IRMLA Project Progress Report: December 2002 to May 2003

R. P. Roetter, M.M. Van den Berg, H. Van Keulen, H. Hengsdijk, M.K. Van Ittersum, C.H. Lu, W. Guanghuo, T.T. Son, E.O. Agustin, N.X. Lai, T. Ponsioen & J. Wolf

IRMLA Project Report no. 3

ABSTRACT

R.P. Roetter, M.M. Van den Berg, H.Van Keulen, M.K. Van Ittersum, C.H. Lu, W. Guanghuo, T.T. Son, E.O. Agustin, N.X. Lai, T. Ponsioen, J. Wolf, 2003. IRMLA Project Progress Report: December 2002 to May 2003. Wageningen, Alterra, Green World Research.. Alterra-Progress report IRMLA-2003-30 May. 148. pp.

IRMLA project is a research network for Integrated Resource Management and Land use Analysis in E and SE Asia. The four years project (2002-2005) was established to develop a framework and methods for multi-scale land use analysis and planning, and identify options for sustainable land use (at farm, district and provincial level). The current progress report covers the period December 2002 to May 2003. Four in-country workshops were held in April 2003, in which special attention was paid to the question whether stakeholders' perceptions on land use issues and resource management problems in four study regions were sufficiently taken into account. Progress and results of the IRMLA project and results and conclusions from the in-country stakeholder meetings and team working sessions form the core of this report.

Keywords: resource use and management, land use planning, systems analysis, agricultural and environmental policies, multiple goal analysis, regional scenario, farm household modeling, Asia, stakeholders, decision behaviour

ISSN 1566-7197

P.O. Box 47, NL-6700 AA Wageningen (The Netherlands).
Phone: +31 317 474700; fax: +31 317 419000; e-mail: postkamer@alterra.wag-ur.nl

Contents

Preface

Currently, in many of the highly productive lowland areas of E and SE Asia a trend to further intensification and diversification of (agricultural) land use can be observed. The gains in productivity and the associated environmental impacts of these developments are unknown. Effective land use planning and resource use analysis at different scales can help to make the issues transparent. This also includes design and analysis of resource-use efficient systems that can serve a broad range of development objectives. Both are key to identifying the scope for technical and policy change and its feasibility in a given region.

IRMLA project is a research network for Integrated Resource Management and Land use Analysis in E and SE Asia. The four years project officially started on 1 December 2001. It was established to develop a framework and methods for multi-scale land use analysis and planning, and identify options for sustainable land use (at farm, district and provincial level).
To this end, the IRMLA Project aims at broadening existing methodology for strategic land use analysis and policy formulation at sub-national scale:

- in width (incorporation of environmental impacts)
- in length (incorporation of long-term effects): and
- in depth (incorporation of farmers' decisions).

To develop and test this new approach, four case study regions have been selected. All are located in important agricultural areas :

1) Pujiang county, Zhejiang province, China (rice-rice)
2) Batac and Dingras municipalities, Ilocos Norte Province, Philippines (rice-dry season crops)
3) Tam Duong district (part of Tam Dao) , Red River Delta, Vietnam (double rice-winter crop)
4) Omon district, Mekong Delta, Vietnam (double or triple rice)

During year 1 of the project, detailed workplans were established (kick-off workshop in February 2002); land use options and resource use conflicts for current production systems were analysed at the regional level – including the temporal dynamics of some in- and outputs of the systems. Furthermore, detailed farm surveys were designed and carried out.

During year 2, technical coefficients describing input–output relations of innovative, future production technologies (years 2005-10, 2015-20) will be generated; adaptation strategies to climate-induced risks will be taken into account; farm household models (FHMs) will be developed to analyse effects of policy measures on resource allocation; farm survey results will be analyzed to gain insight into farmers' decision behavior and to define representative farm household types. Interim reporting and consultations with stakeholders will take place in each study region (March /April 2003) A next round of model refinement and reporting is scheduled for October 03

– as a follow-up to a workshop to be held at Wageningen (29 September – 4 October 2003). Training on relevant techniques and component models will be provided through workshops in Asia and at Wageningen UR. The training/design phase will be completed, and the project will increasingly focus on model development and evaluation.

During year 3, the farm household models will be finalized and operationalized; test results will be presented and discussed with local stakeholders (in-country workshops, most likely between February and April 2004). Expert systems for estimating input – output relations will be refined. Technical documentations will be completed.

During year 4, the link of farm household and regional land use modelling will be operationalized and applied to analyse the response of farm households to different policy measures and examine whether and to what extent implementation of such policies would lead to realisation of policy objectives (rural development goals) at the regional level; on this basis feasible options for sustainable land use will be presented to policy makers; One of the milestones will be an Impact symposium organized by the project (to be held some time in April/May 2005, in the Philippines or Vietnam).

This report presents the main accomplishments made during the first 6 months of the 2nd project year. Focus is on work carried out in preparation of, during and immediately after 4 in-country workshops (31 March – 12 April 03). The report, therefore, also constitutes a compilation of workshop materials and output.

Many thanks to all project team members and stakeholders from the case study regions who helped making these in-country workshops very productive and fruitful events. Special mention deserve Wang Jiangdi (ZU), Alice Laborte (IRRI), Pham Quang Ha, Nguyen Van Chien, Vu Manh Quyet, V. D. Tuan, M. van Trinh (NISF), and Nguyen The Cuong (CLRRI) for contributing individual sections/files to this compilation.

Wageningen,
May 2003 IRMLA Project Co-ordinator

Executive Summary

Context

IRMLA project is a research network for Integrated Resource Management and Land use Analysis in E and SE Asia. The four years project (1 Dec. 2001 to 30 Nov. 2005) was established to develop a framework and methods for multi-scale land use analysis and planning, and identify options for sustainable land use (at farm, district and provincial level). IRMLA, in its second project year, is about to enter the main execution phase.

The current progress report covers the period December 2002 to May 2003. Four in-country workshops were held between 31 March and 12 April 2003, with the aim to check on whether the project is on track regarding design of a multi-scale modeling framework for land use analysis. In reviewing progress, special attention was paid to the question on whether stakeholders perceptions on land use issues and resource management problems in four study regions were sufficiently taken into account. Results and conclusions from stakeholder meetings and team working sessions form the core of this report.

Project progress

Project progress is largely in line with the original work plan (= Technical Annex to the project proposal). There are only two notable deviations from the original plan: Requirements for training in modeling components are higher than anticipated. This is partly due to use of new optimization software, increased complexity of component models (e.g. TechnoGIN) – and, finally, high ambitions of IRMLA partners to advance methodologies in order to enhance the quality of outputs to be generated. This increased demand for training related to new tools /techniques has implications on budget allocations.

Originally, there was the intention to use outputs from existing regional MGLP models to identify conflicts in land use objectives and resource use in the case study regions. So far, this was only partly realized. Inclusion of two new study regions, as well as new developments in the study regions and insight from analysis of problems at lower level of aggregation, imply that the description/documentation of conflicts needs closer analysis – definite and comprehensive descriptions will be provided at a later stage.

Among the most important outputs for the entire reporting period are:

- Preliminary documentation on conflicts in land use objectives for Ilocos Norte and Cantho Provinces

- Results from resource evaluation and mapping (GIS) for Tam Duong, Omon and Pujiang
- Prototype technical coefficient generator (TCG) for Ilocos Norte and its documentation
- CD-ROM with materials (presentations, exercises) and prototype models and databases produced for and during the four in-country workshops 2003

Some of these outputs can also be downloaded from the recently updated IRMLA homepage at www.irmla.alterra.nl

Chapters 2 and 3 of this report deal with project progress made up to March 2003, whereas the results from the in-country workshops are dealt with in chapters 4 to 8 (and in the Annexes – including a compilation of workshop materials and outputs on CD-ROM).

Results from in-country workshops

The workshops consisted of three major parts:
- Stakeholder-scientist meeting (1 day)
- Team working sessions by IRMLA scientists on the various methodology components
- Work planning session on next steps required for development of component models, exchange with stakeholders and research capacity building

Major outputs from the workshops were:
1) Clarification of goals and targets, ranking of agricultural development objectives and characterization of case studies from a local stakeholder and scientists' perspective
2) Detailed account of work carried out by each team
3) Re-design of basic structure of regional MGLP and /or farm household models in response to information gathered and processed during the workshops
4) Increased insight of team members in techniques to be applied and required improvements of databases and component models - and outline of promising specific studies to close knowledge gaps
5) Detailed work plans for each team up to October 2003 and outline of work till April 2004 – including agreements on data exchange and responsibilities for delivery.

A detailed account of the deliberations and outputs from the four workshops is presented in chapter 4 (and in the Annexes). Workplans and required training and back-stopping activities are given in chapters 5 and 6, respectively. Chapter 7 provides an outline of specific individual (academic) studies formulated in the framework of IRMLA, and chapter 8, finally gives a summary of project progress made up to date.

1 Introduction

1.1 Project progress to date

The project, launched in February 2003 with a combined planning and training workshop at Hanoi, Vietnam, is currently in its second project year. The training and prototyping phase is about to finish and the main execution phase will soon be entered (Figure 1.1). This progress report is concurrently the third report released by the project and gives a detailed account of the progress made between December 2002 and May 2003.

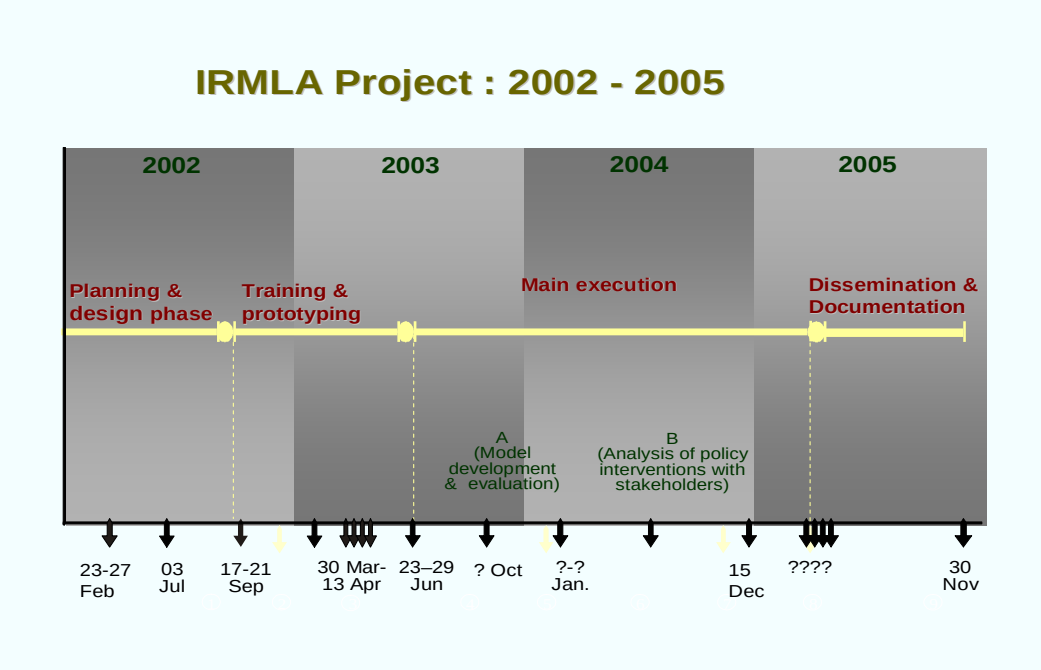


Figure 1.1 IRMLA Project phases

The reporting period was characterized by intensive preparations (data collection and documentation of work carried out, and dialogue with stakeholders) for a series of (4) in-country workshops held in the study regions between 31 March and 12 April 2003. Status of work before these workshops is dealt with in chapters 2 and 3. The major part and remainder of this report deals with the results generated (from stakeholder meetings and working sessions) during and immediately after these workshops. Details on the scientific outputs from the first project year can be found in IRMLA Project Report No. 2, released end of March 2003.

Among the most important outputs of the reporting period are:

- Documentation on conflicts in land use objectives and resource use for Ilocos Norte and Cantho Province

- Results from resource evaluation and mapping (GIS) for Tam Duong, Omon and Pujiang
- Prototype technical coefficient generator (TCG) for Ilocos Norte and its documentation
- CD-ROM with materials (presentations, exercises) and prototype models and databases produced for and during the 4 in-country workshops

Some of these outputs can be downloaded from the recently updated IRMLA homepage at www.irmla.alterra.nl

1.2 Set-up and aims of the four in-country workshops

The four in-country workshops were planned as an interim review and synthesis of work carried out by individual project partners. This included design of the case studies, bilateral dialogue between scientists and stakeholders, and development of databases and prototype component models for multi-scale land use analysis. The workshops were set up to bring together these various elements, check on the appropriateness of project activities and results in the light of stakeholders' information needs and comments, deepen understanding of methodology components, and integrate the information collected thus far by jointly re-designing prototype models in joint working sessions for the individual case studies. Finally, these workshops were meant for an internal review of the project's progress and strategy and for defining actions required in the project's main execution phase. These activities were translated into workplans. The planning was guided by both, ways to contribute to research capacity building and activities to ensure that meaningful project output be delivered in time.

Workshop objectives were as follows:

- To consult with local stakeholders on land use and resource management issues
- To present capabilities and limitations of the IRMLA methodology and discuss exchange of data and results between local stakeholders and scientists
- To foster collaboration between project partners in developing a decision support system for multi-scale land use analysis and planning

A detailed account of the deliberations and outputs from the four workshops is presented in chapter 4 (and in the Annexes, including a collection of materials on CD-ROM). Resultant work plans and required training and back-stopping activities are given in chapters 5 and 6 of this report, respectively. Chapter 7 provides an outline of specific individual (academic) studies formulated in the framework of IRMLA, and chapter 8, finally gives a summary of project progress made up to date.

