 125,444 ha (PSO, 2005). Mean agricultural land area per household in the survey village Phuoc Thuan was less than 0.1 ha (including landless households). The average land-owning household had 0.31 ha of rice.
4. In Dong Thap, rice is the main crop and grown twice or thrice per year. Completely irrigated rice production covers about 35% of total rice land area (DARD, 2007). At the survey village rice production is partly irrigated and

affected by annual floods at the beginning and the end of the first and second crop, and by the acidity of the soils in the wet season. Total growing area is with 453,052 ha larger than the one in the other provinces. Total agricultural land area is 243,475 ha (PSO, 2005). Farm size at the survey village (Tan Hoi Trung) was larger than in the survey villages of the other provinces: about 90% of the households (including landless households) had more than 1.0 ha. The average land-owning household had 1.61 ha of rice.

2.2.3. Data collection

Weather data and farming system

The weather data was collected from the Department of Statistics in each of the provinces. These Departments integrate all data from provincial organizations and publish them annually. Information on the farming system and the cropping calendar was collected from the villages where the household surveys took place.

Demonstration plots

FSPSs each had a training programme focused on rice seed production. Farmers' field studies were carried out as demonstration plots of about 300–500 m^2 on which a locally popular rice variety was grown. The demonstration plots involved traditional cropping practices, such as transplanting in Nam Dinh and Nghe An, but direct seeding in Binh Dinh and Dong Thap, and other crop-care techniques. All FSPS field studies were conducted in both wet and dry seasons. Data was gathered and interpreted by trainers and farmers as part of the training course. Data collection included simple data such as:

- Quantity of fertilizers applied (recording after application);
- Production costs during cropping season (recording all costs of materials, investments and labour);
- Grain yield (harvesting 10 m^2 in the demonstration plot. After threshing, grains were cleaned, dried, and weighed, and moisture content was assessed using a rice moisture tester. In this paper, grain weights presented have been converted to values on the basis of 14% moisture content;

- Selling price of paddy rice at the time of harvesting of four provinces;
- Finally, farmers analysed the economic value and profit of the crops in their field studies in million VND per ha.

In total for both seasons and all provinces there were 429 on-farm demonstrations. Their distribution is given in Table 2.1.

Household surveys

Household surveys were conducted in the same provinces to assess the use of the rice and farmers' criteria of selecting varieties. These criteria included yielding ability, length of grains, eating quality, crop cycle duration, adaptation to agronomic conditions, lodging resistance and resistance to the Brown plant hopper and to the Blast disease. The criteria were selected on the basis of the impact evaluation of the Farm Saved Seed Production Project. The Department of Agriculture and Rural Development (DARD) of each province selected a representative commune (village) for these surveys (Table 2.1). In the targeted village, 60 households were selected to be interviewed randomly from hamlets of the village. Interviewers were selected from agricultural extension agents working in the district. Each interview was conducted at the individual household level with a questionnaire. Data from the questionnaires were transformed to make them suitable for analysis.

Table 2.1: Details on number, timing and location of the demonstration plots in the year 2004, and on the site and number of the household surveys of 2006

Province	No. of demonstration plots		Total	Village of survey	No. of households per village studied
	Wet season	Dry season			
Nam Dinh	65	67	132	Yen Phuong	60
Nghe An	51	56	107	Dong Thanh	60
Binh Dinh	34	56	90	Phuoc Thuan	60
Dong Thap	44	56	100	Tan Hoi Trung	60
Total	194	235	429		240

2.2.4. Data analysis

Data was summarized using simple descriptive statistics such as means and percentages. The SPSS program (version 12.0) was applied for statistical analysis of the data. Data on yields, amount of fertilizers and economic values was analyzed with a one-way analysis of variance (ANOVA) to assess differences among provinces. T-test was used to compare means of the seasons. Tukey's *post-hoc* test of comparing means of eight environments (two seasons in four provinces) was applied at 5% significance level when the ANOVA identified significant differences. For analyses of the relations between yields, technology effects (amount of seeds, fertilizers) and economic values (production costs, gross margin and profit) multiple linear regression was used.

2.3. RESULTS

2.3.1. Weather condition in the four provinces

Total annual rainfall was 1401, 1611, 1325, and 1254 mm in Nam Dinh, Nghe An, Binh Dinh and Dong Thap, respectively. Rainfall distribution in 2004 was different between provinces (Fig. 2.1). Rainfall was distributed regularly in all months in the north (Nam Dinh and Nghe An), with only relatively little rainfall in January to March (spring). The annual rainy (wet) season in Binh Dinh and Dong Thap is usually from May to October, and highest rainfall is observed in September−October associated with rains from typhoons and with flooding. The dry season is from October to April. During this period, shortages of water for rice crop fields may occur occasionally.

Monthly average temperatures were different for each province (Fig. 2.2). Temperature from December to March in the north was lower (16.2−18.9 ^{o}C in Nam Dinh and Nghe An) than in the south (23.6−27.2 ^{o}C in Binh Dinh and Dong Thap). Adverse temperatures may affect establishment and growth of crops in Nam Dinh and Nghe An, but not in Binh Dinh or Dong Thap.

The weather patterns in the different provinces in 2004 were consistent with the characteristic monsoonal weather in the north and the tropical weather in the south.

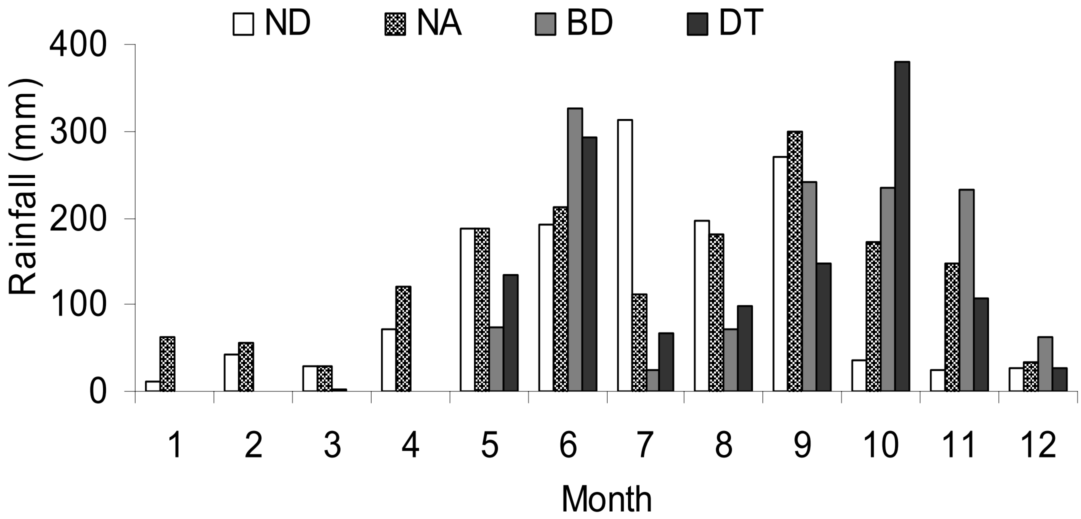

Fig. 2.1: The average rainfall distribution in the four provinces ND (Nam Dinh), NA (Nghe An), BD (Binh Dinh) and DT (Dong Thap), in 2004. Month 1 is January; Month 12 is December.

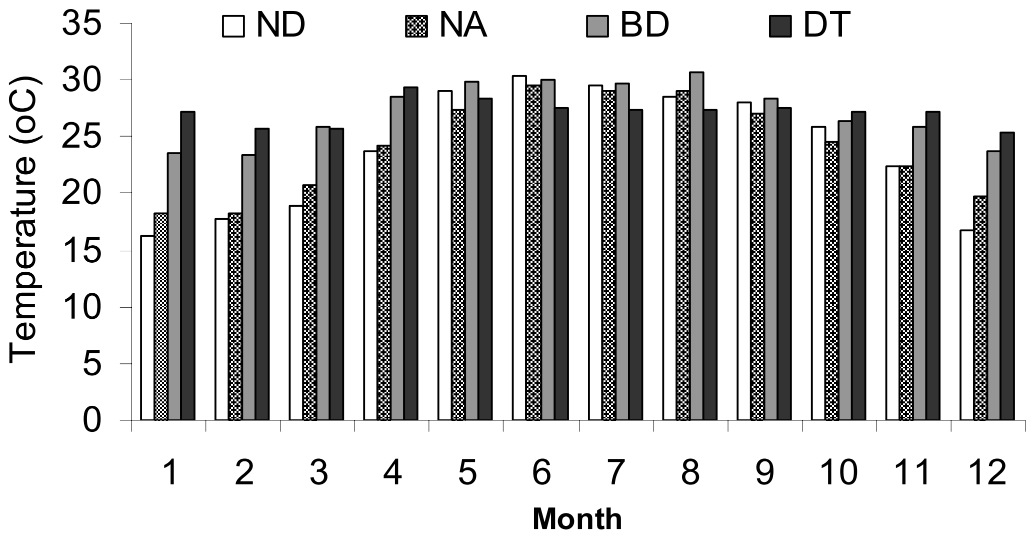

Fig. 2.2: The average temperature in the four provinces ND (Nam Dinh), NA (Nghe An), BD (Binh Dinh) and DT (Dong Thap), in 2004. Month 1 is January; Month 12 is December.

2.3.2. Cropping calendar and farming system

Fig. 2.3 shows the cropping patterns in the surveyed villages. Two rice crops and one vegetable crop (during the winter period of low temperatures) were found in Yen Phuong and Dong Thanh. Rice crop 1 usually had a longer growth cycle (5 months) than rice crop 2 (4 months). The choice for the upland crop depended on the variety of vegetable crops available. Also in Phuoc Thuan two rice crops were grown, with different rice varieties for each season. Here, the second rice crop was followed by a fallow period because of the occurrence of typhoons. In Tan Hoi Trung, a system with two rice crops with short cycle varieties (85–100 days) had been developed in the 1980s when irrigation systems were improved. The second crop was often used for a very short cycle variety (85–90 days) to allow harvesting before flooding could occur.

Climatic and weather conditions influence the cropping pattern and therefore the cropping calendar and the farming systems differ amongst the surveyed villages. Based on rainfall, temperature and the availability of an irrigation system, farmers design cropping patterns that fit the local conditions, making optimal use of the available rainfall, sunlight and suitable temperatures.

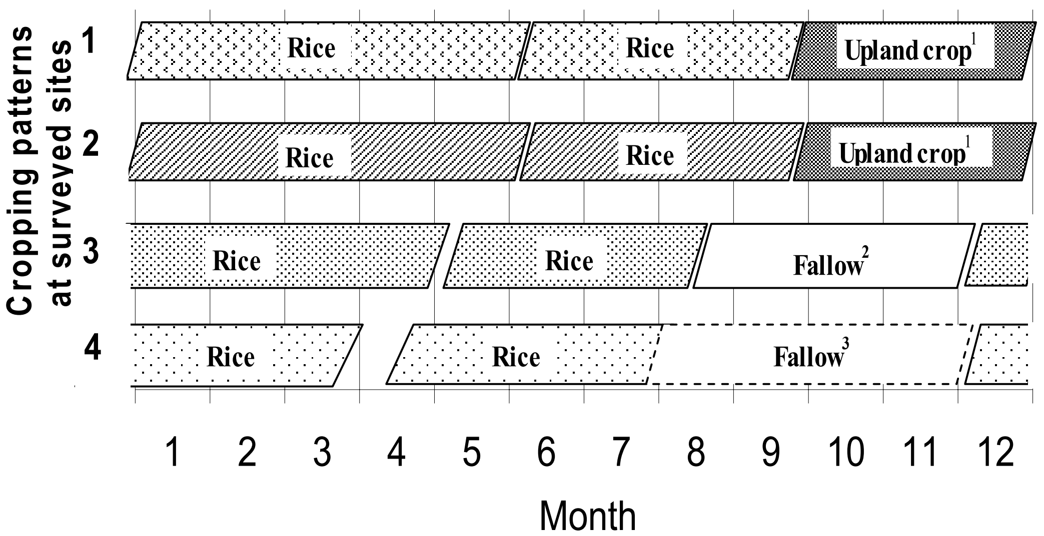

Fig. 2.3: Establishment of cropping patterns at four surveyed sites in Vietnam
1: Yen Phuong, 2: Dong Thanh, 3: Phuoc Thuan and 4: Tan Hoi Trung
(1) Corn, taro, vegetables
(2) Annual typhoon time – no crops
(3) An annual period of flooding (1–2 m water), used only for fishing on the field.

2.3.3. Rice yields in the demonstration plots

The average yields in the four provinces were significantly different ($p < 0.001$). Grain yield was highest in Dong Thap (6.07 t ha^{-1}) and lowest in Nghe An (5.26 t ha^{-1}). The yields between the seasons differed greatly ($t = -13.53$, $p < 0.001$), the mean yields were higher in the dry season (6.04 t ha^{-1}) than in the wet season (5.03 t ha^{-1}). Fig. 2.4 shows that rice yields in the dry season were much more different from those in the wet season in Dong Thap province ($t = -17.640$, $p < 0.001$) and in Binh Dinh ($t= -8.248$, $p < 0.001$) than in Nghe An ($t = -2.819$, $p < 0.001$) or Nam Dinh ($t = -4.014$, $p < 0.001$).

The yield potential is apparently higher in the southern provinces than in the northern provinces, especially during the dry season.

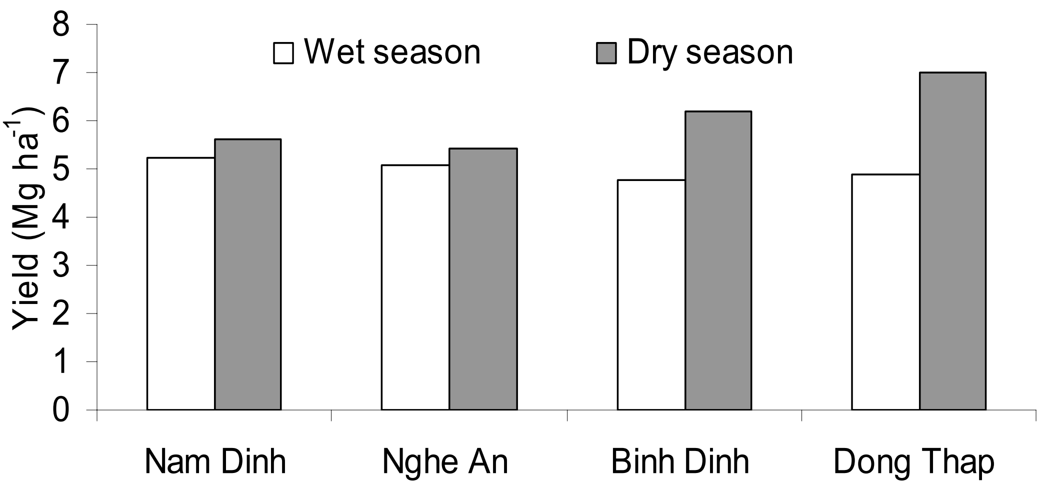

Fig. 2.4: Grain yields of the wet and dry seasons based on the participatory demonstration plots in four different provinces of Vietnam. Mean yields were significantly different ($p < 0.001$). For numbers of observations see Table 2.1

2.3.4. Uses of rice

In Tan Hoi Trung, the mean farm size was more than 1.0 ha, much larger than in the other surveyed villages. At this site, rice production was mainly commercial (Table 2.2). Rice production was to a large extent for household consumption in Yen Phuong, Dong Thanh, and Phuoc Thuan, where farm sizes were small. The rice was also used for rearing pigs and livestock, especially in Yen Phuong and Dong Thanh. Little of the rice was also used for processing; this proportion did not differ amongst sites. Moreover, a small proportion of rice production was kept for seed of household or seed sharing in the community. About 3.4% of total production was used for seed in Tan Hoi Trung and Phuoc Thuan, 6.5% in Yen Phuong and 9.9% in Dong Thanh (Table 2.2). Although there was a large proportion of production used for seed in Yen Phuong and Dong Thanh, farmers only used a very small amount for seed within their own household. The major proportion of the seed was usually sold to the local farm co-operative as assignment being a member of a cooperative.

In conclusion, rice is mainly grown for home consumption but also for other purposes. Especially farmers with a large area of arable land also grow the crop for market outlets. Seed production was mainly for the co-operative.

Table 2.2: Uses of rice (in % of production per household) in four surveyed villages in Vietnam

Villages surveyed	Household consumption(1) (%)	Market(1) (%)	Processing(2) (%)	Animal feed(1) (%)	Seed(1) (%)
Yen Phuong	39.3 a	26.9 c	0.8	26.5 a	6.5 ab
Dong Thanh	41.3 a	15.7 d	2.6	30.5 a	9.9 a
Phuoc Thuan	40.9 a	49.8 b	0.3	5.6 b	3.4 b
Tan Hoi Trung	9.1 b	86.0 a	0.4	1.1 b	3.4 b
P value	0.000	0.000	0.053	0.000	0.000

(1) *Comparing means of production purposes between surveyed villages. Within column, means followed by the same letter are not significantly different (Tukey's test, p = 0.05)*
(2) *not significantly different at 5%*

2.3.5. Variety selection, adoption and the use of seed

Farmers' criteria for selection

Table 2.3 shows that the farmers of Tan Hoi Trung were very much "market-oriented". Almost all farmers were interested in quality traits (long grains, eating quality, both 88%) to sell for export. Farmers at this site also preferred a short growth cycle rice variety (90%) to be able to use water resources sensibly. Farmers in Yen Phuong and Dong Thanh, however, required varieties which are resistant to pests and diseases (50–83%), as the relative humidity during crop growth is high, and varieties which are resistant to abiotic stresses (47%). In Yen Phuong, only a small proportion of the farmers wanted to grow a short cycle rice variety during the first rice growing season. This is in contrast with farmers in the other provinces. The Yen Phuong farmers selecting the short cycle variety wanted to plant relatively late in order to avoid the unusual cold weather at the start of the cropping season. Most farmers, however, took the risk and planted a relatively late variety earlier. Despite the difference in criteria, most farmers in both northern provinces selected the same variety, i.e. KD18.

Farmers usually select varieties based on their yield potential (>90% of households). Relevant characteristics in this respect were large or long grains, long panicles, and large numbers of grains per panicle. Farmers, however, also selected on the basis of other characteristics, depending on their farming conditions and use of the produce. Relevant characteristics were then tolerance to saline or acid soils, or market demands. The options for farmers to choose the best variety have been widened by the introduction of many modern varieties. In future papers, the relation between training of farmers and variety selection will be discussed in detail.

Table 2.3: Farmer's criteria in selecting rice varieties at four research sites in different provinces of Vietnam (% of 60 households interviewed per village)

Villages surveyed	High yield	Long grain	Eating quality	Short duration	Agronomic conditions	Culm strength	Resisting BPH*	Leaf blast
Yen Phuong	95	0	20	15	47	3	0	50
Dong Thanh	95	0	60	82	47	0	0	83
Phuoc Thuan	98	28	73	85	27	32	23	23
Tan Hoi Trung	90	88	88	90	53	52	57	48

* *Brown Plant Hopper*

Variety adoption

In this study, the proportion of households that used a certain variety of rice was used as an indicator of local adoption (Table 2.4). Variety KD18 was the only one which was adopted both in wet and dry seasons, with about 70% (Yen Phuong) to 100% (Dong Thanh) of the households growing it in both seasons. Variety OM1490 was also adopted by a large proportion of households, but was only grown during the wet season in Tan Hoi Trung (100%) and Phuoc Thuan (100%). In contrast, variety OM2718 was only grown in the dry season of Tan Hoi Trung (100%). Variety Ai32 was only adapted to the dry season at Phuoc Thuan (60%). Other varieties were present but had lower levels of adoption.

In most cases, yield was limited by many factors. Variety and seed quality were among these. Table 2.5 shows that farmers changed to new or better seeds after they had grown two crops from the original seed lot. This was observed in Yen Phuong, Dong Thanh, Phuoc Thuan and Tan Hoi Trung (50, 73, 75 and 41%, respectively). Replacement of seeds was also part of the local subsidy policy to improve product quality (except in Tan Hoi Trung). Farmers received about 30−50% subsidy on seed costs when they used good quality (i.e. certified or foundation) seed.

Table 2.4: Rate of adoption of different varieties at four research sites in different provinces of Vietnam

Villages surveyed	Wet season		Dry season	
	Variety	% Households adopting	Variety	% Households adopting
Yen Phuong	Ai32	6	Ai32	9
	KD18	70	KD18	73
	VHC	6	VHC	18
	MS4	18		
Dong Thanh	KD18	100	KD18	100
Phuoc Thuan	OM1490	100	Ai32	60
			DV108	35
			OM576	5
Tan Hoi Trung	OM1490	100	OM2718	100

In Tan Hoi Trung, 41% of the households changed to new or better seeds (or even a new variety) after they had used the seed for two crops due to lack of uniformity in the variety (off-type plants) or because the variety was infected by Brown plant hopper and diseases. Many farmers selected and retained their adapted varieties for over four plantings of crops (22%) until yields started to decline and off-types started to become more frequent. Then they had to change to a better seed source. Table 2.5 implies that farm-saved seed still plays a major role at this research site.

In general, the reasons for changing to a new seed source at the surveyed villages were to look for high yields, better genetic purity, reduced damage by insects and

Table 2.5: Replacement of old seed by new and qualitatively better seed stocks (or even by seed of a new variety) after a certain number of cultivated crops grown from the old seed at four villages in four different provinces of Vietnam

Villages surveyed	Number of crops cultivated from the original seed lot (% of household)				
	1	2	3	4	>5
Yen Phuong	15	50	32	3	0
Dong Thanh	13	73	10	3	0
Phuoc Thuan	12	75	7	6	0
Tan Hoi Trung	13	41	18	6	22

diseases, better quality of produced seeds and reduced production costs. Rice varieties well adapted to the local cultivation conditions were not replaced by farmers, as farmers wanted to avoid risks. Despite different criteria for adoption, often the majority of farmers selected the same variety, even across provinces. Not one single variety could satisfy all criteria, whereas at the same time, varieties selected were all high yielding.

2.3.6. Technical effects on grain yields

Planting techniques and seed rates

Planting techniques for the rice differed amongst the provinces (Table 2.6). Farmers in the Nam Dinh and Nghe An provinces transplanted the rice, but farmers in Binh Dinh and Dong Thap applied direct seeding.

Average amounts of seed used differed considerably ($p < 0.001$) amongst provinces. The amount of seed used to produce transplants was low in Nam Dinh (equivalent to

Table 2.6: Traditional planting methods and seed rates in different provinces of Vietnam

Provinces surveyed	Planting methods	Seed rates (kg ha^{-1})		t-value[(2)]
		Wet season[(1)]	Dry season[(1)]	
Nam Dinh	Transplanting	61.47 d	62.48 d	-0.456 ns
Nghe An	Transplanting	84.52 c	82.85 c	0.503 ns
Binh Dinh	Direct seeding	170.58 b	177.50 b	-1.458 ns
Dong Thap	Direct seeding	219.93 a	216.71 a	0.631 ns

(1) *Comparing means of each season between provinces. Within column, means followed by the same letter are not significantly different (Tukey's test, p = 0.05)*
(2) *Comparing means between two seasons of different provinces; ns: not significant at 5%*

62 kg ha^{-1}) compared to that in Nghe An (83 kg ha^{-1}). Direct seeding required on average 175 kg ha^{-1} in Binh Dinh and 218 kg ha^{-1} in Dong Thap. Analysis of variance of seed rates in both the wet and the dry seasons showed significant differences amongst provinces (p < 0.001). The average amounts of seed farmers used were generally similar for the wet and dry seasons. However, there were cases where farmers used more seeds in the wet season than in the dry season and cases where farmers used more seed in the dry season than in the wet season. In Dong Thap the amount of seed used in the wet season could be as high as 240 kg ha^{-1} to enable the rice crop to compete with the abundant weeds during the seedling stage of the wet season and to allow a good crop stand despite damage caused by golden snails. In addition, the acidity of the soils was most harmful at sowing time of the wet season. In contrast, in Binh Dinh, seed amounts in the dry season were in places higher than in the wet season. This is related to the occurrence of late typhoons in the central areas of Vietnam (including the Binh Dinh province). Farmers then use more seeds to make sure that the seed rate is adequate, even in case of water-logging.

In conclusion, planting techniques differed between the northern and southern provinces, whereas seed amounts were adjusted to cope with specific local abiotic and biotic stresses.

Fertilizer application

Average amounts of N fertilizer did not differ significantly between provinces and varied from 107 kg N ha^{-1} to 114 kg N ha^{-1}. P_2O_5 and K_2O fertilizers did differ significantly (p < 0.001) amongst provinces. More P_2O_5 fertilizer was applied in Nam Dinh (82 kg ha^{-1}) than elsewhere and especially than in Nghe An (49 kg ha^{-1}). K_2O fertilizer was lowest in Dong Thap (44 kg ha^{-1}).

Quantities of N, P_2O_5 and K_2O fertilizers applied did not differ much between wet and dry seasons over provinces (Table 2.7), except in Dong Thap. The amount of nitrogen fertilizer averaged 113 kg ha^{-1} in the wet season and 110 kg ha^{-1} in the dry season. In Dong Thap, more nitrogen fertilizer was applied during the wet season than during the dry season as the larger amount of water in the fields caused more dilution and leaching. The amount of P_2O_5 fertilizer was on average 64 kg ha^{-1} in the wet season and 61 kg ha^{-1} in the dry season. In Dong Thap, more P_2O_5 was provided during the wet season than during the dry season. The amount of K_2O fertilizer was on average 53 kg ha^{-1} in the wet season and 56 kg ha^{-1} in the dry season. In Dong Thap less K_2O fertilizer was applied in the wet season (42 kg ha^{-1}) than in the dry season (46 kg ha^{-1}).

A multiple regression analysis of rice grain yield with five independent variables including seed amount, N, P_2O_5, K_2O fertilizers and amount of muck showed highly significant correlations. The amount of seed, P_2O_5, K_2O and muck accounted for statistically significant proportions of the total variance of the yields. However, the total regression model only explained 12% of total variance of the rice yields over provinces ($r^2 = 0.126$, $p < 0.001$). This result shows that the rice yields were not only influenced by seed and fertilizer amounts but also by many different factors that were not included in our analysis.

Table 2.7: Applied fertilizer amount (N-P_2O_5-K_2O) in kg ha^{-1} in wet and dry seasons on the participatory demonstration plots in different provinces of Vietnam

Province	Wet season$^{(1)}$			Dry season$^{(1)}$		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Nam Dinh***	107.6	80.2 a	62.2 a	111.6	84.8 a	64.5 ab
Nghe An***	115.3	51.6 c	62.6 a	111.9	48.3 b	65.9 a
Binh Dinh**	110.0	57 8 bc	53.0 ab	106.2	53.5 b	56.4 b
Dong Thap*	120.5	64.0 b	42.4 b	109.5	57.7 b	46.4 c
P value	0.095	0.000	0.000	0.700	0.000	0.000

$^{(1)}$ *Comparing means of each season between provinces. Within column, means followed by the same letter are not significantly different (Tukey's test, p = 0.05)*
**** Almost all farmers used muck (compost of dung and rice straw) for rice production in large amounts.*
*** Some farmers used muck for rice production*
** Farmers did not use muck for rice production*

A simple linear correlation matrix indicates the associations between the different factors (Table 2.8). In Nam Dinh and Binh Dinh, only seed amounts had a significant positive correlation with rice yields suggesting that increasing seed amounts increases yields. In Nghe An, rice yields only showed a positive correlation with muck amounts, but the highly significant negative correlation between yield and N supply. This means that the more muck and less nitrogen fertilizer farmers apply the higher yields they could obtain. In Dong Thap, farmers did not use muck for rice production, but K fertilizer enhanced yields despite the fact that little was supplied. Another remarkable finding is the large positive effect of K fertilizer in Dong Thap where apparently the K amounts were lower.

Table 2.8: Simple Pearson correlation coefficients between yield and technical variables in the participatory demonstration plots in four provinces

	Seed	N	P_2O_5	K_2O	Muck
Nam Dinh province					
N	0.13				
P_2O_5	0.17*	0.33**			
K_2O	0.17	0.02	0.43**		
Muck	0.09	–0.29**	–0.00	0.24**	
Yield	0.34**	0.01	0.14	0.15	–0.00
Nghe An province					
N	0.01				
P_2O_5	–0.21*	–0.02			
K_2O	–0.13	0.37**	–0.18		
Muck	0.08	–0.39**	-0.09	0.08	
Yield	–0.07	–0.30**	0.14	0.15	0.58**
Binh Dinh province					
N	0.30**				
P_2O_5	0.30**	0.62**			
K_2O	0.23*	0.62**	0.40**		
Muck	0.13	–0.08	0.27	0.15	
Yield	0.21*	0.08	–0.00	0.02	0.00
Dong Thap province					
N	0.02				
P_2O_5	0.05	0.26**			
K_2O	–0.15	–0.25*	–0.29**		
Yield	–0.12	–0.18	–0.19	0.29**	

** Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).*

Table 2.8 also shows that application of fertilizers should be balanced. In Nam Dinh and Nghe An, muck is important for rice production, while with increasing muck amount farmers apply more K_2O fertilizer but less N and P_2O_5 fertilizer. In Binh Dinh, more seed is associated with more N, P_2O_5 and K_2O fertilizers. In Dong Thap, increasing amounts of K_2O were associated with decreasing amounts of seed, N and P_2O_5.

In conclusion: there was surprisingly little variation in the amounts of N fertilizer used between provinces and seasons, whereas there was more variation in the supply of P_2O_5, K_2O and muck. Our survey clearly showed that there is scope for a better balance of nutrient supply.

2.3.7. Economic profit from rice production

Depending on the local agronomic conditions, rice growers established two or three rice crops per year. The mean profit of rice production over provinces was about 5.83 mil. VND or US\$ 364 ha^{-1}. Results from an analysis of variance of economic values in four different provinces (Table 2.9) show that farmers in Dong Thap invested the lowest production costs (5.79 mil. VND or US\$ 362 ha^{-1}) but obtained the highest profit (7.44 mil. VND or US\$ 465 ha^{-1}). In contrast, gross income and total production costs were highest in Nam Dinh, but the profit was low and similar in Binh Dinh (5.86 mil. VND or US\$ 366 ha^{-1}). Gross income was not different in Dong Thap, Binh Dinh and Nghe An but much higher in Nam Dinh ($p < 0.001$).

Table 2.9: Economic analysis (in UD\$ ha^{-1}) for rice production based on the participatory demonstration plots in four provinces of Vietnam

Province	Gross income(1)	Total production costs(1)	Profit(1)
Nam Dinh	893.00 a	526.32 a	366.86 b
Nghe An	822.23 b	550.54 a	271.99 c
Binh Dinh	822.59 b	457.76 b	348.18 b
Dong Thap	828.21 b	362.49 c	465.42 a
P value	0.000	0.000	0.000

(1) *Within column, means followed by the same letter are not significantly different (Tukey's test, p = 0.05)*
Exchange rate: US\$ 1 = 16,000 VND

A comparison of the profit between seasons is given in Table 2.10. The profit of rice production differed from 4.69 mil. VND (US\$ 294) ha^{-1} in the wet season to 6.70 mil. VND (US\$ 419) ha^{-1} in the dry season averaged across provinces ($t = -9.207$, $p < 0.001$). However, the profit of rice production in Nam Dinh did not differ between the seasons ($t = -0.997$, $p = 0.321$). The profit in the dry season of the Dong Thap province was much higher than that in the wet season by about 4 mil. VND (US\$ 250) ha^{-1}; differences between seasons were 2.7 mil. VND (US\$ 168) ha^{-1} in Binh Dinh and 1.5 mil.VND (US\$ 95) ha^{-1} in Nghe An. The difference in the profit must have been influenced by the level of the yields obtained in seasons, total production costs, and selling prices, because almost all technical investments such as fertilizer amounts among seasons of provinces were similar. It is obvious, however, that the profit of rice production is usually definitely higher in the dry than in the wet season in Vietnam.