2 Status of work by 1 December 2002

2.1 Overview

Tangible outputs available by 1 December 2002

- Documentation on conflicts in land use objectives and resource use for Ilocos Norte and Cantho Province
- Spatial (GIS) databases and maps on resource availability and quality for Batac/Dingras and Omon
- Climatic (monthly) data for all and daily weather databases for Batac/Dingras and Omon
- Potential yield estimations (crop simulations) for Batac/Dingras and Omon
- Databases (in Excel) on actual yields and input – output relations for Omon (series of years) --- (and formats of farm surveys for Tam Duong and Batac/Dingras conditions)
- Soil databases for Batac/Dingras (Ilocos Norte), Omon and Tam Duong
- Prototype technical coefficient generator (TCG) for Ilocos Norte
- Very first versions of regional IMGLP for Tam Duong and Pujiang (and advanced regional models for Ilocos Norte and Cantho – programmed in XPRESS-MP)
- Proceedings of the IRMLA Project Planning Workshop (Kick-off) held at Hanoi, 23-27 February 2002 (= Project Report No. 1)
- CD-ROM with materials produced for the IRMLA training workshop on LUPAS held at Beijing, 17-21 September 2002
- Several draft scientific papers were developed:
  1) Van Ittersum, M.K. et al. on land use planning methodology (target journal: Land Use Policy)
  2) Van den Berg, M.M. & G Kruseman, paper on optimization techniques (to be presented at Durban/South Africa in August 2003)
  3) Roetter, R.P. et al, on operationalized LUPAS methodology (target journal: Environmental Modelling and Software)

Several of these outputs can be downloaded from URL: www.irmla.alterra.nl, from downloads or publications sections

2.2 Regional model output on resource use analysis: Ilocos Norte and Cantho

2.2.1 Case study Ilocos Norte Province

Agriculture in the province basically consists of rice-based production systems. While rice is cultivated in the wet season between June and October, during the dry season, diversified cropping is practiced: tobacco, garlic, onion, maize, sweet pepper, and tomato, all supported by groundwater irrigation, are cultivated in the intensively

cultivated lowlands. Rice is the most common crop. In 1993, the province had a surplus of 100 000 Mt above demand (113,000 Mt). A well-developed marketing system has facilitated the establishment of intensive rice-cash crop production systems (Lucas *et al.*, 1999). Public awareness of current and possible future negative environmental effects resulting from further intensification of agricultural systems, was only created recently through research on groundwater pollution by the Rainfed Lowland Rice Research Consortium (RLRRC). In meetings with local stakeholders, an assessment of trade-offs among rice production, farmers' income and, to a lesser extent, environmental objectives was identified as the major issue to be addressed in exploratory land use analysis for the province.

Production technologies Three major production technologies were considered: (1) average farmers' practice, (2) 'best farmers' yield/high input', and (3) 'improved practice'. The data for the input-output tables were derived from farm surveys in the province (consisting of 1,967 farms in the wet season and 2,523 in the dry season; S Francisco, 1999, unpublished). The values for the input-output relations for the average farmers' practice were derived from the average values for these farms.

For the 'best farmers' yield/high input', data were derived by taking the mean of the values with a yield level between the 90th and 95th percentile and associated input use of the survey data. Fertilizer and pesticide use are 100% higher, labor 70% and other inputs were the same as in the average practice. This is based on survey data indicating that one group of farmers approaching 'best farmers' yield' achieves this by almost doubling fertilizer and pesticide inputs, while labor input increases less.

For the 'improved practice', the same inputs as in the average farmers' practice were used, but fertilizer use efficiency was improved. Average applications of N, P and K decreased by 20% for non-rice. For rice, N application decreased by 40%, P application decreased by 15% and K application increased by 20%. This is partly based on survey data suggesting that another group of farmers achieves 'best farmers' yield' with about the same input as in the average farmers' practice. We further assume that by better balancing nutrient supply with crop demands the efficiency of fertilizer (macro-nutrients N, P, K) can be further improved as demonstrated elsewhere by the efficiency increases in rice.

Results from regional analysis of trade-off between income generation and resource use are illustrated in Figures 2.1a-c., which show 'standardized values' of farmers' income and use of agricultural land, fertilizer, water, pesticides and labor, for three different production technologies (scenarios). 'Standardized' means that the highest values on income and resource-use generated in the various income maximization runs were set at 100. Results show, for instance, that if all farmers in the province would apply technology 2 (Figure 2.1b), this would considerably raise farmers' income compared to technology 1 (Figure 2.1a). While water consumption would decrease by 28%, this would require 21% more fertilizer, 41 % more pesticides and 5% more labor. However, if instead new, more resource-use efficient practices (technology 3) would be applied by all farmers, the same income could be achieved with approximately 30% less fertilizer and pesticides (Figure 2.1 c).

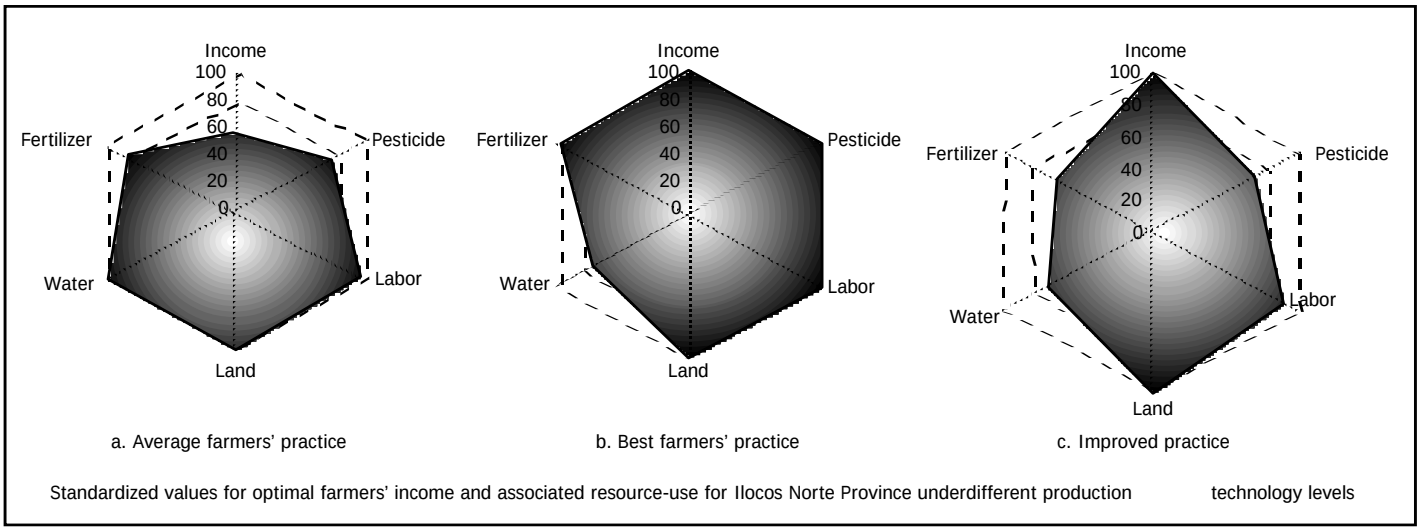


Figure 2.1a-c: Trade-off between farmers' income and resource use in Ilocos Norte Province

Rice production under all scenarios would clearly remain above current production levels. That means, site-specific (and more balanced) nutrient- and pest management practices can lead to considerably more income at reduced environmental cost while satisfying local demand for the various crops in the province : a clear win-win situation. There are, some costs involved, however, in terms of increasing farmers' knowledge and skills, for achieving the fertilizer efficiency gains represented by the 'improved practice'. What is necessary to realize the above-mentioned 'win-win' situation, are investments in dissemination and appropriate policy interventions that would provide incentives to adopt new (nutrient) management practices.

2.2.2 Case study Cantho Province

On the basis of policy views, development plans and targets, two sets of scenarios were formulated:

- Scenarios for 2000 using current data on biophysical and socioeconomic resources and development targets for 2000 to examine by how much each goal could be improved with currently available resources, and what changes in land use would be required to achieve such improvement.
- Scenarios for 2010 using modified biophysical conditions and development targets for 2010. The objective of these scenarios is to explore more future-oriented options for development.

Scenario analysis can illustrate conflicts in land use objectives and resource use. For example, when income is maximized, rice production and employment decrease by 29% and 19%, respectively, compared with the maximum achievement of these two objectives. On the other hand, when employment is maximized, rice production decreases sharply (54%).

In 1999, a review of the economic reform (Doi Moi) in Vietnam concluded with recommendations for decentralization and shifting more distinctly to the free-market system. Under such conditions, skills and decisions of farmers with respect to resource management become more important than in the former centralized economy.

Table 2.1 Goal achievements under the conditions of 1997

No.	Goal	Maximize rice production	Maximize income*	Maximize employment*
1	Rice production (million t)	1,876	1,800	1,800
2	Income (billion VN dong)	5,196	5,489	5,172
3	Labour use (million labour-days)	51.6	49.5	57.2

* with target for rice production = 1.8 million tons.

To increase income of the rural population, improved technology is likely to be introduced faster and capital support provided more effectively to the farmers than before. Under such a scenario, it is assumed that all four farmer groups, including the poor, can apply the improved technology. With such capital availability, in the scenario of maximizing employment, employment, income and rice production could be improved by 3%, 12% and 13%, respectively (Lai *et al.*, 2000).

However, rice production was still considered as the major target for the year 2000, with an (even higher) target of 2 million tons. The relevant 'what-if' question in that case is: What is the consequence for employment generation if rice production has to exceed 2 million tons as required by the central government? A multiple goal scenario is analysed by first maximizing income and setting a target of 2.0 million tons. The results show that employment decreases to 19% of the available rural labour force, while about a 5% improvement in income can be gained. Next, the scenario of maximizing employment shows that at most only 27% of the available labour force can be gainfully employed, while income as well as rice production are significantly lower than their respective maxima, i.e., by 19% and 35%.

Table 2.2 Goal achievements under the conditions of 2000

No.	Goal	Maximize rice production	Maximize income*	Maximize employment*
1	Rice production (million t)	2,567	1,821	1,195
2	Income (billion VN dong)	3,887	5,130	4,180
3	Labour use (million labour-days)	50.5	63.9	79.3

* no target for rice production.

With recently updated input data and information, the picture looks slightly different. As mentioned above, the price for exported rice has changed and the reduction in rice exports has led to a change in policy. Rice production is not as strictly fixed as it used to be and policy favours diversification to boost farmers' income. The stakeholders are looking for an optimal compromise scenario that gives priority to maximizing income rather than rice production. Results for this revised scenario show that, when income is maximized, a total rice production of about 1.8 million tons is achieved (Table 2.2).

Stakeholders comments and conclusions from preliminary results

Comments made will require expansion of the existing Land Use Planning and Analysis System (LUPAS) . The issues raised include among others:

- At the regional level, how to arrive at a compromise option from the multiple goal analysis that satisfies the majority of the stakeholders rather than only identifying the degree of the conflicts.
- How to identify and analyse conflicts in resource management among different decision levels, i.e., regional, district and farm.
- How to incorporate variations in certain factors at different levels in LUPAS, for example, variations in international rice prices.
- To operationalize the LUPAS methodology, cooperation between research organizations and management agencies would need to be strengthened;

2.3 Check against list of deliverables

Table 2.3 Work package, list of deliverables and their status on 1 December 2002			
No	**Deliverable title**	**Deliverable date (month)**	**Status (after 12 months)**
	WP 1 Regional analysis of conflicts in resource use		
D1	Land evaluation and resource supply and demand analysis carried out for study area : Pujiang county, Zheijang province, China.	***10***	**Land evaluation (GIS) – basic maps generated**
D2	Regional model output on resource use analysis generated and documented for study area: Batac and Dingras municipalities, Ilocos Norte Province, Philippines.	***10***	**output available for province as a whole**
D3	Regional model output on resource use analysis generated and documented for study area: Omon district, Can Tho Province, Vietnam.	***10***	**output available for province as a whole**
D4	Land evaluation and resource supply and demand analysis carried out for study area: Tam Duong district, Vietnam.	***10***	**Complete set of maps available**
D5	Major resource conflicts and constraints for the four study regions identified, interpreted and documented (project report).	***12***	**Documentation in progress**
	WP 2 Analysis of yield gaps and climate-induced risks		
D6	Potential and actual production levels for relevant production systems in the four study regions assessed and their temporal and spatial variability quantified (database).	15	**For 2 regions actual yields available. Temporal yield variability quantified for rice**
D7	Main yield–limiting factors (bio-physical) under prevailing climatic conditions identified; frequency analysis of adverse climatic events carried out and farmers' adjustment. strategies to climate-induced risks assessed.	18	**Yield-limiting factors identified**
	WP 3 Technical coefficient generation		
D8	Pujiang county: Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	20	**Input – output database for current systems established for 2 sites**
D9	Batac /Dingras : Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	20	**Input – output database for current systems established; some checks required**
D10	Omon district: Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for	20	**Input – output database for current systems**

	generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.		**established**
D11	Tam Dao (Tam Duong district) : Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	20	**Farm survey on input – output relations in progress**
D12	Technical coefficient generators for Pujiang, Batac, Omon and Tam Dao developed, tested and applied; input-output database generated.	24	**Technical coeff. generator for Batac/Ilocos Norte designed**
D13	Technical coefficient generators for Pujiang, Batac, Omon and Tam Dao documented with detailed description of theoretical background and application for one case, Batac/Dingras (Technical Bulletin).	30	**Draft on Prototype Technical coeff. generator for Batac/Dingras – available**
	WP 4 Farm household model development		
D14	Pujiang county: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed .	24	**No**
D15	Batac and Dingras municipalities: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed.	26	**No**
D16	Omon district: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed .	24	**In progress**
D17	Tam Dao : Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed.	26	**No**

D28	Project progress reports (annual), technical reports, brochures, research reports and case study synthesis report published; scientific papers (2-3) submitted.	48 ***(1 planning workshop proceedings; 1 set of training materials; project website)***

References

Lai, N.X., Jansen, D.M., Hoanh, C.T., Hoa, V.T.K., Nghiep, H.V., Hung, P.Q., Tuan, T.Q., 2000. Developing and applying the SYSNET methodology to explore land use options in Can Tho Province, Vietnam. In : R.P. Rötter, H. van Keulen, A.G. Laborte, C.T. Hoanh, H.H. van Laar (Eds.), Systems research for optimizing future land use in South and Southeast Asia. SYSNET Research Paper Series No. 2, p. 105-115

Lucas, M.P., Pandey, S., Villano, R.A., Culanay, D.R., Obien, S.R., 1999. Characterization and economic analysis of intensive cropping systems in rainfed lowlands of Ilocos Norte, Philippines. Experimental Agriculture 35: 1-14.

3 Progress made from January to March 2003

3.1 Overview

The period from January to March 2003 was mainly devoted to completing the collection of data for land evaluation/GIS, carrying out, entering and analysing detailed farm household survey data, and to preparing the in-country workshops. Progress by Wageningen UR partners was related to further developing and documenting the technical coefficient generator (TechnoGIN). This included, for instance, expansion of the system by training modules, and adding routines, and charts for visualizing results from nutrient balance calculations (as illustrated in Section 3.2). As for LP model (MGLP and FHM) development, a prototype regional IMGLP for Tam Duong district was developed by NISF – its main structure and features are summarized in Section 3.3, below. Furthermore, some basic farm household models were developed for Batac (Ilocos Norte, Philippines) and for Omon district (Cantho, Vietnam). Both, however, still require major revision and supplementation – to be tackled during and immediately after the in-country workshops.

3.2 Additional feature in TechnoGIN : Nutrient flow chart

Nutrient flows and assumptions

Flows of nitrogen, phosphorus and potassium into and out of the system, and between different components (organic and inorganic nutrient pools, plants and animals) of the land use system are illustrated in Figure 3.1. In TechnoGIN, these flows are calculated per season, based on soil properties (clay content), precipitation, crop characteristics, management efficiency, etc. Some of the included nutrient flows are expected to have little influence on the total balance of the systems (irrigation, free living N-fixation, capillary rise, dissolution sedimentation), and other flows are assumed to be in balance (run-off/ run-on, erosion/ sedimentation, immobilisation/ mineralization). They are included for evaluation and consistency of the model. The yearly mineral fertiliser applications are calculated in a way that makes sure that the inflows in the mineral and organic pools are equal to the outflows out of the pools, so that the fertiliser applications and target yields can be repeated for many years without mining the soil or building up a nutrient reserve in the pools. Most parameters for the transfer functions that calculate the different flows are read from the Nutrient sheet. All flows are calculated in kilograms.

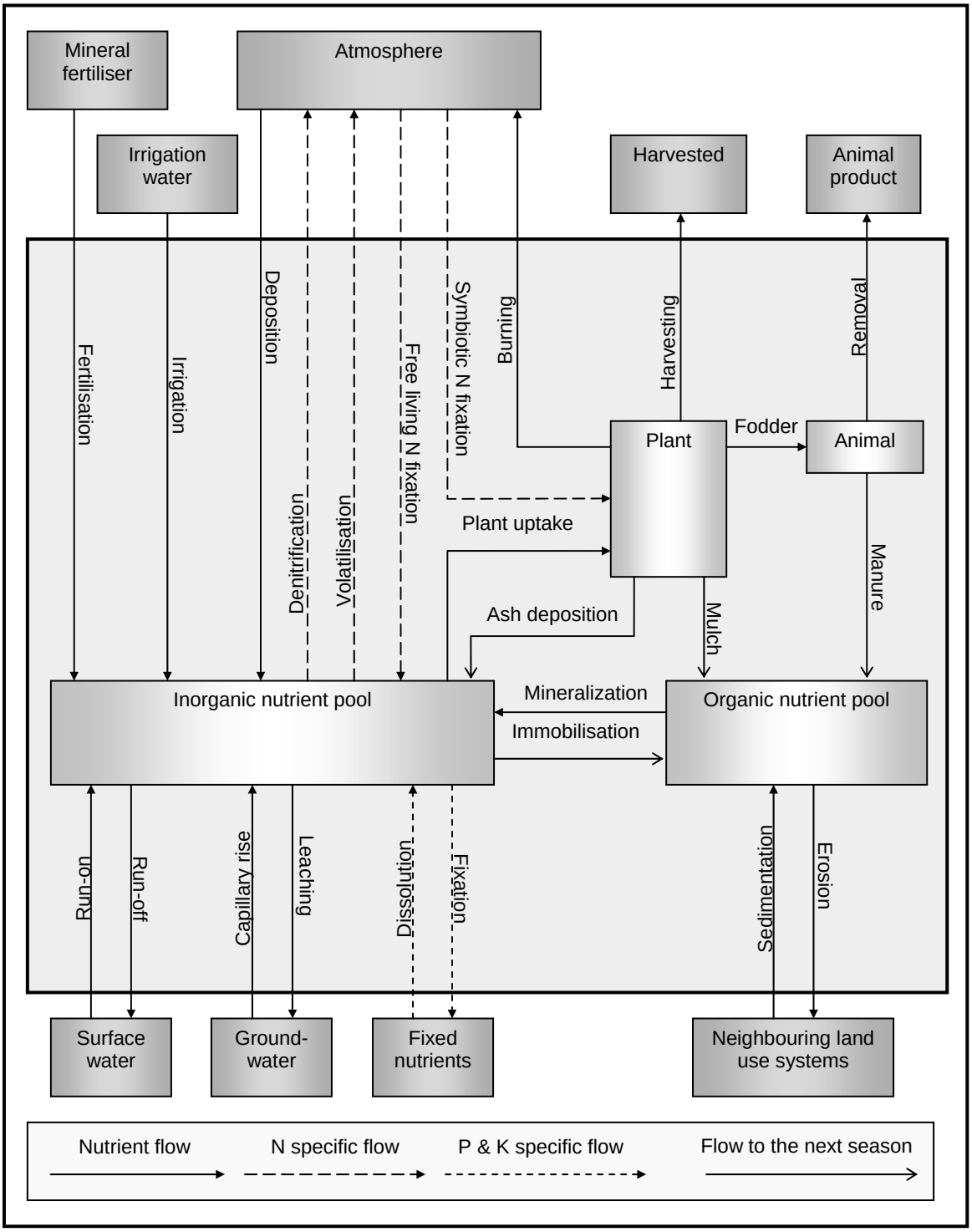


Figure 3.1. Nutrient flows in and out of a cropping season in a land use system and between its components

3.3 An IMGLP model for Tam Duong : Basic elements and some results

3.3.1 Basic elements

Problems and regional objectives as identified by stakeholders in earlier consultations :

Overall strategy	Direct objectives	Comments
- Develop sustainable agricultural system - Industrialization/moder-nization - Diversification/specialization within the region	- Increase income (farmers'and regional) - Increase production and quality of products - Improve quality of natural resources - Reduce poverty	- Economic growth - Food self-sufficiency - Environmentally sound cultivation practices - Environmental protection - Poverty eradication

Based on this assessment, it was decided to consider, in a first approach to regional multiple goal analysis, food production and income generation as major objectives, and water, labor, capital, and various product related targets as constraints.

Size of the model:

Crops	22
Cropping seasons	3,
Land Use Types	44
Land Use Type xTecnologies	226
Objectives	2 major
Resource constraints	4
Land unit schemes/options	2 (Opt 1 : 209 LU ; Opt 2: 229 LU)

Basic maps were generated for land resource evaluation for Tam Duong district (Figure 3.2).

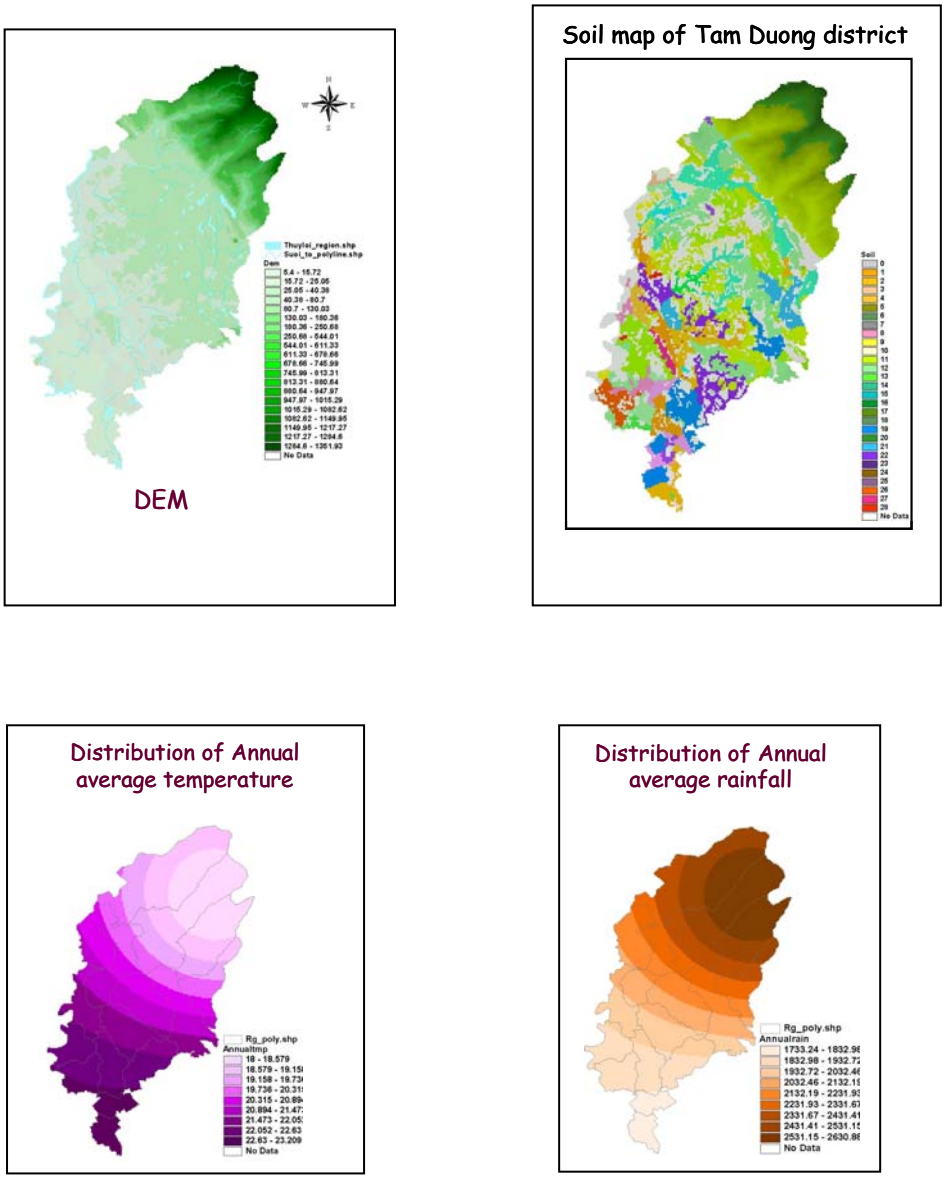


Figure 3.2 Maps for Tam Duong district: a) Digital elevation model, b) Soil Map, c) Annual mean temperature map, d) Annual mean rainfall map.

3.3.2 Some results

Scenario V 1 : Maximizing income from agriculture (with actual production targets 2001 imposed as goal restrictions) :

No	Item	Unit	2001 (actual)	Model
1	Spring rice	ha	4.243	3.474
2	Summer rice	ha	4.960	5.434
3	Corn	ha	2.015	1.572
4	Cassava	ha	300	231
5	Groundnut	ha	390	290
6	Soybean	ha	503	382
7	Greenbean	ha	10	6
8	Fruit (litchi, longan,mango, pinneapple)	ha	1.233	600
9	Tea	ha	28	11
10	Potato	ha	3	2
11	S. Potato	ha	1.386	586
12	Taro	ha	14	12
13	Vegetables	ha	823	9.566
14	Sugarcane	ha	121	103
15	Meat (pork)	ha	-	-

3.4 Deliverables produced between December 2002 and March 2003

No	Deliverable	Status (at month 16)
	WP 1 Regional analysis of conflicts in resource use	
D2	Regional model output on resource use analysis generated and documented for study area: Batac and Dingras municipalities, Ilocos Norte Province, Philippines.	**Batac is completed, Dingras in progress – output available for province as a whole**
	WP 2 Analysis of yield gaps and climate-induced risks	
D6	Potential and actual production levels for relevant production systems in the four study regions assessed and their temporal and spatial variability quantified (database).	**For 3 out of 4 regions data on actual production available (farm surveys)**
D7	Main yield–limiting factors (bio-physical) under prevailing climatic conditions identified; frequency analysis of adverse climatic events carried out and farmers' adjustment. strategies to climate-induced risks assessed.	**Yield-limiting factors identified for all; frequency analysis carried out for Batac/Dingras and Omon**
	WP 3 Technical coefficient generation	
D11	Tam Dao (Tam Duong district) : Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	**Farm survey on input – output relations carried out – data need to be entered**
D12	Technical coefficient generators for Pujiang, Batac, Omon and Tam Dao developed, tested and applied; input-output database generated.	**Technical coeff. generator for Batac developed – testing is in progress**
D13	Technical coefficient generators for Pujiang, Batac, Omon and Tam Dao documented with detailed description of theoretical background and application for one case, Batac/Dingras (Technical Bulletin).	**TechnoGIN documentation version Jan 2003 completed**
	WP 4 Farm household model development	
D16	Omon district: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed .	**In progress – base model Omon is available**
D20	Different farm types, Omon district: Objective functions defined, resource availability and quality quantified, additional technological options defined and integrated, socio-economic environment defined, and FHM results generated under current policy .	**Started**