Table 2.10: Difference of mean profit values (in UD$ ha^{-1}) between wet and dry seasons based on the participatory demonstration plots in four provinces of Vietnam

Province	Wet season	Dry season
Nam Dinh	345.52	378.48 ^{ns}
Nghe An	221.95	316.98**
Binh Dinh	243.56	411.70**
Dong Thap	325.40	575.50**
Mean of four provinces	293.61	418.82**

*ns: not significantly different (t- test, p = 0.05)   **: significantly different at p < 0.001*
Note: rice price in US$ kg^{-1} of each province in 2004: 0.165 (Nam Dinh), 0.158 (Nghe An), 0.145 (Binh Dinh), 0.134 (Dong Thap)
Exchange rate: US$ 1 = 16,000 VND

A multiple linear regression analysis between the gross income and the production costs (including land preparation, seed, planting, fertilizer, pesticide, crop-care and irrigation) shows that the fertilizer, pesticide and crop-care contributed significantly to the regression model. Total variance in total gross income of rice production was accounted for by about 13% by this model over provinces ($r^2 = 0.13$, $p < 0.001$).

Gross income differed from farm to farm as it depended on type of input and level of inputs. In Nam Dinh, land preparation and fertilizer input costs accounted for 19% of total gross income in rice production ($r^2 = 0.19$, $p < 0.001$). In Nghe An, however, 58% of total gross income was explained by investments in fertilizers, irrigation, planting and seed costs ($r^2 = 0.58$, $p < 0.001$). In Binh Dinh, 39% of total gross income was accounted for by inputs of seeds, planting, fertilizers and pesticides ($r^2 = 0.39$, $p < 0.001$), and in Dong Thap land preparation, planting and fertilizer costs explained about 30% of total gross income ($r^2 = 0.30$, $p < 0.001$).

Furthermore, the selling price of paddy differed considerably amongst seasons and between rice areas in Vietnam. It was a very important factor to explain the profit of the rice grower. The paddy price differed from province to province. Mean price was significantly lower ($p < 0.001$) in Dong Thap (2,172 VND or US$ 0.135 kg^{-1}) than in other provinces. In Binh Dinh it was about 2,326 VND or US$ 0.145 kg^{-1}, in Nghe An and Nam Dinh is was 2,528–2,632 VND or US$ 0.158–0.164 kg^{-1}.

Among seasons, the averaged paddy prices over provinces was higher in the dry season (2,482 VND or US\$ 0.155 kg^{-1}) than in the wet season (2,378 VND or US\$ 0.148 kg–^{1}) (t = –2.762, p = 0.006). Rice farmers in Vietnam lack the means for post-harvest handlings (drying equipment and rice storage) in the wet season. This is especially true for the farmers in Dong Thap with a large farm size. Farmers, therefore, have to sell their products just after threshing or drying. Then, the selling prices depend on what the local rice traders are willing to pay.

2.4. DISCUSSION

Within a development programme with the aim of improving the capacity of Vietnamese farmers to produce, process, store and use rice seed, farmers were trained in so-called Farmer Seed Production Schools, in which the generally known farmer field school approach was combined with participatory on-farm demonstrations to transfer knowledge on improved practices. In this paper, the agronomic and economic results of the proposed improved practices are analyzed as shown in on-farm demonstrations across provinces and seasons. The use of the rice and farmers' criteria of selecting varieties are also analyzed based on household surveys.

Tin et al. (unpublished data) identified five important sources of income of the households in the surveyed villages, including rice production, other crops, livestock, aquaculture and off-farm activities. In Dong Thanh and Phuoc Thuan off-farm activities were more important sources of income than rice production. In Yen Phuong, production of other crops, but also livestock production, was of economic importance. In Tan Hoi Trung, rice was the most important source of income and the total average income of the households in this village was much higher than in the other villages. Aquaculture also contributed to the income in this village. Overall income ranged between US\$ 1073 and US\$ 1902 per household (Tin et al. unpublished).

Analysis of farmers' adoption of rice varieties and traditional cultural practices in rice production illustrates some common approaches in choosing and using adapted varieties and techniques. In particular, farmers have experienced learning by doing. Results in Table 2.3–2.6 show that a variety which is well adapted to local cultural conditions is very important. It can reach high yields with limited inputs. KD8 was grown by 70–100% households at two research sites. On the other hand, data on seed rates and fertilizer application confirm farmer's adoption of new cultural practices. The differences amongst households for these aspects were relatively small. The proper combination of variety and cultural practice can lead to a stable yield. However, Balasubramanian (1999) showed that most farmers' rice crops suffer from one of the following six conditions (in order of decreasing importance): poor water control, less than optimum plant population, partial nutrient application, insufficient weed control, uncertainty in the timing of sowing – transplanting - weed control - harvest operations, and poor post-harvest processing. More than 95% of the demand of seed used for annual rice production is covered by farm saved seed. It is produced by individual farmers and groups for exchange or local seed trading in the community (Danida, 2001). Therefore, rice growers in the research sites are still not applying all options for better seed quality and better crop management available for rice production in their local conditions.

Minot and Goletti (2000) showed that rice production in Vietnam is characterized by multiple cropping, small irrigated farms, labour-intensive practices, and widespread use of fertilizer. The average agricultural household has just 0.45 hectares of agricultural land, and less than 12% of rural households have more than 1.0 hectare. At the surveyed villages, almost all farms were small, except those in Tan Hoi Trung. This is a constraint for investment and application of improved techniques. Indeed, Table 2.2 shows that a large proportion of rice production is used for household consumption; only in Tan Hoi Trung the crop is commercial.

Agricultural production of rice growers is aimed at maximizing total grain output and gross income per land unit. The farmer tries to choose and apply suitable techniques regarding transplanting, direct sowing and applying inputs for his rice fields. This study showed that differences in yield between the wet and dry seasons happened in all rice production areas investigated. The magnitude of these differences depended on three main factors: (i) cultivation practices and variety, (ii) weather, and (iii) soil conditions. Amongst these factors weather was likely the most important one. The relevance of these factors differed amongst provinces. In Dong Thap, the difference in yields between seasons was large whereas it was small in Nghe An (Fig. 2.4). The yield in the dry season (winter-spring crop) was always higher than in the wet season (summer-autumn crop). Although weather can affect yield in all provinces, suitable application of improved practice/techniques was shown to increase yield, especially in the wet season.

Balanced fertilizer application may be one of the most important factors to improve rice yield in Vietnam. At the sites investigated, amounts of inorganic fertilizers applied could be unbalanced (Table 2.8). Rice yields were positively correlated with K fertilizer at all sites, but especially in Dong Thap province. Mussgnug et al. (2006) conducted a long term experiment on degraded soil in the Red River Delta of Vietnam and identified K as the most limiting macronutrient in intensive rice-based cropping systems. For the Mekong River Delta, (Hoa, 2003) reported that unbalanced fertilization with high NP and low K application in intensive rice cropping systems may generate soil K depletion. K is in balance if 35 kg ha^{-1} K fertilizer is added and rice straw is returned to the field. Actually, most farmers have not responded fully to this recommendation; the rice straw is burned just after threshing in Dong Thap and Binh Dinh and used for feeding animals and other purposes in Nghe An and Nam Dinh. However, in Nam Dinh and Nghe An, muck is used in rice fields as a small contribution to returning K to the soil.

Furthermore, inorganic fertilizers applied in the surveyed provinces were different to current institutional recommendations. For acid sulphate soils such as in the Long Xuyen Quadrangle, along the West Hau River and in Dong Thap Muoi (including Dong Thap province), N-fertilizer recommendation is lower than for alluvium soils, *i.e.* 80−100 kg N ha^{-1} in the dry season and 60−80 kg N ha^{-1} in the wet season (Hach and Nam, 2006). However, Table 2.7 indicates that the amount of N fertilizer used in Dong Thap province was higher than the recommended amounts, especially in the wet season. Farmers gave the following reasons for using more N fertilizer than recommended in the wet season: (i) advancing the crop establishment after sowing under unfavourable conditions of acid sulphate soils; (ii) compensation for leaching of N and loss of N by high water temperature on sunny days, and (iii) increasing the ability to compete with weeds and volunteer rice plants from the previous crop. The applied N-fertilizer amount, perhaps, is unsuitable in rice production in Dong Thap. In this case, properly managing plant density will be more essential than using a high N-fertilizer amount. In the Red River Delta, the amount of N fertilizer varies from 91 to 113 kg ha^{-1} in winter rice and from 104 to 124 kg ha^{-1} in spring rice (Kurosawa et al., 2004). The amounts of N fertilizer used were not much different for the research sites. However, in Nghe An, N-fertilizer amount should be balanced with muck and K fertilizer.

Planting density can be inadequate in Binh Dinh and Dong Thap (Table 2.6), as farmers may plant too densely and unbalanced nutrients then may affect the growth of the rice plant. Pest and diseases can cause damage and yield loss, especially in dense crops, thus increasing the need for scarce inputs. On the other hand, planting techniques and fertilizer investments can contribute to increasing production costs. All of that is the cause of low profit in rice production at research sites. To increase the economic profit for rice growers in Vietnam, some research projects have been conducted to improve the existing local practices in rice production. The "Three Reductions Program" (Huan et al., 2005) in the Mekong River Delta showed that the highest contribution to increased gross margins was from pesticides reduction, comprising 80% of the increase. Pesticides spray reduction also meant reducing workdays used for spraying thus providing additional incentive for the reduction of seeds and fertilizer. However, this study shows that the costs of pesticides amounted to about 16% of total input costs (not including labour costs for application) in Dong Thap. Using the leaf colour chart to manage nitrogen fertilizer in rice production has been introduced in Vietnam. It has given a good initial result in saving N-fertilizer and reducing pesticide costs. Meanwhile, in India, adoption of the leaf colour chart (LCC) saved 25.0−31.4 kg N ha^{-1} in the *boro* season. LCC adoption also reduced insecticide applications by 50% (Islam et al., 2007). In addition, improved sowing techniques are adopted in Vietnam, especially in the Mekong Delta (Phung et al., 2003; Paris and Chi, 2005).

Profit of rice production in Vietnam is low. There were clear differences in profit amongst seasons and provinces (Table 2.9). Low profit of rice production was found in Nghe An, Binh Dinh and Nam Dinh (US$ 272, 348 and 366 per ha, respectively) where farms were small. The highest profit of rice production was in Dong Thap (US$ 465) with large farms and commercial production. The profit of rice growers also differed between seasons, in the dry season it was higher by about US$ 62.5 ha^{-1} per crop than in the wet season averaged over provinces in Vietnam. The results from this study show that the profit of rice production mainly depends on rice prices in the south and on rice yields in the north of Vietnam. Moreover, high input costs cause low profit of rice production. The fertilizer, pesticide and seed costs were the main input costs, accounting for more than 46% of total production costs (Table 2.11). However, the proportion of these three input components in the total production costs was much lower than the values presented by Pampolino et al. (2007): 22, 20 and 14% for Vietnam, Philippines and India, respectively. At our research sites, labour costs made up a large proportion of total production costs with transplanting costs in Nam Dinh and Nghe An being much higher than direct seeding costs in Binh Dinh and Dong Thap. Direct seeding is usually applied in areas where there is a lack of labour for agricultural activities.

Table 2.11: Proportion (%) of some inputs in the total costs of rice production based on the participatory demonstration plots in surveyed provinces of Vietnam

Region	Seed	Fertilizer	Pesticide	Land preparation	Planting	Crop-care	Irrigation
Nam Dinh	2.23	31.43	6.35	9.24	11.78	10.48	4.97
Nghe An	5.57	31.81	4.91	13.57	18.40	7.68	5.48
Binh Dinh	6.66	32.08	7.19	11.03	2.98	9.72	7.81
Dong Thap	9.73	31.84	16.17	6.06	0.90	5.84	8.91
Average	6.05	31.79	8.66	9.98	8.52	8.43	6.79

2.5. CONCLUSIONS

The farmer seed production schools in association with participatory on-farm demonstrations were a useful instrument for debate with farmers on best practices. The approach also served to identify strategies to optimize yield and profit under diverse agro-ecological conditions. The household survey yielded useful information on the use of rice by the households in the different agronomic settings and on the strategies for variety choice. The data set (including aspects not provided here) will allow further detailed analysis of agronomic and sociological aspects of rice seed production in Vietnam and of the effectiveness of this combined approach of farmer seed production schools and on participatory farm demonstrations. The authors will report on those analyses in future papers.

The study based on a large set of on-farm demonstration plots and household surveys in four provinces of Vietnam showed that rice production in the dry season (winter-spring crop) had a significantly higher yield potential than the crop in the wet season throughout Vietnam, but especially in the Dong Thap province.

The variety KD18 was best adopted by rice growers in Nam Dinh and Nghe An provinces; OM1490 was adopted well for the wet season in Binh Dinh and Dong Thap.

The fertilizer input costs occupied a large proportion of total production costs.

Our hypothesis that the best agricultural practices are not yet reached has been confirmed, especially with regard to a balanced fertilizer application. To increase the yield potential, it is necessary: (i) to increase the K-fertilizer amount at all research sites, especially in Dong Thap; (ii) to adjust seed rates in Nam Dinh and Binh Dinh; (iii) to increase muck amount; and (iv) to reduce N-fertilizer in Nghe An.

A good market price was the most important factor for getting high profit for the rice growers, especially in the south of Vietnam.

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CHAPTER 3

Comparative analysis of local and improved practices used by farmer seed production schools in Vietnam

This chapter has been published as:

Huynh Quang Tin, Paul C. Struik, Lisa L. Price and Tran T. Be, 2008, Comparative analysis of local and improved practices used by farmer seed production schools in Vietnam. *Field Crops Research* (2008) 108: 212-221.

Comparative analysis of local and improved practices used by farmer seed production schools in Vietnam

Huynh Quang Tin[a,b], Paul C. Struik[b], Lisa L. Price[c], Tran T. Be[a]

[a] Mekong Delta Development Research Institute (MDI), Cantho University, Vietnam
[b] Centre for Crop Systems Analysis, Wageningen University, P.O. Box 430, 6700 AK Wageningen, The Netherlands
[c] Sociology of Consumers and Households, Wageningen University, P.O. Box 8060, 6700 DA Wageningen, The Netherlands

ABSTRACT

Farmer seed production schools in combination with participatory field experimentation might be effective instruments to enhance the skills of farmers to produce high-quality seed in the informal seed system in Vietnam. Four hundred twenty nine, unreplicated on-farm experiments were carried out in four different provinces and analyzed by the farmer seed production schools. These experiments consisted of two adjacent seed production plots: one with common local practice and one with improved practice. Differences between the two plots in yield and profit were assessed. Averaged across provinces, yields of the "improved practice plots" were 0.43 Mg ha^{-1} higher in the wet season and 0.78 Mg ha^{-1} higher in the dry season than the "local practice plots". In the Nam Dinh and Nghe An provinces more hills per m^2, more input of potassium and muck, and fewer seedlings per hill at transplanting contributed to the higher yields in the "improved practice plots". In the provinces Binh Dinh and Dong Thap, using a drum seeder for sowing, reduced seed rate, less input of nitrogen fertilizer and more potassium contributed to the yield advantage of the "improved practice plots". The profit of the improved practice plots was 212 US$ ha^{-1} higher than the profit in the local practice plots. Rice growers can benefit from lower seed rates, better yields and higher prices when grains are sold as seeds. These findings may direct the seed policies and extension approaches in Vietnam.

Key words: *Farmer's seed production school, On-farm experiment, Profits,* Oryza sativa, *Rice, Vietnam, Yield*

3.1. INTRODUCTION

Seed is probably the most important single input for arable cultivation, as it determines the potential production and thus the productivity of all other inputs (Hansen, 1995). Formal or informal seed systems need to provide high-quality seed in order to realize the best possible productivity from a crop in a specific condition. Seed of the preferred variety needs to be available at any time, so that farmers can use their land and labour resources with the best yield expectations (Weltzien and Brocke, 2000). Often, the formal seed system can only supply a small proportion of the total seed demand: in most developing countries the informal seed system provides over 80% of the seed required (Chopra, 1999; GTZ, 2000). The informal seed system develops naturally over time in response to farmers' demands through different types of diffusion: farmer to farmer; community to community and between households within a community (Almekinders, 2000). The informal seed system plays an important role in seed security in the rural areas but has a low level of organization, lacks formal quality control as seed is multiplied without any generation control and is not subject to seed trade regulations (Chopra, 1999). Therefore, seed quality of the informal system is often low and poor seed quality can be one of the yield constraints in rice. Evidence from farmer's participatory experiments carried out in the Philippines and Bangladesh shows that good quality seed can increase rice yield by 8–10% (Hossain et al., 2002). We surmised that this would also be the case in Vietnam.

In Vietnam, rice production increased considerably during the last decade: from 25 million tons in 1995 to 36 million tons in 2006 (GSO, 2007). However, this production is achieved while 90% of the rice is still grown with farmer saved seed (MARD, 1998). It has been suggested that the yields may be improved through the use of better seed. The Farm Saved Seed Production Project of the Agricultural Sector Programme Support (ASPS) in Vietnam therefore developed a strategy to improve the seed quality of the informal seed system by improving farmers' cultural practices. Kalirajan and Shand (2001) showed that the gap between actual and potential yields was caused by several factors but that about 67% of the yield gap could be attributed to suboptimal technical efficiency caused by not following the best practices. Therefore, in order to improve performance, suitable approaches to transfer technology to the farmers needed to be designed. Llewellyn (2007) claims that the slow adoption rates for many agricultural practices are often a source of frustration for researchers and extension agencies. Several technologies are not performed well in farmer's fields or are not properly adopted by the farmers (Balasubramanian, 1999). Farmers need to be trained through joined learning experiences for which participatory research and participatory technology development can be important tools. In the 1980s, farmer participatory research received increased attention and recognition since the "Farmer First" and "Participatory Technology Development" concepts were first introduced (Van de Fliert and Braun, 2002). The term "Farmer Field School" came in vogue and was first used in an Indonesian Programme on Integrated Pest Management (Gallagher, 1999). A similar programme was implemented in Vietnam and this "Vietnam National Integrated Pest Management (IPM) Programme" has become larger and more multi-faceted since 1999 (IPM-VN, 2001). Nowadays, the farmer field school (FFS) approach has also been applied for training farmers in other fields. In the implementation of the Farm Saved Seed Project, the FFS training approach and farmers' participatory research were applied to develop *farmer seed production schools* (FSPSs).

In this chapter, we analyse impacts of technological innovations at participatory on-farm experiment sites of the farmer seed production schools in 2004 through four provinces of Vietnam. The specific objectives of the study were to: (1) compare yields and profits between the local and improved practices, and (2) evaluate efficiency of the farmer's improved practices in on-farm experiments in Vietnam.

3.2. MATERIALS AND METHODS

3.2.1. General methodology

This present study is a follow-up of a previous study that analyzed the grain and seed production situation of rice from demonstration plots based on local practices in the following four provinces of Vietnam: Nam Dinh and Nghe An in the north and Binh Dinh and Dong Thap in the south of Vietnam (Tin et al., 2009). In the current chapter, improved practices are compared with local practices.

Participatory research was carried out in farmer seed production schools (FSPS) under the Farm Saved Seed (FSS) Project[1] in the same four provinces of Vietnam as the previous study. The methodology of the FSPS was based on that of farmer field schools on Integrated Pest Management and similar to that in Local Agricultural Research Committees (Braun et al., 2000). In the case of FSPS, however, special topics are addressed related to seed production and an on-farm experiment is a compulsory part of the FSPS. The on-farm experiment compares commonly used seed production methods (the "local practice plot", coded as LP) with improved seed production (the "improved practice plot", coded as IP) and farmers themselves apply improved techniques, record effects and evaluate their findings.

To define and apply the two treatments, the farmer's participatory research process included the following steps:

- Step 1: At the first class meeting, the facilitators concurrently listed farmers' proposals for improvement and seed production problems and used that to list proposals for the FSPS and the on-farm experiment.
- Step 2: Listing of all technologies in which the participants were interested.
- Step 3: Identifying relevant technologies related to farm seed production.
- Step 4: Selecting suitable technologies to be tested in the on-farm experiment.
- Step 5: Monitoring and evaluating results during the FSPS by farmers.

Each of the Farmer Seed Production Schools consisted of 20−25 farmers. Throughout the season meetings were held to evaluate the weekly practices in the plots. After the growing season, several meetings were held to evaluate differences between treatments in physical and financial yields. Knowledge level of the participants was assessed before and after the programme (to be reported in a future paper). Each FSPS was active for at least 2 years. For further details on the methodology see Tin et al. (2009) and other chapters in this thesis.

[1] This is a sub-component of the Seed Component of Agricultural Sector Programme Support (ASPS), Danida-MARD.

3.2.2. Seed source and materials

The rice variety used within a single on-farm experiment had to be the same for both plot types present in one location and one season. But the choice of variety could differ between seasons for the same FSPS and between different FSPSs, whether they were in the same province or in different provinces.

Seed lots included two different quality levels and sources: (1) for the local practice plot, it could be any variety which the farmers considered to be locally popular. Seeds used were the "farm saved seed" and sampled randomly from farmers of the FSPS; (2) for the improved practice plot, seeds used were the foundation level seed, for which the formal sector was also a source of supply. It was considered as an important improved practice component in seed production.

Other materials for the study fields were provided by the Farm Saved Seed Production Project.

3.2.3. Site selection

The FSPSs were targeted by the Farm Saved Seed Project in 16 villages of four districts including all important rice areas of the province. In Binh Dinh and Dong Thap, rice was grown in irrigated and mono-cropped systems with two or three rice crops per year. In Nghe An and Nam Dinh, rice was grown in a rotation system with two rice crops and an upland crop per year. The on-farm experiments were conducted in both the wet and dry seasons: in total 132 were carried out in Nam Dinh, 107 in Nghe An, 90 in Binh Dinh and 100 in Dong Thap.

3.2.4. Technological innovations

Facilitators and farmers jointly decided on the local and improved practices to be compared in the on-farm field experiments of the FSPSs. The rice production systems in the northern and southern provinces differed greatly.

In the northern provinces:

- For the LP, all practices (from preparing seedbed to post-harvest handling) were applied according to normal farmers' practices and these normal practices were detailed during the first class meeting. Farmers applied transplantation methods with a planting arrangement of 40−50 hills m^{-2} and 3−5 seedlings per hill.

- For the IP, besides using seeds of better quality, a few new practices in seed production were introduced, including transplanting with one seedling per hill and 50−65 hills m^{-2}. In Nam Dinh and Nghe An, the new practices also included transplanting of a single seedling per hill into strips of about 3−4 m wide and 10−20 m long (depending on farm size). Two strips were separated by a permanent walking lane of about 30 cm wide for easy crop care and roguing.

In the southern provinces:

- For the LP, all practices related to seed production were as decided upon or developed by the FSPS-farmers. The direct seeding method was applied, and seed rate applied was above 200 kg ha^{-1}.

For the IP, applying a drum-seeder for sowing was introduced in Binh Dinh and Dong Thap with seed rates around 100−120 kg ha^{-1}. Differences in practices between the LP and IP are detailed in Table 3.1.

3.2.5. Selecting and carrying out the experimental fields

Selecting experimental fields

The experimental fields at each FSPS were selected by the farmers. Different research groups carried out two types of experiments: the main experiment had a set up with a plot with traditional practices (LP) and a plot with improved practices (IP); an additional and optional experiment could be carried out depending on farmers' expectations. In the latter experiment, farmers could choose to test the effects of variety adaptation, rehabilitation selection, planting density, seeding rate, kind or amount of fertilizer and other factors. The FSPS-farmers divided themselves into small groups depending on the number of experimental plots (Photo 3.1) to manage a plot and collect data on it during the FSPS.

Carrying out field experiments

Experimental sites were chosen on the basis of the following criteria: the sites were at a farm of a FSPS participant; the farm was representative for the local conditions of farming; and the site was near a road to allow easy access by other farmers to carry out the

Table 3.1: Differences in cultural practices between the "local practice plots" and the "improved practice plots" at the farmers' seed production schools in four provinces of Vietnam, 2004

Province and cultural practice		Local practice plots	Improved practice plots
1. Planting method		Normal transplanting	Transplanting in strips [a]
Seed quality		Farm saved seeds	Foundation seeds [a]
Seed rate (kg ha^{-1})	- Wet season	50−80	20−30
	- Dry season	50−80	20−30
Planting density (hills/m^2)	- Wet season	45−50	50−65
	- Dry season	40−45	50−65
Seedlings per hill at transplanting		3−5	1
Fertilizer (N-P_2O_5-K_2O)	- Wet season	Normal amounts	Less N and more K
	- Dry season	Normal amounts	Less N and more K
Applying pesticides		Planned as in previous crops	When needed
Roguing (removing off-type plants)		Once per season	At least twice per season
2. Planting method		Normal transplanting	Transplanting in strips [a]
Seed quality		Farm saved seeds	Foundation seeds [a]
Seed rate (kg ha^{-1})	- Wet season	60−100	40−50
	- Dry season	60−100	40−50
Planting density (hills/m^2)	-Wet season	50−55	60−75
	- Dry season	55−60	60−75
Seedlings per hill at transplanting		3−6	1
Fertilizer (N-P_2O_5-K_2O)	- Wet season	Normal amounts	Less N and more K
	- Dry season	Normal amounts	Less N and more K
Applying pesticides		By calendar as in previous crops	When needed
Roguing (removing off-type plants)		Once per season	At least twice per season
3. Planting method		Direct seeding	Sowing using drum seeder [b]
Seed quality		Farm saved seed	Foundation seed [a]
Seed rate (kg ha^{-1})	- Wet season	180−240	100−120
	- Dry season	180−240	100−120
Fertilizer (N-P_2O_5-K_2O)	- Wet season	Normal amounts	Less N and more K
	- Dry season	Normal amounts	Less N and more K
Applying pesticides		Once insects and diseases were detected	When yields and seed quality could become affected
Roguing (removing off-type plants)		Once per season	At least twice per season
4. Planting method		Direct seeding	Sowing using drum seeder [b]
Seed quality		Farm saved seed	Foundation seed [a]
Seed rate (kg ha^{-1})	- Wet season	180−240	100−120
	- Dry season	180−240	100−120
Fertilizer (N-P_2O_5-K_2O)	- Wet season	Normal amounts	Less N and more K
	- Dry season	Normal amounts	Less N and more K
Applying pesticides		Once insects & diseases were detected	When yields and seed quality could become affected
Roguing (removing off-type plants)		Once per season	At least twice per season

Practices that were the same for both types of plots are not included in this table.

Provinces: 1 = Nam Dinh, 2 = Nghe An, 3 = Binh Dinh and 4 = Dong Thap
[a] *Quality seeds and practices introduced by the facilitators of the Farm Saved Seed Project*
[b] *Note: Row seeder (drum seeder) is a simple tool/ machine, which can be used for sowing pre-germinated rice seeds in rows on puddled soil directly in the main field. A row seeder has six to eight drums (16 mm in diameter) each with a pair of rows of holes (8−9 mm in diameter) on each side of the drum. In each drum, a mechanism pushes the seeds towards the holes as the drum rotates. Row seeder was originally designed by IRRI but was modified and adapted by the Cantho Plastic Company in Vietnam using plastic material. A plastic row seeder weighs about 6 kg when empty. The adapted version is less expensive and can be easy pulled and transported from field to field* (Paris and Chi, 2005).

observations. The experiments were designed by the FSPS-farmers. A single on-farm experiment consisted of two plots, next to each other. In the plot using the local seed production method (i.e. the LP plot), the crop was produced for grain, i.e. for food consumption, and a small portion of the plot was kept for seed, as is common in the area. At the ripening stage of the rice crop, farmers selected spots in the field with a good rice crop for roguing (i.e. removing off-type plants) and harvested those areas separately to obtain the seed. The other plot was the "improved practice plot" (IP) in which some new or improved techniques were applied. The size of each plot was suggested to be at least 300 m^2 in Nam Dinh and Nghe An and 500 m^2 in Binh Dinh and Dong Thap. The on-farm experiments were considered an important tool for transferring and testing improved practices.

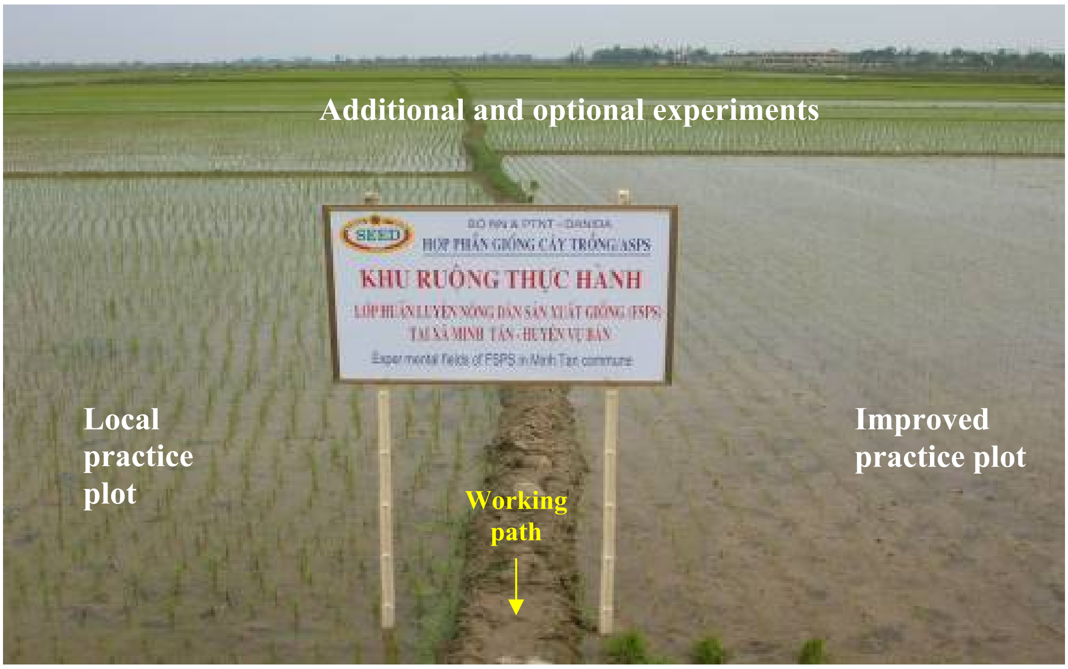

Photo 3.1: Lay-out of on-farm experiment at the FSPS.

3.2.6. Data collection and analysis

At weekly meetings of the FSPS, trainers/facilitators and trainees/farmers went to the on-farm experiment to measure and monitor growth of the rice crop. During the FSPS, farmers also recorded data on seed rates, applied fertilizers, all production costs, and yields. Finally, the farmers' reports of the FSPS-on-farm experiments were presented and submitted to the Provincial Component Management Unit (PCMU). We collected the data of 429 FSPSs during 2005−2006 at the PCMUs of Nam Dinh, Nghe An, Binh Dinh and Dong Thap.

The data was standardized to values per hectare and converted into yield, technical variables (amount of seed and N–P_2O_5–K_2O fertilizers) and economic variables (total production costs, gross income and net profit). Total production costs did not include costs of buying equipments and taxes, and used prevailing prices at each locality for rice paddy, seeds, fertilizers and labour. The gross income was obtained by multiplying the yields by paddy prices for the LP and by seed prices for the IP. The profit was computed by deducing the total production costs from the gross income (Huan et al., 2005).

To compare the means of yields, seed rates, amounts of fertilizers, the production costs, gross incomes and profits from the LPs and the IPs, the *t*-test was applied at 5% significance level. Pearson correlation and linear multiple regression analyses were also used to analyze the effects of technical variables on yields.

Secondary data related to the seed production system of the provinces were gathered at the Department of Agriculture and Rural Development (DARD), the Seed Center, the Agricultural Extension Center, the Department of Statistic, etc. Besides, key formants were interviewed to collect information on trends in the seed system development of each province.

3.3. RESULTS

3.3.1. Formal seed production system and farm saved seed

Seed production and the seed supply system of the formal sector in the four surveyed provinces accounted for about 8.5% of the total seed requirement (Table 3.2). This system included several institutions, including the Seed Center, the State Seed Company and private seed companies. The Seed Center had a function in carrying out variety adaptation tests and selection, and high-quality seed production, while the seed companies only produced and bought foundation or certified seeds for sale. However, they had not enough land area for seed production. To satisfy the seed requirements of the province, this seed production system had to contract farmers and co-operatives in the local communities to produce seed. Besides, the seed companies in Nghe An imported a lot of hybrid rice seeds from China, and this accounted for 24% of the seed supply to the farmers. In Dong Thap, more than 90% of the seed was farm saved.