D28	Project progress reports (annual), technical reports, brochures, research reports and case study synthesis report published; scientific papers (2-3) submitted.	***1st annual report, 1 technical report, 1 paper submitted and website updated***

Available tangible outputs by March 2003 (associated with deliverables 6, 8-10, 12-13, 16 and 28) include:

- Spatial (GIS) databases and maps on resource availability and quality for Pujiang, Tam Duong, Batac/Dingras and Omon
- Climatic databases for all and daily weather databases for Pujiang, Batac/Dingras and Omon
- Potential yield estimations (crop simulations) for Batac/Dingras and Omon
- Databases (in Excel) on actual yields and input – output relations for Pujiang, Omon (series of years) --- raw data (farm surveys) for Tam Duong and Batac/Dingras
- Soil databases for Batac/Dingras (Ilocos Norte), Omon and Tam Duong
- Prototype technical coefficient generator (TCG) and documentation for Ilocos Norte
- Prototype regional IMGLP for Pujiang and Tam Duong (and regional models for Ilocos Norte and Cantho – programmed in XPRESS-MP)
- Prototype farm household (base) – programmed in GAMS - model for Omon.
- Scientific Papers produced by IRMLA team members :
    1) Van Ittersum, M.K. et al. A systems network (SysNet) approach for interactively evaluating strategic land use options at sub-national scale in South and South-east Asia (Submitted to Land Use Policy)
    2) Van den Berg, M.M. & G Kruseman, Studying technological improvement in smallholder farming in less-favoured areas - to be presented at Durban/South Africa, August 2003.
    3) Lu Changhe et al., A scenario exploration of strategic land use oprions for the loess plateau in northern China (submitted to Agricultural Systems)

    These files are available on the IRMLA website as downloadable zip files (password protected).

4 Results from stakeholder meetings and joint working sessions

Objectives formulated prior to the workshop:

- To consult with the stakeholders on land use and resource management issues, with particular attention to regional development goals, priorities of different stakeholders, policy views and measures, future scenarios, objectives and constraints;
- To present capabilities of the methodology and data requirements and discuss the procedure of exchanging data and results
- To foster collaboration between the Asian and European IRMLA teams by working together on the design and integration of the components of a decision support system for multi-scale land use planning

The expected output from the in-country workshops were thus three-fold:

1) Land use and natural resource management problems and agricultural development goals for the study region have been clarified - through intensive *stakeholder consultations* and subsequently the findings have been translated into an (multiple goal) optimization problem
2) The understanding of the appropriate methodology (concepts and tools) to be applied for the study has been deepened, and a thorough discussion of a suitable (basic) model framework and structure for analyzing future land use options (and required policy measures) has been conducted.
3) Required data, appropriate techniques and procedures, responsibilities have been identified and screening the available information in that context has been conducted – in joint *team working sessions* in order to combine local with international expertise; based on this assessment, workplans for the coming year have been determined and documented

In the subsequent sections, along these lines the major results from stakeholder meetings and joint team working sessions are summarized for each case study region/national team. More comprehensive documentation of stakeholder meetings, discussions and presentations is given in Annexes C-F.

4.1 Report from workshop at Zhejiang University, Hangzhou

IRMLA Workshop on Multi-scale Land use analysis and Planning in Pujiang county, Zhejiang province was held at Zhejiang University, Hangzhou, P.R. of China, 31 March to 4 April 2003

For complete information on this IRMLA workshop, see Annex E.

4.1.1 Presentations

During the opening session presentations were given on the following topics:

- Urgent need for land use planning for sustainable land use in Zhejiang province due to its high population and limited land resources and the expectations about the IRMLA project with respect to new approach in land use planning and fostered cooperation between Zhejiang university and Wageningen university (by Prof. Huang Changyong (former Dean of ZU) and Prof. Wu Cifang (Deputy Dean of Environmental and Resource Sciences of ZU))
- Objectives of the IRMLA project, main actvities carried out so far and expected project outputs (by Prof. Wang Guanghuo (IRMLA teamleader of ZU))
- Overview of research approach within IRMLA and of the kind of information that can be provided to policy makers and planners with the IRMLA approach. Stake holder involvement is a main aspect of IRMLA. Example of this approach is given, using case study for Ilocos Norte province in the Philippines as an example (by Dr. Reimund Roetter (IRMLA project coordinator))
- Characterization of land use and agriculture in Zhejiang Province. The main cropping and farming systems, environmental problems, legislation and government policies were discussed which indicated the need for improved land evaluation and planning (by Prof. Xiao Dongsun (Deputy Director, Zhejiang Agricultural Bureau))
- Overview of land use issues and natural resource management in Pujiang county (by Dr. Huang Ting (Director agricultural bureau Pujiang))

These presentations were followed by a general discussion. The main topics of this discussion were a) suitability of proposed crops (e.g. new crops and/or expansion of certain crops; b) major problems and objectives of farmers (e.g. instability in the agricultural systems due to weather variability and/or price uncertainty); c) possibilities for credit and agricultural investment; d) major development objectives of government (high quality, high efficiency, high yield, high safety, high ecology).

4.1.2 Outcomes

Team achievements (by Dr Wang Jiangdi, ZU)

Collected information and maps for Pujiang county:
a. Resource assessment/land evaluation
b. Soil map
c. Isoline map (DEM)
d. Slope
e. Administrative map – townships
f. Current land use

Agreements on exchange of data and information on Pujiang county

a. Resource evaluation; land suitability map (qualitative)

b. Information on specific rules and regulations that may affect future land use options:
   - Land use act: which areas 'reserved' for agriculture;
   - Environmental protection recommendations/standards: which 'biocides' not permitted anymore;
   - Land use planning: (some) peri-urban areas to be (co-)developed for recreation/nature development;
   - Sloping land above a certain steepness to be taken out of production, reforested.

c. List of data requirements and information needs checked by IRMLA team and additional information requirements specified and communicated for new information research.

4.1.3 Workshop Participants ZU

International Scientists:

No.	Name	Position	Organization
1	Dr. Herman van Keulen	Crop /livestock ecologist, land use systems analysis	Wageningen Univ, and Plant Research International, The Netherlands
2	Dr. Reimund Roetter	Crop ecologist, land use systems analysis	Alterra, Wageningen UR, The Netherlands
3	Dr. H Hengsdijk	Agronomist, land use systems analysis	Plant Research International Wageningen, The Netherlands
4	Dr. Lu Changhe	GIS specialist, land use modeller	IGSNRR, Beijing and Wageningen University, The Netherlands

Local stakeholders:

No.	Name	Organization	Position
1	Prof. Xiao Dongsun	Zhejiang Agricultural Bureau	Deputy Director
2	Mr. Wu Guocheng	Pujiang county	Vice Mayor
3	Mr. Huang Ting	Pujiang Agricultural Bureau	Director
4	Dr. Wang Yuangao	Zhejiang University	Scientist of Land use planning and information techniques
5	Prof. Ding Xianghai	Jinhua Agric. Tech. Exten. Station	Director
6	Prof. Hu Xijun	Zhejiang Normal University	Head of Department of City planning

ZU Scientists and IRMLATeam Members:

No.	Name	Organisation	Position
1	Prof. Chen Yingxu	Zhejiang University	Deputy Dean
2	Prof. Huang Changyong	Zhejiang University	Scientist of Soil and environmental chemistry
3	Prof. Wang Guanghuo	Zhejiang University	Scientist of Soil science and fertility
4	Dr. Wang Jiangdi	Zhejiang University	Scientist of GIS and Land use planning
5	Mr. Fangbin	Zhejiang University	Ph. D student
6	Mr. Hu Hong	Zhejiang University	Ph. D student

7	MS Zhang Qichun	Zhejiang University	Ph. D student
8	MS Lei Hanyun	Zhejiang University	MSc student
9	Ms Xie Wenxia	Zhejiang University	MSc student

4.2 Report from workshop at NISF, Hanoi

IRMLA Workshop on Multi-scale Land use analysis and Planning in Tam Duong district, Vinh Phuc province was held at National Institute for Soils and Fertilisers (NISF) at Hanoi, 4 to 8 April 2003. The land use analysis work of the NISF team within IRMLA is focussed on the Tam Duong district. For complete information on this workshop, see Annex C.

4.2.1 Presentations

During the opening session presentations were given on the following topics:

- Introduction about the role of the IRMLA project for land use planning in Vietnam and the intended use of the IRMLA approach within NISF (by Dr. Bui Huy Hien (Director of NISF))
- Introduction to the objectives of the IRMLA project, the main activities carried out so far, and the expected outputs of the IRMLA project (by Dr. Tran Thuc Son (Vice-director of NISF, IRMLA team leader)
- Overview of research approach within IRMLA, the types of scenarios that can be analysed, and the kind of information that can be provided to policy makers and planners by the IRMLA approach (by Dr. Reimund Rötter, IRMLA project coordinator)
- Overview on land use, cropping and animal production systems, and socio-economic characteristics in the Vinh Phuc province. Main objectives and limitations for agricultural development in Vinh Phuc province and the provincial plans on agricultural development and land use were discussed (by Dr. Van Quy, Provincial head of Agric. Station)
- Overview on land use, agricultural production, objectives for agricultural development over the coming 20 years, and socio-economic characteristics of the Tam Duong district (by Dr. Nguyen Van Ngoc, Head Dep. Agric. & Rur. Dev.)

These presentations were followed by plenary discussions. The main topics of these discussions were: a) Land use planning and possible conflicts between sectors; b) Planning process and coordination between national, provincial and district level; c) Expected changes in contribution to GDP from agriculture, industry and services; d) Water resources and shortage in Tam Duong district; e) Planned increase in food grain production in Tam Duong district; f) Planning process in Tam Duong district.

4.2.2 Outcomes

The major problems for the farmers in Vinh Phuc province and the resulting objectives for agricultural development were discussed. These also apply for the Tam

Duong district. These results are used for formulating and prioritizing major development objectives and for determining targets and constraints in the optimization model for agricultural development in the Tam Duong district.

Goals

- Improved irrigation systems
- Improve safety and quality of agricultural products to allow export
- Increase in production
- Marketing cooperatives
- Training especially in INM and IPM
- Increase in farm income
- Improve quality of natural resources and reduce environmetal pollution
- Reduce poverty

List of possible land use and resource management problems:

- poor soils
- limited irrigation systems
- poverty
- low education
- marketing
- land/labour ratio very low (500 m^2 per capita)
- post harvest
- policy
- bad quality of vegetables

List of agricultural development objectives for Vinh Phuc province:

- change from 64% of relative income from crop production to 48 - 50% after 2005
- change from 26% of relative income from livestock production to 35-38% after 2005
- 6 main commodities (rice, maize, mulberries, vegetable, fruit tree, flower)
- to produce 400,000 t grain food per year (i.e. mean yield level of 5.3 t/ha for rice and 4.1 t/ha for maize)
- maintaining the area of agricultural land but decreasing the grain/rice area
- 3000 ha of mulberries in total (increase from current: 2000 ha)
- 500 ha flower and bonsai
- 60-100 ha with environment-friendly produced (organic) vegetables
- 1000 ha tree cultivation (forestry)
- 1500- 2000 ha for fish and shrimp with 20,000 t total annual production
- 10,000 cows and 10,000 pigs in 2020
- 2313 billion VND income value per year from agriculture and fishery after 2005

For further information on the presentations and discussions during the workshop, see Annex C. Additional information, such as Powerpoint-files with information on land use and natural resources in Tam Duong district and Vinh Phuc province, is on

the attached CD-ROM. A detailed table of contents of the CD-ROM is given in Annex G.

A Workplan formulated for the coming year at the end of the workshop, and details of the team with responsibilities for the various tasks are both given in Chapter 5.

The participants of the workshop (scientists and local government representatives) are listed in the subsequent section.

4.2.3 Workshop Participants NISF, April 2003

International Scientists:

No.	Name	Position	Organization
1	Dr. Reimund Roetter	Project coordinator	Altera, the Netherlands
2	Dr. Marrit van den Berg	Economic Specialist	Wag.Univ., the Netherlands
3	Dr. Lu Change	GIS Specialist	Chinese Academy of Science
4	Dr. Huib Hengstdijk	Agronomic Specialist	PRI, the Netherlands

Local stakeholders (Vinh Phuc Province or Tam Duong District):

No.	Name	Position	Organization
1	Nguyen Van Quy	Head Agronomic station	Div. Agric. & Rural devel., Prov.
2	Do Hai Trieu	Scientist	Agronomic station, Prov.
3	Nguyen Van Nam	Scientist	Agronomic station, Prov.
4	Nguyen Van Loc	Vice-Director	Div. Land Management, Prov.
5	Nguyen Thi Thanh Huong	Scientist	Div. Land Management, Prov.
6	Nguyen Trong Niem	Scientist	Div. Land Management, Prov.
7	Nguyen Hong Quan	Scientist	Div. Agric. & Rural devel., Prov.
8	Nguyen Viet Xuan	Scientist	Div. Agric. & Rural devel., Prov.
9	Nguyen Van Ngoc	Head	Dept. Agric. & Rural devel., District
10	Nguyen Quoc Oanh	Scientist	Dept. Agric. & Rural devel., District
11	Vu Phi Hung		Extension service, District

NISF – Scientists and IRMLATeam Members:

No.	Name	Position	Department / Team= T
1	Bui Huy Hien	Director	
2	Tran Thuc Son	Vice Director / Teamleader	T
3	Pham Quang Ha	Head	Dept. Soil Environment
4	Ho Quang Duc	Head	Dept. Soil Genesis/Classif./GIS
5	Bui Quang Xuan	Head	Dept. Planning & Science Manag.
6	Nguyen Cong Vinh	Head	Dept. Land Use Planning
7	Nguyen Van Chien	Deputy Head	Dept. Plant Nutrition
8	Nguyen Van Truong	Deputy Head	Dept. Soil Properties
9	Vu Manh Quyet	Scientist	Dept. GIS / Land Evaluation
10	Nguyen Van Dao	Scientist	Dept. GIS / Land Evaluation
11	Nguyen Van Ga	Scientist	Economics (under GIS Dept.)
12	Luong Duc Toan	Scientist	Dept. GIS
13	Pham Duc Thu	Scientist	Dept. Economics
14	Le Thi My Hanh	Scientist	Dept. Economics

15	Tran Thi Minh Thu	Scientist	Dept. GIS
16	Vu Dinh Tuan	Scientist	Dept. GIS
17	Nghiem Thu Hien	Scientist	Dept. GIS
18	Nguyen Quoc Hai	Scientist	Dept. Soil Properties
19	Le Thi My Hao	Scientist	Dept. Plant Nutrition
20	Vu Nguyen	Scientist*	Dept. Mathematics / GIS

* scientist at VASI

4.3 Report from workshop at CLRRI, Omon

IRMLA Workshop on Multi-scale Land use analysis and Planning in Omon district, Cantho province was held at Cuulong Delta Rice Research Institute (CLRRI) at Omon, 9 to 12 April 2003. The land use analysis work of the CLRRI team within IRMLA is focussed on the Omon district. For complete information on this workshop, see Annex D.

4.3.1 Presentations

During the opening session 4 presentations were given on the following topics:

- Importance of IRMLA project and research approach from the perspective of CLRRI (by director Dr B.C. Buu)
- Results from previous studies and capability and limitations of proposed methodology (Dr N.X. Lai and Dr R.P. Roetter)
- Land use and development plans for Cantho Province
- Land use and development plans for Omon District

These were followed by comprehensive plenary and group discussions, which ultimately focused on identifying a) major development goals and targets for the province, and b) major problems and objectives for the farmers in Omon district. Subsequently, the task was to formulate and prioritize major development objectives, and targets and constraints for the short (2010) and medium term (2015) at regional and farm level and translate this into scenarios to be subjected to multiple goal analysis (LP optimization problem).

4.3.2 Outcomes

Goals and targets for the Cantho province

- Rice production: to produce at least 2 Mio tons per year; current level is 2.2 Mio tons (rice exported was 600,000 t and rice for local consumption amounted to 1,6 Mio tons)
- Environmental aspects: Food safety (less pesticide residues) → reduction of input use (biogas is promoted); improved waste treatment
- Employment: Increase employment in general and maintain certain level of job opportunities in agriculture (try to restrict movement from rural to urban areas). Note: there is hope to reduce problem of unemployment by 2010; currently there

are some contrary tendencies: for some areas, introduction of new technologies (mechanization) will decrease employment opportunities; however, still in other areas the introduction /or switch to high-intensive , high value agricultural activities will increase job opportunities

Group discussion followed, wherein a list of possible problems was presented, from which to select and prioritize the ones applying to Omon district.

List of possible land use and resource management problems:

- Poor soils
- Unemployment
- Availability of good quality fertilizers
- Pests and diseases
- High variability in yields
- Limited irrigation systems
- Limited availability of good drinking water
- Low education
- Marketing
- Little land per capita
- Post harvest losses
- Bad/limited government policy
- Bad quality of agricultural products
- Unhealthy food crops
- Farmer health problems due to biocide use (spraying)
- Bad roads
- Labor scarcity during peak season
- Food insecurity
- High variability in input prices
- High variability in output prices
- No investment capital/credit (for example to buy machines or plant trees)
- No working capital/credit (for example to purchase fertilizers)
- Knowledge about new technologies (with farmers)
- Availability of appropriate technologies (at research stations/with good farmers)

List of possible agricultural development objectives :

- The province/district should produce enough food for its people
- The region should produce healthy food
- Each individual should have enough to eat, either through own production or through market purchase with cash income
- Livestock production should be animal friendly
- Income per hectare should increase
- Income per capita should increase
- The poor should become richer
- Drinking water should be clean
- Agricultural production should not harm wildlife

- There should be employment for everyone
- Production methods should not harm the health of the farmer

Results from these group discussions led to formulation and (during working sessions, see below) partial realization of a basic, prototype farmhousehold model with the following characteristics:

a. Objectives :
- income
- stability (price fluctuations)
- leisure
- food security: rice (30%-50% sell everything and buy rice, no or little storage place in rainy season quality reduces) not all farmers grow rice
- health/environment??? Most farmers do not care.

This combination of objectives implies that we need to estimate a utility function based on survey data on income, leisure, and consumption.

b. Constraints that are in the model :
- land
- family labor
- cash & credit for inputs (should include renting of dryer). ***Not all growing seasons are parallel (2 crops and 3 crops). We should find a way to consider this in the liquidity and credit constraints.***
- capital for investment
- availability of off-farm and non-farm employment

c. Constraints that are not yet in the model :
- education, knowledge of new technologies. In the model this translates in the availability of technologies for the different farm types;
- market: difficult to sell large amounts, infrastructure does not allow sale of some crops for farmers in remote areas. In the model this translates in maximum sales levels and low or zero prices.
- labor hiring in peak season: harvesting especially in wet season. In the model this translates in upper boundaries for hiring in certain months.

Notes :
- farmers consider last-year prices when making decisions
- most important changes: different rice varieties
- few fruit plantations, conditions not favorable, limited skills
- renting in land: 10%, renting out land 10%?. ***Depending on the outcome of the survey, we either consider actual land cultivated or land ownership and the possibility to rent in/out land.***
- Good quality rice (for export) is more expensive to produce and the farm-gate price is only somewhat higher. So it is currently not profitable for the farmer.
- No tax on agricultural production and land

- Around 10% of the households get remittances from family members in city or abroad. *Currently, the model includes exogenous working capital. This is assumed not to be used for consumption, but to be saved as working capital for next year. Remittances are an exogenous source of income that can also be used for consumption. So we should include this in the model as a separate parameter.*
- Double cropping systems have different seasons than triple cropping systems! *See cash & credit constraints*
- low prices are a problem for many farmers
- village leader can encourage farmers to do some things by giving information, e.g. grow upland crops. *You can mimic this in your model by increasing the set of available technologies.*

Joint team working sessions concentrated on inventory of work carried out so far and on hands-on training on the following components of the multi-scale land use analysis methodology (and techniques):

- assessment of natural resource availability in time and space /land evaluation (GIS)
- generation of technical coefficients for the various current and alternative future production activities (incl. training on TechnoGIN expert system)
- formulation of multiple goal (LP optimization) model using GAMS software

Work carried out so far on Omon case study

During the joint working sessions, presentations were made by the CLRRI team on the status of work carried out on the various MGLP (model) components. Most of the work done related to the resource assessment /land evaluation part. Furthermore, based on the provincial MGLP model developed in an earlier project (LUPAS-Cantho), a modified version for Omon XPRESS-MP had been prepared:

- resource assessment /land evaluation Five maps of Omon district were collected and digitized including administrative, inundation, soil, present land use and road and canal system maps.
- 25 biophysical land units were delineated by combination of soil, water flooding depth and flooding duration.
- Collecting and digitizing statistical data on socio-economic condition. The collected data include agricultural production, population and labor, policy related to agricultural development.
- Modifying Omon district LUPAS based on provincial (Cantho) LUPAS.

For illustration, the soil and inundation maps for Omon district are given here (Figure 4.1).

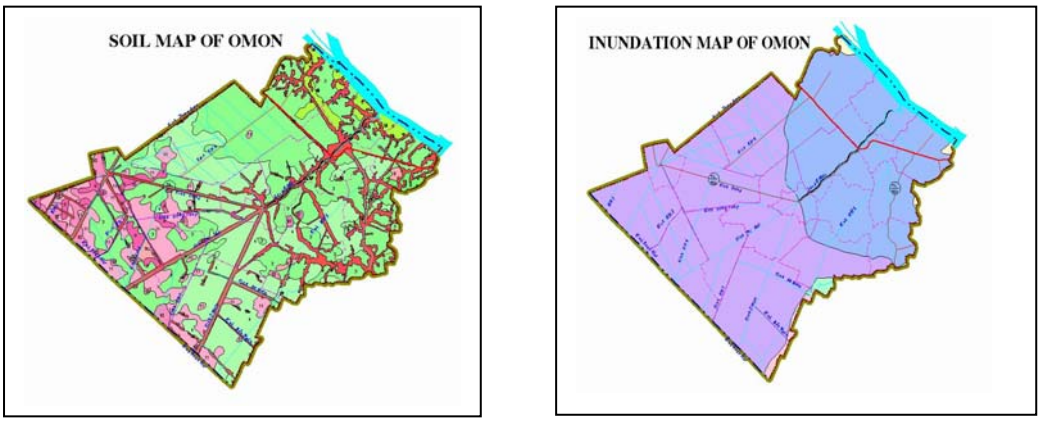


Figure 4.1 Soil and Inundation maps for Omon district

The preliminary agro-ecological unit map (now containing 25 units) will be further generalized, combining map units that don't differ too much in bio-physical potential and land suitability for the major crops /production systems in Omon district

Further data generated and model modification realized during the team training sessions are contained on the attached CD-ROM with results from the IRMLA In-country workshops, April 2003. A detailed table of contents of the CD-ROM (list of the files with description of their contents) is given in ANNEX G.
A Workplan formulated for the coming year at the end of the workshop, and details of the team with responsibilities for the various tasks are given in Chapter 5.

The participants of the workshop (scientists and local government representatives) are listed in the subsequent section.

4.3.3 Workshop Participants CLRRI, April 2003

International Scientists:

No.	Name	Position	Organization
1	Dr. Reimund Roetter	Project coordinator	Altera, the Netherlands
2	Dr. Marrit van den Berg	Economic Specialist	Wageningen, the Netherlands
3	Mr. Micheal Crestani	Ph.D. scholar	Melbourne University, Australia
4	Mr. Daniel Kayser	M.Sc. scholar	Utrach, the Netherlands

Local stakeholders:

No.	Name	Position	Organization
1	Nguyen Van Dien	Deputy head of Eco. Office	Deprt. of Planing and Investment
2	Nguyen Tan Hung	Deputy head of General Cooperation Office	Deprt. of Planing and Investment
3	Le Minh Lam	Economic specialist	Omon People Committee
4	Ngo Hong Yen	Head of Agri. Section	Omon District
5	Huynh Thanh Han	Agri. In Charge	Thoi Long Village, Omon District

CLRRI - Project Team Members:

No.	Name	Position	Department
1	Nguyen Xuan Lai	Head	Agricultural Economics Deprt.
2	Nguyen The Cuong	Computer Specialist	Sci. Man. & Inter. Coop. Deprt.
3	Nguyen Duc Loc	Agri. Economist	Agricultural Economics Deprt.
4	Nguyen Hong Thao	GIS & Land Management	Agricultural Economics Deprt.
5	Nguyen Huynh Phuoc	Agri. Economist	Agricultural Economics Deprt.
6	Nhan Hong Hoa	Computer Specialist	Sci. Man. & Inter. Coop. Deprt.
7	Hoang Dinh Dinh	Deputy Head	Extension Department
8	Nguyen Van Quyen	Agronomist	Fert. and Agronomic Deprt.
9	Ho Xuan Thien	Plant Pathologist	Plant Protection Department
10	Nguyen Duc Hanh	Computer Specialist	HCM National Technology Center
11	Truong Thi Ngoc Chi	Social-economic	Farming Systems Department
12	Tran Thi Ngoc Huan	Agronomist	Fert. and Agronomic Deprt.

CLRRI scientists:

No.	Name	Position	Department
1	Bui Chi Buu	Director	CLRRI
2	Duong Van Chin	Head	Farming Systems Department
3	Luong Minh Chau	Head	Plant Protection Department
4	Nguyen Van Tao	Head	Rice Seed Production Deprt.
5	Phan Van Tuan	Computer Technician	Director Office
6	Truong Thi Minh Giang	Research Assistant	Farming Systems Department
7	Huynh Hong Bi	Research Assistant	Farming Systems Department

4.4 Report from workshop at MMSU, Batac

IRMLA workshop on Multi-scale Land use analysis and Planning in Batac and Dingras districts, Ilocos Norte province was held at Mariano Marco State University (MMSU) at Batac, 7 to 11 April 2003. The land use analysis work of the MMSU team within IRMLA is focussed on the Batac and Dingras municipalities.

For more information on this IRMLA workshop, see Annex F.

4.4.1 Presentations

During the opening session presentations were given on the following topics:

- growing concern for participation of stakeholders in land use planning and the need for participants to get their ideas across to legislative and executive authorities (by Dr. S. Ocampo, President MMSU)
- objectives of the IRMLA workshop: 1) consultation of stakeholders on land use and resource management issues (e.g. regional development goals, policy views and measures, priorities of different stakeholders); 2) presentation of potential of IRMLA methodology and the required data; 3) fostered collaboration between

Philippine and European IRMLA teams by working together on land use planning system (by Prof. Herman van Keulen and Dr. Martin van Ittersum, Wageningen Univ.)