Table 3.2: Seed requirement, capacity of seed production of the formal seed sector, imported amounts, and total amounts of formal seed supplied and the proportion of the total requirement fulfilled by the formal seed sector in the four provinces surveyed in Vietnam, 2006

Province	Seed requirement (Mg year^{-1})	Production capacity (Mg year^{-1})		Imported amount (Mg year^{-1})		Supplied seeds (Mg year^{-1})	Portion satisfied (%)
		Improved rice	Hybrid rice	Improved rice	Hybrid rice		
Nam Dinh	12,000	820	17	50	330	1,217	10
Nghe An	10,920	1,400	70	-	1,200	2,670	24
Binh Dinh	7,750	1,000	-	-	50	1,050	14
Dong Thap	48,000	3,377	-	-	-	3,377	7
Total	78,670	6,597	87	50	1580	8,314	

Source: Seed centres and seed companies of the different provinces

The prevailing seed prices in 2006 differed considerably between quality levels and provinces (Table 3.3). Certified seed was twice as expensive as paddy rice and hybrid seed was even 10 times as expensive as paddy rice. Farm saved seed prices were only slightly higher than paddy prices, the difference in Dong Thap being only about 0.01 US\$ kg^{-1}.

Seed prices in Binh Dinh and Dong Thap were lower than those in Nam Dinh and Nghe An. These lower prices for rice seed could encourage farmers to use better quality seed. For example, in Binh Dinh and Nghe An, the local governments had a subsidy policy for seed. Farmers benefited from a discount of about 0.06−0.10 US\$ kg^{-1} of the certified seeds and foundation seeds. In fact, the provinces with small farm size (Nam Dinh, Nghe An and Binh Dinh) used better quality seeds than the province Dong Thap where farm size was much larger.

Table 3.3: Prices (in US\$ kg^{-1}) of different seed quality levels and grain in four surveyed provinces of Vietnam, 2006

Province	Quality levels[a]				Grain/Paddy[b]	Farm saved seed[c]
	Hybrid seed (F1)	Pre-basic seed	Foundation seed	Certified seed		
Nam Dịnh	1.44	0.93	0.38	0.30	0.15	0.20
Nghe An	1.78	0.81	0.33	0.28	0.14	0.19
Binh Dinh	1.63	-	0.28	0.25	0.15	0.18
Dong Thap	-	-	0.30	0.27	0.14	0.15

[a] *Seed centres and seed companies of the different provinces, 2006; exchange rate: US\$ 1 = 16,000 VND*
[b] *Average paddy prices of provinces were estimated by seed centres and seed companies in 2006*
[c] *Seed prices of farm saved seed production (Improved practice plots) were collected from the research sites at prevailing prices in 2004*

For farm saved seed, seed quality could be similar to that of the certified seed from the formal seed sector, but the seed price was much lower. Hence, development of the farm saved seed production system will benefit rice-farmers by providing them with easy access to new or good seeds and by saving seed costs.

3.3.2. Analysis of technological innovations

Many farmers' improved practices differed significantly from the local practices (Table 3.4). In Nam Dinh and Nghe An, improved technology included significant changes in hill density, number of seedlings per hill and seed rates compared to local practices. In Binh Dinh and Dong Thap remarkable technology changes included reduced seed rates and the use of drum seeders for sowing. Moreover, in all improved plots fertilizer applications were more balanced in all surveyed provinces. Potassium fertilizer was 17, 23 and 26 kg ha^{-1} higher in the improved practice plots than in the local practice plots in Nam Dinh, Nghe An and Binh Dinh, respectively. In contrast, nitrogen fertilizer was reduced significantly compared with the local practices, but only so in Dong Thap. The most salient innovation was the reduction by about 50% of the seed rates in all provinces. This innovation will have great repercussions for the seed requirements in all provinces.

Table 3.4: Mean differences between the local practices and the improved practices in four provinces of Vietnam, 2004 (n, number of samples; means ± S.E.)

Variables	Local practice		Improved practice	
	n	Mean ± S.E.	n	Mean ± S.E.
Nam Dinh province				
Hill density (m^{-2})	132	42.5 ± 0.2^b	132	52.5 ± 0.2^a
Seedlings/hill	132	4.0 ± 0.0^a	132	1.0 ± 0.0^b
Seed rates (kg ha^{-1})	127	63.2 ± 0.1^a	132	28.8 ± 0.3^b
N (kg ha^{-1})	129	110.2 ± 2.7	122	111.1 ± 2.2
P_2O_5 (kg ha^{-1})	130	82.3 ± 1.6	122	86.9 ± 1.1
K_2O (kg ha^{-1})	126	64.3 ± 1.4^b	117	81.6 ± 0.5^a
Muck (Mg ha^{-1})	119	7.9 ± 0.9	113	8.1 ± 0.4
Nghe An province				
Hill density (m^{-2})	100	56.0 ± 0.3^b	103	62.9 ± 0.5^a
Seedlings/hill	99	4.2 ± 0.1^a	103	1.0 ± 0.0^b
Seed rates (kg ha^{-1})	99	86.8 ± 1.3^a	95	45.2 ± 0.8^b
N (kg ha^{-1})	102	112.8 ± 1.9	103	108.8 ± 1.3
P_2O_5 (kg ha^{-1})	100	49.4 ± 0.8^b	86	54.5 ± 0.7^a
K_2O (kg ha^{-1})	100	65.8 ± 1.6^b	101	88.7 ± 0.8^a
Muck (Mg ha^{-1})	101	8.7 ± 1.0	103	8.8 ± 1.0
Binh Dinh province				
Seed rates (kg ha^{-1})	89	176.0 ± 2.2^a	90	80.9 ± 1.6^b
N (kg ha^{-1})	89	106.1 ± 2.9	88	105.6 ± 1.7
P_2O_5 (kg ha^{-1})	87	51.6 ± 2.6^b	90	75.6 ± 3.3^a
K_2O (kg ha^{-1})	77	54.1 ± 2.7^b	88	80.3 ± 2.1^a
Muck (Mg ha^{-1})	36	8.0 ± 3.2	55	8.3 ± 3.1
Dong Thap province				
Seed rates (kg ha^{-1})	100	218.1 ± 2.5^a	99	108.4 ± 1.3^b
N (kg ha^{-1})	100	114.4 ± 2.6^a	98	97.3 ± 1.3^b
P_2O_5 (kg ha^{-1})	100	60.5 ± 2.4^a	96	54.1 ± 1.0^b
K_2O (kg ha^{-1})	100	44.7 ± 1.7	100	46.0 ± 1.0

Within rows, a different superscript letter indicates a statistically significant difference at the 5% level.

3.3.3. Comparison of yields

The average grain yields of the improved practice plots were significantly higher than those of the local practice plots in all four provinces. The average differences were

0.43 Mg ha^{-1} in the wet season and 0.78 Mg ha^{-1} in the dry season (Fig. 3.1). Fig. 3.2 shows that mean differences between IP and LP were 0.50, 0.51 and 0.35 Mg ha^{-1} in Nam Dinh, Nghe An and Binh Dinh, respectively. However, there was only a small and statistically non-significant difference of 0.23 Mg ha^{-1} in Dong Thap.

To predict the effects of innovation on rice yields, all technical variables (hill densities, number of seedlings per hill, amount of fertilizers) and seasons were included in a multiple linear regression analysis. Table 3.5 shows that in Nam Dinh the model accounted for 25% of the total variation of yields with season, number of seedlings per hill and K_2O fertilizer amount being most influential. In Nghe An, the model accounted only for 15% of the total yield variation ($R^2 = 0.15$, $p = 0.038$), and the variable hill density had the largest impact. In Binh Dinh, especially season and sowing technology explained the greater part of the total of 36% of total yield variation accounted for ($R^2 = 0.36$, $p < 0.001$). In Dong Thap, season and amount of K_2O fertilizer, and sowing technology contributed considerably to the total of 76% of the variation of yield accounted for ($R^2 = 0.76$, $p < 0.001$).

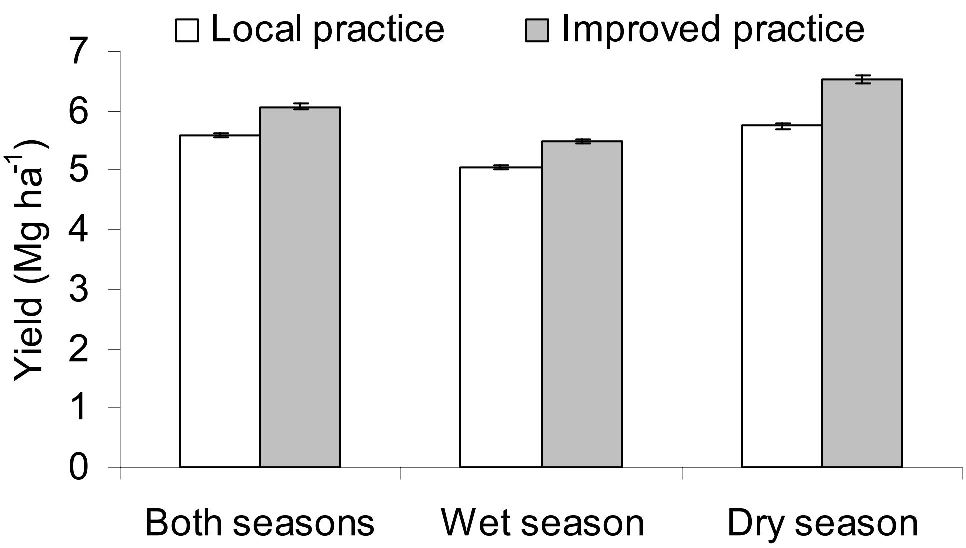

Fig. 3.1: Yields of plots exposed to local practice or improved practice averaged over four provinces. Error bars represent the standard error of the mean. Yields differed highly significantly between the two practices, $p < 0.001$.

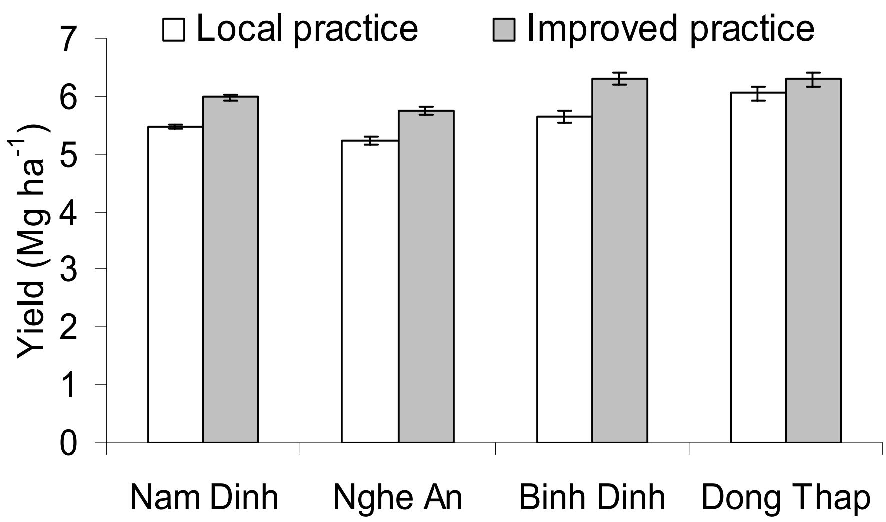

Fig. 3.2: Yields of plots exposed to local practice or improved practice averaged over the two growing seasons. Error bars represent the standard error of the mean. Yields differed highly significantly between the two practices, $p < 0.001$, except for Dong Thap.

Table 3.5: Results of multiple regression analysis of yields on predictor variables: regression coefficient (b), standard error (S.E.) and standardized coefficient (beta)

Independent variables	R^2	b	S.E.	beta
Nam Dinh: - Constant		5.36	0.28	
- Seedling	0.25	-0.12	0.03	-0.29**
- Season		0.37	0.07	0.30**
- K_2O fertilizer		0.01	0.00	0.15*
Nghe An: - Constant		4.72	0.96	
- Hill density m^{-2}	0.15	0.02	0.01	0.28*
- Seedlings/ plant		0.38	0.35	-0.18
- K_2O fertilizer		0.01	0.01	-0.01
- Lime		0.00	0.00	0.14
Binh Dinh: - Constant				
- Season		4.92	0.18	
- Sowing technique	0.36	1.05	0.19	0.50**
		0.69	0.19	0.32**
Dong Thap: - Constant		4.55	0.16	
- Season	0.76	2.06	0.01	0.85**
- K_2O fertilizer		0.01	0.00	0.91*
- Sowing technique		0.21	0.09	0.09*

** statistically significant at p<0.01; ** statistically significant at p<0.001*

Farmer's improved practices had large effects on rice yields in the on-farm experiments. Table 3.6 shows that in Nam Dinh, improving hill densities, K_2O fertilizer, and number of seedlings per hill at transplanting contributed to yield increases. Similarly, in Nghe An, particularly amount of muck and hill densities were strongly related with yield. Less nitrogen fertilizer and fewer seedlings also gave higher rice yields. In Binh Dinh and Dong Thap, farmers applied the direct seeding method for rice production. The improved practices for sowing by using drum seeders were very successful. Applying drum seeders with low seed rates and more potassium

Table 3.6: Correlations coefficients between yield, profit and technical variables of the study plots in four provinces

Nam Dinh

Variables	Hills (m^{-2})	Seedling[a]	N	P_2O_5	K_2O	Muck	Yield	Price
Seedling	-0.89[b]							
N	-0.00	-0.02						
P_2O_5	0.10	-0.15[c]	0.25[b]					
K_2O	0.51[b]	-0.59[b]	-0.10	0.33[b]				
Muck	0.06	-0.09	-0.31[b]	-0.06	0.30[b]			
Yield	0.22[b]	-0.39[b]	-0.02	0.13[c]	0.34[b]	0.15[c]		
Price	0.45[b]	-0.51[b]	0.36[b]	0.13[c]	0.30[b]	0.04	-0.04	
Profit	0.61[b]	-0.68[b]	0.14[c]	0.14[c]	0.38[b]	0.06	0.41[b]	0.61[b]

Nghe An

	Hills m^{-2}	Seedling	N	P_2O_5	K_2O	Muck	Lime	Yield	Price
Seedling	-0.61[b]								
N	-0.37[b]	0 .10							
P_2O_5	0.14	-0.29[b]	-0.12						
K_2O	0.39[b]	-0.65[b]	0.18[c]	0.10					
Muck	0.36[b]	-0.01	-0.31[b]	-0.07	0.17[c]				
Lime	0.08	-0.08	0.30[c]	0.43[b]	0.63[b]	0.39[b]			
Yield	0.52[b]	-0.34[b]	-0.26[b]	0.27[b]	0.38[b]	0.61[b]	0.18		
Price	0.26[b]	-0.47[b]	0.07	0.08	0.18[c]	-0.24[b]	-0.56[b]	-0.13	
Profit	0.58[b]	-0.55[b]	-0.20[b]	0.13	0.28[b]	0.11	-0.48[b]	0.35[b]	0.81[b]

Binh Dinh

Variables	Seed rates	N	P_2O_5	K_2O	Yield	Price
N	0.15					
P_2O_5	-0.30[b]	0.44[b]				
K_2O	-0.41[b]	0.29[b]	0.29[b]			
Yield	-0.17[b]	0.07	0.12	0.22[b]		
Price	-0.65[b]	-0.04	0.26[b]	0.41[b]	0.34[b]	
Profit	-0.49[b]	-0.02	0.14	0.37[b]	0.78[b]	0.71[b]

Dong Thap

N	0.36[b]					
P_2O_5	0.18[c]	0.27[b]				
K_2O	-0.13	-0.20[b]	-0.21[b]			
Yield	-0.11	-0.24[b]	-0.17[c]	0.19[c]		
Price	-0.59[b]	-0.30[b]	-0.16[c]	0.07	0.39[b]	
Profit	-0.34[b]	-0.38[b]	-0.19[b]	0.17[c]	0.90[b]	0.68[b]

[a] *Number of seedlings per hill at transplanting* [b] *Correlation is significant at the 0.01 level,* [c] *at the 0.05 level.*

contributed significantly to improved yields in Binh Dinh. In contrast, in Dong Thap, less nitrogen and phosphate, and more potassium increased yields.

3.3.4. Economic analysis

In general, the mean profit values of the improved practice plots differed significantly from those of the local practice plots ($t = -17.91$, $p < 0.001$) in all four provinces and both in the wet season ($t = -13.21$, $p < 0.001$) and in the dry season ($t = -18.73$, $p < 0.001$). Fig. 3.3 indicates that the average differences in profit between the improved practice plots and the local practice plots were 212, 174 and 298 US$ ha^{-1} across provinces for the average of both seasons and for the wet and dry season, respectively.

The *t*-tests on profit values and input costs showed highly significant differences between the LP and IP (Table 3.7). By using the improved planting practices and good seeds, investment costs of seeds were lower than in the local practice, the difference being 2.0, 13.7, 8.2 and 16.8 US$ ha^{-1} in Nam Dinh, Nghe An, Binh Dinh and Dong Thap, respectively. In addition, input costs of pesticides were also significantly lower in the improved practice plots than in the local plots, except in Binh Dinh.

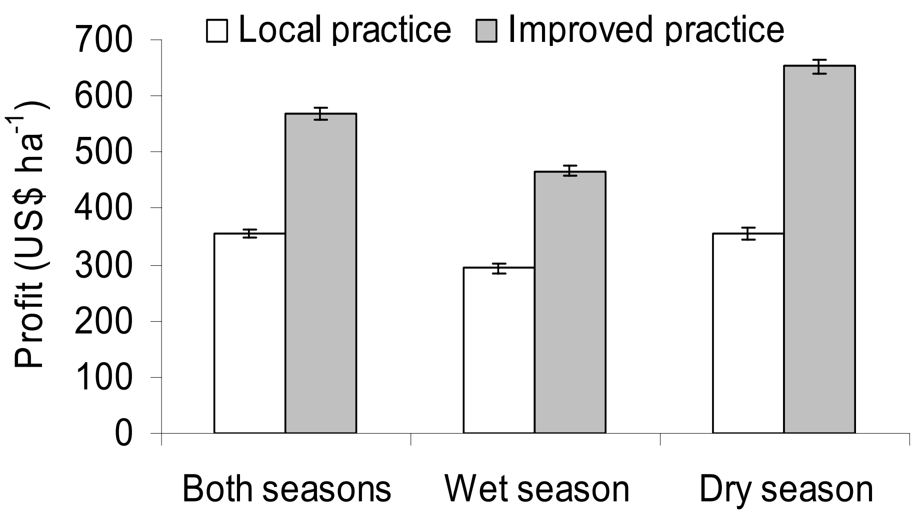

Fig. 3.3: Main profits (US$ ha^{-1}) averaged over both seasons, and for the wet and dry seasons separately, averaged over the four provinces. Error bars represent the standard error of the means. Mean profits of the local practice and improved practice differed highly significantly ($p < 0.001$).

Table 3.7: Mean differences of resource inputs, total production costs, gross incomes, prices and profits (in US\$ ha^{-1} and for price, in US\$ kg^{-1}) between the local practices and improved practices in four provinces of Vietnam, 2004[1]

Variables	Local practice		Improved practice	
	n	Mean ± S.E.	n	Mean ± S.E.
Nam Dinh				
- Seed costs	132	11.5 ± 0.3^{a}	132	9.5 ± 0.2^{b}
- Fertilizer costs	132	164.0 ± 4.8^{b}	132	85.0 ± 6.6^{a}
- Pesticide costs	132	33.1 ± 1.7^{b}	132	27.9 ± 1.1^{a}
- Total production costs	130	530.0 ± 7.4^{b}	127	580.0 ± 7.5^{a}
- Gross income	132	893.0 ± 13.0^{b}	132	1168.0 ± 16.1^{a}
- Price	132	0.16 ± 0.0^{b}	132	0.20 ± 0.0^{a}
- Profit	127	348.6 ± 9.3^{b}	127	566.7 ± 11.8^{a}
Nghe An				
- Seed costs	86	30.3 ± 1.6^{b}	87	16.6 ± 0.6^{a}
- Fertilizer costs	86	175.0 ± 3.8^{b}	87	190.0 ± 3.6^{a}
- Pesticide costs	71	28.2 ± 2.2^{b}	71	21.2 ± 1.3^{a}
- Total production costs	106	549.0 ± 6.8^{b}	105	595.0 ± 6.5^{a}
- Gross income	107	821.0 ± 14.4^{b}	107	1110.0 ± 21.4^{a}
- Price	107	0.16 ± 0.0^{b}	107	0.19 ± 0.0^{a}
- Profit	107	270.2 ± 13.0^{b}	107	510.7 ± 20.4^{a}
Binh Dinh				
- Seed costs	90	30.2 ± 0.8^{b}	90	22.0 ± 0.5^{a}
- Fertilizer costs	90	146.0 ± 3.6^{b}	90	160.0 ± 4.4^{a}
- Pesticide costs	90	32.9 ± 1.6	90	35.1 ± 1.5
- Total production costs	90	460.0 ± 7.6^{b}	90	513.0 ± 9.2^{a}
- Gross income	90	823.0 ± 18.4^{b}	90	1116.0 ± 26.6^{a}
- Price	90	0.14 ± 0.0^{b}	90	0.18 ± 0.0^{a}
- Profit	88	348.2 ± 14.9^{b}	88	601.9 ± 21.5^{a}
Dong Thap				
- Seed costs	100	43.5 ± 1.8^{a}	100	26.7 ± 0.6^{b}
- Fertilizer costs	100	113.8 ± 2.1^{a}	100	99.0 ± 1.4^{b}
- Pesticide costs	100	58.4 ± 1.6^{a}	100	46.0 ± 1.2^{b}
- Total production costs	100	362.5 ± 6.2	100	355.9 ± 4.1
- Gross income	100	828.2 ± 19.0^{b}	100	59.3 ± 22.4^{a}
- Price	100	0.13 ± 0.0^{b}	100	0.15 ± 0.0^{a}
- Profit	100	465.4 ± 15.7^{b}	100	603.5 ± 21.3^{a}

n, number of samples; within rows, averages with different superscript letters are significantly different at the 5% level; [1] Prices of fertilizers, pesticides were collected at the cooperatives in Nam Dinh, Nghe An and Binh Dinh and at the local traders in Dong Thap
Within rows, a different superscript letter indicates a statistically significant difference at the 5% level.

In almost all cases, the total production costs of the IP were higher than those of the LP. This was associated with costs for using more fertilizers (potassium, muck and lime) and more labour for the roguing and the post-harvest activities for seed production. Despite these higher production costs, the IP gained significantly higher profits than the LP, the difference being 218, 240, 253 and 138 UD$ ha^{-1} in Nam Dinh, Nghe An, Binh Dinh and Dong Thap provinces.

Table 3.6 shows correlations of technical components increasing the profits of the improved practice plots. Almost all investments from farmer's improved practices led to increases in the profit, except for using lime in Nghe An. The most important component was the price differential between the grain/seed of the local practice plots and the seed of the improved practice plots (see Section 3.2). The correlation coefficients between the profit and prices varied from 0.61 – 0.81 amongst the provinces. Price differences contributed mainly to the higher profit of the IP. The mean price differential was 478 VND kg^{-1} (~0.03 US$ kg^{-1}). This critical issue is further debated in Section 3.4 of this chapter.

3.4. DISCUSSION

3.4.1. Efficiency of farmer's technological innovations

Good quality seeds are not always available to the farmers in the remote areas. Therefore, farm saved seed constituted about 80% of the rice seed planted every season in Vietnam and this will probably be the case for many years to come (ASPS, 2007). Table 3.2 shows that the formal seed sector provided less than 10% of the seed required, although there was considerable import of hybrid rice seed as well. Thus, farmers had to use rice grain of unsatisfactory quality for seed and that could reduce the yield potential of rice. Our findings from the on-farm experiments at the FSPSs also proved that using good quality seed in association with some improved practices (Table 3.1) increased yields by 0.5 Mg ha^{-1} (Fig. 3.1). This yield increase is similar to the ones reported for the Philippines and Bangladesh (Hossain et al., 2002).

Increasing hill densities and reducing the number of seedlings per hill were very efficient and simple improved practices, but these are not yet applied widely in Nam

Dinh and Nghe An. This could be due to the lack of on-farm demonstrations and farmer's participatory research. This lack of adoption was also found for using a drum seeder in Binh Dinh and Dong Thap although the drum seeder was already introduced in Vietnam in 1988 and despite the fact that it has been reported that the use of drum seeder reduced seed rates by more than 70 kg ha^{-1} and resulted in a 10–12% higher rice yield (Paris and Chi, 2005). However, use of drum seeders also had some constraints including increased damage caused by the Golden snail and less land levelling for controlling weeds by water management.

Increased yield of the improved practices plots could be an important impact factor to enhancing farmer's adoption of new techniques and using better quality seeds in Vietnam. Therefore, Longo (1990) indicated that farmer's actions and decisions are often made throughout life. Adoption of new or improved techniques is a process that is dependent on the prior existence of certain factors and conditions. Moreover, any new agricultural technology should bring economic benefit in order to be adopted and accepted by farmers (Bishaw, 2004). Efficiency of other farmer's technical innovations in the FSPS (Table 3.4) confirms that farmers were successful in applying simple improved practices including higher hill densities per m^2 and fewer seedlings per hill as observed in Nam Dinh and Nghe An, and sowing by drum seeder with low seed rates as observed in Binh Dinh and Dong Thap.

For application of fertilizers, the farmers seemed to be indecisive in reducing the amount of nitrogen fertilizer of the improved practice plots. Some studies in Vietnam showed higher yields with less fertilizer N through improved fertilizer use efficiency based on site-specific nutrient management (Pampolino et al., 2007). Moreover, applying more potassium certainly increased yields of the improved practice plots in four provinces. This result is in line with previous findings (Tin et al., 2009). Improved practices in farmer saved seed production made it possible to decrease seed rates, fertilizer N application and pesticide use. These effects will reduce the adverse environmental impacts of rice production in Vietnam and thus will make rice production more sustainable.

3.4.2. Economic profit from improved practices

Table 3.7 shows that the economic profit of the IP was 212 US$ ha^{-1} higher than that of the local practice plots, an effect mostly caused by positive effects on yield and seed price. Season was the main factor accounting for differences in yield in Vietnam (Tin et al., 2009). However, crop management according to the improved practices significantly increased yield in all four provinces (by 0.5 Mg ha^{-1}) and both in the wet and dry season (Fig. 3.1).

Differences in price between food grain and seed were small in the local practice crops. However, due to the higher quality of the seed, price differences between food grain and seed were much larger in the improved practice crops. Differences in price between seed and grain considerably increased the profit of the improved practice plots if the produce could be sold against the higher seed prices. In fact, seed price (certified seed) of the formal seed sector was high (double the price for grain) in the southern provinces, but much lower in the northern provinces due to differences in the organization of the seed system (see also below).

The economic analysis of the seed production with applying the improved practices showed a higher increase in profit than other changes in technology as reported in other studies in Vietnam. The profit of site-specific nutrient management (SSNM) was 34 US$ ha^{-1} (Pampolino et al., 2007) and the profit in the Three Reductions Project (reducing pesticides, fertilizers and seed rates) in the Mekong Delta was 35–58 US$ ha^{-1} (Huan et al., 2005). The very positive result of the IP could further enhance developing farm saved seed production in Vietnam.

3.4.3. Outlook for farm saved seed production

In surveyed provinces, the formal seed sector included the state and private seed companies and monopoly suppliers of rice seeds. The division of seed activities between the two seed sectors was not adequate. The formal seed sector has held an important role in providing new varieties and high-quality seeds, i.e. breeder seed and pre-basic seed. This system is funded and invested considerable material facilities, but it only supplied a small amount (less than 10%) of the rice seed requirement. In contrast, the farm saved seed system seemed to be out of support from the local government, but it produced and distributed more than 80% of the seed requirement (Table 3.2). This system could be considered as a very efficient model for supplying seed to end-users at low seed prices (Table 3.3) while the formal market transaction resulted in a high price and was not flexible. However, the relative contribution of each sector was relevant for the local seed demand, as there are five major functions to fulfill: (1) variety maintenance, (2) multiplication, (3) quality improvement, (4) storage and security stocks, and (5) distribution (Ndjeunga, 2002). Moreover, Tables 3.4, 3.6 and 3.7 showed a great efficiency in increasing yields and profits of seed production. This should be a stimulus to reconsider the agricultural extension strategy, especially in seed sector that has existed by the top-down process of transferring technologies to farmers in Vietnam.

For developing the farm saved seed production (informal seed supply system) in Vietnam, this system needs to be supported strongly by the formal sector and governmental agriculture policies. However, an organizational framework for the informal seed supply system could be considered further:

- Training of farmers should be organized in seed groups or clubs to produce and supply seed for cooperatives in the northern provinces. A strong cooperative can develop into a seed company with many seed production groups (or clubs). Thus, seed production may become more beneficial for the individual member of the cooperative than when seed is sold to the local state seed company.
- In the southern provinces, training of farmers should also be organized in seed clubs based on availability of land resources and facilities for post-harvest handling. These seed clubs can produce and supply directly to the seed users. The seed clubs in the provinces should be embedded in a seed production network, and should combine the in production and distribution of seeds to the rural areas, thus increasing the profit for farmer-seed producers. Furthermore, strong networks of seed clubs should develop into farmer-private seed companies, which would be able to compete with the formal seed supply system and to bring great social benefit.

3.5. CONCLUSIONS AND COMMENTS

- Rice production can be increased considerably by using better seed.
- Rice production in Vietnam can also profit from a change in fertilization, particularly by applying less N and more P, K and organic fertilizer.
- Farmer's decisions on technological innovations resulted in better yields and higher profits compared to their local practices.
- As farmers are reluctant to make certain changes, field demonstrations could have an impact on the diffusion of improved practices in communities.
- The Farmer Seed Production Schools have strengthened the local seed systems by helping farmers overcome constraints in their access to new varieties and high-quality seeds.
- Support to improve a simple local practice may be more efficient than efforts to introduce a new technology in rice production.
- To efficiently develop the farm saved seed production system in Vietnam, the local governments should have proper support policies and the formal seed sector should be enhanced in training and cooperating seed services.

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CHAPTER 4

Impacts of farmer seed production schools on seed production in Vietnam

This chapter will be revised for publication as:

Huynh Q. Tin, Paul C. Struik, Lisa L. Price, Nguyen H. Cuc, Lars Bødker, Per Andersson, and Michael Turner. Impacts of farmer seed production schools on seed production in Vietnam.

Impacts of farmer seed production schools on seed production in Vietnam

Huynh Q. Tin[a,b], Paul C. Struik[b], Lisa L. Price[c], Nguyen H. Cuc[a],
Lars Bødker[d], Per Andersson[d], and Michael Turner[d]

[a] Mekong Delta Development Research Institute, Cantho University, Cantho City, Vietnam
[b] Centre for Crop Systems Analysis, Wageningen University, P.O. Box 430,
6700 AK Wageningen, The Netherlands
[c] Sociology of Consumers and Households, Wageningen University, P.O. Box 8060,
6700 DA Wageningen, The Netherlands
[d] Seed Component, Agricultural Sector Programme Support (ASPS), Danida, Vietnam

Abstract

The formal seed system in Vietnam supplies only a small proportion of rice seed required by the nation's farmers. In order to meet farmer's seed demands the Farmer Seed Production Schools (FSPSs) were developed and implemented. These field schools, modelled on the successful farmer field school participatory education approach of IPM, had the objective to improve seed quality and agronomic practices for the farm-saved seed system. The FSPS were set up in seven provinces between 2003 and 2006. A study to assess whether farmers applied improved practices after attending the field school was executed by comparing the practices of 30 FSPS farmers and a control group of 30 non-FSPS farmers in each of four villages. FSPS farmers used better quality seed; reduced pesticide costs and seed rates considerably of both directly sown and transplanted crops; applied more roguing, and balanced efficiently fertilizer application. FSPS farmers obtained 0.6 t ha^{-1} higher yields in transplanted crops and 0.9 t ha^{-1} higher yields in sown crops compared with the control, and also had 61 US$ ha^{-1} higher profits in directly sown crops than non-FSPS farmers. The FSPS farmers applied their acquired technical knowledge well. Based on the practices of non-FSPS farmers we documented, there also appears to have been some dissemination of the improved practices through informal social channels in the four surveyed villages.

Key words: *Farmers field schools, impact assessment, improved practices,* Oryza sativa*, rice, Vietnam*

4.1. INTRODUCTION

4.1.1. Importance of seed

Seed is the most important input in crop-based agriculture and plays an important role in rural development and food security (Louwaars 2007). The use of high-quality seed promotes an appreciation of the importance and benefits to be obtained from high-quality seed such as achieving higher crop yields (Muhamed 1999). But having an understanding of the importance of high-quality seed and being able to produce seeds of the highest quality are not one and the same. Farmers may have gaps in their seed production knowledge and skills that could ultimately hinder them in better bridging the disparity between achievable and actual yields (Pingali and Heisey 1999).