- Main issues and changes in land use in Ilocos Norte province, such as crop diversification, agricultural intensification, application of high doses of pesticides, application of high (N) fertiliser doses on vegetables, contamination of groun water (by Dr. E. Agustin, IRMLA teamleader at MMSU)
- IRMLA results should be implemented, otherwise useless, hence results should yield practical recommendations (by Dr. Samson, member of Municipal Agriculture & Fisheries Council Batac and Municipal Development Council)
- Information from Provincial Physical Framework Plan, such as present and possibly future land use and crop rotations (by Dr. Agcaoilli, Provincial Planning Office)
- Information on land use activities and resource management issues in Batac district, such as water resources, agricultural production, environmental concerns, etc. (by Engr. Jesse Matac, MPDO Batac)
- Information on development and resource management issues in Dingras district (by Engr. Noel Salvatierra (Municipal Planning Officer) and Engr. Cesar Derrada (Municipal Agric. Office).

These presentations were followed by plenary discussions. The main topics of these discussions were: a) alternative crops in Batac and Dingras districs; b) main problems of farmers in both districts (e.g. high costs of inputs and low prices for most products, labour shortage in 'peak' periods; overproduction of crops); c) needed changes in the agricultural system (e.g. expansion of market, post harvest processing and storage facilities, government support price for rice); d) conflict between long-term quality of natural resources and profitability of cropping systems (i.e. intensification of agricultural system by increasing use of biocides and chemical fertilisers).

4.4.2 Outcomes

A number of main issues in the Ilocos Norte province were formulated for which the implications of their changes were partly analysed. This was mainly done with a preliminary Farm Household Model as designed in the following for the Dingras district.

Issues at farm level :

- What if there will be a policy regulating the use of chemicals (fertilizers and biocides), how will this affect farmers' income and production level (targets)? (Municipal, Farm)
- If there will no longer be fuel available for curing tobacco, what will be the effect on farmers' income? (Farm)
- What is the implication of the promotion of fish culture on resource allocation (land, labor, capital)? (Farm)

- What if animal production (livestock and poultry) is increased, how will this increase affect land, labor use and capital? (Provincial, Farm)
- What is the effect of SWIPs to productivity and farmers' income? (Farm)
- If we promote crop diversification during the wet season cropping, what will be the effect on production of staple food? (Provincial, Farm)
- What is the implication of changes in price of input and output (land, labor use, production)? (Farm, Municipal, Provincial)

Issues at higher level – municipality/region :

- What is the implication of provincial industrialization to agricultural land use (land allocation, agricultural labor and water availability)? (Municipal, Provincial)
- What if post-harvest facilities (cold storage, processing plants) will be introduced, how will this affect farmers' income? (Municipal, Provincial)

Designing a Farm Household Model for a farm in Dingras with required information :
(i.e. Resource characterization and generation of technical coefficients)

A. Farm typology as proposed by team (i.e. farm classification)***:***

a) Farm size: 0.0 – 0.5 ha
0.5 – 1.0 ha
1.0 – 1.5 ha
> 1.5

b) Water availability: Rainfed or irrigated
Supplementary irrigation
NIA (National Irrigation Administration; Dingras)
Province

c) Land/labour ratio: Farm size/family size (average family size: 4 adults + 2 children = 5; land labour ratio: 0.1 - 0.2 - 0.3)

d) Capital: Farm asset ranges (kPesos; land ownership not considered)
0 – 50
50 – 100
> 100

e) Classification of soils: Very good
Good
Average

Poor soils will not be evaluated. Soil classification has to be checked with input/output data from the farm survey and texture data.

In the low altitudes the NIA schedules can be found, and in the middle and upper altitudes rainfed cropping systems can be found with supplementary irrigation from groundwater, creeks and SWIPs (Small Water Impounding Project).

B. Main present and possible future crop rotations :

For example, ***rice-pepper-'green'corn:***
cropping calender:
rice: July 5-November 5
pepper: November 20-March 20 (from transplanting, seedbed three weeks earlier)
greencorn: March 10-May 15 (seeds dibbled in before final harvest of peppers)
yields: rice: 4.5 t/ha
pepper: 6.0 t/ha (dry)
corn: 4.0 t/ha

C. Generation of technical coefficients for selected crop rotations with TechnoGIN. This technical coefficient generator requires a yield estimation. Yield estimation can be based on expert knowledge and/or results from crop growth models (as described below).

Yield estimation

In the current TechnoGIN-version for Ilocos Norte yield estimates are included that were derived from the 1999 (?) agricultural survey in the province. Yields for current activities are set equal to the average yields reported in the survey. Yields for improved technology ('future-oriented') are set equal to the average of the highest 10%-percentile of the reported yields.

More future-oriented yield estimates should be included in the models for Batac and Dingras. Prof. Herman van Keulen presented an approach for quantification of the input-output (i.e. yield estimate) coefficients for agricultural activities. This approach is well-described by van Ittersum & Rabbinge (1997). The conclusion, after some discussion, was that for a limited number of annual crops the WOFOST model[1] (of which a copy is available at MMSU, from the SysNet CDRom) can be used, wheras for other crops for which insufficient data are available, a more simplified LINTUL-type of crop growth model should be applied. There appears to be interest within the team, and particularly with prof. Joselito Rosario, responsible for yield estimation, to follow this approach. Obviously, they need to familiarize themselves with the crop growth simulation approach in general, and with WOFOST and the LINTUL-type approach in particular.

[1] According to Tommie Ponsioen, within SysNet, WOFOST has been applied for approximately 10 crops in Ilocos Norte to explore the yield potentials for these crops and to estimate their yield gap in relation to the maximum yields incorporated in TechnoGIN. I (Herman) cannot remember that I have ever seen a report on these simulations, but obviously whatever has been documented with respect to these activities should be made available to the MMSU-team.

Further information on this workshop is given in Annex F. A Workplan formulated for the coming year at the end of the workshop, and details of the team with responsibilities for the various tasks are given in Chapter 5.

The participants of the workshop (scientists and local government representatives) are listed in the subsequent section.

4.4.3 Workshop Participants MMSU, April 2003

International Scientists:

No.	Name	Position	Organization
1	Dr. Herman van Keulen	Agronomic Specialist	Wageninge Univ, the Netherlands
2	Dr. Martin van Ittersum	Agronomic Specialist	Wageningen Univ., the Netherlands
3	Ir. Tommie Ponsioen	Agronomic Specialist	Wageningen Univ., the Netherlands

Local stakeholders:

No.	Name	Position	Organization
1	Dr. Pete Agcaoili	Scientist	PPDO planning office, Province
2	Dr. Percival Libed	Scientist	OPAG agricult. office, Province
3	Dr. Samson	Scientist	Agric.&Fish.+ Develop.Councils Batac
4	Engr. Jesse Matac	Official	MPDO Batac
5	Engr. Noel Salvatierra	Official	Planning Office Dingras
6	Engr. Merryline Gappi	Official	MAO Agricult. Office Batac
7	Engr. Cesar Derrada	Official	MAO Agricult. Office Dingras
8	Jesus Garcia		NGO

MMSU – Scientists and IRMLA teammembers

No.	Name	Position	Department, Teammember= T
1	Dr. Saturnino Ocampo	President MMSU	
2	Dr. Epifania O. Augustin	Scientist, IRMLA teamleader	Dept. Soil Water Management, T
3	Dr. Stanley Malab	Scientist	
4	Dr. Alice Laborte*	Scientist	IRRI
5	Dr. Ferdinand Aguila*	Scientist	UP Diliman

* collaborator of IRMLA project, not at MMSU.

4.5 General assessment of in-country workshops

This section gives a summary of the status of project progress after completion of the four in-country workshops. It consists of two parts :

a) Characterization of case study prospects from a project management perspective;
b) Scientific assessment : specific outcomes from consultations and components of model development.

Ad **a**) An overview is given in Table 4.1.

Table 4.1: Characterization of research capacity of teams, support from research and local government organizations, main activities and focus in the coming year and required immediate action /intervention

Case study/ partner	Preliminary assessment	Proposed action
Pujiang, ZU	Teamleader (Prof. Wang) with profound international experience in managing complex research projects – at same time, very capable and leading scientist in rice (integrated nutrient & pest management) – with clear understanding and vision of integrated systems analysis - very supportive and accountable; team expertise in components not fully balanced (GIS and MGLP modeling skills strong; skills in expert systems for generating technical coefficients less developed; strong institutional support for study by ZU research managers and local stakeholders/government representatives (key role: Wu Wenyi); technical skills perhaps too much concentrated on one scientist (Wang Jiangdi) – transfer required for agronomic/production ecology knowledge, students depend a lot on comprehensive knowledge and supervision by Prof. Wang – training required.	Dr Lu Changhe (regional co-ordinator) to pay specific attention to this case study and support the team in generating databases for a meaningful regional model -- back-stopping trips immediately after workshop and later (intensive till October); Back-stopping mission Hengsdijk & Van Keulen (late. Oct) on TCs might be required.
Tam Duong, NISF	Both, teamleader and deputies (Dr TT Son and Drs. Ha and Chien) very capable, and well-versed in all aspects of the methodology; very supportive and accountable (note: Dr TT Son and Dr PQ Ha experienced and successful in conducting many international projects ; Dr Son is at the same time Vice Director of NISF) ; strong institutional support and interest from local research managers and stakeholders (province and district); expertise deficits by team so far only in area of developing suitable TCG for non-rice crops – (on-going PhD study might partly bridge that gap); MGLP/FHM group very strong with prospects for further studies (candidate : Tuan) – moreover, interesting link between work on multi-agent modeling – S Boisseau – and IRMLA optimization approach possible through specific post-doc study	Close exchange with team on scientific aspects to stimulate further studies by indiv.team members and in making fast progress – so FHM component can also be realized (Tuan as key person – with study periods at WUR) Support in producing meaningful TCG is required – partly facilitated by stay of NISF PhD student at WUR – follow-up missions Marrit & Huib required early 2004 to provide guidance in model development, and guide extended studies ; contact with S Boissau to be maintained to exchange /integrate LP optimization with multi-agent approach (e.g. role play to examine decision-making processes)
Omon, CLRRI	Teamleader and deputy (Dr NX Lai, and NT Cuong) very capable and supportive; team work culture less developed – team apparently	It is recommeded to closely communicate with Cuong and Lai to further progress –

	a bit overloaded with projects -agronomy expertise under-represented; GIS/land evaluation expertise limited. However, advantage is comprehensive expertise of NT Cuong and Dr Lai – moreover, possible (PhD) research idea was formulated which can exploit a wealth of data for a new way of FHH model application - an innovation of high academic value. Research managers and local (district) stakeholders are supportive – prospect for early implementation of method not yet clear;	further elaboration of PhD proposal – and sourcing of funds required –e.g. WUR and /or Dutch embassy, Vietnam; After WUR workshop, hands-on training on TCG and LP can be largely organized internally ; link to INREF-Pond PhD study on rice-fish systems to be exploited
Batac/Dingras, MMSU	Teamleader (Dr EO Agustin) very capable and supportive & accountable (note: Dr Agustin very experienced in conducting international projects; Dr Agustin is at the same time Director for Research of MMSU); team with strong agronomic expertise – still training required in GIS and simulation modeling; strong institutional support, and from municipal stakeholders; focus of team will be on FHH model and municipality model	It is recommended that individual team members participate in IRRI trainings on simulation modeling and GIS, to regularly communicate with teamleader (and deputy ?) – and, through WUR supervisors, keep in touch with progress made by PhD candidate AG Laborte working on link between FHH and regional models.

Ad **b**) Major purpose of the stakeholder meeting was to identify and prioritize natural resource management and (agricultural) development problems and objectives. This should provide scientists with a sound basis for translating the information in problem-oriented multiple goal analysis problem. This objective was largely realized for the various cases, however, with differing extent of completeness (see the previous sections 4.1 to 4.4 and the summary provided in Table 4.2).

Regarding the outputs from the working sessions, the basic work on resource mapping, farm survey, case study definition in terms of major activities and technologies, and objectives to be included in modeling has been completed. However, in terms of development of model components, substantial differences exist. For all cases, additional information needs to be collected for constructing meaningful scenarios, as indicated by the required follow-up activities (see Table 4.3).

Table 4.2: Scientific assessment : I. Outcome from stakeholder consultations with indication of case study focus and training needs

	Pujiang	**Tam Duong**	**O Mon**	**Ilocos Norte**
Policy objectives	-Maintaining the area of agricultural land -Increasing farm income -Increasing safety and quality of agricultural products -Increase environmentally friendly production -Regional self-sufficiency in rice (Zhejiang does not need to produce rice!) -Economic growth -Maintain/improve attractive landscape near urban areas	-Maintaining the area of agricultural land -Reduce poverty by stimulating economic growth -Increase farm income -Improve safety & quality of agricltural production taking into account the environment -Increase rice productivity -Improve irrigation system -(Decrease grain/rice area) -(Reduce erosion, but this is not (seen as) a major problem)	Goals ordered with team: (1) The province/district should produce enough food for its people (2) Income per capita should increase through high income per hectare (3) Agricultural production should not harm environment (drinking water, farmer health, soil productivity, healthy food) (4) There should be employment for everyone *((5) Each individual should have enough to eat* *(6) The poor should become richer)* Other goals mentioned by policy makers: -Industrialization -Increase interactions between sectors	-Higher income -Maintain Self-sufficiency level in rice -Production targets (for several well-known products) -(Environmental sustainability) Strategy: agro-industrialization & eco-cultural tourism development
Instruments	-Technical support/training -Governmental recommendations -Land use law -???	-Reclamation of unused land for urban areas (by whom??) -Technical support/training/farmer demo's -Improving input access (how??) -Output contracts from public processing units -No government plans for irrigation -???	-fertilizer price subsidies -low export tax -encourage rice storage when price is low -post-harvest processing (by whom???) -irrigation schemes -training & demo sites -subsidized tools & equipment -new roads	-Farmer field schools (IPM) -Putting up of agri-based industries & ready market for produce (who??) -Development of small water impounding projects/small farm reservoirs -??

Constraints/ problems	-How to stimulate farmers to follow recommendations for safe/- environmentally friendly production? -Urbanization, part-time farmers, temporary labor shortage/(high wage rates) -Weather & price variability -High interest rates	-Urbanization, but there seems to be a large labour surplus -How to stimulate farmers to follow recommendations for safe/ -environmentally friendly production? -Market/processing development -Market demand for products puchased/processed by the government -Water constraints in upland/Limited irrigation systems - Poor soils - Poverty - Low education - Land/labour ratio very low (500m2 per capita) - Policy - Bad quality of vegetables and other crops (export)	Major: - High variability in input & output prices - Insufficient investment capital/credit (for example machines/trees) Regular: - Low education - Marketing - Knowledge about new technologies (with farmers) - Little land per capita <1 ha per household - Post harvest losses (in wet season) - Unemployment Somewhat: - Pests and diseases - Limited availability of good drinking water - Bad quality of agricultural products - Unhealthy food (vegetables, some fruit trees) - Farmer health problems due to biocide use (spraying) - Bad roads Minor: - Poor soils (only in some remote areas, 5% of total)	-Contamination of groundwater (fertilizers) -Labor cost per day is higher than in other provinces in the country -Migration -Hidden unemployment in agriculture -Yet in Batac there is lack of labor force (peak labor requirements) farmers are forced to hire from nearby municipalities; use farm machines -Farmers cannot venture on other crops when area is irrigated?? -High pesticide use in some crops -Credit: Informal credit available at high interest rate (banks are too bureaucratic & same interest rate), Formal loans in kind available (inputs, animals,..) -No monetary incentives for organic production -During the wet season, farmers can only grow rice. Transition to other crops is too expensive -risk: flooding (Dingras), drought (Batac) -high cost of inputs & low price for products -Water availability (Batac) -Seasonal output price fluctuations (no storage facilities) -Deforestation
Case focus	District IMGLP, yield estim. (Wenxia)	District IMGLP, FHMs (PhD Tuan) & link FHM-multi-agent (post-doc study) & valid.TCG w.focus on nutrient balances (PhD MvTrinh)	FHM PhD Cuong (new FHM applic.)	FHMs PhD Alice Laborte: Province & district IMGLP, FHMs & link
Training needs	TC IMGLP/general support by Lu	TCG Market constraints in IMGLP FHM theory (Programming skills available)	Focus training on Cuong/Lai (Programming skills available) FHM theory	TC and FHH modelling, and GIS

Table 4.3: Scientific assessment : II. Outcome from team working sessions with indication of immediate follow-up activities required (for further activities till 2004, see chapter 5, workplans)

Case study/ partner	Accomplishments	Follow-up activities in the short run
Pujiang, ZU	Base maps (bio-physical & administrative) established; farm survey conducted and data keyed in excel; stakeholder meetings held and support/dialogue established; very preliminary prototype regional model formulated; future technology options identified (for rice)	Last bits on synthesis map (land units) to be carried out; check farm survey data on plausibility; get additional info on constraints from county liason officier; develop prototype regional MGLP based on results from stakeholder consultations ; training on indiv. components
Tam Duong, NISF	Land evaluation /Land unit delineation following FAO procedure completed; farm survey conducted; regional MGLP developed and results generated; started with FHM design; stakeholder meetings held and support/dialogue fully established – further studies initiated	Component 1, land evaluation needs to be simplified (less units); future technology direction to be identified, for rice (and other systems); initiate crop simulation to estimate pot yields
Omon, CLRRI	Land evaluation/land unit delineation completed; stakeholder dialogue established; simple FHM designed based on stakeholder consultation; further studies initiated	Synthesis of land evaluation and resource assessment requires refinement; available farm survey data to be analysed – and new survey (300) for FHM to be initiated; future technology direction to be identified, and TCs for pure rice systems to be established; district MGLP to be revised
Batac/Dingras, MMSU	Stakeholder dialogue established; farm survey conducted – work on municipality model carried out – prototype technical coefficient generator (TechnoGIN) developed , and partly tested; prototype FHM established for Batac	Land evaluation /GIS for Dingras; yield estimation for the various crops and further testing & refinement of TechnoGIN for use of output as input to LP models (indiv. training)

References

Ittersum, M.K. van, Rabbinge, R., 1997. Concepts in production ecology for analysis and quantification of agricultural input-output combinations. Field Crops Res. 52: 197-208.

5 Workplans for period April 2003 to March 2004, team formation and responsibilities

5.1 Workplan for Zhejiang University

For the Pujiang case study, the team from Zheijiang University defined the following workplan based on the outcome of the workshop

Detailed plan : 1 April – 30 September

April :

- Carry out exercises on IMGLP- and start work on resource assessment (land, labor, water) by Lu Changhe, Wang Jiangdi, Prof. Wang , Xie Wenxia, Wang Xueping)

- Determine direction for alternative technologies, cropping systems to be included, and yield estimation procedure for prototype model;

- Further discuss plausibility of farm survey data (H. van Keulen, Prof Wang, Fang Bin, Xie Wenxia – Wu Wenyi)

- Finalize land evaluation component : maps and tables on land units for Pujiang (Wang Jiangdi & Lu Changhe)

May:

- Screen farm survey data systematically, cross-checks keyed data with originals (Prof. Wang in collaboration with Huib and Herman), statistical analysis (Marrit) – farm type classification and input – output for current systems
- Conduct final checks on spatial data/GIS (Jiangdi in collaboration with Lu)
- Establish input-output tables (making use of TechnoGIN) for future alternative production systems and technologies --- Fang Bin and Xie Wenxia in collaboration with Huib H.
- Prof. Wang to communicate on missing data and information (see, updated data requirement list – ZU – still to update with most recent achievements) with liaison officers of Pujiang county --- and send feed-back to Wageningen scientists and Lu Changhe
- Study land use dynamics 1992 to 2000 (existing GIS maps for Pujiang) and derive indications for projections of resource availability for 2010-15 (have also look at PhD thesis Peter Verburg) (Jiangdi in collaboration with Lu Changhe --- just the GIS work ---- interpretation lateron with Reimund/Herman - September)

- Establish resource balances per land unit /administrative unit (townships)
- Make prototype regional IMGLP based on all data collected (Jiangdi and Lu Changhe)
- Develop simple procedures for input – output estimation for livestock activities (Herman)
- Carry out back-stopping trip : Lu Changhe some time end May)

June

- Communicate results of work to Wageningen (progress report) Preparations for September workshop

July

- Discuss open questions with stakeholders of Pujiang (plan for more detailed, expanded IMGLP will be major result); this implies collection of additional information

- Start collecting info required for addressing extended objectives/constraints etc. for revised IMGLP

Aug-Sep

- Prepare concept and start collecting data on input – output for liveststock activities
- Develop yield estimation procedure for Pujiang (Herman/Wenxia)
- Participate in Wageningen workshop – September 29 – October 4, 2003
- Update different components (Land units; data on resources, technical coefficients etc.) as required – based on discussions during workshop

Outline

October 2003 – March 2004

- Gradually expand databases for expanded MGLP model
- Refine model and define relevant scenarios
- Present first scenarios analysis results to stakeholders and discuss required improvements (end October)
- Revise model based upon feed-back from stakeholders
- Formulate expanded scenario's, conduct model runs and report on results (case study documentation of 1st regional model version)

Responsibilities for carrying out the tasks/delivering the expected output by Zhejiang University have been re-defined, as shown in Table 5.1.

Table 5.1 Key team members of Zhejiang Univerversity and responsibilities for the various IRMLA tasks

Tasks	Resource balance/GIS	Yield estimation	Techn. Coefficients	IMGLP
In charge	**Wang Jiangdi**	**Xie Wenxia**	**Wang Guanghuo**	**Wang Jiangdi**
Deputy	***Hu Xijun***	***Wang Guanghuo***	***Fang Bin***	***Xie Wenxia***
Member	Wang Guanghuo	[Wu Wenyi]	Ding Xianghai	Wang Guanghuo
Member	(Lu Changhe)		Lu Ribao	Huang Xueping
Member			[Wu Wenyi]	(Lu Changhe)

[ ] = district liaison officer /scientist; ( ) = support from regional training officer; underlined = see below: specific studies.

Specific studies :

- Planned Ph.D.-study : Input – output calculation for land use scenario analysis in Pujiang county (Fang Bin) --- deadline: august 2004
- Planned Msc study : Estimation of potential yields for Pujiang case study using different methods (Xie Wenxia)
- Probably later switch to topic : MGLP analysis for Pujiang (Xie Wenxia)

5.2 Workplan for NISF

For the Tam Duong case study, the team from The National Institute for Soils and Fertilizer defined the following workplan based on the outcome of the workshop.

Detailed plan April to September 2003

Before 30 April (coordinate by Dr. TT Son): allocated staff members & key persons to each task (***tasks A, B1, B2, C, see Table 5.2***). For tasks A and B: 3 NISF staff members, 2 Tam Duong staff members and 1 province staffmember in each task group. For task C: 3 staff members from NISF and 1 staff member from VASI.
Finalize update data check-list with most recent achievements and send to Wageningen Co-ordinator

May:

- Screen farm survey data, cross-check (Dr. Chien in collaboration with Huib and Marrit), statistical analysis (Marrit) – farm type classification and input – output for current systems

- Checks on spatial data/GIS (Quyet and Dao, Tran Minh Thu, Nguyen Hoa Hong, in collaboration with Dr. Son, Dr Ha, Dr. Duc and Dr Rötter)
- Establish input-output tables (making use of TechnoGIN) for future alternative production systems and technologies (Chien /Hai, Le My Hao, Dr. Nguyen Cong Vinh, Dr. Nguyen Van Truong in collaboration with Huib H.)
- Dr TT Son to communicate on missing data and information (see, *updated data requirement list*) with liaison officers of Tam Duong district and send feed-back to Wageningen scientists (with Tam Duong & B groups)
- Establish resource balance per land unit /administrative unit (commune) (Dr. Chien & A, B groups)
- Prepare prototype regional IMGLP based on all data collected (Tuan, V Nguyen, Nghiem Thu Hien, and Marrit, PQHA)
- Develop simple procedures for input – output estimation for livestock activities (Herman and Le Hong Hanh, Tam Duong district Staff, Dr. Son)

Milestone: 26-31 May first output of C.

June

- Communicate results of work to Wageningen (progress report) before **10 June**
- Start preparations for workshop on TCG and IMGLP/FHM in Wageningen (re-)scheduled September 29 – October 4, 2003(2-3 team members participate: ……..); invitation letter to be sent in June from Wageningen Co-ordinator with explicit mentioning of what costs will be covered by Wageningen UR and/or IRMLA country budgets

July

- Communicate /brief stakeholders about results, but also discuss open questions (more detailed, expanded IMGLP will be major result) this implies collection of additional information
- Start collecting info required for addressing extended objectives/constraints etc. for revised IMGLP

Aug-Sep.

- Prepare concept and collect data on input – output for liveststock activities
- Wageningen Workshop participation September 29 – October 4, 2003
- Update different components (Land units if required; data on resources, technical coefficients et.) as much as possible
- Gradually expand databases for expanded MGLP

Outline for period October 2003 to March 2004

October 03

- Report back first scenario analysis results to stakeholders (prep. Workshop), and discuss open questions with stakeholders of Tam Duong (more detailed,

expanded IMGLP will be major result) this implies collection of additional information

November 03 – March 04

- Next iteration of model analysis and scenario analysis
- Workshop /coaching for key stakeholders (advisors) on interpreting results and understanding the methodology

Responsibilities for carrying out the tasks/delivering the expected output by NISF have been re-defined, as shown in Table 5.2.:

Table 5.2 Key team members of NISF and responsibilities for the various IRMLA tasks

Task/ Responsibility	Resource balance eva. (A)	Input/output (B1)	Techn.coeff. generat. (B2)	IMLP (opt.) (C)
Leaders (L)	N.V.Dao (L) HQDuc (L)	N.V. Chien (L)	Nguyen Q.Hai (L)	V.D. Tuan (L)
and members	Vu Thi Hanh V.M.Quyet (vice L)	Pham Duc Thu	N.CVinh (L)	V. Nguyen (vice L)
	Tran Minh Thu	Le Thi Hanh (L)	N.V. Truong	Nghiem.Thu Hien
	N.Hoa Hong	N. Q. Oanh N.Thanh Huong	Vu Phi Hung *Do Hai Trieu*	PQHA (L)
		Le My Hao One more)from PQH	Tran Thuc Son (L)	Luong Duc Toan
Liaison district staff	*T. anh Tuan*	*Ng. Trong Niem*	*Nguyen Van Nam*	
Counter-part in Wageingen	R Roetter	H Hengsdijk	Hengsdijk & Roetter	M van den Berg (GAMS)
PhD student currently at Wageningen			MVTrinh	

5.3 Workplan for CLRRI

For Omon case study, the team from Cuu Long Delta Rice Research Institute defined the following workplan based on the outcome of the workshop

Detailed plan

30 april

- Updated data availability list and completion of land evaluation (land unit delineation + land resource assessment) for district MGLP – reported to Wageningen Coordinator
- Selection of production activities (LUTs) and technologies to be included in simple MGLP

10 June :

- Interim report on work carried out (6 monthly progress report for EU submitted to coordinator)
- Input-output generated for simple prototype MGLP (with 4-5 activities)
- Resource balances (labor, land) established (water not constraint – 100% of agric land irrigated - and ongoing projects do not substantially affect biophysical potential)
- (Multiple objective) Scenarios formulated
- Simple prototype district MGLP completed
- Screening of farm survey data for Omon from the 1980s to present started – inventory for specific study completed and send to Marrit vd Berg
- Finalize design – cross-ceck with Marrit - and start conducting farm survey

September

- Farm survey (sub-sample of 300 households) completed, data keyed and analysed
- input-output tables for current systems completed --- and also for a limited set of future technologies (b1, c) --- also deal with non-rice crops and rice – fish/shrimp (the latter will receive attention through collaboration with INREF-Pond programme – PhD student Phong)
- Wageningen WORKSHOP participation(September 29– October 4, 2003)
- Operationalize basic farmhousehold model for Omon with suitable input - and conduct some scenario analysis
- [Proposal for specific study of FHM application elaborated and discussed with potential supervisors in Wageningen]
- Apply for funding for specific FH application

Outline

October 03 to March 04

- develop simple procedures for input – output estimation for livestock and integrated rice-fish activities
- Communicate /brief stakeholders about results, but also discuss open questions (more detailed, expanded IMGLP will be major result) this possibly implies collection of additional information
- Start collecting info required for addressing extended objectives/constraints etc., more detailed land units and extended number of LUTs and technologies for revised IMGLP
- Collect additional information /data needed to improve FH model
- Apply for co-funding for specific FH application

Responsibilities for carrying out the tasks/delivering the expected output by CLRRI have been re-defined, as shown in Table 5.3.