Farmers across Asia traditionally save their own seeds and rely on their local knowledge and their personal experience in their attempts to improve seeds as their main source of planting materials (Kugbei 2003; SEARICE 2007). For Vietnam, this has been the pattern of seed production among rice farmers. Regrettably, farmers have had neither little support for their knowledge system to enhance their seed quality nor options for obtaining high-quality seeds. High-quality seed (commercial/certified and basic seed) supplied by the formal seed sector can cover only about 6-8% of total potential seed demand in the whole country (COWI 1999). In the Mekong Delta the formal seed sector produced and supplied about 3.5% of the total seed demand (Tin 2009). It is recognized that formal seed systems in general have trouble meeting the needs of small farmers (Bishaw and Turner 2007). Ultimately, the quality of farm-saved seed can have considerable consequences for agricultural production. Low seed quality can be one of the factors limiting rice yields. Hossain et al. (2002) propose that the use of good-quality seed can increase rice yields by 8-10% in the Philippines and Bangladesh.

Farmer field schools for integrated pest management (IPM-FFS) have been well supported in Vietnam as they have been throughout Southeast Asia. Inspired by IPM-FFS, a curriculum and programme called the Farmer Seed Production School (FSPS) was developed to improve the quality of farm-saved seed in Vietnam. This was developed through a project entitled *The Farmer Seed Production Project* housed under the Agricultural Sector Programme Support (ASPS). The objective of the FSPS was to support farmers in improving their capacity to produce, process, store and use good-quality seed. The project was undertaken from 2002-2007 (Anon. 2004). There were 42,401 farmers who attended the FSPSs over the five year project period (SC8 2007). Results of the on-farm demonstrations (field studies) at the FSPS showed that seed quality, yields and profits increased by applying the farmer's improved practices (Anon. 2004; Tin et al. 2008; 2009a).

This chapter examines how well the knowledge was applied in seed production and how farmers managed their inputs and established seed clubs after the FSPS in Vietnam. The chapter further examines the influence that the trained farmers have had on the dissemination of improved practices to the broader community.

4.1.2. Farmers seed production school (FSPS)

The field schools were undertaken for a rice crop cycle, lasting from three and a half to five months. Each field school group of the FSPS consisted of approximately 25 farmers who would meet for a half day once a week. In a typical school session, the farmers would divide into small groups of five for field observations and discussions, then come together again in the larger group with the facilitator of the course.

The field school curriculum included aspects of agro-ecosystem analysis, observation of growth and development of rice, and distinguishing off-type plants in seed production plots. The FSPS content covered five main areas in the seed production process, and subjects in each area were linked to discussions on how to

- Identify, know and apply cultural practices and prepare seed for planting,
- Manage insects, diseases and weeds,
- Improve seed quality and yields,
- Handle seeds after harvesting,
- Plan and market seed.

At the FSPS "improved practice" plots were compared to "local practice" plots. Farmer's observations were then discussed in session with the larger group with the aid of a facilitator (trainer/teacher). At the FSPS, farmers and facilitators discussed how to carry out on-farm experiments, how to collect and analyze information, and keep records. In addition, some optional subjects were identified by the farmers that they wanted to learn more about and these were discussed in class with each other and with the facilitator.

The facilitator's role was to assist in the highlighting of farmer's observations and with the interpretation of these observations. Price (2000) discusses the importance of the field school facilitator in that the interpretation of observations is vital to the participants drawing sound conclusions from their observations. The science of building knowledge includes observation, fact, and interpretive theory. What we have often neglected in participatory agricultural research is a framework within which farmers interpret their observations and facts. This is what makes the field school approach as participatory farmer education a quality approach (Price 2000).

4.2. METHODS

4.2.1. Site selection and sample size

Four provinces were selected for this study, namely Nam Dinh, Nghe An, Binh Dinh and Dong Thap. In each selected province, FSPSs were organized in 16 villages and they started in April-May 2003. One village per province was selected for impact evaluation; impact assessment took place in May-June 2006. In each village, some FSPSs were conducted as diffusion units using farmer's improved practices in seed production. To assess the influences of the increase in farmer's knowledge from the FSPS and of the application of that knowledge in seed production in the community, 60 households were randomly selected in each of the four selected villages: 30 FSPS farmers and 30 non-FSPS farmers. The non-FSPS farmers lived in the same village as the FSPS farmers at the time of the survey.

4.2.2. Survey and data collection

A field survey was conducted to collect the data used in this study. A survey team was established in each province including six members from the Extension Center and Plant Protection Department. Questionnaires and lists of the FSPS and non-FSPS farmers with their addresses were available. Data and information gathered included aspects such as production costs, applied practices after FSPS, diffusion (verbal sharing of information and/or demonstration) of improved practices to farmers in the community, constraints in seed production and trends for farm-saved seed production. After the survey, raw data on yield and technical and economic variables was converted to values per hectare; qualitative data was coded into classes.

Secondary data relating to land area and seed requirement was gathered at the Cooperatives and Agricultural Unit of each surveyed village.

4.2.3. Seed sampling and quality testing

Seed samples were collected during the survey in the dry season of 2006. Farmer's seed lots had been separated and harvested around 20 days before sampling. The seed lots were processed and retained by the farmers for the next season's crop. Each sample of 1 kg was packed in cloth bags and stored in plastic bags and sealed to maintain the original seed moisture content.

Methods of assessing moisture content and germination percentage were based on the International Rules for Seed Testing (ISTA 2003). The Vietnam Standards on Agricultural Crops Seed (TCVN 2004) were used as the national standard check to assess the levels of seed quality for the two groups of farmer. The seed testing was carried out at the Seed-bank Laboratory of Cantho University, Cantho, Vietnam, in 2006.

4.2.4. Terms used in this chapter:

- The term "good seed" is used in this chapter to refer to good-quality seed produced by farmers but without formal certification. High-quality seed is used to refer to good seed that is also formally certified, including commercial certified, basic seed and pre-basic seed (i.e. good seed in the terminology used by ISTA 2003; Bishaw 2007).
- The Integrated Pest Management (IPM) is based on beneficial insects/spiders for pest control. The Economic Threshold Level (ETL) is a formula relying on pesticides when economic loss of the crop's value exceeds the cost of a pesticide application. When the number of pests per hundred plants (or some representative number) goes above a certain predetermined quantity, economic loss will occur (Mangan 1998).
- Profit in this chapter was computed by deducting the total production costs from the

gross income.

4.2.5. Control local practices

To assess the changes from applying FSPS improved practices and impacts to non-FSPS farmers after the training in the four surveyed villages, we used demonstration plots of "local practices" in the first FSPSs at the same four villages as "control local practices" for comparison. Twenty-two demonstration plots (6 in Yen Phuong, 5 in Dong Thanh, 4 in Phuoc Thuan and 7 in Tan Hoi Trung) were selected in both the wet and dry seasons in 2003-2004. Some main control local practices are described in Table 4.1.

Table 4.1: Local practices used in on-farm study fields at the FSPS of the four surveyed villages in Vietnam 2003-2004

Local practices	**Yen Phuong & Dong Thanh**	**Phuoc Thuan & Tan Hoi Trung**
Purpose of rice production	Food	Food and commercial paddy
Planting method	Transplanting	Direct sowing
No. of seedlings per hill	≥ 4	-
Sowing method	-	By hand
Using seed quality levels	Farm saved seed - good seed	Farm saved seed
Seed rates (kg ha^{-1})	65-80	200-240
Nitrogen fertilizer (kg ha^{-1})	70-120	115-130
P_2O_5 (kg ha^{-1})	70-100	70-90
KCl (kg ha^{-1})	< 60	30-40
Yield (Mg ha^{-1})	4.5-5.5	4.5-6.0

4.2.6. Data analysis

In this study, a wide range of analytical tools were used. The data was analyzed using frequency distributions and percentages to describe characteristics of rice production in the four surveyed villages. We used the Chi-square test to analyze differences in the demography, education characteristics, and use of seed quality levels among farmer groups.

To get a better view of the impact of FSPSs on the application of agronomic practices and the use of selected inputs, we analyzed the data for crops that were transplanted or sown directly (direct seeded) separately. An analysis of variance (ANOVA) was used combined with Tukey's test at 0.05% for comparing household resources in the surveyed villages, and differences between the local control practices and application of improved practices by FSPS and non-FSPS farmers. The t-test was applied to compare inputs and profits between FSPS and non-FSPS farmer groups.

4.2.7. Limitation of the study

The study had some limits. Surveyed sites were located in rice growing areas where conditions are unfavourable (acid sulphate soils in Tan Hoi Trung, saline-rain fed in Phuoc Thuan; unlevelled and small landholdings in Dong Thanh and Yen Phuong) and the average level of education was low (remote rural areas). In addition, the baseline study conducted assessed only the seed production capacity of the formal seed sector and potential seed demand. Thus, the baseline did not describe all local practices and seed quality standards at the research sites before the training programme. This was a limitation in comparing farmer's improved practices and seed quality after the FSPS. The data gathered from interviewing farmers on inputs costs, sale prices, income, etc. was estimative because most of the farmers did not invest or sell at the same time and farmer record keeping was not complete for all inputs. The interviewers then reminisced and gathered data of what farmers remembered or estimated. Finally, seed samples collected from FSPS and non-FSPS farmers were tested for germination rate (%) and seed moisture content (%). Some other quality standards were not available.

4.3. RESULTS

4.3.1. Agricultural and demography characteristics, seed demands

Agricultural characteristics

Village level: The total land area of Yen Phuong village was smallest (550 ha) and that of Tan Hoi Trung the largest (3,730 ha). However, the proportion of the total land area that was under rice cultivation varied greatly among the surveyed villages: it was 70% in Tan Hoi Trung, 28% in Phuoc Thuan, 12% in Dong Thanh and 59% in Yen Phuong. Rice is an important food and cash crop in these villages and farmers grow two rice crops per year (wet and dry season). Seed rates differ between wet and dry season in the surveyed villages except in Tan Hoi Trung. Rice crops are established through transplanting in Yen Phuong and Dong Thanh, and through direct seeding in Phuoc Thuan and Tan Hoi Trung. Because of differences in rice area, method of crop establishment and the associated seed rates, potential demand of rice seed differed among villages. In Tan Hoi Trung 418 Mg year^{-1} of seed was required for annual rice production, while seed demand was only about 15 Mg year^{-1} in Yen Phuong (Table 4.2).

Table 4.2: Agricultural characteristics and seed demand for rice production in the surveyed villages in Vietnam, 2006

Characteristics/ Village	Yen Phuong	Dong Thanh	Phuoc Thuan	Tan Hoi Trung
Total land area (ha) [a]	550	3,082	2,100	3,730
Agricultural land area (ha) [a]	325	535	603	2,809
Rice area (ha) [a]	325	380	580	2,614
Potential demand of seed of village (Mg year^{-1}) [b]	15	30	117	418
Characteristics/ Household				
- Rice area (ha)	0.31	0.25	0.31	1.61
- Effective demand of seed (kg year^{-1}) [c]	19	26	114	548
Rice-based production system (% of respondents)				
- Two rice crops	32	0	100	50
- Three rice crops	0	0	0	45
- Two rice crops + upland crop	68	100	0	2
- Two rice crops + fish	0	0	0	3

[a] *Data was collected at the Co-operative of Yen Phuong and Dong Thanh; at the Village People Council of Phuoc Thuan and Tan Hoi Trung; and 240 households*
[b] *Actual seed need by farmers based on demand survey*
[c] *Estimation of seed based on rice area*

Household level: The mean arable area per household in three of the four villages (Yen Phuong, Dong Thanh and Phuoc Thuan) was very small (0.3 ha). The fourth village, Tan Hoi Trung, had a mean of 1.6 ha of arable land per household. Because of the small land area per farm and because of crop establishment through transplanting, seed demands per household were very small in Yen Phuong and Dong Thanh village. On the larger farms, the seed demand was higher, especially when crop establishment was through direct sowing, such as in Phuoc Thuan and Tan Hoi Trung.

Production systems differed among the surveyed villages. In Yen Phuong and Dong Thanh, farmers established a rotation cropping system with two rice crops and an upland crop. In contrast, a continuous cropping system of rice with two crops per year was found in Phuoc Thuan and with three rice crops per year in Tan Hoi Trung. Rice varieties used in the production system at Tan Hoi Trung village were more diverse (seven varieties) than in other surveyed villages. The *Khang Dan* rice variety was most popular in Yen Phuong and Dong Thanh; *Dong Van* variety was the most popular in Phuoc Thuan and OM1490, OMCS95, OM2518, IR50404 were popular in Tan Hoi Trung. Almost all of these varieties were short cycle rice varieties (around 100 days to maturity).

Sources of household income

We identified five important sources of household income in the surveyed villages (Table 4.3). In Tan Hoi Trung, the total average income of the households was much higher than in the other villages, rice being the main source of income. In Yen Phuong, other crops played an important role in the households' income. The contribution of livestock products to the income varied from US$ 139 to 378 per household per year; in Tan Hoi Trung aquaculture was also important. In Dong Thanh and Phuoc Thuan, off-farm activities were more important sources of income than rice. These results indicate that on-farm activities proved to be the main sources of income for rice farmers in the surveyed villages.

Table 4.3: Comparison of income sources (US$) of 240 households in the four surveyed villages in Vietnam

Household sources	Yen Phuong	Dong Thanh	Phuoc Thuan	Tan Hoi Trung
- Rice	446 ^{b}	383 ^{b}	406 ^{b}	1418 ^{a}
- Other crops	118 ^{a}	78 ^{a}	9 ^{b}	2 ^{b}
- Livestock	378 ^{a}	370 ^{a}	139 ^{b}	214 ^{b}
- Aquaculture	82 ^{b}	31 ^{b}	10 ^{b}	223 ^{a}
- Off-farm activities	304 ^{b}	432 ^{ab}	521 ^{a}	40 ^{c}

Within a row, means followed by the same letter are not significantly different (Tukey's test, p = 0.05); (n=240)

Household demographic characteristics

The age of the men in the households varied from 19 to 74 years old, with a high proportion being between 30–50 years old. While these men were the main source of on-farm labour, more than 80% of the women also performed work in agricultural production in Yen Phuong, Dong Thanh and Phuoc Thuan (Table 4.4). It could be explained by the fact that these households have little rice land; the men often go out

Table 4.4: Some demographic and educational characteristics of the four surveyed villages in Vietnam for both farmers participating in the farmer seed production schools (FSPS) and for farmers who did not participate (non-FSPS) (% of respondents)

Household resources	FSPS	non-FSPS	χ^2
Age (years)	*(n=118)*	*(n=120)*	
- <30	3.4	10.0	*4.442, p = 0.217*
- 30–40	35.6	34.2	
- 41–50	38.1	32.5	
- >50	22.9	23.3	
Education level	*(n=116)*	*(n=116)*	
- Primary school	14.7	24.1	*3.478, p = 0.176*
- Secondary school	62.9	57.8	
- High school	22.4	18.1	
Farming experience (years)	*(n=105)*	*(n=116)*	
- <10	15.2	30.2	*14.209, p = 0.001*
- 10–20	61.9	37.1	
- >20	22.9	32.8	
No. of previous training courses	*(n=120)*	*(n=120)*	
- None	32.2	78.3	*53.597, p < 0.000*
- One	49.6	15.0	
- Two	14.0	6.7	
- Three	4.1	0.0	

to find other work (off-farm activities) after the planting and harvesting times to contribute to the income of their family. This was not the case in Tan Hoi Trung. Because rice is a main income source there, men work together with the women in rice production. Moreover, machines have replaced human labour. The level of education of the farmers was higher in Yen Phuong and Dong Thanh than in the two other villages: most farmers in Yen Phuong and Dong Thanh had at least reached secondary level (sixth to ninth grade). In Tan Hoi Trung and Phuoc Thuan, a considerable proportion of the farmers had less than a primary school level of education (less than sixth grade).

Although the age and levels of education did not have a significant association with the FSPS and non-FSPS groups in the four surveyed villages, farming experience and number of attended training courses was higher for the FSPS group than for the non-FSPS group of farmers. Seventy-eight percent of the non-FSPS farmers had not yet participated in any training course organized in the village, while 68% of the FSPS farmers participated at least in one training course before entering the farmer seed production schools (Table 4.4). Thus, it appears that those farmers who volunteered to participate in the FSPS had previously shown an interest in learning how to improve their farming. This is an important basis for assessing the acceptance and taking up of improved practices by non-FSPS farmers.

4.3.2. Impact assessment of the Farmer Seed Production School

Changes in purposes of production and use of quality seeds

Based on remarks of interviewed farmers and villagers, before 2003 almost of farmers used farm saved seed, and their production purposes were for food and feeding livestock, except in Tan Hoi Truong where production was market oriented. Results in Table 4.5 indicate that more than 41% of the FSPS farmers and 20% of non-FSPS farmers applied improved practices to produce seed for household use and sharing seeds in their community. Usually, to produce seed, farmers transplant or sow high-quality seeds (certified seed and basic seed) in the first crop, they apply roguing techniques to maintain high-quality seed plots and harvest those plots for re-use as seed or to share seeds with other farmers in the community.

Our results show that the majority of FSPS (58.6%) and non-FSPA farmer (52.5%) used high-quality seeds. The use of high-quality seed was associated for seed production with seeds being supplied by cooperatives. The organization of the local seed supply system was such that cooperatives directly supplied seed to the farmers in Yen Phuong, Dong Thanh and Phuoc Thuan villages where farm size was small and farmers benefited from the local seed price subsidy policy through the cooperatives. Such a system was not in place in Tan Hoi Trung. However, many farmers who had the intention of producing rice for food still used lower-quality seed (for example by not roguing before harvesting for seed or by using seeds from the grain stock) at the four surveyed villages. The farmers in the surveyed sites seemed to have changed their views on the importance of using quality seed for seed and rice production, especially households having small rice farms (see also Chapter 5 of this thesis).

Table 4.5: Differences in the purpose of production and in the use of different seed quality levels between FSPS and non-FSPS farmers in four surveyed villages in Vietnam, (*FSPS: n = 120, non-FSPS: n = 120*)

Household resources [1]	FSPS	non-FSPS	χ^2
Purposes of production	*(n=120)*	*(n=120)*	
- For seed [2]	41.3	20.8	*11.799, p = 0.001*
- For food and goods	58.3	79.2	
Seed quality levels [3] used after FSPS			
- HH	0.0	31.7	*58.928, p < 0.001*
- RA	41.3	15.8	
- CS	10.7	20.0	
- BS	42.1	28.3	
- PS	5.8	4.2	

[1] *Control practices: Purpose of production was for food and used seed quality was farm-saved seed (HH)*
[2] *Producing seed for selling all or a part of total production*
[3] *Levels: HH: Households use grains from food stock (or harvesting a good rice plot without selection) for seed, AR: applying roguing, CS: certified seed, BS: basic seed, PS: pre-basic seed*

Adoption of improved planting techniques

There was a significant difference between FSPS and non-FSPS farmers with regard to the application of improved planting practices in Yen Phuong and Dong Thanh (transplanting), and in Phuoc Thuan and Tan Hoi Trung (directly sown system). Compared to the control local practices, Table 4.6 shows the important impacts of the FSPS in that most FSPS farmers used one seedling per hill when transplanting, while only 22% of them used two or three seedlings per hill. Among the non-FSPS farmers, only 23% followed the traditional practice (3-7 seedlings per hill).

Table 4.6: Percentage of respondents applying different planting practices for FSPS and non-FSPS farmers averaged for the surveyed villages in Vietnam

Impact fields [1]	FSPS	non-FSPS	X^2
Transplanting method [2]	*(n=60)*	*(n=60)*	
One seedling per hill	78	47	*19.620, p < 0.001*
2–3 seedling per hill	22	30	
More than 3 seedlings per hill	0	23	
Direct sowing method [3]	*(n=61)*	*(n=60)*	
Using drum seeder	30	15	*46.241, p < 0.001*
Sowing reduced seed rates	70	30	
Using common seed rates	0	55	

[1] *Control practices: more than 3 transplanted seedlings per hill; direct sowing by hand with high seed rates*
[2] *Transplanting is only applied in Yen Phuong (Nam Dinh) and Dong Thanh (Nghe An)*
[3] *Direct sowing is only applied in Phuoc Thuan (Binh Dinh) and Tan Hoi Trung (Dong Thap)*

In Phuoc Thuan and Tan Hoi Dong villages, 30% of the FSPS farmers used drum seeders for sowing and 70% of them used reduced seed rates of around 150 kg ha^{-1}. In contrast, 45% of the non-FSPS farmers applied the improved direct sowing practice and 55% still applied the traditional sowing practice with seed rates varying from 180 to 220 kg ha^{-1}. Ultimately, both the FSPS participants and non-participants (to a lesser degree) began to use improved practices.

Application of improved practices

Almost all improved agronomic practices that were applied by both the FSPS and the non-FSPS farmers differed significantly from the control local practices (Table 4.7). Average seed rates of FSPS farmers were reduced to 35.94 kg ha^{-1} in transplanted rice, much lower than the control (73.18 kg ha^{-1}). Similarly, a reduction to 159.90 kg ha^{-1} in direct seeded rice was documented compared to the control (225.45 kg ha^{-1}). Nitrogen amount in the transplanted crop did not differ significantly while FSPS farmers gave lower amounts (a difference of 26 kg ha^{-1} with the control) in the directly sown crop; P_2O_5 fertilizer applied was lower than in the control; KCl was reduced in transplanted crops compared with the control but increased effectively in the directly sown crop. Application of balanced fertilizers and suitable planting practices resulted in considerably higher rice yields than in the control (differences for the FSPS farmers 0.58 and 0.93 Mg ha^{-1} in transplanted and directly sown crops, respectively).

Results in Table 4.7 were important impacts of improved agronomic practices by FSPS farmers. Farmers explored and learned during the FSPS those practices that were not introduced before the FSPS. They also improved their knowledge on such practices as shown in Chapter 5. Non-FSPS farmers appear to have also benefited, although to a lesser degree than the FSPS farmers as they too applied lower seed rates, balanced better the amount of fertilizers and obtained higher yields compared to the control.

Inputs and profits

When crops were transplanted, some inputs differed significantly between FSPS-farmers (who produced seed) and non-FSPS farmers who produced food grain. FSPS

Table 4.7: Differences in agronomic practices and yields among the control compared to FSPS and non-FSPS farmers averaged for the surveyed villages in Vietnam

	Control practices	non-FSPS farmers	FSPS farmers
Transplanting crop	*n=11*	*n=120*	*n=120*
Seed rates (kg ha^{-1})	73.18 ^{a}	45.96 ^{b}	35.94 ^{c}
Nitrogen fertilizer (kg ha^{-1})	84.70	93.94	97.04 ^{ns}
P2O5 fertilizers (kg ha^{-1})	80.12 ^{a}	54.01 ^{b}	61.77 ^{b}
KCl fertilizers (kg ha^{-1})	85.16 ^{a}	70.15 ^{b}	56.18 ^{c}
Muck (Mg ha^{-1})	0.85 ^{a}	0.68 ^{b}	0.88 ^{a}
Yield (Mg ha^{-1})	5.19 ^{b}	5.47 ^{ab}	5.77 ^{a}
Direct sowing crop	*n=11*	*n=120*	*n=120*
Seed rates (kg ha^{-1})	225.45 ^{a}	189.31 ^{b}	159.90 ^{c}
Nitrogen fertilizer (kg ha^{-1})	123.86 ^{a}	105.25 ^{ab}	97.80 ^{b}
P2O5 fertilizers (kg ha^{-1})	80.21 ^{a}	54.74 ^{b}	51.37 ^{b}
KCl fertilizers (kg ha^{-1})	36.77 ^{b}	48.83 ^{ab}	52.05 ^{a}
Yield (Mg ha^{-1})	5.12 ^{b}	6.05 ^{a}	6.05 ^{a}

Within a row, means followed by the same letter are not significantly different (Tukey's test, $p \leq 0.05$)
^{ns} not significantly different of all means within the row.
** 1: Farm saved seed; 2: Certified seed; 3 Basic seed; 4: Pre-basic seed*
*** Roguing: removing off-type plants in the seed production plots*
Note: Number of respondents and data are based on both cropping seasons: spring-winter, autumn-summer; Transplanting is only applied in Yen Phuong (Nam Dinh) and Dong Thanh (Nghe An) and Direct sowing is in Phuoc Thuan (Binh Dinh) and Tan Hoi Trung (Dong Thap)

farmers had higher input costs (18 US$ ha^{-1} more for fertilizers and for post harvest handling, and 10 US$ ha^{-1} more for pesticides) than non-FSPS farmers (Table 4.8). However, sale prices and profits were not very different. In contrast, with direct sowing, most of the input costs of FSPS farmers were lower than for non-FSPS farmers, except for the post harvest handling costs. Only costs of pesticides were significantly lower (15 US$ ha^{-1}) for FSPS farmers. Differences in selling prices (0.003 US$ kg^{-1}) and profit (60 US$ ha^{-1}) were also significant between FSPS and non-FSPS farmers.

In general, the profit of FSPS farmers with the directly sown crop was about 227 US$ ha^{-1} higher than with the transplanted crop whereas for the non-FSPS farmers this difference was 174 US$ ha^{-1}.

Table 4.8: Comparison of inputs and profit among FSPS and non-FSPS farmers for the surveyed villages in Vietnam

	FSPS		non-FSPS		*t*-value
	No.[1]	Mean	No.[1]	Mean	
Transplanting method [2]					
• Seeds (USD ha^{-1})	120	24.9	120	19.3	*3.447***
• Fertilizers (USD ha^{-1})	119	186.7	118	168.9	*3.997***
• Pesticides (USD ha^{-1})	120	44.5	120	34.1	*3.810***
• Postharvest costs [4] (USD ha^{-1})	120	166.1	120	148.0	*5.253***
• Total production costs (USD ha^{-1})	120	648.9	120	608.2	*4.342**
• Sale price (USD kg^{-1})	120	0.147	120	0.149	*-1.493* ^{ns}
• Profit ((USD ha^{-1})	118	197.0	118	209.0	*0.370* ^{ns}
Direct sowing method [3]					
• Seeds (USD ha^{-1})	120	33.9	120	34.6	*-0.581**
• Fertilizers (USD ha^{-1})	120	126.5	120	133.2	*-1.326* ^{ns}
• Pesticides (USD ha^{-1})	120	44.7	120	61.9	*-6.698***
• Postharvest costs [4] (USD ha^{-1})	120	132.0	120	126.1	*0.825* ^{ns}
• Total production costs (USD ha^{-1})	120	443.1	120	488.6	*-2.283**
• Sale price (USD kg^{-1})	120	0.144	120	0.141	*2.606***
• Profit ((USD ha^{-1})	120	423.7	120	362.9	*2.146* ^{ns}

** Significantly different at 5% level; ** at 1% level, based on t-test;* ^{ns} *not significantly different*
[1] *Number of respondents and data are based on both cropping seasons: spring-winter, autumn-summer*
[2] *Transplanting is only applied in Yen Phuong (Nam Dinh) and Dong Thanh (Nghe An)*
[3] *Direct sowing is only applied in Phuoc Thuan (Binh Dinh) and Tan Hoi Trung (Dong Thap)*
[4] *Costs of drying seeds and storage materials*

Seed quality

The results from testing the seed quality of the sampled seeds (Table 4.9) show that seed quality was good for both FSPS and non-FSPS farmers in the four surveyed villages. Germination rates always met the national standard for seed quality. However, about 20% of the FSPS farmers did not meet the national standard for moisture content. In most of these cases, the moisture content was between 13.6 and 14.5%, reflecting inadequate drying and storage methods. As seeds are only stored for a short period from the harvest of the spring-winter season to sowing of the summer-autumn season, this is not considered a major risk. Therefore, the moisture content should be lower 13.5% for commercial seeds.

Diffusion of the improved practices

Most FSPS farmers applied improved agronomic practices for their rice fields,

Table 4.9: Comparison of proportion of seed samples meeting the national standards for moisture content and germination rate* in samples from FSPS and non-FSPS farmers in four surveyed villages in Vietnam

Seed quality	FSPS (%; *n = 121*)	non-FSPS (%; *n = 118*)	χ^2 value
Moisture content			
• Meeting national standards*	81.0	83.1	*0.172*^{ns}
• Not meeting national standards	19.0	16.9	
Germination			
• Meeting national standards	100.0	100.0	*ns*
• Not meeting national standards	0.0	0.0	

** National standards of rice seed quality: minimum germination rate is 80%, maximum moisture content is 13.5% (TCVN 2004).*

especially in better balancing the amount of fertilizers and reduced seed rates (Table 4.7). Farmers reduced P_2O_5 and increased KCl amounts. Fig. 4.1 shows that only about 25% of the FSPS farmers reduced pesticide applications by applying integrated pest management (IPM). This can be accounted for by the Blast disease outbreak that occurred in Yen Phuong and Dong Thanh (North Vietnam) and Brown plant hopper infestation in Tan Hoi Trung and Phuoc Thuan (South Vietnam), the majority of farmers then applied pesticides at the "economic threshold level" to protect the crops against yield loss. Moreover, most FSPS farmers improved their seed quality by roguing the rice plots before harvesting for seed. The application of improved practices by FSPS farmers also had an impact on the non-FSPS farmers. Many non-FSPS farmers (70%) learned and applied improved practices for their rice production from neighbouring FSPS farmers within the same community.

There were different pathways of diffusion of improved practices in place (Table 4.10). Seventy nine percent of the respondents shared their knowledge on improved practices with family members (their parents, wife, children, sisters, brothers, etc.). There was also considerable farmer-to-farmer diffusion within the community outside the family relations. FSPS farmers could share their knowledge on improved practices in the village coffee-house during the early morning hours. Therefore, the Agricultural Extension Centers linked with the coffee-houses to establish a few farmer clubs named "Agricultural Extension Coffee-House" in the Mekong Delta to facilitate this diffusion processes.

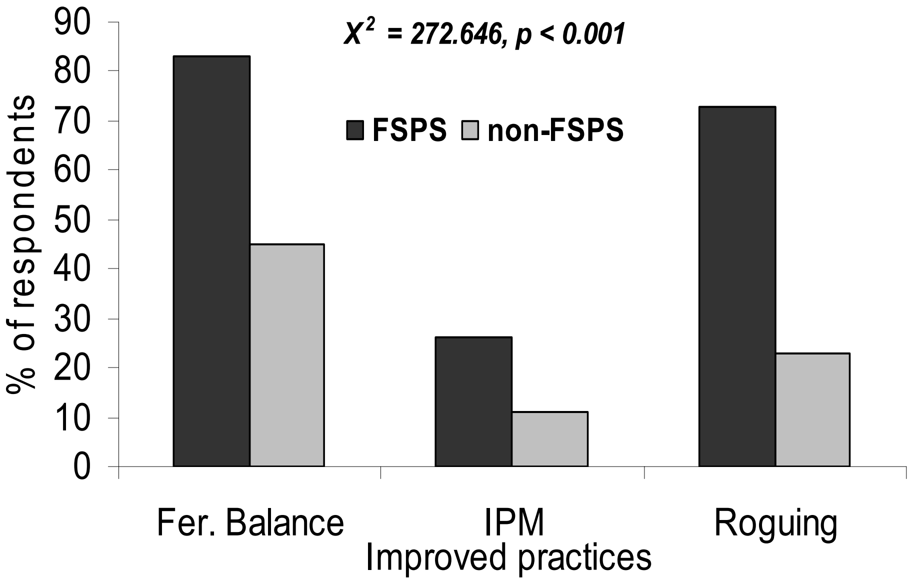

Fig. 4.1: Comparison of proportion of respondents applying improved practices amongst FSPS and non-FSPS farmers in four surveyed villages in Vietnam (*FSPS: n = 120, non-FSPS: n = 120*). Fer. Balance: fertilizer balance; IPM: integrated pest management

Sharing good-quality seeds also was an important diffusion activity in the surveyed villages. Fifty seven percent of the respondents provided seeds to other farmers for rice production. This activity contributed considerably to improving the household seed quality.

Table 4.10: Diffusion of the information, improved practices and seed from FSPS farmers in the four surveyed villages in Vietnam (*n=120*). FSPS farmers were asked to indicate whether, after participating in the FSPS, they provided assistance to the community through technical guidance for family members or farmers in the community or by sharing good seed with other farmers

Impacts	% of respondents
- Technical guidance to members in their family	79
- Technical guidance to farmers in the local community*	49
- Sharing good quality seed with other farmers in the local community	57

** Sharing technical information through various ways: farmer-to-farmer; community meeting; coffee-house*

4.3.3. Establishing seed clubs

Establishing a "seed club" was a final step in the FSPS programme. After attending the FSPS, farmers, individuals or groups of the FSPSs, who were interested in seed production, were encouraged to self-establish a rural seed supply model called a "seed club". Members of each seed club could be a maximum of 15 farmers at the beginning. They had to prepare an actual plan and submit it to the local People's Council at the village level. The Council would then issue an official decision for approval which gave the seed club legal support and further technical assistance from the local formal seed sector (Fig. 4.2).

At the time of the survey, four seed clubs were established in each project province. The seed clubs could be placed in co-operatives such as with the seed clubs in Yen Phuong, Dong Thanh or privatization as was the case in Tan Hoi Trung. The major activity of a seed club was to produce good seeds (from basic seed) and supply these seeds to farmers within their community and/or sell them to the co-operatives or local seed companies. Some initial achievements realized active contributions of farmer-

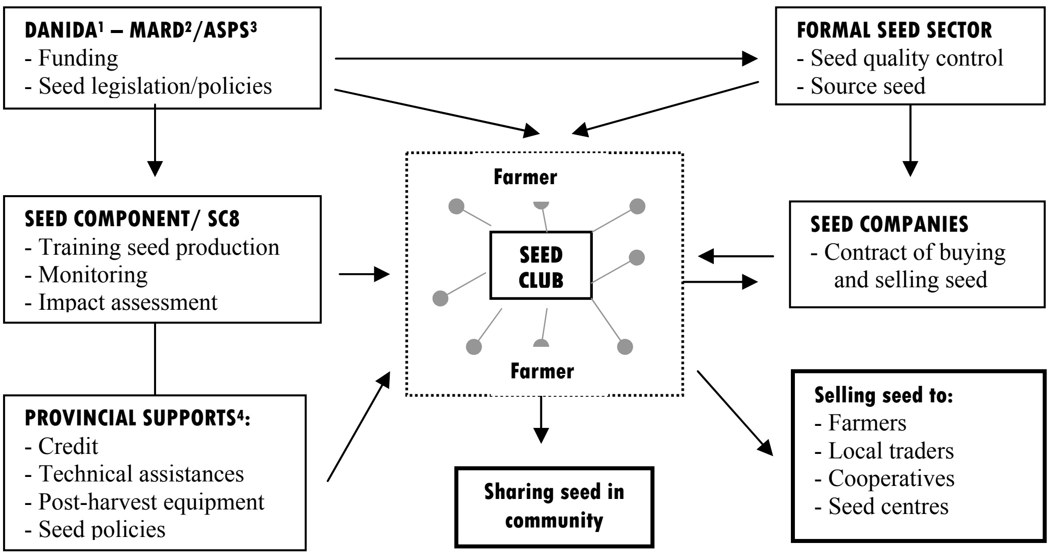

Fig. 4.2: A conceptual framework of seed the supply system under the Farm Saved Seed Project in Vietnam.
[1] Danish International Development Assistance; [2] Ministry of Agriculture and Rural Development; [3] Agricultural Sector Programme Support; [4] Department of Agriculture and Rural Development

seed producers (seed clubs) in sharing, supplying and increasing access of good seed through reasonable seed prices, low transaction and transportation costs and availability of seeds based on farmers' needs in the rural areas.

4.4. DISCUSSION

In evaluating the effects of the FSPS training programme distinction should be made between immediate effects and long-term or after-effects.

4.4.1. Immediate effects

Overall, the experimental learning process enabled the FSPS farmers to enhance their practical skills and technical knowledge. This new knowledge was also shared in the community to a certain extent. As a result, we see significant numbers of farmers who applied the improved practices with a reduction in number of seedlings, seed rates and balancing fertilizer amounts in the transplanted and directly sown crops which greatly impacted rice and seed production for FSPS and non-FSPS farmers. However, a few improved practices were not taken up to a significant degree such as using the drum seeder method of sowing despite successful experiments during the previous FSPSs. A possible explanation for this can be found in Palis (2006) and Pingali et al. (1998) who remark that risk, coupled with the lack of confidence is directly related to the knowledge, culture and social relations that exist among members of a society or social group. While risk is an important factor to consider, we are uncertain what factors influenced the lower rate of adoption of the drum seeder method. It is an area that deserves further investigation. Overall, studies on the FFS-IPM and participatory on-farm research in Thailand, Vietnam and Philippines confirm that trained farmers significantly change their behaviour for the better, retain their knowledge they gained, and continue improved practices (Price 2001; Rola et al. 2002; Huan et al. 2005; Palis 2006; Praneetvatakul and Waibel 2006).

Additionally, this study shows that the gains made from the FSPS approach were suitable in disseminating improved practices from farmer-to-farmer in seed (and rice) production in the four surveyed villages. A large number of the FSPS respondents

(Table 4.9) shared the acquired knowledge willingly and produced good seeds with non-FSPS farmers. The programme was remarkably effective in producing and using better quality seed, despite the fact that about 30% of the non-FSPS farmers still used farm saved seed. This was expressed by Muhamed (1999) in Pakistan, the quality of farmer seeds significantly improves if farmers were given basic training in seed production, cleaning and storage. Moreover, when farmers use high-quality seed, it assures good establishment at low seeding rates, minimizes weed contamination, and reduces the incidence of insect infestations and disease. High quality seed also results in good grain filling, and leads to high grain yields, especially in direct-seeded crop (Balasubramanian 1999).

Generally, seed production appeared to be unprofitable comparing profit between two farmer groups. No difference in sale prices between seeds and grains could be a main reason of unprofitability for farmer-seed producers in surveyed villages (Table 4.8). A case study in the Mekong Delta shows that farmers could access seeds through an agreed exchange rate, for example, for every 1 kg of seeds obtained from the seed producer (or seed club), the farmer should return 1.2 kg of paddy (Cuc et al. 2008). In fact, sale prices of seed produced by the FSPS-farmers are still under that basic exchange rate (1.2) while seed prices at the commercial seed level of the Seed Centers or Companies are almost two times higher than grain prices.

To establish a basic sale price, Kugbei and Bishaw (2002) suggested that sale price should be the price of grain (taken as the basic production costs) + a premium paid to the seed producers (%) + enterprise's cost margin (%) + enterprise's profit margin (%). This sale price is much higher and more attractive than the seed price in the four surveyed villages. In fact, seed prices in these research sites depended on the local seed market, weak service information system, inadequate local policy, and social relationships in the community. Therefore, the seed sale price from the farmer-seed producers to other farmers in the community was low which has been a major obstacle for finding the right difference in seed prices between the informal and formal seed supply systems. Low seed price actually benefits rice growers in the rural areas whereas the seed producers would not benefit from investing and developing seed production and supply. Consequently, how to promote farmer-seed producers? First of all, the local seed policy makers should formally recognize the important role of a community-based seed production and supply system. They should advocate and support the formation of small seed enterprises which is consistent with current policy trends towards privatization, decentralization and rural business development (Bishaw and Turner 2007; Kugbei and Bishaw 2002; David 2004; Tin 2008).

4.4.2. Long-term effects

Training farmer: The FSPS programme might have contributed significantly in enhancing farmer's knowledge and capacity in seed production in the pilot provinces. Both FSPS and non-FSPS farmers in the four study sites have recognized the importance of education on seed. Table 4.11 shows significantly associated concerns of two farmer groups. Many farmers were willing to cooperate with local extension agencies in providing their land for on-farm experiments without economic compensation and to pay for trainer's local travel costs. This means that the FSPS programme truly stimulated the farmer's desire to learn about how to improve their technical rice production knowledge. However, there has been little investment in farmer education (Van den Berg and Jiggins 2007). Van den Berg and Jiggins (2007) stated that this is true "both in the narrow sense of offering farmers structured learning opportunities and in the broad sense of expanding their capabilities to understand, innovate, and adapt to the changing context". Farmer education needs to be strongly supported by investment policies from government.

Table 4.11: Proportion of farmers willing to contribute to expand training courses from the FSPS and non-FSPS farmers in four surveyed villages in Vietnam (% of respondents)

Contributions by farmers	FSPS (n=121)	non-FSPS (n=120)	χ^2
Payment for tea-break fees	25	0	*45.050, p < 0.001*
Training materials [a]	59	28	
Local travel costs for facilitators [b]	33	12	
Lending fields for practice	21	39	

[a] *These are books, pens, large paper (A0 size) or blackboard and place for training*

[b] *There could be gasoline for motorcycle and other fees about 2 USD per trainer of each weekly meeting.*

Local seed supply system: In the context of farmer's seed production, we found some disadvantageous restrictions for seed production of FSPS farmers (Table 4.12). These were: (1) low seed price in all village sites; (2) small farm size for producing seed; (3) lack of equipment for drying seed, especially in Tan Hoi Trung with large farm sizes; (4) expansion of hybrid rice in Yen Phuong and Dong Thanh villages from the local government; (5) the monopoly role of co-operatives in seed supply for farmers, except in Tan Hoi Trung. These disadvantages can influence farmer's willingness to invest in seed production. To develop better farmer-seed supply systems, we not only need to build the technical capacity among individuals and/or farmer-group seed producers, but there needs to be support from the formal sector such as providing appropriate and reliable seed testing, favourable loans, credit for inputs, or designs for a new class of seed with less stringent quality parameters (Kugbei and Bishaw 2002; David 2004). Despite the above, the seed supplied by seed clubs does provide a potential alternative model. Seed clubs annually produce and supplies more than five times the total seed amount coming from the formal seed sector in the Mekong Delta (Tin et al. 2009b).

Table 4.12: Constraints in developing seed production of the FSPS farmers in the four surveyed villages in Vietnam (% of 240 respondents)

Problems	Yen Phuong	Dong Thanh	Phuoc Thuan	Tan Hoi Trung
Small farm size	10	10	17	0
Pests	0	3	3	39
Low seed price	47	27	23	35
Lack of labour	10	7	3	3
Lack of equipment	0	0	0	16

Given the seed club's importance, how to develop better local seed supply system? Jaffee and Srivastava (1994) stated that in many developing countries the large-scale, centralized state farms and public seed corporations (established to multiply and disseminate improved seeds of selected crops) have proved ineffectual and failed to meet the diverse crop and varietal requirements of farmers. Despite this problem, most developing countries were not successful in establishing efficient seed production and supply systems (Jaffee and Srivastava 1994). The seed club model in Vietnam requires a certain partnership with the formal sector in support of farmer seed producers. The Department of Agriculture and Rural Development (DARD) plays a more important role in affecting directly local policy makers regarding the coordination of technical assistance, seed quality control, and providing source seed to the seed clubs. Bishaw and Turner (2007) suggest that the government should create an enabling policy and regulatory environment in which both formal and informal sectors can contribute in a complementary way to the overall goal of increasing seed supply. Currently, the seed club has initially received some basic policy supports from the formal seed sector and local government to enable sustainable development.

4.5. CONCLUSIONS AND COMMENTS

The indirect evidence that farmers changed their practices as a result of the Farmer Seed Production School Programme suggests that the Farmer Seed Production Schools changed the trained farmer's perception and confidence in using quality seed, reducing seed rates, applying roguing for seed plots and balancing fertilizer amounts. A large proportion of both farmer groups used high-quality seed to produce and supply good seed to farmers in the community. That affirmed the farm saved seed has improved reliably in seed quality at the four surveyed villages.

The FSPS farmers broadly disseminated the improved practices to non-FSPS farmers in their communities gauged by the large proportion of non-FSPS farmers adopting improved practices in rice production.

Low profit in seed production could affect the potential inputs of farmer-seed producers. We think that support from the local government and formal seed sector for seed clubs would be beneficial. This could be done by better linking clubs with the seed supply systems, especially making seed buying contracts and issuing appropriate seed quality standards and privatizing seed supply mechanisms. Those issues will improve profits for farmer-seed producers.

Community capacity was strengthened through facilitating the establishment of seed clubs by FSPS farmers. It created a seed supply network in linking both the informal and formal seed systems to increase access to good seed in the rural areas.

This led to changes in the local seed policy to support the informal seed system, establish seed clubs and recognize the role of the community-based seed supply system as a primary seed source for local farmer use.

The selected villages in unfavourable rice cultivation areas could not be representative of the complete effects of the project. However, both farmers from the FSPS and non-FSPS applied improved practices in the four surveyed villages. The expectation that the FSPS programme would help trained farmers to acquire knowledge and technical skills in seed production and to apply this knowledge are met in the subsample on which this chapter is based.

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CHAPTER 5

Ex-ante and ex-post evaluation of improvement in farmer's knowledge through farmer seed production schools in Vietnam

This chapter has been accepted for publication in the *Journal of Agricultural Education and Extension* as:

Huynh Q. Tin, Paul C. Struik, Lisa L. Price, Nguyen P. Tuyen, Nguyen P. Hoan, Heleen Bos. Ex-ante and ex-post evaluation of improvement in farmer's knowledge through farmer seed production schools in Vietnam.

Ex-ante and ex-post evaluation of improvement in farmer's knowledge through farmer seed production schools in Vietnam

Huynh Q. Tin[a,b], Paul C. Struik[b], Lisa L. Price[c],
Nguyen P. Tuyen[d], Nguyen P. Hoan[e], Heleen Bos[f]

[a] Mekong Delta Development Research Institute, Cantho University, Cantho, Vietnam
[b] Centre for Crop Systems Analysis, Wageningen University, P.O. Box 430, 6700 AK Wageningen, The Netherlands
[c] Sociology of Consumers and Households, Wageningen University, P.O. Box 8060, 6700 DA Wageningen, The Netherlands
[d] Extension Center of Dong Thap Province, Vietnam;
[e] Seed Center of Nam Dinh Province, Vietnam
[f] Seed Component, Agricultural Sector Programme Support (ASPS), Danida, Vietnam

Abstract

The study was designed to assess changes in farmer's knowledge of farmer seed production schools (FSPSs) in Vietnam. A set of 25 questions covering five technical areas of the seed production process was used for pre and post knowledge testing at 12 FSPSs in the provinces Binh Dinh, Nam Dinh, Nghe An and Dong Thap. The main findings show an overall increase in farmer's knowledge scores after attending the FSPS. FSPS-farmers with low scores on the pre-field school test (ex-ante) scored much better on the post field school test. Gender had no effect on the test scores. Binh Dinh province had significantly higher mean scores on the post field (ex-post) school test compared to farmers in Nam Dinh, Nghe An and Dong Thap provinces. The increase in knowledge score is linked to the application of good practices learned in the field school as farmers who applied good quality seeds, low seed rates and the transplanting method showed a large increase in scores. The results of this study indicate that the tests provide insight into the knowledge gaps.

Key words: *Farmer seed production school, ex-ante and ex-post test, knowledge increase, social learning*

5.1. INTRODUCTION

5.1.1. Background of Farmer Field Schools

Improving agricultural systems can only be realized by good information and sound advice. Information and advice have often been provided to farmers through public extension services. In many countries, and for both economic and social reasons, the state will continue to play a significant role in agricultural extension (Kidd et al. 2000). How to design an agricultural extension programme in developing countries has been the subject of heated debate. In the past few decades, there was a shift from the transfer-of-technology approach to the Training-and-Visit (or "T&V") System (Godtland et al. 2004). During the 1970s, technology diffusion became the key focus of agricultural extension, when new, high-yielding varieties for staple cereals were released by international research centres, and adopted by national research systems. In 1974, the concept of Training and Visit Extension was developed and pilots were implemented in Turkey and in India, both funded by the Work Bank (Anderson et al. 2006). Instantly, the Training and Visit System was adopted and quickly applied in many countries; it was evaluated as a good option and improved extension service. The system remarkably improved the technical competence of the extension agents by providing a climate under which extension agents developed a favourable attitude towards their clientele through frequent interactions (Adeola 2005; Amin and Stewart 2000; Feder et al. 1987).

Due to huge investments of capital and human capacity, these extension efforts achieved some degree of success but still left the extension system facing many constraints and challenges. There were high costs involved in reaching many farmers located in the remotest areas (Frempong et al. 2006). When the funding for the T&V System stopped, several countries made ad-hoc changes in extension approaches mainly to reach more farmers (Sulaiman and Hall 2004).

According to Ejembi et al. (2006) the Training and Visit Extension has been criticized for being top-down, top-heavy, inefficient and ineffective. Extension needs to consider the benefits of acquisition and application of existing knowledge and the production of new knowledge. Hence, the agricultural extension has to change from an instructional, top-down manner to more participatory ways of facilitating communication and exchange of knowledge (Fleischer et al. 2002). Recently, agricultural education has been central to building this capacity for the production, dissemination, and utilization of knowledge (Lemma and Hoffmann 2006).

The Farmer Field School (FFS) approach, developed and supported by FAO, has been in the National Integrated Pest Management Programs (IPM) of Indonesia, Vietnam and several other countries. The FFS is an innovative training model in which farmers gain the capacity to make their own decision regarding pest and disease control (Rahadi and Widagdo 2002). Initial results of this approach were evaluated and showed that the effectiveness of the diffusion process is of great practical importance in the design of farmer knowledge enhancement strategies, as it affects the cost-effectiveness and financial sustainability of publicly funded farmer information services such as extension and adult education (Feder et al. 2004).

5.1.2. Status of training of farmers in Vietnam

Agriculture is the most important sector in the Vietnamese economy. Rice is the major crop and it contributes greatly to rural employment, household income, food security and gross domestic product. To improve rice yields and income for the farmers from agricultural production, the government extension system including agriculture and forestry areas was officially created in March 1993 by the Decree # 13/1993/ND-CP, and in January 2008 it was re-named “the National Center of Agriculture and Fishery Extension” by the Decree # 01/2008/ND-CP (KNQG 2008). This system built an extension network in 64 provinces of Vietnam, including three levels in each province: provincial extension centre, district extension station and commune extension workers. It has played an important role in providing a range of technical, administrative and training activities. In the previous decade, the approach was quite top-down based on project planning driven by rural development targets formulated at the provincial and central levels (Poussard 1999). Since then, the extension approach has been in transition. The participatory training approach was introduced in Vietnam in 1992 through Community Integrated Pest Management (IPM) funded by the FAO – Inter-country Programme for IPM in Rice in South and Southeast Asia (IPM-VN 2002).

This approach has been applied in several areas of training farmers in Vietnam to build up farmer's capacity in agriculture, forestry, livestock production and especially in rural developmental and poverty alleviation projects. The Community Biodiversity Development and Conservation Project started in the Mekong delta in 1996 and has trained farmers on participatory plant breeding (PPB), and seed production and supply systems (SSS) applying the field school approach (Tin 2007). The Farm Saved Seed Production Project was carried out in Vietnam from 2002−2007; it developed a curriculum for Farmer Seed Production Schools (FSPSs) by combining participatory approaches and technical topics. This project trained many farmers in seed production in Vietnam (SC8 2007). This training approach is currently endorsed by the Department of Crop Production as the standard approach for training farmers in seed production in Vietnam.

5.1.3. Assessment of farmer's knowledge in the Farmer Field Schools

The FFS approach is an essentially informal educational model within extension that is experiential and participatory in nature, and it is called a "school without walls" in which farmers learn together by undergoing intensive training over the entire life cycle of the crop (Palis 2006; Price 2001). To assess the training impact, Marcotte et al. (2002) proposed an evaluation model with various levels:

- Level 1: Training event evaluation, to assess satisfaction of trainees at the completion of training.
- Level 2: Skill/knowledge attainment, to assess change in knowledge, skills and attitudes. This is conducted by pre- and post-tests.
- Level 3: Skill/knowledge transfer, to assess extent of application of skills/ knowledge to related activities. Interviews or questionnaires are used after training for 3−6 months.
- Level 4: Impact, to assess organizational change as a result of skills/knowledge transfer. This assessment is executed after training for 1−3 years.

When assessing the impact of farmer-based training programmes, it is necessary to consider the human capital in the context of upgrading knowledge, enhancing skills, decision-making and experimentation. Acquisitive assessment after training is usually done by measuring to what extent the farmers retained the knowledge and at what level they were able to practice skills learned in post FFS scenarios (Khan et al. 2004). However, application of pre- and post-tests to assess farmer's knowledge from Farmer Field Schools on IPM and seed production has not often been done systematically. Studies in which such a comparison was made include those of Price (2001) and Mancini (2006).

The primary focus of this study was to assess the change in farmers' technical knowledge levels from ex-ante to ex-post tests (so-called pre- and post-tests) in 12 FSPS in four provinces of Vietnam, and to study factors influencing documented increases in farmer knowledge from the field schools. This chapter reports the findings of this study.

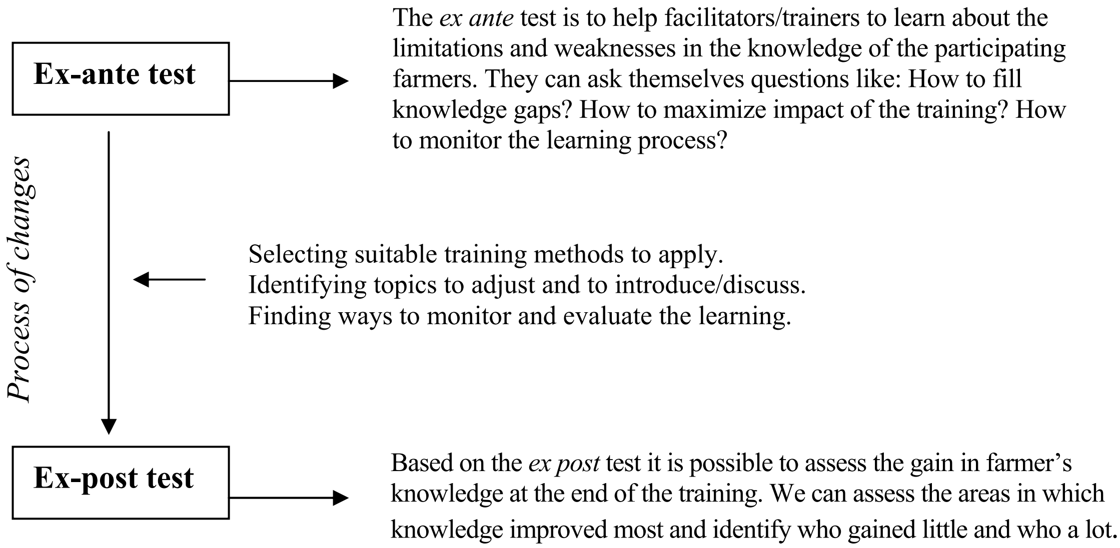
5.2. METHODS

5.2.1. Conceptual and analytical framework

The framework of assessing improvement in farmer's knowledge through FSPS is conceptually based on Röling and Jiggins (1998) and Price (2001). The conceptual framework of Röling and Jiggins (1998) emphasizes five dimensions to enhancing ecological soundness in agriculture that requires more knowledge on the part of farmers and greater demands for research on the *understanding of learning*. These dimensions are: 1) ecologically sound practices, 2) learning, 3) facilitation, 4) support institutions and networks, and 5) conducive policy contexts (Röling and Jiggins, 1998: 286). Participatory educational approaches in agriculture, such as the farmer field school, should be concerned with the facilitation of farmer's knowledge acquisition that will assist them in reducing their dependency. According to Price in her pre- and post-testing of IPM field school knowledge, "The development of measures of viability of the intervention – cultural, economic, and environmental – depends upon the accurate capture of domain knowledge and the expression of that knowledge in farmer behavior." (Price 2001:173).

What is an easy, reliable, and valuable way to assess the impact of the Farmer Seed Production Schools project? The pre- and post-test (or ex-ante and ex-post test) method offers an appropriate evaluation of changes (Price 2001; Rockwell and Kohn

1989). The terms ex-ante and ex-post tests are defined by Lexicon (2007): The *ex ante* perspective is forward looking and the *ex post* perspective is backward looking. One of the most important evaluations is the ex-ante test as baseline to adjust implementation and compare changes at the end of project.



Based on this framework, our study included an ex-ante test (pre-test) at the start of the training course and an ex-post test (post-test) at the end of the training course. Based on these two tests the gain in knowledge was assessed. This assessment is further detailed under the headings Training context, Research instruments, Sample size and Coding data and analysis.

5.2.2. Training context

Training process of Farmer Seed Production School (FSPS): To conduct the FSPS training programme, the Farm Saved Seed Project created a very strong human resource training system with three levels: Training of Main Trainer (ToMT), Training of Trainer (ToT) and Training of Farmer Trainer (ToFT) in each project province. The local technicians (ToMT/ToT) and farmer-trainers (ToFT) cooperated to organize the FSPSs and to train the farmers.

The organizational process of each FSPS consisted of several steps, including:

- *Selecting participants in each FSPS.* The number of farmers varied between about 20−25. Participating farmers had to register at the Village Council of the project villages. When a list of farmers became available, the Chairman of that village informed the provincial project management unit that the training could be planned.

- *Identifying facilitators.* Each FSPS usually included two trainers (ToMT or ToT and ToFT). Trainers had several meetings with the Local Council to discuss how to organize an FSPS and how to meet with farmers to make a detailed plan and on-farm experiments before starting the FSPS.
- *Grouping farmers.* Farmers divided themselves into small groups (4−5 groups per FSPS) which served as working groups and in which farmers worked together on the on-farm experiments. Each group had the task of taking care of an experiment, collecting data, sharing results and preparing a report.

Curriculum topics: The FSPS's curriculum included four main sections: organizational preparation, technical topics, on-farm experiments and study-tour. An FSPS could vary in duration from 4−5 months depending on the growth cycle of the rice varieties and the length of the cropping seasons. In addition, the facilitators added a few weeks before initiating the FSPS to do organizational preparations and a week for helping farmers to prepare data and reports of on-farm experiments. The curriculum topics were developed by the project based on the formal seed production process and the existing farmers' cultural practices. However, some special topics could be modified based on farmer demand at the first class meeting or when problems occurred during the FSPS. The facilitator and farmer built up a training plan in which all topics and activities were listed logically in the programme matrix. As the programme included several weeks with many activities and topics to be dealt with simultaneously, two days of FSPS were needed in those weeks to complete all activities. The topics and activities are indicated in Table 5.1.

Agenda for weekly class meeting: The weekly class meeting played an important role in the process of knowledge acquisition in the FSPS. To make the class meeting efficient, the facilitators and farmer-trainees had a weekly meeting (of one day) to discuss and practice technical topics. The agreed improved practices were applied in the on-farm experiments. Topic discussion and on-farm practices were arranged suitably for each weekly class meeting (Table 5.2). After a working day, farmers could acquire technical knowledge through learning by doing.

On-farm experiments: Each FSPS had a main experiment for studying and applying improved practices. It was divided into two plots, one plot with traditional practices (TP) and another plot with improved practices (IP). Each plot had a size between 300 and 500 m^2. The cultural practices of TP and IP plots were described in Chapter 3 by Tin et al. (2008).

Some optional experiments were added by the FSPS-farmers such as:

- Variety testing, a test with around 4−6 promising varieties being provided by the provincial seed centre was designed without replication and with 50−100 m^2 of each variety. With this experiment, farmers could select the best one to multiply seed for the next crop.
- A plot grown from farm saved seed (grains for seed) with an area of about 200 m^2 to practice roguing and to observe off-type plants during the FSPS.
- The FSPS-farmers always suggested having a practice seed production plot based on the technical process in seed production of the formal seed sector.
- In addition, farmers could add some special experiments like sowing densities, using the leaf colour chart and different amounts of fertilizers.

5.2.3. Research instruments

To assess improvement in knowledge as a consequence of the training, the facilitators used ex-ante and ex-post tests including a set of 25 questions covering all basic elements of the seed production process. The set was divided into five technical areas: (1) cultural practices and seed preparations; (2) plant protection; (3) variety selection and roguing; (4) post harvest handling of seed; and (5) seed quality and planning. For each technical area, five questions were asked, and for each question four possible answers (multiple-choice) were provided among which only one was correct. Each correct answer was awarded 20 point, and therefore the maximum score for each technical area was 100, equivalent to 100 percents.

At the first meeting, the facilitators executed the ex-ante test by printing each question on a sheet of paper (A4 size) and hanging (or sticking) it to the trees or walls. Farmers, one by one, moved to each question and took some minutes for reading and answering that question in the answer sheet. The ex-post test was conducted in the same way or took place in the classroom. The questions in the two tests were the same. The number of correct answers was assessed separately for each test.

In addition, demographic characteristics of participants and information on the economics of their households and agronomic aspects of their farms were also collected using a questionnaire sheet supplied with the ex-ante test.

5.2.4. Sample size

In the dry season of 2006, many FSPSs were conducted in each province in which three FSPSs were selected per province for this study. To collect reliable data, farmers who had been absent twice in the whole FSPS process were excluded from the data set provided in Table 5.3. In total, 219 farmers (119 women and 100 men) of 12 FSPSs participated fully and their completed ex-ante and ex-post tests were selected for further study.

5.2.5. Coding data and analysis

Some data needed coding and this was carried out as follows:

- Gender was divided into two groups: (1) men and (2) women.
- Age: the age of farmers was coded into five groups: (1) younger than 20 years; (2) from 20 to 29 years; (3) from 30 to 39 years; (4) from 40 to 49 years; and (5) at least 50 years old.
- Education was coded into three levels: primary level included grades 1 to 5; secondary level was from grade 6 to 9 and high was grade 10 to 12.
- Purposes of rice production: (1) for food consumption, (2) for sale (market-oriented rice production).
- Planting method: (1) directly sown crop (by hand), (2) directly sown crop (by drum seeder) and (3) transplanted crop.
- Seed quality levels: (1) farm saved seed, (2) certified seed, (3) basic seed and (4) pre-basic seed.

Table 5.1: Example of a training programme matrix. The case refers to a situation with a rice variety with a growth cycle of 100 days and with direct sowing of the crop.

No.	Topic / activity	Weeks after start of FSPS																		
		-2	-1	0	1	2 [f]	3	4	5	6	7	8	9	10	11	12	13	14 [f]	15	16
Act. A	Link with the local government for preparing an FSPS [a]	x																		
Act. B	First class meeting with listed farmers and local authority [b]		x																	
Act. C	Ex-ante test, opening ceremony, seed bed preparation			x																
Act. D	Organizing farmers' field days [c]																	x		
Act. E	Preparing reports of on-farm experiments																		x	
Act. F	Ex-post test, closing ceremony (handing out certificates to farmers)																			x
Topic 1	Techniques of testing seed viability and breaking seed dormancy				x															
Topic 2	Techniques of land preparations for seed production					x														
Topic 3	Techniques of soaking and incubating seeds				x															
Topic 4	Techniques of transplanting and direct sowing in seed production					x									x				x	
Topic 5	Fertilizers and their application						x													
Topic 6	Weeds and ways of managing them					x		x							x					
Topic 7	Insects, animals and ways to control them [d]					x	x	x	x	x	x	x	x	x	x	x	x	x		
Topic 8	Diseases and ways to control them [d]						x	x	x	x	x	x	x	x	x	x	x	x	x	
Topic 9	Growth and development stages of rice (five stages [e])						x			x		x			x		x			
Topic 10	Variety regeneration and rehabilitation method										x									
Topic 11	Isolation and roguing techniques for seed production plots					x						x			x		x			
Topic 12	Techniques of harvesting and threshing seeds															x			x	
Topic 13	Techniques of cleaning, drying and storing seeds															x			x	
Topic 14	Planning for seed production												x							
Topic 15	Marketing and organizing seed service at small scale													x						
Topic 16	Role of gender in agricultural production										x		x							
Exp.	How to carry out on-farm experiment, and manage water, collect, analyze and prepare reports?		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Study tour	Visiting a seed club or seed company to see and share experiences in seed production and post harvest handling techniques.															x				

[a] Discussing some requirement for help like how to conduct an FSPS in the village; inform farmers to register; selecting a venue for weekly meetings, a field for on-farm practices, etc.
[b] Organizational preparing and discussing the details of training programme and additional topics. All things needed for an FSPS were available and agreed among participants.
[c] Inviting farmers in surrounding villages and local authorities, technicians, agricultural officers in the district and province levels for sharing and observing farmers' on-farm research results.
[d] At each weekly meeting, the topic is discussed when insects or diseases are occurring on the field
[e] Stages of seedling, tillering, panicle differentiation, booting and flowering, and maturity.
[f] In this week, farmers have to work 2 days.

Table 5.2: Time frame for a weekly class meeting at the FSFS in the four surveyed provinces

Time frame	Activity
7.00-8.30	Field activities: observing growth of rice, agro-ecosystem, collecting data and identify pests and diseases (problems).
8.30-10.00	Group work on analyzing collected data and presentation of results.
10.00-11.30	Technical topic(s) related with observed problems is (are) discussed to solve occurring problems and take notes on technical concerns in seed production.
11.30-13.00	Lunch time.
13.00-14.30	Discussion and agreement on what kind of improved practices will be applied into on-farm experiments. Going to the field for applying those improved practices.
15.00-15.30	Planning for the next meeting, remarks and closing of a weekly meeting.

Table 5.3: Villages and number of (female) farmers who participated in 12 FSPSs in the four surveyed provinces

Province	Villages	No. of farmers	No. of female farmers
Nam Dinh	1. Lien Minh (a)	25	23
	2. Lien Minh (b)	20	19
	3. Minh Tam	11	10
Nghe An	1. Bong 1	18	12
	2. Hong Tien	17	10
	3. Ban	17	13
Binh Dinh	1. Phuoc Loc	25	12
	2. Phuoc Hung	23	21
	3. Phuoc Thanh	25	10
Dong Thap	1. Binh Thanh	11	0
	2. Long Hung	09	0
	3. Tan Hoi Trung	18	2
Total	12	219	119

The Chi-square test was applied for analyzing differences among farmers participating in the FSPSs based on characteristics such as gender, age, education, purpose of rice production; training courses attended and used seed quality levels.

Analysis of variance (ANOVA) was applied to compare differences between provinces in household farm size, used seed rates, proportion of income from rice production, and rate of acquired knowledge in the FSPS.

To evaluate differences in scores (%) between ex-ante and ex-post tests in each technical area and ranges of score, the t-test was applied. In addition, we calculated bivariate correlations to account for associations.

5.3. RESULTS

5.3.1. Household resources

Demographic characteristics and education

Table 5.4 indicates the demographic and educational characteristics and purpose of rice production of participating farmers in the 12 Farmer Seed Production Schools (FSPSs) in the four surveyed provinces. Women were an important number of the participants in FSPSs, except in Dong Thap, where only a few women participated. Overall, there were more women attending the FSPSs (59%) than men (49%). The average age of the 219 respondents was 40 years old. The youngest farmer was 16 and the oldest one was 63. In Nghe An, participating farmers were younger than the farmers in the other provinces.

Formal education of farmers in the rural areas in Vietnam usually ends at the highest grade of level 2. This also shows up in our data set: the majority of respondents in this study completed grades at the secondary school level (64%) and only 17% reached a higher schooling level. There is a significant difference of level of education of participants in the different provinces at the 5% level, but the relationship between education levels and provinces was loose (χ^2=15.2*). That means that the majority of participating farmers in FSPSs reached the secondary level of education. In general, farmers in FSPSs of Nam Dinh and Binh Dinh completed a higher educational level than in Nghe An and Dong Thap province. In this study, many young farmers in the FSPSs had an education level beyond the ninth grade.

Farmer's purposes in rice production in the FSPSs differed among provinces (Table 5.4). Rice production in the Mekong Delta of Vietnam is market oriented. Hence, almost all farmers in Dong Thap produced rice for sale (97%), while the farmers in the other provinces only grew rice for food consumption.

The majority of farmers who participated in the FSPS had not previously attended technical training courses organized at the local level except in Binh Dinh where more than 50% of the respondents had previously participated in the farmer's field schools on integrated pest management and/or other agricultural techniques.

Table 5.4: Some demographic, educational characteristics and experience of rice production of participating farmers, and purpose of rice production of farmers who participated in 12 FSPSs in the four surveyed provinces in Vietnam

Characteristics	Provinces				Chi-square values
	Nam Dinh	Nghe An	Binh Dinh	Dong Thap	
Gender (%)					
- Men	7	33	42	95	*73.857***
- Women	93	67	58	5	
Age classes (%)					
- <20 years old	0	29	0	3	*80.091***
- 20-29	27	32	6	29	
- 30-39	12	25	32	24	
- 40-49	41	12	36	23	
- 50 and over	20	2	26	21	
Education levels (%)					
- Primary	9	25	12	32	*15.231**
- Secondary	66	67	68	53	
- High	25	8	20	15	
Training courses attended (%)					
- 0	95	77	35	92	*75.485*
- 1	5	12	52	8	
- 2	0	11	10	0	
- 3	0	0	3	0	
Working time in rice field (%)					
- <25	12	35	60	8	*91.158***
- 25-49	64	23	28	76	
- 50-75	20	10	3	16	
- >75	4	32	9	0	
Experience of rice production (%)					
- <10 years	23	57	10	26	*56.501*
- 10-19	20	29	41	55	
- 20-30	50	12	45	16	
- >30	7	2	4	3	
Purpose of rice production (%)					
- Home consumption	100	100	97	3	*199.058***
- Sale	0	0	3	97	

** Significant difference at 5%; ** significant difference at 1%*
Note: For training courses attended and experience in rice production, the statistical significance is not indicated because more than 20% of cells for these variables have an expected count of less than 5.

Years and time in rice production

Working time spent in the rice field differed significantly among the four provinces at the 1% level (Table 5.4). The time farmers had available for work was not only spent on rice production but was also used for a variety of other activities to create additional income. The calculated time in percentage of total daytime actually worked on the rice field ranged from about 25% to 50% per cropping season in Nam Dinh and Dong Thap provinces, and less than 25% of daytime was in Binh Dinh. The remaining time was usually used for livestock production and off-farm activities/occupations (bricklayer, tailor, local trader, etc.), especially fish breeding at the research sites in Dong Thap. The time allocated to rice production expresses a positive relation to large farm size and commercial rice production. The majority of farmers had around 10−30 years of experience in rice production in Nam Dinh, Binh Dinh and Dong Thap. On the other hand, farmers in the FSPSs in Nghe An had ten years less experience in rice cultivation than farmers in the other provinces.

Farm size and agronomic applications

The farmers in the FSPSs in Nam Dinh, Nghe An and Binh Dinh provinces owned little land (≤ 0.36 ha per household) whereas the farmers in Dong Thap had more land than the FSPS-farmers in the other provinces. Farmers in Dong Thap also had more income from rice production (Table 5.5).

In addition, the crop establishment in Nam Dinh and Nghe An province was through transplanting the rice crop and in Binh Dinh and Dong Thap through direct sowing. Transplanting required less seed than cropping by direct sowing (Table 5.5).

Table 5.5: Mean rice area per farmer, seed rates and income from rice production of farmers who participated in 12 FSPSs in the four surveyed provinces of Vietnam

Province	Rice area (ha)	Seed rates (kg ha^{-1})	Rice-income (% of total)
Nam Dinh	0.36 a	62.7 a	59.3 b
Nghe An	0.27 a	94.6 b	52.6 ab
Binh Dinh	0.20 a	185.3 c	45.8 a
Dong Thap	1.51 b	185.9 c	72.2 c

Within a column, means followed by the same better are not significantly different (Tukey's test, p=0.05)

Fig. 5.1 indicates that the FSPS-farmers in Dong Thap with large farms and requiring large amounts of seed for the direct sown crop used seed of lower quality (farm saved-seed), while farmers in the FSPSs of other provinces used high-quality seed including pre-basic seed, basic seed and certified seed. The demand for higher quality seed was associated with the use of smaller rates per hectare. In addition, the Farm Cooperative in Nam Dinh, Nghe An province and Binh Dinh has been a strong seed supply system in linking with seed companies. For that reason, the farmers in the FSPSs of Nam

Dinh, Nghe An and Binh Dinh used better seed for rice production than farmers in Dong Thap.

5.3.2. Findings of acquired knowledge through the FSPS

Difference of acquired knowledge among provinces

Mean scores in percentage in Fig. 5.2 indicate significant differences in scores on the ex-ante and ex-post tests and acquired knowledge of the FSPS-farmers among the four surveyed provinces. The mean ex-ante scores in Nam Dinh, Nghe An and Dong Thap were very low (35−38%), but in Binh Dinh very high. The mean scores of the ex-post test of each province were considerably higher than the ex-ante scores. Farmers in Binh Dinh attained the highest ex-post scores, but the difference between ex-ante and ex-post scores was lowest in Binh Dinh. The highest increase in score was recorded in Nam Dinh (39.6%).

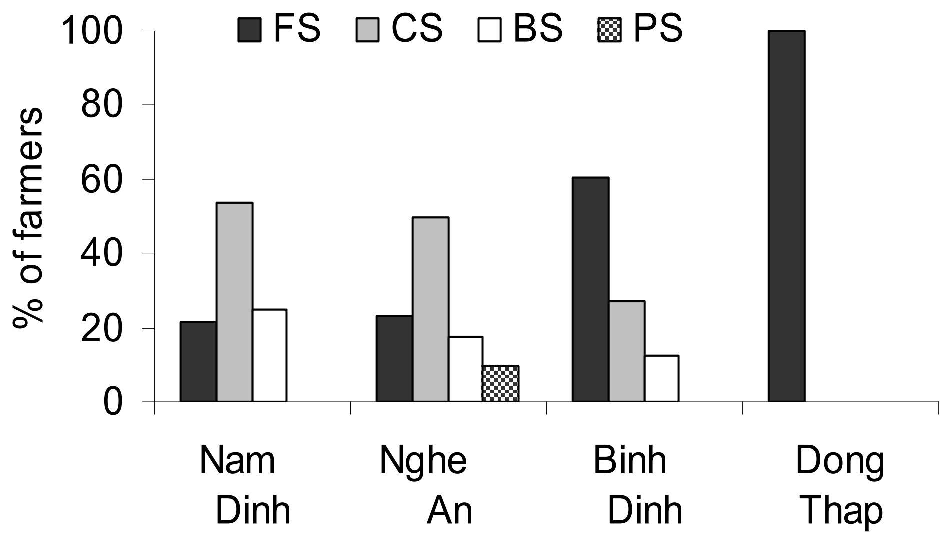


Fig. 5.1: Percentage of farmers using different seed quality levels for rice production in 12 FSPSs in the four surveyed provinces in Vietnam. (n = 219, $\chi^2 = 88.162, p < 0.001$).
FS: farm saved-seed, CS: certified seed, BS: basic seed, PS: pre-basic seed

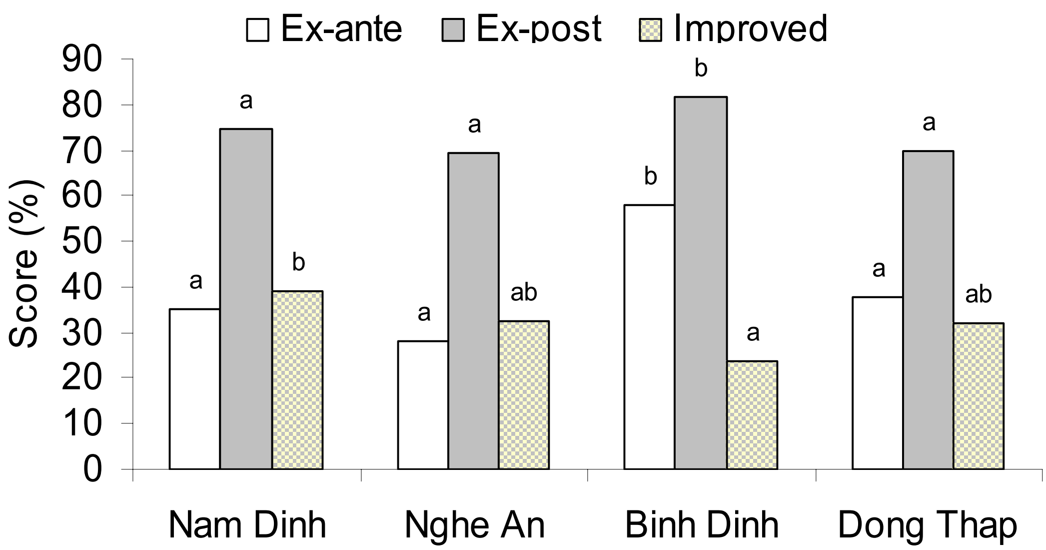


Fig. 5.2: Mean score (%) of the ex-ante, ex-post tests and improvement of farmers in 12 FSPSs in the four surveyed provinces.

Above columns within each group, province means with a same letter are not significantly different at 5% level

Increase in knowledge for different technical areas

The increase in mean scores between the ex-post and ex-ante tests averaged over 12 FSPSs was 30.9%. To depict knowledge improvement in different technical areas, Fig. 5.3 shows that farmer's knowledge at the ex-ante test was relatively low (around 38%) in the technical areas of plant protection (PP), seed selection (SS) and post harvest handling (PH), while scores of the area of cultural practice (CP) was highest (57.6%). On the ex-post test, farmers obtained much higher scores for the CP and PP areas than they did on the ex-ante test (more than 80%), while their final scores for other areas were around 74%.

The increase in score (as a measure of knowledge gain) was highest for seed selection (43.2%), and around 31% for the other technical areas. For the knowledge on cultural practices, the gain was little as many farmers already achieved high scores on the ex-ante test.

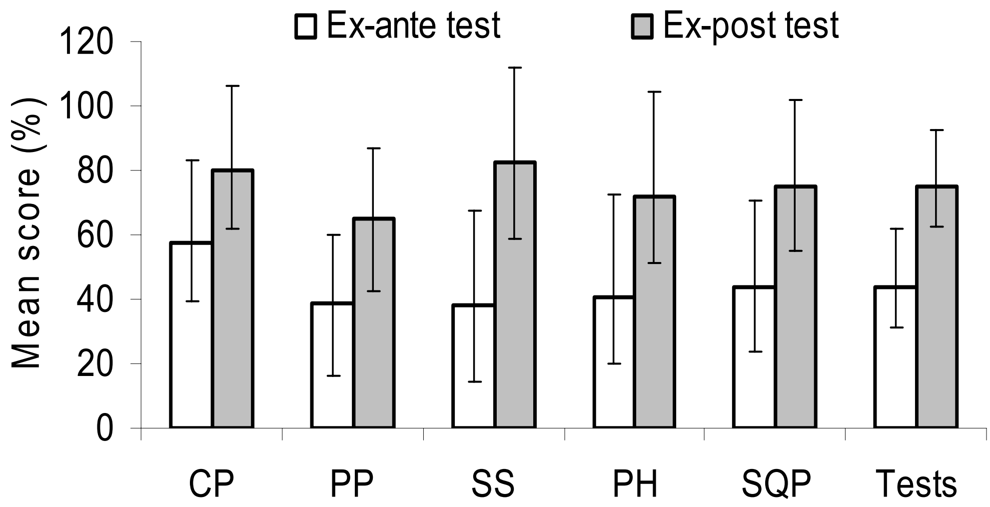


Fig. 5.3: Mean scores (%) obtained at the ex-ante and ex-post tests for each of the technical areas achieved by farmers in 12 FSPSs in the four surveyed provinces in Vietnam.
Error bars represent the standard error of the mean. n=129, statistically significant at p < 0.001. (CP: cultural practices, PP: plant protection, SS: seed selection, PH: post harvest, SQP: seed quality and planning).

Differences in increased knowledge for different ranges of ex-ante scores

Table 5.6 shows the large increases in scores when the ex-post test outcomes are compared with the ex-ante test results. For each category of farmers (categorized based on their score in the ex-ante test), the scores increased significantly between ex-ante and ex-post tests. However, there was a clear trend: the higher the score in the ex-ante test, the smaller the increase in the score. This result is relevant for further developing effective training programmes.

Table 5.6: Average absolute test scores (expressed in %) for the ex-ante and ex-post tests and their differences when farmers were tested who participated in 12 FSPSs in the four surveyed provinces in Vietnam. Scores are arranged on the basis of the score at the ex-ante test

Range of Ex-ante test scores	No. of farmers	Average score Ex-ante test	Average score Ex-post-test	Increase in score between two tests	t-value
s <20	13	14.2	69.5	55.4	12.39**
<20 s <30	38	24.7	73.8	49.1	44.99**
<30 s <40	42	33.4	69.7	36.3	42.44**
<40 s <50	48	43.7	71.5	27.8	54.67**
<50 s <60	24	53.7	77.8	24.2	24.49**
<60 s <70	35	63.0	79.8	16.8	42.82**
<70 s <80	9	73.8	84.9	11.1	05.94**
<80 s <90	10	81.2	87.6	6.4	05.06**

*** Significantly different at 1% level, based on t-test*

Correlations between social, economic and agronomic aspects and acquired knowledge

Simple correlation coefficients (Table 5.7) indicate relationships between the increase in knowledge of the FSPS-farmers and different social, economic and agronomic aspects. Women and men received similar mean scores on the tests and had similar increases in knowledge. The social factors age, education level, years in rice production, and number of attended training courses before the FSPS influenced the scores in the ex-post test. Similarly, some economic factors (i.e. small farm size, less income from rice and rice production for food only) affected the ex-post test scores.

Although these factors correlated significantly with the scores at the ex-post test, correlation coefficients were low. Consequently, some of these factors did not have a significant correlation with knowledge improvement. Table 5.7 shows a closely negative correlation (–0.759**) between the ex-ante test score and increase in knowledge. In addition, the increase in the ex-post test score correlated to high scores of the ex-ante test.

Table 5.7: Correlation coefficients between increase in scores or final ex-ante scores and social-economic and agronomic factors of farmers participated in 12 FSPSs in the four surveyed provinces in Vietnam

Variables	Increase in score	Ex-post test score
Ex-ante test score	−.759**	.350**
Gender [a]	.105	−.004
Age	.033	.202**
Education level [a]	−.003	.261**
Rice area	.117	−.140*
Purpose [a]	.022	−.204**
Planting method [a]	.276**	−.215**
Seed rates	−.251**	.169*
Used seed quality levels [a]	.200**	.040
Income from rice production	.081	−.212**
Time working on rice field	−.029	−.139*
No. of years experience in rice production	−.001	.184**
Training courses attended	−.127	.143*

*** Correlation is significant at the 0.01 level, * Correlation is significant at the 0.05 level (2-tailed).*
[a] *Variables were coded in section 5.2.5 of M&M*

Besides, correlations with some agronomic factors (i.e. planting methods, seed rates and seed quality levels) show that the farmers with transplanted rice crops had lower scores at the ex-post test than farmers with direct sowing method, but the farmers applied direct sowing method had higher increased scores from ex-post to ex-ante tests (0.276**). The factor seed rate was inversely correlated with the planting method factor. In addition, the significant correlation coefficient (0.200**) between increase in score and seed quality level implies that farmers who used high-quality seed showed better knowledge improvement than farmers who used farm saved seed.

5.4. DISCUSSION

5.4.1. Training principles and knowledge acquisition

In general, the FFS approach is based on the principles of non-formal education and IPM. It emphasizes guided learning by doing and empowers farmers to identify and solve their own problems (Braun et al. 2000; van de Fliert 2003). In our case, the FSPS approach also developed the principle of "learning by doing" by on-farm practices of seed production process. The farmers made their own materials to remember what they learned and saw: they made their own notes and drawings, they wrote their findings on paper, and they discussed their own ideas in small groups. The facilitators provided learning guidance and illustrated this with slides, pictures and data tables. In addition, all FSPS-farmers were provided with a technical guidebook at the last weekly meeting for reviewing practical topics and for further reference after training. By this principle, farmers acquired better technical knowledge through facilitated learning and practicing on-farm seed production (Fig. 5.2 and Fig. 5.3). This could accord with the remark that farmers' "knowledge is directly linked to cognition and is acquired and retained through a process of learning and experimentation" (Price 2001).

Fig. 5.3 presents details of the increase in farmer's knowledge for each technical area; the area of cultural practice (CP) already showed a high score at the ex-ante test. This could be because the majority of farmers are experienced in cultivation processes, but also due to technical sharing within the community or local extension activities. Largest improvements in scores between the ex-ante and ex-post tests scores were found in the seed selection area (SS). This could be an essential interest of farmer-seed producers on improving seed quality in seed production. Moreover, seed selection was also main area of the training program, and then farmers could be introduced and discussed more and better than other areas.

5.4.2. Factors influencing the acquisition of knowledge during Farmer Field Schools

Different people have different learning abilities. The learner might misinterpret some knowledge (Kiptot 2007). In this study, the FSPS-farmers acquired different knowledge levels during the FFS (Table 5.6). Those results imply that different factors could influence the acquisition of knowledge in learning. In order to understand the learning process Maarleveld and Dangbegnon (1999) developed a guiding framework by questions: who learns, what is learned, how is it learned, why is it learned and from whom. The FSPS-learning process took place through trainers and on-farm experimentation, observation and practices that were similar for all farmers but the increase of scores at the ex-post test differed among farmers. The increase in scores for seed selection (Fig. 5.3) shows that also the interest of the farmers in seed production and learning played a role. However, Pontius et al. (2000) show that learning in the technical domain alone may not lead to the desired change, since the learner may not be able to apply the knowledge. Farmers need to select technologies that both benefit them and contribute to overall food production, and they need to understand the issues affecting their livelihoods.

We did not analyze the role of the trainer (or facilitator). The results in Table 5.6, however, reflect that the trainers contributed importantly to the increase in knowledge. The number of years in rice production, the number of trainings attended and the age correlated with the scores at the ex-post test. This suggests that the training approach with on-farm trials and practices suited the farmers experienced in rice production. In addition, farmers who had been better educated acquired more knowledge. Cultural practices were relevant for the knowledge gained because farmers who applied the drum seeder for direct sowing with low seed rates (in Binh Dinh and Dong Thap) and farmers who used high-quality seed in the transplanting method (in Nam Dinh and

Nghe An) showed a larger increase in test scores than other farmers. The results in Table 5.6 imply that every body seemed to have learned. However, how farmers with different backgrounds can acquire equal knowledge at the end of the training should also be considered.

5.4.3. Applying ex-ante and ex-post tests in training farmers

The FSPSs applied the ex-ante and ex-post tests as the way to assess increase in farmers' knowledge at the training end. However, the tests could be used well as a tool to further bridge gaps in farmer's technical knowledge during the training. When the FFS training is implemented, and the ex-ante test is done to assess farmer's knowledge on the training contents, the facilitator can then adjust the training module by fine-tuning or preparing suitable topics or on-farm practices.

In a case of different knowledge levels at the ex-ante test, the facilitator can divide the farmers into different classes. Then, the result of the ex-ante test is a basic tool for improving knowledge and monitoring advance of the trainees. Farmers who received low scores at the ex-ante should be more concentrated in practice during training and receive more conceptual and explanatory support from their trainer. This will hopefully lead to an equal knowledge at the ex-post test.

5.6. CONCLUSIONS

The ex-ante and ex-post tests were simple and effective tool to assess advances in farmer's knowledge in the FSPSs in Vietnam. The results of the two tests show that there was an absolute increase of 30.9% points in the 12 FSPSs.

The FSPS-farmers with the lower scores (<20%) in the ex-ante test realized an enormous improvement of 55.4 % points in the ex-post test. There was a clear trend: the higher the score in the ex-ante test, the smaller the increase in the score.

Several demographic, economic and agronomic factors correlated with the increase of the scores in the ex-post test, but the gender factor did not.

Use of both the ex-ante and ex-post tests to evaluate the impact of FSPS programme was necessary: the ex-ante test can indicate gaps in knowledge of the training participants, and these tests were also a useful tool for the facilitators to choose the suitable techniques for training farmers. Moreover, if we do not have the ex-ante test at the beginning, proper impact assessment at the end of the training of farmers by the FFS approach would be impossible.

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CHAPTER 6

General discussion

General discussion

6.1. INTRODUCTION

Farm-saved seed has always been an important seed source for agricultural production in Vietnam. To enhance farmer's capacity in seed supply and production, the farmer seed production school training programme was conducted in seven provinces of Vietnam in the period 2003–2007. Chapters presented in this thesis describe data and findings from performance of on-farm experiments, training courses, and household surveys in four out of those seven provinces. Some impacts of farmer-based training in seed production in Vietnam were found in farmer's applications of newly acquired knowledge in rice and seed production in the surveyed provinces.

In this chapter, the importance of grain and seed of rice in agricultural production in Vietnam is analyzed. The main discussions focus on why the FSPSs were successful and on how to create links between formal and informal sectors to ensure local seed supply systems for sustainable agricultural production in Vietnam.

6.2. IMPORTANCE OF RICE

Rice for Future Generations will be the theme of the International Rice Congress – 2010 (IRRI 2009), because rice (*Oryza sativa*) is feeding more people than any other crop and it has done so for thousands of years. For more than 100 countries in the world "*Rice is life*". Rice is the staple food and it is also a simple and cheap food in Asia and many other countries where rice is widely cultivated (Vanichanont 2004).

Vietnam is a basically agricultural country, and its agricultural production land is about 9.4 million ha occupying 28% of the country's natural land. Agriculture contributes 27% of the Gross Domestic Product and 30% of the export value (GSO 2006). Rice is the most important food and cash crop for the Vietnamese farmers. Vietnam has a population of about 85 million and the majority of them live in the rural areas of the Red and Mekong River deltas. A large proportion of farmers only have small farms which they use for rice production, which yields only a low household income (Table 4.3); yet, 70% of the rural population depends on food production as the main source of income (Hai 2003). During the last two decades, rice production of Vietnam increased annually (Fig. 1.1), but nowadays there is an increased pressure to maintain high levels of rice production for consumption and export. This has resulted in intensive cropping and in high chemical inputs (including pesticides and inorganic fertilizers) on rice fields (Chi et al. 1999). This intensification could result in the use of unsustainable pest control strategies and could produce negative effects on the environment and the population. Therefore, Vietnam is also facing new challenges in economic development and environmental protection, management of natural resources toward sustainable agricultural development (Quyen et al. 1995).

Given the importance of rice in the food supply and the economic development of Vietnam, the government has invested considerably in the formal seed sector to enhance rice breeding programmes and quality seed production to supply for farmer's use. The Farmer Seed Production School (FSPS) training programme was designed to meet that objective. It stimulated the improvement of farmers' practices, adoption of improved suitable techniques and enhancement of public awareness in using good seeds for rice production (Table 4.6). With good seed and with new practices, the FSPS farmers gained better rice yields (Table 4.7). This achievement has contributed to the orientation in agricultural development projects of Vietnam in the future.

6.3. IMPORTANCE OF SEED IN AGRICULTURAL PRODUCTION

What is seed? Misra and Mew (1994) stated that the term "seed" connotes both immature and mature fertilized ovules. Rice seed generally refers to the whole fruit (caryopsis). Seed will refer specifically to mature ovules that contain an embryo, and rice seed will refer only to the rice grain. Seed, "*the germ of life*", has received worldwide attention due to global agricultural cooperation and the increasing need to develop good seed[1], resulting in high yielding food plants. Thus, seeds are today's treasure and hope for feeding future generations.

[1] The term "good seed" is used in this chapter to refer to good-quality seed produced by farmers but without formal certification. High-quality seed is used to refer to good seed that is also formally certified, including commercial certified and basic seed (i.e. good seed in the terminology used by Bishaw (2007)).

In agriculture, seed is probably the simplest input for arable cultivation, as it determines the potential production and thus the productivity of all other inputs (Hansen 1995). And then, introduction of new seeds (or varieties) is one part of total inputs. If the full benefits of new technology are not to be harnessed, it is absolutely necessary to apply large quantities of chemical fertilizers, pesticides and other inputs (Wilson 2000).

In Vietnam, the potential demand of rice seed, needed to plant all rice land area in the whole country, is about one million Mg year^{-1} (CPD 2008). That means seed is a critical and basic input for enhancing agricultural production and productivity. Therefore, a relevant question is to what extent the quality of seeds could affect crop production. Findings in Fig. 3.1 in Chapter 3 show that on average rice yields increased by 11 percent by using good seed and farmer's improved practices. This result was in line with some previous studies in Vietnam, Philippines and Bangladesh, which showed that the use of good quality seeds can increase rice yield by 8–15%, and good-quality seeds assure good crop establishment at low seeding rates, minimize weed contamination, lessen insect pest and disease incidence, result in good grain filling, and lead to high grain yields, especially in direct-seeded rice (Hossain et al. 2002; Suong and Cuc 2008; Balasubramanian 1999). On the other hand, Chapter 3 shows some important findings. When good-quality seed is used, it could promote application of suitable practices such as adjustment of planting densities, low seed rates, balance of fertilizer applications and using row seeders for directly sowing. Using good seeds could be associated with applying improved practices thus increasing rice yields by 0.68-0.93 Mg ha^{-1} (Table 4.7) and generating an increase in profit of 212 UD$ ha^{-1} (Fig. 3.3) compared with using farm saved seed and applying traditional practices in rice production in the surveyed provinces in Vietnam.

6.4. ROLE OF FARMERS IN AGRICULTURAL CHANGE

Farmers are key actors in plant genetic resource development and conservation. Chapter 2 shows how farmers diversified their rice varieties and the rate of the different varieties adopted through evaluating their use in various farming systems of four surveyed villages (Table 2.4). Chapter 2 also showed that selection criteria such as high yield, short growth cycle and adaptation to local cultivation practices were more important than other characteristics (Table 2.3). In addition, seed diffusion through sharing and exchanges in communities (Table 4.10) has contributed significantly to food security and diversification of plant genetic resources in agricultural production in the surveyed provinces. Jarvis and Hodgkin (1999) stated that in the process of planting, managing, harvesting, and processing their crops, farmers make decisions that affect the genetic diversity of the crop populations. While improving their crops farmers often prefer agro-morphological characteristics that reflect adaptation to local conditions and meet market demands. Then, they make decisions on suitable practices and the acreage to be planted with each crop variety in each cropping. The amount of seed to be saved for re-use and to be bought or exchanged from other sources can affect the genetic diversity of cultivars in farming systems.

Currently, seed security is becoming more critical to human survival, and is a major concern of most developing countries (Larinde 1997). Indeed, the farmer seed production training programme of this study is all about seed security. Using good rice seed that was produced by farmers (seed clubs) increased grain yields and could improve household's income (Fig. 3.3) and contributed to food security for rice-farmers through sharing improved practices and good seeds amongst farmers in surveyed villages (Table 4.10). Normally, places where seed insecurity can be seen as part of food insecurity (Bishaw and Turner 1998), farmer's production can not meet the family food requirement reflecting the socio-economic condition of farmers.

Development of cultural practices, indigenous knowledge and farmer-oriented technologies are also an important source of the location-specific technological domain and need to be properly utilized (De 2006). The local practices in rice production in the surveyed provinces are still valid; yet results in Table 4.6 and 4.7 indicate that farmers could adjust and improve themselves by adopting better cultural practices given the local conditions to obtain higher yield stability.

6.5. IMPACTS FROM FARMER SEED PRODUCTION SCHOOLS

Farm-saved seed constitutes about 80% of the rice seed planted in Vietnam every season and this will probably be the case for many years to come. This seed is often of undesirable quality resulting in low yield and high incidence of diseases (SC8 2007). In order to assist farmers to become better seed producers, the Farm-saved seed project trained a large number of farmers in seven provinces in Vietnam. An impact assessment was conducted. In this part of the general discussion, some issues arising from that study are discussed.

Why were the Farmer Seed Production Schools successful in Vietnam?

In general, in many developing countries, the formal seed industry arrangements cater for less than 10% of the seed needs of the farmers. The most important reason given for this is the fact that seed programmes have concentrated on major food and cash crops which are considered national priorities (Larinde 1997). This also relates to Vietnam where rice is a main food crop. However, Vietnam's agriculture is still weak in terms of low productivity, poor rice quality, poor competitiveness in the market and low level of technology in agriculture (PEM 2005). The FSPS training programme, then, could meet the growing demands in improving the quality of farm-saved seed system. Thus, the programme expanded quickly in the number of provinces in Vietnam involved and in the participation of farmers.

Besides, it is generally recognized that a major challenge for the agricultural extension system is how to develop extension services into a more efficient, farmer-oriented and demand-driven undertaking. In the report of PEM (2005), it is also mentioned that in order to facilitate proper integration and cost-efficiency, a much more demand-driven, and decentralized approach to agricultural service provision is needed. This should result in changes in both institutional set-up and in mandates of agricultural services at province, district and commune levels.

The limited capacity and budget may be major constraints for the extension programme in Vietnam. Annual budget for agricultural extension mainly came from provincial governments, for example the budget of 21 provinces/cities in 2001 was about 1.6 million USD of which 14 percent came from the central government budget under national targeted programmes (De 2006). Thus, this training programme was an additional opportunity to enhance capacity for local institutions and farmers in seed production and extension activities.

The above-mentioned could be important reasons why the Farmer Seed Production School training programme was successful in Vietnam.

What were the effects of the Farmer Seed Production Schools?

Enhancing farmer's technical knowledge and extension approach: It is clear that the trained farmers acquired and improved greatly their technical knowledge on seed production throughout the FSPS. This implies that farmers have technical creative potential when they are given suitable opportunities to test. The principle of learning by doing in association with on-farm practices of the seed production process could help farmers to make decisions with new ideas/practices and to remember what they shared and learnt. This principle could accord with the remark that farmer's knowledge is directly linked to cognition and is acquired and retained through a process of learning and experimenting (Price 2001). Results in Fig. 5.2 and Fig. 5.3 also indicated improvement of farmer's knowledge during the FSPS as affected by the farmer field school approach of the FSPS training programme. This approach has strongly influenced the agricultural extension programme in Vietnam. Moreover, agricultural extension has been based on adult education, communication science, community development, rural development and international development, and has strong linkages with agriculture research and practices. Agricultural extension, thus, has become a public service for human resource development in the agri-food sector, including farmers, and its approaches vary greatly, from the traditional transfer-of-technology approach to the more modern Training-and-Visit System (Godtland et al. 2004), and now shift to the farmer field school (FFS) approach as an innovative training model in which farmers gain the capacity to make their own decision regarding integrated pest management (Rahadi and Widagdo 2002) or seed production technology (this thesis). Innovative approaches also include participatory approaches in integrated rural development, combining scientific knowledge with indigenous or local knowledge, moving from subsistence farming to entrepreneurship, including ideas of a multi-function agriculture (Karbasioum et al. 2007).

Regarding changes in seed production knowledge of the farmers: the trained farmers adopted improved practices in seed production after the FSPS. Focusing on the process of change, it is difficult to measure impact, but at farm level it is important in the Vietnam context. In Tables 4.6 and 4.7 it is shown that there was a shift from traditional practices to improved practices. The change in awareness could be the result of a process of learning by doing and on-farm practices of seed production. It is concluded that change in farmer's awareness through learning in the technical domain alone may not lead to the desired change, since the learner may not be able to apply the knowledge (Pontius et al. 2000).

Moreover, a relatively high rate of adoption by farmers who did not attend the FSPS also indicates a strong influence from the training programme. However, how could the FSPS be applied successfully? Results in Table 4.6 and Fig. 4.1 showed the high rate of adoption of improved practices. FSPS-farmers could influence directly friends and relatives who did not attend the FSPS by on-farm guidance or communication. A way of farmer-to-farmer diffusion of improved practice was observed (Table 4.10). On the other hand, farmer's confidence was improved using new means such as demonstration plots and farmer's field days at the FSPSs. Rogers (1995) stated that the rate of adoption is the relative speed with which an innovation is adopted by numbers of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period, such as a year. Rate of adoption is explained by:

1) Perceived attributes of innovations;
2) Type of innovation-decision;
3) Communication channels;
4) Nature of the social system;
5) Extent of change agents' promotion efforts.

We have not yet had the opportunity to evaluate the effectiveness of all FSPSs in adopting improved crop management practices or to assess the effect on local seed production and supply, but findings also expose a chain of impacts in the surveyed provinces (Fig. 6.1) and local seed policy on farm-saved seed system. The training programme was welcomed at the surveyed sites. The FSPS was planned by the authorities as a locally main agricultural development programme. This was a good opportunity to strengthen the farm-saved seed system. Currently, the establishment of seed clubs after seed production training courses is basic to produce and supply seeds in the locals. Hence, some national and local seed policies were issued of which the Decision 35/BNN (2008) on management of farm-saved seed production has had an important effect on the development and existence of the farm-saved seed system in Vietnam.

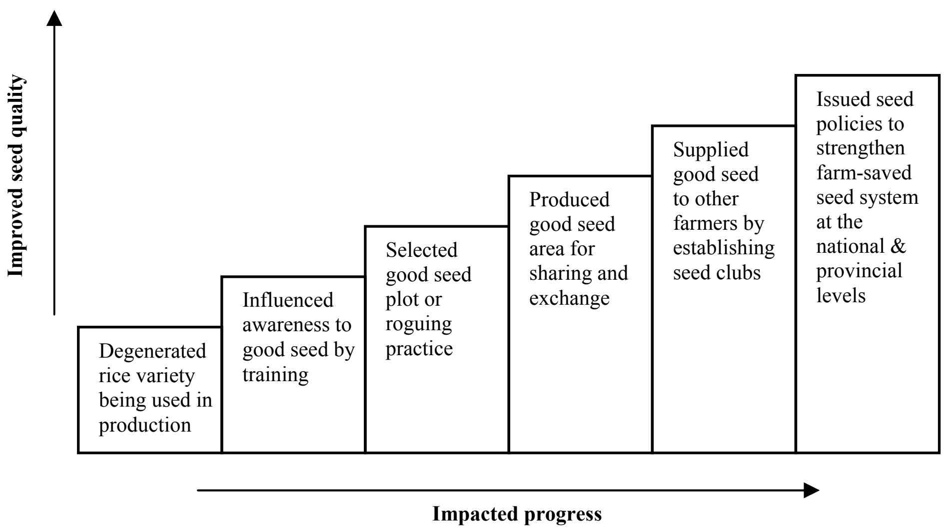

Fig. 6.1: Steps of impact from FSPS in improving quality of farm saved seed production in Vietnam

6.6. OUTLOOK FOR LINKAGE OF LOCAL SEED SYSTEMS

Good-quality seeds are not always available to the farmers in the remote areas in Vietnam. The formal seed sector has been challenged in meeting the households' demands for good seed. The farm-saved seed is widely recognized as a main seed supply source to meet the seed needs of rice-growers. To enhance the local seed supply systems in Vietnam, a linkage between the formal and informal (farm-saved seed) systems is discussed.

The end of farm-saved seed?

While trying to answer this question, Almekinders et al. (1994) affirmed that all other seed and planting materials are produced by farmers. This important seed source for local, as well as improved cultivars has been largely ignored by breeders and technologists. This also seems to apply to the Vietnam's agriculture where the farm-saved seed system exists and still has an important role to play in the seed supply. It may still be relevant because:

1. Rice is self-pollinating, so farmers can do their own breeding, and can select good seed plots and rehabilitate degenerated varieties for re-use;
2. Exchange of seeds in the communities is still popular;
3. Seeds are available within the community and seed production has low input costs; and
4. Farmers can use grains for seed when the original seed source is lost by disaster or pests.

Moreover, the existence of the informal seed system depends on culture and belief of the local people; some varieties are main materials for the offer. In addition, some rice varieties are indicator plants of particular soils, and these varieties are difficult to be replaced by new ones.

Although the informal seed system is an important seed source in agriculture, it has been faced with mechanisms to limit this seed supply system. GRAIN (2007) noticed that the Plant Variety Protection (PVP) System has been enhanced by the International Union for the Protection of New Varieties of Plants (UPOV). When the new PVP system is issued and can be applied widely, probably it will influence the farm-saved seed production system and restrict free access to PVP-protected material for plant breeding.

In Vietnam, the PVP was considered and applied since 1995 (Minh 2006) to protect plant varieties. Some disadvantages may affect the farmers:

1) The price of a variety may be higher due to royalties; and

2) Exchange or propagation of the protected varieties for exploitation will be not free.

Rice is the main food crop of the Vietnamese people, thus the Ministry of

Agriculture and Rural Development has limited the application of PVP for rice. This facilitates farmer's free access of rice seed in Vietnam, and benefits particularly the farm-saved seed system. Moreover, farm-saved seed networks are rising in the Mekong River delta and some other provinces in Vietnam through "seed clubs". These networks have self-enhanced their existence and facilitated access to good seeds and new varieties for farmers in the rural areas.

How to link formal and informal seed systems?

Local seed systems could be rational and dynamic, and have a high level of flexibility in meeting the demands of farmers. However, the relative pace of the linking processes in local seed systems can also form a constraint with regard to sustainability of the system (Almekinders et al. 1994). Hence, to link local seed systems, three components may be considered, i.e. the technological component, the economic component and the legal/policy component.

The technical component

The technical component often implies suitable technologies in seed production and selection that is applied by the formal seed sector. The formal plant breeding has been beneficial to farmers who either enjoy favourable environments, or could profitably modify their environment to suit new cultivars. However, many new varieties are released, but not many varieties are grown (Ceccarelli et al. 2007). Nowadays, plant breeding has expanded to participation of farmers in developing countries including Vietnam.

In the practice of Vietnam, both seed systems are linked while the market-oriented seed production systems are essential to widen farmers' access to good seeds for producing high-quality products that can meet market-demands. Although these seed systems vary in steps taken in the seed production process, linking the farm-saved (informal) and public (formal) sees systems will create a participatory co-operation in seed production, improve seed quality of the informal system, establish a wide seed supply network and will create a better local seed system governance.

Besides, it is necessary to have participatory orientation from the formal sector where activities on seed production and selection at community level will be prior (Fig. 6.2). The plant breeders will assist and work with farmers to strengthen them in technical knowledge and skills. Farmer's access to research activities in seed selection/evaluation and production at the local research institutions/ stations should be welcomed.

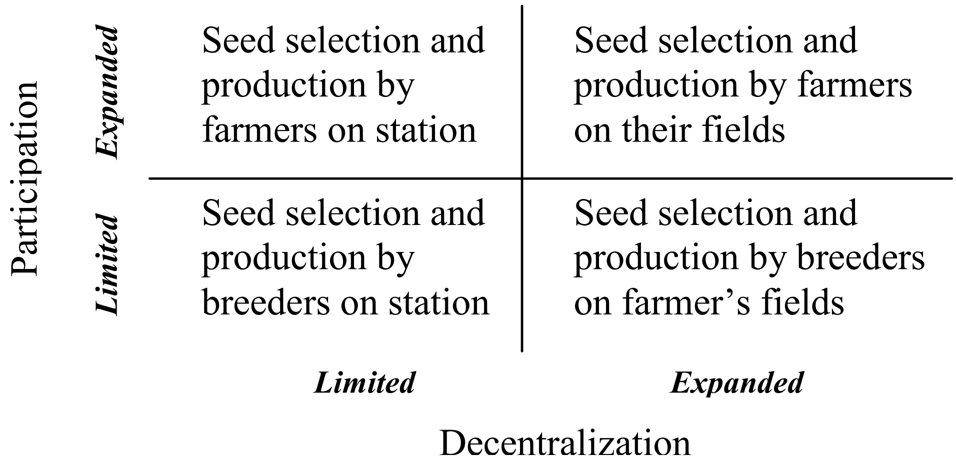

Fig. 6. 2: Participation and decentralization in linkage of seed production and selection

The economic component

The economic component includes seed production and marketing: formal and informal seed systems often give different meanings to the term seed quality. A key element of the formal seed system is a clear distinction between seed and grain (Louwaars 1994) while distinction amongst grain and seed is less defined in the informal system. The formal seed system in Vietnam applies better technologies than the farm-saved seed in seed production such as variety selection, seed production plots, seed processing means, package, storage, quality control, certification and distribution/marketing. Thus, its seed prices usually are much higher than those in the informal seed system. This could limit farmer's access to good seeds, especially for those farmers who need large amounts of seed, such as the farmers in Tan Hoi Trung - Dong Thap (Table 4.2). Therefore, the linkage of both seed systems is necessary to strengthen the informal seed system through related projects and seed policies to seed production. Then, seed prices of good seeds will be adjusted and more reasonable.

The seed policy component

A seed policy component is needed for governing the seed sectors. Bishaw (2004) reported that the key policy objectives are to build a sustainable national seed industry by establishing efficient and effective seed production and supply systems through the participation of public and private sectors, and to improve institutional linkages and appropriate regulatory oversight. Thus, seed policies in practice may be inadequate for the informal seed system and may completely ignore the farmers' contribution in sustaining genetic diversity and their capacity as plant breeders and quality seed producers (SEARICE 2007). Currently, the mechanisms to link local seed supply systems have been improved in Vietnam. The seed policies mentioned farm-saved seed for the first time in 1996 in the Decree-07 (1996) and in the OPV (2004)[2]. These policies stipulated terms to facilitate and encourage participation of all individuals and stakeholders in seed selection, seed production and plant genetic resource conservation activities. Lastly, the Decision-35 (2008) issued by the Ministry of Agriculture and Rural Development on farm-saved seed management is important. It is detailed in guidance and support for individual farmers and seed clubs in seed selection and production. This is considered as a basis and stimulation for linking local seed systems. However, any policy aimed to ensure local seed security should take into account factors that can affect seed supply systems by asking some of the following questions (Larinde 1997):

1. How can formal and informal seed supply systems be made to function in a complementary fashion?
2. What categories of farmers should be considered?
3. What are the constraints?
4. What level of technical know-how do farmers require?
5. How is this to be provided?
6. By whom?

In our study, Fig. 4.2 could account for almost all above questions whereas provincial support from the Department of Agriculture and Rural Development (DARD) and co-operation from seed clubs will be important for suitable development

[2] Ordinance of Plant Varieties

of local seed systems.

In summary

There is increasing awareness that the different seed systems need to be linked (van Amstel 1995) because the formal system may not be able to solve the problem of availability of quality seed. In a broad effort to modernize agriculture, many governments realize that the formal system depends on the potential of the traditional and informal seed systems of which are well adapted to the local seed requirements for annual food crops produced under variable conditions. Moreover, the informal seed system relies on simple technology, low costs and can provide seed at low prices.

To develop local seed systems, the current informal seed systems need to be strengthened, and linked with formal seed sector whereas the formal seed system also needs to be linked to the local seed supply systems in order to function optimally. Therefore, the linkage of seed systems requires technological adaptations for farm-saved seed production, a flexible seed legislation and regulation, and suitable institutional capacity. Farmers should be recognized as essential and active partners in seed system development.

The way ahead

In general, the seed company is usually versus the farm-saved seed system, but the governmental seed sector should be cooperative and strengthen informal seed systems to ensure local seed systems. In Vietnam, the initial achievements from FSPS in seed production and supply flow "farmer-to-farmer" in the surveyed provinces indicated a positive way to develop. In addition, results of establishing a seed club network of more than 325 seed clubs in the Mekong delta (Tin 2008) has contributed significantly to farmer's seed demands. Improved seed production will have a good effect on quality, not only of farm saved and locally shared seed, but also of the seed which is supplied by the formal sector which sub-contracts a large amount of their raw materials supply to farmers. Consequently, the "socialization of seed supply and production" has been an active strategy for enhancing farm-saved seed system where *seed clubs are considered similar to formal seed production farms*. It is recommended to extend this model in Vietnam and to use the expenses from provincial public budgets for training of farmers and supporting them in buying seed processing tools. This approach would be more profitable than investing in buying lands and substructures for new seed farms. The linkage between the formal and informal seed systems not only promotes an integrated ability of both formal and informal systems in seed production, but also creates a much better supply to deal with small rice-farmer's seed needs in Vietnam.

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Summary

This summary provides descriptions and analyses on the status of rice production and seed systems in Vietnam, the applied cultural practices (local and improved) in farm-saved seed production, and the impacts of Farmer Seed Production Schools (FSPSs); finally it evaluates the increase in farmers' knowledge as a result of the training programme in Vietnam.

Introduction

Vietnam is located in South East Asia where the climate is of the tropical monsoon type with hot weather and high humidity throughout the year. The population is dense in the rural areas of the Red River delta in the north, the Mekong River delta in the south, and the small rice land areas in the central coastland of Vietnam. Most Vietnamese depend on agricultural production, the main economic activity contributing considerably to the GDP through export earnings. Since 2000, agricultural land area has been in the decline because of industrial development, housing, infrastructure, recreation and other land uses. However, it is expected that food crop production (mainly rice) will be maintained at a very high level of production (more than 35 million tonnes) to ensure food security and to allow for export.

In Vietnam, rice is not only the most important food crop; it is also the main source for the household's income and the basis for agricultural development, much more so than other crops. However, farmers who produce rice grain and seed face problems as they use poor-quality seeds, inadequate cultural practices and unnecessarily high inputs (Chapter 1). They therefore obtain unstable yields and low income. This has led the Vietnamese Government to invest considerably in the formal seed sector. Nevertheless, this formal seed system currently meets less than 10% of the households' total seed requirements. This system certainly does not provide enough high-quality seed while seed demands are high. Hence, the farm-saved seed system still plays an important role in the seed security for rice production in Vietnam. The Vietnamese government issued seed policies to strengthen the farm-saved seed

production system, but to further improve seed quality finding a suitable approach and adequate funding could be main limiting factors. Therefore a training programme for farmer seed production schools (FSPSs) was started in seven provinces in Vietnam in the period 2003-2007. This programme trained many farmers and had significant positive effects. The impacts of this training programme are described.

Status of local practices in rice production

Chapter 2 describes a study based on 429 on-farm demonstration plots with local practices applied in farm-saved seed production and 240 interviewed households in Nam Dinh, Nghe An, Binh Dinh and Dong Thap provinces of Vietnam. This study shows that rice was mainly grown for home consumption but to some extent also for other purposes. Especially the farmers with large areas of arable land grew rice for market outlets (e.g. in the Dong Thap province). Almost all rice growers interviewed were interested in high yield, quality traits and they all preferred rice varieties with a short growth cycle. Rice varieties were adapted to specific cropping seasons, but the variety KD18 was dominant in the Nghe An and Nam Dinh provinces in both seasons. This specific adaptation led almost all farmers to use the same variety and reduced the genetic diversity in agricultural production.

In addition, farmers appeared to cultivate their rice crops in a traditional way, investing more than 40% of the total input costs in fertilizers and pesticides; nevertheless the rice yield potential was 6.04 Mg ha^{-1} in the dry season and was 1.01 Mg ha^{-1} higher than in the wet season throughout the provinces evaluated. Averaged profit in both seasons was about 363 US$ ha^{-1} when the grain price was 0.151 US$ kg^{-1}.

To increase the yield potential, it is necessary to increase the amount of K fertilizer applied (especially in Dong Thap), to adjust seed rates at all research sites, to reduce N-fertilizer rate and to increase the rate of muck application in Nghe An. A good market price is the most important factor for getting high profit for the rice growers in Vietnam.

Comparison of local and improved practices used in farm-saved seed

Results from a large number of on-farm experiments, including a local practice plot and an improved practice plot, were reported in Chapter 3. These demonstration trials were conducted at the FSPSs in Nam Dinh, Nghe An, Binh Dinh and Dong Thap provinces of Vietnam in 2004 including wet and dry seasons. Farmer's improved practices (reduced seed rates, balanced fertilizer amounts and adjusted planting densities) were compared to the local practices on the basis of yield potential and profit for both transplanted and directly sown crops. Results showed that the farm-saved seed system in four surveyed provinces supplied about 90% of farmers' seed needs. The on-farm experimental plots exposed to improved practices showed increases in grain yields of 8.5% during the wet season and of 13.6% during the dry season averaged across four provinces. Especially planting fewer seedlings per hill and more plants per square meter in the transplanted crop proved to be important. With high yields and sale prices, lower seed rates and lower fertilizers-pesticides input costs in the improved practice plots resulted in a better profit (by 212 UD$ ha^{-1}) than the local practice plots. As farmers were reluctant to make certain changes, on-farm demonstrations could have impacts on the diffusion of improved practices in communities.

Impacts of farmer seed production schools

The Farm-Saved Seed Project set up a training programme involving so-called "farmer seed production schools (FSPSs)" in seven provinces in Vietnam during the period 2003–2007, with more than 40,000 farmers being trained. For impact assessment of the FSPS programme, four villages were selected: Yen Phuong in Nam Dinh province and Dong Thanh in Nghe An province (where the transplanting method of crop establishment is applied) and Phuoc Thuan in Binh Dinh province and Tan Hoi Trung in Dong Thap province (where crops are directly sown). In those four villages in total 240 households were interviewed, 30 FSPS-farmers and 30 non-FSPS farmers per village. Data were gathered to analyse the adoption of improved practices in seed production and the diffusion of acquired knowledge in the farmers' communities after training.

Chapter 4 shows that household's actual seed demand varied from about 19 till 26 kg year^{-1} for transplanted crops and from 114 till 548 kg year^{-1} for directly sown crops. Rice was the farmers' main source of income in Tan Hoi Trung (accounting for 75% of the total income) whereas less than 37% of the total income came from rice production in the other villages. After training, 59% of the FSPS-farmers used high-quality seeds and 41% became rice seed producers. Almost all FSPS-farmers applied roguing to maintain seed quality and applied reduced seed rates (by 49% for the transplanted crop and by 30% for the directly sown crop). Most of the FSPS-farmers adopted the practice of planting only one seedling per hill in the transplanted crops in Yen Phuong and Dong Thanh, whereas 30% of the farmers adopted the use of drum seeders in the directly sown crops in Phuoc Thuan and Tan Hoi Trung. However, yields and profits were not statistically significantly different between FSPS and non-FSPS farmers. However, grain yields of FSPS and non-FSPS farmers differed significantly with the local practice plots (as control). That could be accounted for by the strong impact from the project: the majority of non-FSPS farmer used better seed, and more than 72% of the respondents learned and applied the improved practices from neighbouring FSPS farmers. For the further development of farm-saved seed supply and production in Vietnam, the seed club could be an effective model.

Increase of farmers' knowledge through FSPS

In Chapter 5, ex-ante and ex-post tests with 25 questions were carried out at 12 FSPSs (three FSPSs in each of the provinces Nam Dinh, Nghe An, Binh Dinh and Dong Thap), with in total 219 farmers, to evaluate the increase in farmers' knowledge. Findings show that women and men did not differ in mean scores in the tests and also had similar increases in knowledge as shown by the ex-post test. But FSPS-farmers with low scores in the pre field-school test scored much better in the post field-school test, especially those farmers who scored less than 30% in the ex-ante test. Improvement in farmers' knowledge differed for the various technical areas for which farmers were tested. The largest increase in knowledge was obtained for seed selection. Use of ex-ante and ex-post tests was useful tool to evaluate the impact of the FSPS training programme. The ex-ante test can indicate gaps in knowledge of participants and then the facilitators can choose the best possible techniques to train farmers.

Synthesis

An overview on importance of rice and rice seed is presented in Chapter 6. *Rice is life* was the theme of the International Rice Year in 2004, and *Rice for Future Generation* will be the theme of the International Rice Congress to be held in 2010. These themes illustrate that rice is the important food source in the world. Moreover, seeds are today's treasure and hope to feed future generations because for many agricultural countries, seed is the simplest input to improve arable farming, as it determines potential production.

In Vietnam, rice is the main food crop and it contributes to household income and the national GDP through export value. To plant all rice land areas in the whole country, the potential seed demand needed is about one million Mg year^{-1}, for which the informal seed system is the main supply source. Some studies report that using good seeds can increase grain yields considerably. Hence, improving seed quality and strengthening the capacity to produce good-quality farm-saved seed is an important strategy in Vietnam. Results of the farmer seed production school training programme showed positive effects on farmer's seed production potential and on applications of improved practices. We also discussed the possible effects of the FSPS. Why were the FSPSs successful in Vietnam? and how could they link with the local seed systems to ensure seed supply?

First of all, to support and develop the production system of farm-saved seed in Vietnam, the formal seed sector should expand a participatory strategy. Then, through a linkage of the formal and the informal seed systems, a sustainable seed supply system can be created based on formal seed farms and informal seed clubs.

The study combined data and information from on-farm demonstration plots (comparing local and improved practices), household surveys, FSPS-tests and laboratory analysis to provide better knowledge on the role of seed systems and seed policies to ensure the local seed supply through impact assessment of the farmer seed production school training programme in Vietnam.

Concluding remarks

This study selected four provinces and four villages (one village per provinces) for impact assessment. It could therefore not be completely representative of all effects of the project. However, both FSPS and non-FSPS farmers applied improved practices, used better seeds and produced and supplied seeds to other farmers in the four surveyed villages. We believe that the project had greater impact in the more favourable cultivation areas.

In an agricultural country like Vietnam, the education of farmers may be one of the most effective ways for agricultural development. The expectation that the FSPS programme would help the trained farmers to retain acquired knowledge and technical skills and to apply this knowledge in seed production was met in the subsample on which this thesis is based.

Thus, the FSPS's impacts have been observed, acknowledged and applied by farmers, not just by the researchers.

Samenvatting

Deze samenvatting geeft beschrijvingen en analyses van de rijstproductie en zaaizaadsystemen in Vietnam, de teeltmaatregelen die lokaal worden toegepast in de productie van zaaizaad op het eigen bedrijf en de verbeteringen daarin, en de invloed van de Farmer Seed Production Schools (FSPSs; onderricht aan boeren in zaaizaadproductie); deze samenvatting geeft ten slotte een evaluatie van de toename in kennis van de boeren als gevolg van dit trainingsprogramma in Vietnam.

Inleiding

Vietnam ligt in Zuid-Oost Azië. Het klimaat is er tropisch en heeft een moessonkarakter. Het is er daarom gedurende het gehele jaar heet en vochtig. De bevolkingsdichtheid in de rurale gebieden van de Red River Delta (in het noorden), de Mekong Delta (in het zuiden) en in de rijstgebieden in het centrale kustgebied van Vietnam is hoog. De meeste Vietnamezen zijn afhankelijk van de landbouw, de belangrijkste economische activiteit die ook aanzienlijk bijdraagt aan het bruto nationaal product en aan de export. Sinds 2000 neemt het landbouwareaal echter af, als gevolg van industriële ontwikkeling, huizenbouw, aanleg van infrastructuur, recreatie en andere vormen van landgebruik. Het ligt echter in de lijn van de verwachting dat de voedselproductie (en vooral die van rijst) hoog zal blijven (meer dan 35 miljoen ton) om de voedselvoorziening te verzekeren en export van voedsel mogelijk te maken.

Rijst is niet alleen het belangrijkste voedselgewas in Vietnam, het is ook de belangrijkste bron van inkomsten en de basis van de ontwikkeling van de landbouw, veel meer dan enig ander gewas. De boeren die rijst voor voedsel of voor zaaizaad verbouwen ondervinden grote problemen, omdat ze veelal zaaizaad van slechte kwaliteit gebruiken, niet de juiste teelttechniek toepassen en onnodig veel hulpbronnen gebruiken (Hoofdstuk 1). Hun opbrengsten en inkomens zijn daarom instabiel. Daarom heeft de Vietnamese overheid besloten stevig te investeren in de formele zaaizaadsector. De formele zaaizaadsector voorziet echter op dit moment slechts in 10% van de totale zaaizaadbehoefte. Het systeem verschaft zeker niet genoeg zaaizaad van hoge kwaliteit terwijl de vraag daar naar groot is. Daarom speelt de informele sector (het boerenzaaizaad) nog steeds een hoofdrol in de zaaizaadvoorziening in de rijstteelt in Vietnam. De Vietnamese overheid vaardigde zaaizaadbeleid uit om de productie van boerenzaaizaad te verhogen, maar voor het verder bevorderen van de zaaizaadkwaliteit is het lastig de juiste benadering en voldoende fondsen te vinden. Daarom werd in zeven provincies van Vietnam in de periode 2003–2007 een trainingsprogramma opgezet volgens het model van de Farmer Seed Production Schools. Dit programma voorzag in het scholen van vele boeren en had belangwekkende positieve effecten. De invloed van dit trainingsprogramma wordt in detail beschreven.

Status van lokale teeltpraktijken in de rijstteelt

Hoofdstuk 2 beschrijft een studie die is gebaseerd op 429 demonstratievelden op boerderijen met lokale teeltmaatregelen zoals die worden toegepast in de productie van boerenzaaizaad en op interviews van 240 huishoudens in de Vietnamese provincies Nam Dinh, Nghe An, Binh Dinh en Dong Thap. Deze studie laat zien dat rijst vooral voor de eigen consumptie wordt geteeld maar dat er ook andere teeltdoelen zijn. Vooral de boeren met grote teeltoppervlakten verbouwden rijst voor de markt (bijvoorbeeld in Dong Thap). Bijna alle geïnterviewde rijstboeren stelden belang in hoge opbrengst en in kwaliteit; ze prefereerden ook allen vroege rassen. De rijstrassen waren aangepast aan de specifieke teeltseizoenen, maar het ras KD18 was in zowel het natte als het droge seizoen dominant in Nghe An en Nam Dingh. Deze specifieke adaptatie resulteerde er in dat bijna alle boeren hetzelfde ras teelden waardoor de genetische diversiteit in de landbouw sterk afnam.

Boeren bleken bovendien hun gewassen op traditionele wijze te verbouwen. Ze investeerden meer dan 40% van de totale kosten van hulpbronnen in meststoffen en pesticiden; desondanks werd in het droge seizoen een opbrengst van 6.04 Mg ha^{-1} gehaald, 1.01 Mg ha^{-1} meer dan in het natte seizoen over alle onderzochte provincies. Bij een prijs van 0.151 US$ per kilo rijst was het gemiddelde saldo ongeveer 365 US$ ha^{-1}.

Om opbrengst te verhogen moet meer K bemesting gegeven worden (vooral in Dong Thap), moeten de zaaidichtheden in alle onderzochte provincies worden aangepast, moeten de hoeveelheden N bemesting worden verlaagd en dient de hoeveelheid toegediende organische, natte mest in Nghe An te worden verhoogd. Voor een hoog saldo is een hoge marktprijs voor de rijsttelers in Vietnam de belangrijkste factor.

Vergelijking tussen lokale en verbeterde teelttechnieken in de teelt van boeren-zaaizaad

In Hoofdstuk 3 worden de resultaten weergegeven van een groot aantal proeven op het boerenbedrijf, waarin steeds een veld met lokale praktijk en een veld met verbeterde technieken werden vergeleken. Deze demonstratievelden werden aangelegd op FSPSs in de Vietnamese provincies Nam Dinh, Nghe An, Binh Dinh en Dong Thap. De experimenten vonden plaats in 2004, zowel in het natte als in het droge seizoen. De verbeterde teelttechnieken hielden in minder zaaizaad, een gebalanceerde toediening van meststoffen en aangepaste plantdichtheden. Hun gezamenlijke effecten werden vergeleken met die van de lokale praktijk op basis van opbrengstpotentie en saldo, zowel bij gewassen die tot stand kwamen door transplanten als bij gewassen die direct gezaaid werden. In de vier provincies waarvoor gegevens bekend zijn, was ongeveer 90% van het zaaizaad afkomstig van de eigen zaadteelt. Gemiddeld over de vier provincies leverde de verbeterde teelttechniek in de demonstratieproeven in het natte seizoen ongeveer 8.5% meer korrelopbrengst op. In het droge seizoen was dat verschil 13.5%. Vooral het poten van minder zaailingen per plantplaats en het verhogen van het aantal planten per vierkante meter bleken belangrijk in de geplante gewassen. Bij hoge opbrengsten en verkoopprijzen leverden de veldjes met een verbeterde teeltechniek vanwege lagere zaaizaadhoeveelheden en minder input van mest en pesticiden 212 US$ ha^{-1} meer op dan de veldjes met lokale teelttechniek. Omdat boeren aarzelden met het toepassen van vernieuwingen konden de demonstratievelden een belangrijke rol spelen bij het verspreiden van verbeterde technieken.

Invloed van de Farmer Seed Production Schools

Het project met de titel Farm-Saved Seed startte een trainingsprogramma op waarin boeren in "farmer seed production schools" (FSPSs) werden opgeleid. Het programma voltrok zich in zeven Vietnamese provincies in de jaren 2003−2007. Meer dan 40,000 boeren werden op deze wijze getraind. Vier dorpen werden geselecteerd om het effect van het programma vast te stellen. Dat waren Yen Phuong in de provincie Nam Dinh en Dong Thanh in de provincie Nghe An (dorpen waarin het gewas tot stand kwam via transplanting) en Phuoc Thuan in de provincie Binh Dinh en Tan Hoi Trung in de provincie Dong Thap (dorpen waarin rijst direct werd gezaaid). In deze vier dorpen werden in totaal 240 huishoudens geïnterviewd. In elk dorp ging het om 30 boeren die hadden geparticipeerd in het programma en 30 boeren die dat niet hadden gedaan. De gegevens die werden verzameld moesten inzicht verschaffen in hoeverre de verbeterde technieken ook inderdaad werden toegepast en of er sprake was van verspreiding van de verkregen kennis naar andere leden van de boerengemeenschap na de training.

Hoofdstuk 4 laat zien dat de feitelijke behoefte aan zaaizaad per huishouden varieerde van 19 to 26 kg per jaar voor gewassen uit transplants en van 114 tot 548 kg per jaar voor gezaaide gewassen. Rijst was de belangrijkste bron van inkomsten voor de boeren in Tan Hoi Trung (verantwoordelijk voor 75% van het inkomen), terwijl minder dan 37% van het totale inkomen uit de rijstteelt kwam in de andere drie dorpen. Na de training gebruikten 59% van de boeren die aan het programma hadden deelgenomen zaaizaad van hoge kwaliteit en 41% werden producenten van zaaizaad van rijst. Bijna alle boeren verwijderden ongewenste typen uit hun gewassen om de kwaliteit van het zaaizaad te handhaven en ook werd minder zaaizaad gebruikt in de teelt (49% minder voor transplantgewassen en 30% minder bij direct gezaaide gewassen). De meeste boeren die aan het programma deelgenomen hadden, gingen ook er toe over om slechts 1 zaailing per plantplaats te gebruiken in de transplantgewassen (in Yen Phuong en Dong Thanh), terwijl 30% van de boeren die aan het programma hadden deelgenomen trommelzaaiers gingen gebruiken in de direct gezaaide gewassen in Phuoc Thuan en Tan Hoi Trung. De opbrengsten verschilden echter niet significant tussen de beide typen boeren. Evenwel, de korrelopbrengsten van FSPS boeren en niet-FSPS boeren verschilden significant van de opbrengsten van de velden met de lokale teelttechniek (de controle). Dit kan verklaard worden uit het grote effect van het project: de meeste boeren die niet aan het programma hadden meegedaan gebruikten beter zaaizaad en meer dan 72% van de respondenten hadden kennis genomen van de verbeterde technieken via de buren die wel aan het programma deelnamen en hadden ze vervolgens toegepast. Voor de verdere ontwikkeling van de aanvoer van boerenzaaizaad in Vietnam kan de zogenaamde zaadclub een belangrijk instrument worden.

Toename van de kennis van boeren dankzij de training

In Hoofdstuk 5 wordt beschreven hoe ex-ante en ex-post testen werden uitgevoerd met elk 25 vragen om te evalueren of er sprake was van een toename in kennis. Deze testen werden uitgevoerd in 12 FSPSs (3 FSPSs in de provincies Nam Dinh, Nghe An, Binh Dinh en Dong Thap). In totaal waren daar 219 boeren bij betrokken. Uit de resultaten bleek dat mannen en vrouwen het net zo goed deden in de testen. Mannen en vrouwen bleken ook een vergelijkbare kennistoename te vertonen. Maar FSPS boeren met een lage score in de ex-ante test deden het veel beter in de ex-post test, vooral diegenen die extreem laag scoorden in de ex-ante test. De verbetering van de kennis van de boeren was niet hetzelfde voor alle technische terreinen waarop getoetst werd. De grootste kennistoename werd geconstateerd voor zaaizaadselectie. Het gebruiken van ex-ante en ex-post testen bleek een nuttig instrument om de effecten van het trainingsprogramma te evalueren. Bovendien kan de ex-ante test een indicatie geven van de specifieke leemten in de kennis van de deelnemers en daarmee de docenten helpen in het ontwerpen en op maat snijden van het curriculum.

Synthese

Hoofdstuk 6 bevat een overzicht van het belang van rijst en zaaizaad van rijst. Het jaar 2004 was het Internationale Jaar van Rijst met als thema "Rijst is leven". In het 2010 zal er een internationaal rijstcongres worden gehouden met als thema "Rijst voor de toekomstige generatie". Deze thema's illustreren dat rijst een belangrijke bron van voedsel is in de wereld. Bovendien moeten zaden worden beschouwd als belangrijke schatten en de basis voor hoop om ook de toekomstige generaties te kunnen voeden. Voor veel landen waarin de landbouw nog overheerst, is zaad de meest eenvoudige hulpbron waarmee de akerbouw op een hoger plan kan worden getild, vanwege de belangrijke invloed op de opbrengst.

In Vietnam is rijst het belangrijkste voedselgewas; het draagt ook in belangrijke mate bij aan het inkomen van de huishoudens, aan het bruto nationaal product en aan de export. Om al het voor de rijstteelt beschikbare land te beplanten is ongeveer 1,000,000 Mg zaad per jaar nodig. Dit zaad wordt vooral door de informele zaadsector geleverd. Sommige studies geven aan dat het gebruik van goed zaad een aanzienlijke verbetering van de opbrengst geeft. Daarom is het voor Vietnam belangrijk om de zaaizaadkwaliteit te verbeteren en om boeren in staat te stellen eigen zaaizaad van hoge kwaliteit te produceren. De resultaten van het trainingsprogramma via de farmer seed production schools waren positief, zowel met betrekking tot de potentie om zaaizaad te produceren als ten aanzien van de toepassing van verbeterde teelttechnieken. Het proefschrift bespreekt ook de mogelijke effecten van deze scholen en behandelt de vraag waarom ze in Vietnam zo succesvol waren en de vraag hoe deze scholen kunnen worden gekoppeld aan de formele zaaizaadsector.

Allereerst is het van belang dat de formele zaaizaadsector een participatieve strategie ontwikkelt om het produceren van eigen zaaizaad door boeren te ondersteunen en verder te ontwikkelen. Vervolgens kan er, door een koppeling van formele en informele zaaizaadsystemen, een duurzaam zaaizaadsysteem worden geschapen gebaseerd op formele zaadproductiebedrijven en informele zaaizaadclubs.

In de studie werden uiteenlopende zaken bijeengebracht: data en informatie afkomstig van demonstratievelden op de boerderij (waarin lokale en verbeterde teelttechnieken werden vergeleken), surveys van huishoudens, testen om de kennistoename te meten en laboratorium analyses van zaaizaadkwaliteit. Al deze informatie moet leiden tot een betere kennis omtrent de rol van zaaizaadsystemen en zaaizaadbeleid gericht op het verzekeren van de lokale zaaizaadvoorziening door middel van het vaststellen van het effect van het FSPS trainingsprogramma in Vietnam.

Ten slotte

De “impact assessment” van deze studie is gebaseerd op vier provincies en vier dorpen (een per provincie). De studie kan daarom niet als geheel representatief voor het gehele project worden beschouwd. We hebben echter waargenomen dat in de onderzochte dorpen zowel participerende als niet-participerende boeren overgingen tot het toepassen van verbeterde technieken, beter zaaizaad gingen gebruiken en bovendien zaaizaad gingen produceren en verschaffen aan andere boeren. Wij vermoeden dat het project vooral veel invloed had in de betere landbouwgebieden.

In een landbouwstaat als Vietnam is onderricht van boeren wellicht één van de meest effectieve manieren om de landbouw te doen ontwikkelen. De verwachting dat het FSPS programma de getrainde boeren zou helpen om de verkregen kennis en technische vaardigheden vast te houden en toe te passen in de productie van zaaizaad kwam uit in de deelpopulatie die hierop werd onderzocht.

Geconcludeerd kan worden dat de farmer seed production school methode invloed heeft, dat boeren dat ook erkennen en dat boeren nieuw verkregen kennis ook gebruiken.

Tóm tắt

Tóm tắt nầy cung cấp những mô tả và phân tích về thực trạng sản xuất lúa, các hệ thống cung cấp hạt giống ở Việt Nam, những kỹ thuật canh tác đã áp dụng (kỹ thuật cải tiến) trong sản xuất giống nông hộ, và những tác động của chương trình huấn luyện sản xuất giống nông hộ (FSPS); sau cùng là đánh giá sự cải thiện kiến thức của nông dân như kết quả của chương trình huấn luyện ở Việt Nam.

Giới thiệu

Việt Nam là quốc gia thuộc Khu vực Đông Nam Á với khí hậu gió mùa nhiệt đới – nóng và ẩm. Mật độ dân số đông đúc trong những vùng nông thôn ở đồng bằng sông Hồng, sông Cửu long và đồng bằng ven biển Trung bộ. Hầu hết nông dân Việt Nam phụ thuộc vào sản xuất nông nghiệp và là hoạt động kinh tế chủ yếu đang đóng góp đáng kể đến GDP từ nguồn thu xuất khẩu. Từ năm 2000 đến nay, diện tích đất nông nghiệp bị giảm dần bởi sự phát triển công nghiệp, nhà ở, cơ sở hạ tầng, khu vui chơi giải trí và những mục đích sử dụng khác. Tuy vậy, sản lượng hoa màu lương thực (chủ yếu là lúa gạo) thì được mong muốn duy trì ở sản lượng cao (trên 35 triệu tấn/ năm) để đảm bảo an ninh lương thực quốc gia và xuất khẩu.

Ở Việt Nam, lúa không chỉ là cây lương thực quan trọng nhất mà còn là nguồn thu nhập chính của nông hộ so các hoa màu khác và là nền tảng cho sự phát triển nông nghiệp. Tuy nhiên, nông dân người sản xuất ra lúa gạo và hạt giống đã gặp những khó khăn như là: sử dụng hạt giống kém chất lượng, áp dụng những kỹ thuật cánh tác chưa phù hợp và chi phí đầu tư cao (Chương 1). Vì vậy, nông dân thu được năng xuất lúa không ổn định và lợi nhuận thấp. Để cải thiện những khó khăn đó, Chính phủ Việt Nam đã và đang đầu tư đáng kể cho hệ thống cung cấp hạt giống chính thống. Dù vậy, hệ thống nầy đã cung cấp dưới 10% của tổng nhu cầu hạt giống. Hệ thống nầy chắc chắn sẽ không thể cung cấp đủ lượng giống chất lượng cao khi nhu cầu giống thì rất lớn. Vì thế, hệ thống sản xuất giống nông hộ vẫn giữ vai trò quan trọng trong an ninh nguồn giống cho sản xuất lúa ở Việt Nam. Mặc dù, Chính phủ Việt Nam đã ban hành các chính sách giống để tăng cường hệ thống sản xuất hạt giống nông hộ nhưng vấn đề là tìm giải pháp phù hợp và đầu tư đúng chỗ vẫn còn nan giải. Để cải thiện chất lượng hạt giống tốt hơn, chương trình huấn luyện sản xuất giống nông hộ đã được triển khai trong bảy tỉnh ở Việt Nam từ 2003-2007. Chương trình nầy đã tập huấn nhiều nông hộ và thu được những tác động đáng kể được mô tả trong luận án.

Thực trạng về canh tác truyền thống trong sản xuất lúa

Nghiên cứu được mô tả trong Chương 2 dựa trên 429 điểm thử nghiệm đồng ruộng với những kỹ thuật canh tác truyền thống đã áp dụng trong sản xuất giống nông hộ và 240 hộ được phỏng vấn ở tỉnh Nam Định, Nghệ An, Bình Định và Đồng Tháp - Việt Nam. Kết quả nghiên cứu cho thấy canh tác lúa chủ yếu cho nhu cầu lương thực gia đình và vài mục đích khác. Đặc biệt những nông dân ở tỉnh Đồng Tháp có diện tích đất canh tác lúa lớn thường sản xuất cho mục đích hàng hoá. Hầu hết những nông dân đã phỏng vấn, họ đều quan tâm đến giống lúa có năng suất cao, phẩm chất tốt và chu kỳ sinh trưởng ngắn. Nhiều giống lúa đã thích nghi với những mùa vụ canh tác đặc biệt. Giống KD18 là tiêu biểu ở Nam Định và Nghệ An thích nghi tốt cả hai vụ lúa. Sự thích nghi đặc biệt của giống lúa nầy hướng đến nhiều hộ canh tác cùng một giống đã là nguyên nhân làm giảm đi tính đa dạng cây trồng trong sản xuất nông nghiệp.

Thêm vào đó, nông dân canh tác bằng kỹ thuật truyền thống đã đầu tư phân bón và thuốc trừ sâu chiếm hơn 40% tổng chi phí sản xuất. Tuy nhiên năng suất lúa trung bình của bốn tỉnh khoảng 6.04 tấn/ha trong vụ Đông Xuân và khoảng 5.01 tấn/ha trong vụ Hè Thu. Lợi nhuận từ sản xuất lúa trung bình cả hai vụ khoảng 363 USD/ha với giá lúa khoảng 0.151USD/kg.

Để có thể nâng cao năng suất lúa, cần bón thêm phân Kali (ở tỉnh Đồng Tháp), giảm lượng giống, lượng phân đạm và tăng lượng phân chuồng (ở Nghệ An). Giá lúa trên thì trường là nhân tố quan trọng nhất quyết định lợi nhuận cho người trồng lúa ở Việt Nam.

So sánh kỹ thuật cải tiến và truyền thống được sử dụng trong sản xuất giống nông hộ

Kết quả từ nhiều nghiên cứu đồng ruộng, bao gồm lô kỹ thuật truyền thống và kỹ thuật cải tiến, đã báo cáo trong Chương 3. Những thử nghiệm nầy được thực hiện tại các lớp huấn luyện sản xuất giống nông hộ (FSPS) ở tỉnh Nam Định, Nghệ An, Bình Định và Đồng Tháp trong năm 2004 cả hai vụ Đông Xuân và Hè Thu/mùa. Những kỹ thuật cải tiến của nông dân (giảm lượng hạt giống, cân đối lượng phân và điều chỉnh mật độ gieo - cấy) được so sánh với kỹ thuật truyền thống về năng suất và lợi nhuận đối với canh tác lúa bằng phương pháp cấy và sạ thẳng. Số liệu từ hệ thống giống chính thống cho thấy hệ thống giống nông hộ ở bốn tỉnh đã cung cấp khoảng 90% nhu cầu hạt giống cho sản xuất. Kết quả lô thử nghiệm với kỹ thuật canh tác cải tiến đã đạt năng suất lúa cao hơn khoảng 8.5% trong vụ Hè Thu và 13.6% trong vụ Đông Xuân so với lô kỹ thuật truyền thống (Đặc biệt là lúa cấy với một hoặc vài tép (dãnh) mạ cho mỗi bụi và tăng mật độ cây cho mỗi mét vuông). Giá bán cao, năng suất tăng, giảm lượng giống gieo cấy, chi phí sử dụng phân bón - thuốc trừ sâu ít của lô thử nghiệm kỹ thuật canh tác cải tiến đã cho lợi nhuận cao hơn 212 UD$/ha so với lô kỹ thuật canh tác truyền thống. Các điểm nghiên cứu đồng ruộng đã có tác động rất lớn đối với những nông dân còn do dự trong việc ứng dụng kỹ thuật cải tiến vào sản xuất, làm thay đổi tập quán canh tác truyền thống và phổ triển kỹ thuật canh tác cải tiến rộng rãi trong cộng đồng.

Tác động từ chương trình huấn luyện sản xuất giống nông hộ

Tiểu hợp phần sản xuất giống nông hộ đã xây dựng chương trình huấn luyện được gọi là "Lớp học sản xuất giống nông hộ (FSPS)" bao gồm bảy tỉnh ở Việt Nam từ 2003-2007 và đã huấn luyện hơn 40,000 nông dân. Để đánh giá tác động của chương trình huấn luyện nầy bốn xã đã được chọn: Yên Phương tỉnh Nam Định và Đồng Thành tỉnh Nghệ An (ở đó sản xuất lúa bằng phương pháp cấy); xã Phước Thuận tỉnh Bình Định và Tân Hội Trung tỉnh Đồng Tháp (sản xuất lúa bằng phương pháp sạ thẳng). 240 nông hộ ở các xã nầy đã được phỏng vấn bao gồm 30 hộ đã tham dự lớp FSPS và 30 hộ trong xã chưa tham dự lớp FSPS. Số liệu đã thu thập và phân tích về sự chấp nhận những kỹ thuật cải tiến trong sản xuất hạt giống và sự phổ biến kiến thức đã học đến các nông dân trong cộng đồng.

Chương 4 chỉ ra nhu cầu hạt giống thật sự của nông hộ thay đổi từ 19-26kg/năm đối với lúa cấy và 114-548kg/năm đối với lúa sạ. Lúa là nguồn thu nhập chính của nông dân ở Tân Hội Trung (75% tổng thu nhập/hộ) khi đó thu nhập từ lúa ở các xã khác ít hơn 35%. Sau khi tham gia lớp FSPS, 59% nông dân đã sử dụng lúa giống chất lượng cao để sản xuất và 41% nông dân đã trở thành nông hộ sản xuất lúa giống. Hầu hết nông dân tham dự lớp FSPS đã áp dụng khử lẫn để duy trì chất lượng hạt giống và đã giảm lượng hạt giống khoảng 49% (lúa cấy) và 30% (lúa sạ) so với trước khi tham gia lớp FSPS. Hầu như những nông dân đã học đều thay đổi tập quán cấy nhiều tép (dãnh) mạ/bụi sang cấy 1 tép mạ/bụi ở xã Yên Phương và Đồng Thành, và khoảng 30% nông dân đã áp dụng công cụ sạ hàng để gieo lúa ở Phước Thuận và Tân Hội Trung. Năng suất lúa và lợi nhuận đã không khác biệt ý nghĩa thống kê so với đối chứng. Điều đó có nghĩa chương trình huấn luyện đã tác động tốt ở những xã nầy: nhiều nông dân chưa được tham gia lớp FSPS cũng đã sử dụng lúa giống chất lượng tốt để sản xuất, 72% nông dân được hỏi đã được hướng dẫn kỹ thuật canh tác cải tiến từ các nông dân đã học trong xã. Thành lập "Câu lạc bộ giống" có thể là mô hình hiệu quả nhất để phát triển tốt hơn hệ thống sản xuất và cung cấp hạt giống nông hộ chất lượng cao được cho sản xuất lúa ở Việt Nam.

Cải thiện kiến thức của nông dân qua lớp FSPS

Trong Chương 5, công cụ kiểm tra đầu và cuối khoá tập huấn với 25 câu hỏi đã thực hiện tại 12 lớp FSPS (3 lớp ở mỗi tỉnh Nam Định, Nghệ An, Bình Định và Đồng tháp) với 219 nông dân tham dự đã được áp dụng để đánh giá sự cải thiện kiến thức của nông dân. Kết quả cho thấy nữ và nam không có khác biệt điểm trung bình trong các lần kiểm tra và đã cải thiện kiến thức tương đương nhau tại kết quả kiểm tra cuối khoá. Những nông dân có điểm kiểm tra đầu khoá thấp đã đạt điểm tốt hơn nhiều tại kiểm tra cuối khoá, đặc biệt đối với những nông dân có số điểm thấp hơn 30 tại kiểm tra đầu khoá. Sự cải thiện kiến thức của nông dân cũng đã khác biệt trong các lĩnh vực kỹ thuật. Nông dân đã nâng cao kiến thức nhiều nhất trong lĩnh vực chọn giống. Việc kiểm tra đầu và cuối khoá là công cụ rất hữu ích để đánh giá tác động huấn luyện. Đánh giá đầu khoá không chỉ để nhận ra những lĩnh vực kỹ thuật yếu của học viên mà còn giúp hướng dẫn viên chọn lựa phương pháp tốt nhất để huấn luyện.

Tóm lại

Tầm quan trọng của lúa gạo và lúa giống được trình bày trong Chương 6. *Lúa gạo là* *sự sống* đã là nội dung của Năm Quốc tế Lúa gạo – 2004, và *Lúa gạo cho thế hệ tương lai* sẽ là chủ đề của những Hội nghị Lúa gạo Quốc tế sẽ được tổ chức năm 2010. Những chủ đề trên minh chứng rằng lúa gạo là nguồn lương thực quan trọng trên thế giới. Hơn nữa, lúa giống ngày nay là niềm hy vọng và là loại quí báu để nuôi sống những thế hệ tương lai bởi vì những quốc gia nông nghiệp, hạt giống còn là loại đầu tư đơn giản nhất để cải thiện sản xuất nông nghiệp, và nó cũng có thể xác định sản lượng tiềm năng.

Ở Việt Nam, lúa là hoa màu lương thực chủ yếu và nó đóng góp đến thu nhập nông hộ và GDP quốc gia qua giá trị xuất khẩu. Để canh tác lúa trong cả nước, nhu cầu hạt giống đã cần khoảng 1.000.000 tấn/năm, với như cầu đó hệ thống giống nông hộ là nguồn cung cấp chủ yếu. Các nghiên cứu trước đây đã công bố rằng sử dụng hạt giống chất lượng có thể gia tăng năng suất lúa đáng kể. Vì thế, cải thiện chất lượng hạt giống và nâng cao năng lực để sản xuất hạt giống chất lượng ở nông hộ là chiến lược quan trọng ở Việt Nam. Những kết quả của chương trình sản xuất giống nông hộ đã chứng minh những tác động tích cực về tiềm năng sản xuất hạt giống của nông dân và áp dụng những kỹ thuật cải tiến trong sản xuất lúa. Những tác động có thể của nó đã được thảo luận: tại sao chương trình huấn luyện FSPS thành công? Và làm thế nào nông dân có thể liên kết với các hệ thống giống ở địa phương để đảo bảo sự cung ứng hạt giống?

Trước tiên, để hỗ trợ và phát triển hệ thống sản xuất giống nông hộ ở Việt Nam, Hệ thống giống chính thống nên mở rộng chiến lược nông dân cùng tham gia. Khi đó, xuyên qua sự liên kết của hệ thống giống chính thống và nông hộ (không chính thống), một hệ thống cung cấp hạt giống bền vững có thể được mở ra dựa trên những trại giống nhà nước và câu lạc bộ giống nông dân.

Nghiên cứu nầy đã kết hợp những thông tin và số liệu từ các lô nghiên cứu đồng ruộng (cải tiến và truyền thống), điều tra nông hộ, đánh giá khoá huấn luyện và phân tích trong phòng thí nghiệm để cung cấp kiến thức tốt hơn về vai trò của các hệ thống giống và chính sách giống nhằm đảm bảo nhu cầu giống địa phương xuyên qua đánh giá tác động chương trình huấn luyện sản xuất gíông nông hộ ở Việt Nam.

Kết luận và nhận xét

Nghiên cứu nầy đã chọn bốn tỉnh và bốn xã của các tỉnh đó để đánh giá tác động. Nó có thể không hoàn toàn đại diện của tất cả các tác động từ dự án. Tuy nhiên, cả những nông dân đã và chưa tham dự lớp FSPS điều áp dụng nhựng kỹ thuật cải tiến từ lớp FSPS, đã sử dụng hạt giống chất lượng tốt hơn để sản xuất, và sản xuất – cung ứng lúa giống cho nông dân khác trong các xã nghiên cứu. Chúng tôi tin tưởng rằng Chương trình huấn luyện nông dân sản xuất giống nông hộ đã có tác động thật sự và lớn hơn trong những vùng có điều kiện canh tác thuận lợi.

Quốc gia nông nghiệp như Việt Nam, huấn luyện nông dân có lẽ là một trong những giải pháp hiệu quả nhất cho phát triển nông nghiệp. Điều mong muốn mà Chương trình huấn luyện sản xuất giống nông hộ là giúp cho những nông dân đã tập huấn duy trì được kiến thức đã học và những kỹ năng kỹ thuật và ứng dụng kiến thức đó trong sản xuất lúa giống, điều đó đã tìm thấy ở những điểm nghiên cứu và về tác động dự án, luận án nầy là nền tảng.

Như thế, tác động của Chương trình huấn luyện sản xuất giống nông hộ được đã được minh chứng, được biết đến và được ứng dụng bởi nông dân, không chỉ bởi những nhà nghiên cứu.

List of Publications

1. Published

Journal articles

1. Tin, H.Q., T. Berg, and Å. Bjørnstad, 2001. Diversity and adaptation in rice varieties under static (*ex situ*) and dynamic (*in situ*) management: a case study in the Mekong delta, Vietnam. Euphytica 122: 491-502
2. Tin, H.Q., N.N. De, R. van Treuren, and L. Visser, 2006. Analysis of spatial and temporal variation of the farmers' rice variety Tai nguyen under changing cropping systems in the Mekong delta, Vietnam. Plant Genetic Resources Newsletter 146: 49-55
3. Cuc, N.H, P.C. Sta. Cruz, T.H. Borromeo, J.E. Hernandez and H.Q. Tin, 2008. Rice seed supply systems in the Mekong delta, Vietnam. Asia Life Sciences: 17 (1): 1-20
4. Huynh Quang Tin, Paul C. Struik, Lisa L. Price, Tran T. Be, 2008. Comparative analysis of local and improved practices used by farmer seed production schools in Vietnam. Field Crops Research 108: 212-221

Proceedings papers

1. Huynh Quang Tin, 2000. Agromorphological characters and farmer perceptions: data collection and analysis. Proceedings of a workshop on Conserving agricultural biodiversity *in situ*: A scientific basis for sustainable agriculture, 5-12 July 1999 – Pokhara, Nepal. IPGRI: 119-121
2. Vo Minh Hai, Huynh Quang Tin and Nguyen Ngoc De, 2003. Agromorphological variation of *Mon sap* taro populations in the Mekong Delta, Vietnam: Role of *on-farm* conservation. Proceedings of a symposium on On-farm management of agricultural biodiversity in Vietnam, 6-12 December 2001 Hanoi Vietnam. IPGRI: 28-32
3. Vo Minh Hai, Huynh Quang Tin and Nguyen Ngoc De, 2003. Agromorphological variation of *Trang Tep* rice populations in the Mekong

Delta, Vietnam: Role of *on-farm* conservation. Proceedings of a symposium on On-farm management of agricultural biodiversity in Vietnam, 6-12 December 2001 Hanoi Vietnam. IPGRI: 72-77

Book chapter

1. Huynh Quang Tin, 2003. Community Biodiversity and Conservation in the Mekong Delta, Vietnam. Policy and legal frameworks. Conservation and Sustainable Use of Agricultural Biodiversity: A sourcebook. CIP-UPWARD. Volume 3: 564-569

2. Journal articles submitted

1. Huynh Q. Tin, Paul C. Struik, Lisa L. Price. Evaluation of rice cropping systems across Vietnam based on a large set of on-farm demonstration plots and household surveys. Submitted
2. Huynh Q. Tin, Paul C. Struik, Lisa L. Price, Nguyen P. Tuyen, Nguyen P. Hoan and Heleen Bos. Ex-ante and ex-post evaluation of improvement in farmer's knowledge through farmer seed production schools in Vietnam. Submitted
3. Huynh Q. Tin, Paul C. Struik, Lisa L. Price, Nguyen H. Cuc, Lars Bødker, Per Andersson and Michael Turner. Impacts of Farmer Seed Production Schools on Seed Production in Vietnam. Submitted

3. Thesis

1. Huynh Quang Tin, 1983. Evaluating tolerance to drought conditions of improved rice varieties (in Vietnamese). Unpublished B.Sc. thesis, Cantho University, Cantho City, Vietnam.
2. Huynh Quang Tin, 1998. Genetic differences of *Ex-situ* and *In-situ* rice germplasm: A case study in the Mekong Delta, Viet Nam. Unpublished M.Sc. thesis of the Agricultural University of Norway.

4. Other scientific outputs (in Vietnamese)

1. Huynh Quang Tin, 2006. Community-based natural resource management (B.Sc. level). Publishing House Cantho University
2. Huynh Quang Tin and Nguyen Hong Cuc, 2003. The process of rice seed production. Unpublished Training Manual in Seed Component of Agricultural Sector Programme Support (ASPS, DANIDA-MARD, Vietnam
3. FSPS*, 2006. Farmer seed production school. Training of Trainers, Training of Farmer Trainers and Training for Farmer. ASPS, DANIDA-MARD. Agricultural Publishing House. (* Huynh Q. Tin was a main editor of the FSPS curriculum)
4. Huynh Quang Tin, 2006. Improving skills in participatory rice breeding and seed production. Training of Trainers (ToT) of the CBDC Project, Vietnam

PE&RC PhD Education Certificate

With the educational activities listed below the PhD candidate has complied with the educational requirements set by the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) which comprises of a minimum total of 32 ECTS (= 22 weeks of activities)

Review of Literature (5.6 ECTS)
- Literature review of fields related chapters of the thesis (2005-2009)

Writing of Project Proposal (7 ECTS)
- Impacts of farmer-based training in seed production in Vietnam (2005)

Laboratory Training and Working Visits (0.6 ECTS)
- Centre for Resources the Netherlands (Gene-bank); CGN-WUR (2005)
- Rice breeding experiments; IRRI (2006)

Post-Graduate Courses (6.3 ECTS)
- Competence for integrated agricultural research; WUR (2007)
- Community self-assessment; SEARICE-Philippines (2008)
- Methodologies of participatory plant breeding of maize, bean and sorghum; Development Fund-Norway CIPRES, Nicaragua (2008)

Competence Strengthening / Skills Courses (2.9 ECTS)
- Techniques for writing and presenting a scientific paper; WUR (2005)
- Project and time management; Valley Consult (2007)
- PhD Competence assessment; WUR (2007)

Discussion Groups / Local Seminars and Other Meetings (10 ECTS)
- Seed Component Workshop; Danida, Nha Trang, Vietnam; oral presentation (2005)
- Workshop on Ideas of Establishing Seed Club; Danida, Dong Thap, Vietnam; oral presentation (2006)
- Conference on Using the PVP and Seed Policies to Strengthen Seed Systems; SEARICE, Hanoi, Vietnam; presentation (2006)
- National Workshop on Summary and Evaluation of Farmer Seed Production Schools (FSPS); Danida, Hanoi, Vietnam; oral presentation (2007)
- Rice Variety Selection for the problem soil areas in the Plain of Reeds in the South Vietnam; IAS, Long An, Vietnam; oral presentation (2008)
- National Workshop in Improving Crop Quality in the Mekong River delta ; Department of Crop Production, Vinh Long, Vietnam; oral presentation (2009)
- Workshop on Evaluation of Community Biodiversity Development and Conservation Project; Cantho University, Cantho City, Vietnam; oral presentation (2009)

PE&RC Annual Meetings, Seminars and the PE&RC Weekend (0.9 ECTS)
- PE&RC Day (2007)
- SENSE Context symposium (2007)
- PE&RC Facilitation day on stakeholder participation and scientific research (2008)

International Symposia, Workshops and Conferences (10.8 ECTS)
- Southeast Asia Regional Meeting on Community Biodiversity Development and Conservation and Rice Festival; SEARICE, Philippines; presentation (2006)
- The Asia Meeting on Community Biodiversity Development and Conservation; SEARICE, Chiangmai, Thailand; presentation (2008)
- The International Participation Participatory Plant Breeding Workshop; SEARICE, Hanoi, Vietnam; poster presentation (2008)
- The Asia workshop on Biodiversity Use and Conservation in Asia; SEARICE, Hanoi, Vietnam; presentation (2008)

Curriculum vitae

Huynh Quang Tin was born in Cantho Province, Vietnam, on December 20, 1961. He completed his high school in 1979 and started in the same year with his Bachelor of Science degree specializing in Crop Production of the Faculty of Agronomy at the Cantho University (CTU), Cantho City, Vietnam.

After obtaining the bachelors degree in 1983, he worked as a research assistant in the Department of Rice Research and Development (renamed Department of Crop Resources) belonging to the Mekong Delta Development Research Institute (MDI) of the Cantho University in Vietnam. He participated in rice breeding work as a rice breeder since 1983, and subsequently he joined the rice germ-plasm collection and conservation project in cooperation with the International Rice Research Institute (IRRI), the International Plant Genetic Resources Institute (IPGRI) and the Southeast Asia Regional Initiatives for Community Empowerment (SEARICE) for a period of six years (1990-1996).

With an MSc scholarship from the Loaning Programme of the Norwegian Government for students in the developing countries, he enrolled the master degree programme in Natural Resource Management and Sustainable Agriculture at the Agricultural University of Norway, where he graduated in June 1998. After finishing the Master of Science degree, he worked at the MDI as a rice breeder and a Project Coordinator of the Community Biodiversity Development and Conservation in the Mekong Delta, Vietnam, working on capacity building for farmers in participatory plant breeding and conservation of local crop varieties at the community level.

In 2002, he worked in the technical consultant team for Farm Saved Seed Production Project belonging the Agricultural Sector Programme Support (ASPS), DANIDA-MARD Vietnam. He participated in the technical group to develop the curriculum for the Training of Trainers (ToT) and Farmer Seed Production Schools (FSPS) of the Farm-Saved Seed Project; he also organized and trained the local technicians. He was awarded a fellowship for a sandwich PhD study in 2005 by the

Agricultural Sector Programme Support (ASPS), DANIDA-MARD Vietnam. He started a PhD programme in May 2005 at the Crop and Weed Ecology Group (CWE) of the C.T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC) of Wageningen University. The research output under this fellowship is described in this thesis.

He is married to Nguyen Hong Cuc with whom he has two sons, Huynh Nguyen Vu Lam and Huynh Nguyen Bao Lam.

Funding

Financial support for this thesis was obtained from the Agricultural Sector Support Programme (ASPS), DANIDA-MARD, Vietnam. On-farm researches were carried out under the Farm-Saved Seed Sub-Component No. 8 (SC-8) belongs to the Seed Component.