Table 5.3 Key team members of CLRRI and responsibilities for the various IRMLA tasks

Tasks	1. Resource balance/GIS	2a. Yield estimation	2b. Techn. Coefficients	3 MGLP/FHM
In charge	**Nguyen Xuan Lai**	**Tran Thi Ngoc Huan**		**Nguyen The Cuong***
Deputy	***Nguyen Van Quyen***	***Hoang Dinh Dinh***		***Nhan Hong Hoa***
Member	Ngiyen Hong Thao	Ho Xuan Thien		Nguyen Duc Hanh
Member		Truong Thi Ngoc Chi		
Member		Nguyen Huynh Phuoc		
Member		Nguyen Duc Loc		

* Planned PhD study (project idea available, see, chapter 7)

5.4 Workplan for MMSU

For the Dingras/Batac case study, the team from Mariano Marcos State University defined the following workplan based on the outcome of the workshop. The main focus will be on:

1. Farm survey data analysis: data have to be further entered and analysed; outliers have to be identified; maybe necessary to re-visit farmers (Dingras) to check on information available (use can made from recent survey for Batac –).

2. Farm Household Model: in the coming months emphasis will be on development of Farm Household Model, development of regional MGLP-models for the municipalities Batac and Dingras will be done in 2004

Detailed plan

May-June

Resource characterization + farm typology (for farm type, know the number of wells available; use groundwater – yes-no)

1. land – land units, forming the resources in the municipal models and serve as inputs in yield estimation and TC-generation; prepare Batac and Dingras maps for land management units; land management units to be included in the FHM have been identified for Batac; needs to be checked for Dingras with survey data.
2. water – quantification of the resource side (how much water is available- hard to quantify- cubic meters) – in SysNet it has been assumed that in the irrigated areas there is water enough to grow double or triple rice; in non-irrigated areas: is rainfall in the wet season enough to grow an irrigated rice crop? Do farmers use supplementary irrigation? Water availability in terms of farm typology; should follow from analysis of availability of pumps for shallow tube-well irrigation; as can be deduced from the stakeholders presentations on Monday rather great attention is paid to development of Small Farm reservoirs and Small Water Impounding Projects. The quantitative consequences of implementation of such projects on water availability at farm level should be taken into account; these consequences obviously are of importance for (some) policy makers.
3. labor – no additional work to be done for farm level; for municipal level, also sufficient information appears to be available.

July-August

Yield estimation

1. use WOFOST for a number of common field crops: rice, maize; possible other crops to be identified

- study and familiarize with crop growth simulation in general and WOFOST in particular; books of Van Keulen&Wolf (!986) and Goudriaan & Van Laar (1994) will be made available;
- collect reliable experimental data for Batac/Dingras/Ilocos Norte; data should be used for a systematic calibration/validation exercise; for the main variety(ies) from the region; best to start with rice, the most important crop

2. use LINTUL for 'other crops'; a concentrated effort (at least also involving Zhejiang University) should be made to develop the procedure and parameterize it for the most important crops. Data on leaf area development and yield are necessary for such an exercise, in combination with climatic data.

May-September

TC-generation

- Check cropping calendars for Batac and Dingras in current version of TechnoGIN
- future oriented technologies should form an important part of the analysis; for rice (and also other commodities) reliable technical coefficients should be

developed for such practices as Integrated Pest Management (IPM) (considered an important technology by decision makers to reduce the use of biocides) and Site-Specific Nutrient Management; other interesting and/or promising crops/technologies should be identified.

- Verify the technical coefficients for Dingras.

LP

Suggestion: start by defining 4-5 typical farm types for Batac; the advantage is that a start can be made from the work of the M.Sc.-students Pradel and Bi; models should be made more comprehensive: more specific and more realistic; more complete list of cropping systems; development of definition of water resources at farm level.

Further develop FHM for Dingras

Participate in Wageningen UR IRMLA workshop, September 29 – October 4, 2003

Outline

October 2003 – March 2004

1. Develop regional MGLP for Batac
2. Expand FHM for Batac and develop for Dingras
3. Stakeholder interaction

   As soon as possible, preliminary, but relevant results from the farm model are available these should be discussed with the stakeholders

Prioritization

1) further development of the LP model for Batac
2) farm typology – hands-on training with Rey Villacillo using SPSS
3) data gathering/literature review for the wofost model and lintul
4) stakeholders consultation
5) (further) development of the lp model of dingras
6) hands-on training in irri with gis and crop growth simulation
7) re-survey

Responsibilities for carrying out the tasks/delivering the expected output by MMSU have been re-defined, as given in Table 5.4.

Table 5.4 Key team members of MMSU and their responsibilities for the various IRMLA tasks

Tasks	1. Resource balance/GIS	2a. Yield estimation	2b. Techn. Coefficients	3 MGLP/FHM

In charge	**Dionisio S. Bucao**	**Artemio B. Alcoy**	**Epifania O. Agustin** **
Deputy	**Joselito I. Rosario**	**Charito G. Acosta**	**Isidro Galdores**
Member	Leah M. Tute	Criselda M Balisacan	Reynold Villacillo
Member	Arman Barruga	Epifania O. Agustin**	Facundo B. Asia
Member	Reynold Villacillo	Susan G. Aquino	Margarita P. Caluya
		Dionisio S. Bucao	Susan G. Aquino
IRRI staff	(AG Laborte)		(AG Laborte) *

* output from ongoing PhD study for Batac contributes directly to output
** Director for Research MMSU and team leader

Team members and scientific field:

Prof. Charito G. Acosta	Agrometeorology
Dr. Artemio B. Alcoy -	Agronomy/Farming Systems
Prof. Margarita P. Caluya	Agricultural Economics & Environmental Science
Prof. Joselito I. Rosario	Forestry/Agroforestry/Stat.
Prof. Facundo B. Asia -	Fisheries/Environmental Sci.
Mr. Isidro Galdores	Economics
Mr. Reynaldo Villacillo	Computer Science/Programming
Mr. Dionisio S. Bucao	Agronomy/Agr'l Engineering/GIS
Ms. Criselda M. Balisacan	Soil Physics/Agr'l Engineering
Ms. Susan G. Aquino	Rural Development/ Agr'l Engineering

6 Requirements for training and technical back-stopping

With a few exceptions, the IRMLA teams are well-versed in basic techniques and tools applied in land use modeling and systems analysis for strategic planning. What needs to be practiced is the integration of tools for a specific study purpose. This also implies the need to deepen understanding of the assumptions underlying the modeling framework, its capability and limitations. To meet these requirements, the project needs to provide on the job training as well as the possibility for individuals to participate in specific training workshops.

6.1 Requirements for training

Two recent developments within IRMLA have implications on specific training requirements:

- During the first project year, major efforts have been made to develop a versatile (quasi-generic) tool for the generation of agro-technical, ecological and economic coefficients characterizing alternative production systems. This development, resulting in TechnoGIN version 1.1, was led by Wageningen scientists. Training is now required to fully make use of the possibilities of this tool, including its expansion for other cropping systems and use in other agro-environments.
- Another development with implications on training was the decision for optimization software GAMS, which is being used for both, farm household modeling and regional multiple objective land use modeling. Specific materials for the study purpose have to be generated for training sessions on the use of GAMS in land use modeling exercises.

To meet a number of the most important training requirements, a 6 days training workshop will be organized at Wageningen between 29 September and 4 October 2003.

This workshop will address theory underlying land use systems analysis at farm and regional level as well as specific trainings on technical coefficient generation and GAMS for land use optimization, the integration of tools, and interpretation and communication of results. The training workshop will consist of four parts:

1) THEORY: Half a day devoted to presentation of progress made by teams on developing models and databases and refresher on "concepts applied and problems encountered in land use systems analysis at different scales" (lectures)
2) MODEL COMPONENTS: Three and a half days devoted to team work on development of model components and their integration, using data sets specific for each case study
3) PRESENTATION, EVALUATION & PLANNING: Half a day devoted to interpretation and effective communication of model results and workshop evaluation, and half a day for the planning of next steps

4) DEMONSTRATION OF IMPACT One day devoted to a field trip to a pilot farm (De Marke) where research results are being implemented on prototype farm

The team work sessions (days 1-4) on developing and integrating model components will comprise the following topics:

- Resource evaluation & mapping
- Technical coefficient generation
- FHM /MGLP using GAMS
- ***With focus on*** Integration and scenario formulation

Data sets and prototype models for this undertaking need to be prepared in advance.

6.2 Organization of technical backstopping and on-the-job training

6.2.1 ZU Team

Dr Lu Changhe will provide support to the team in designing appropriate regional MGLP model, finalizing the land evaluation and integrating data and tools. Visits in May and October 2003 to work with the team and regular communication by email/phone will ensure that the required backstopping and on-the-job training can be provided.

Support in reviewing farm survey data on input – output relations of production activities wil be provided by H Hengsdijk and Marrit van den Berg through regular email. Prof. Van Keulen & Marrit vd Berg & Lu Changhe will pay a visit to the team end of October 2003 to provide on-the-job training on estimation of technical coeffients for future livestock systems.

6.2.2 NISF Team

Marrit van den Berg will support the team in designing an appropriate regional MGLP and an FH model. Dr Hengsdijk will support the team in checking farm household survey data through regular email communication before end July 03. Prof. van Keulen and Dr Roetter will provide on-the-job training and support to Mai van Trinh in generating technical coefficients for future production activities /TCG at Wageningen. Visit of Tuan to Wageningen (in September 2003) for further training in FHM theory may be an option that needs to be explored. Visit of M van den Berg and R Roetter in February 2004 to evaluate model development.

6.2.3 CLRRI Team

Visit of NT Cuong to Wageningen (in September 2003) for further training in FHM theory may be an option that needs to be explored.

6.2.4 MMSU Team

Participation of team members in trainings on crop growth simulation and GIS, provided by IRRI, should be considered. Support in reviewing farm survey data on input – output relations of production activities will be provided by R Roetter and Marrit van den Berg through regular email.

MSc Student Anne Gerdien Prins is going to work in the period July to November 2003 at MMSU on the Farm Household Model for Batac. In the period Februari to September 2004 A.G. Laborte comes to Wageningen to complete and defend her Ph.D.-thesis at Wageningen University.

The schedule and list of participants of the second round of stakeholder -scientist workshops is to be determined during the Wageningen workshop, early October 2003.

7 Special studies (embedded in IRMLA)

7.1 Draft Ph.D.proposal of Mai van Trinh, NISF

'Integrated nutrient dynamics with special emphasis on erosion'
(promotor: Prof. H. van Keulen)

7.1.1 Background information and hypotheses

- Red river delta of Vietnam has tropical climate conditions. Soil erosion is a serious problem, because also the hilly land areas are exploited over long periods without applying soil conservation. There is no input of organic matter and very low applications of inorganic fertiliser. Soils are degraded both by surface erosion and by depletion of nutrients. In particular in Tamduong, a rather hilly land area (with originally forest and fallow) was cleared about 10 years ago (Nhuan 1996) for cultivating annual crop like cassava, maize, beans etc. These cultivated soils are vulnerable for water erosion under high rainfall conditions.

- Crop yields are low, although the farmer uses very high doses of fertilizers, especially in rain-fed soils. The resulting fertilizer use efficiency is quite low, and hence this agriculture system is not sustainable. The cultivation practices and the nutrient management in this agricultural system should be improved. This shows the need for site-specific nutrient management and soil conservation.

7.1.2 Objectives of the study

- To determine the factors that effect soil erosion and nutrient losses in the system within the project area. Deriving the degree of soil erosion and nutrient losses in different agricultural systems should yield the required information for optimizing land use systems in the district.
- To assess soil erosion in the project area (Tam Duong district) using remote sensing, Geographic Information System, erosion modelling and field observations.
- To quantify the nutrient losses due to erosion from different agricultural systems within watershed of project area.
- To map the potential soil erosion and to determine suitable land use types for sustainable agriculture development.

7.1.3 Approach and Study area

Research is done within the network of the IRMLA project. The project is dealing with: i) Quantitative tools for generating technical coefficients, ii) Spatial differentiation of resource availability and quality (introduce intermediate scales: farm, district. iii) Incorporation of risks in land use scenario analysis, iv) Incorporation of farmers behavior in the analysis, v) Conceptual and operational link between regional land use optimization and farm household modelling. This should lead to improved knowledge

about methods to achieve sustainable agriculture in the project area by minimizing erosion effect and nutrient losses from agricultural systems.

Tamduong district located in the upstream of Red River Basin with co-ordinate: X1 = 551,772.28, Y1 = 2,352,608.33; X2 = 567,440.46, Y2 = 2,377,538.03 in zone 48, UTM coordinate system (Figure 7.1). It is about 60 kilometer from Hanoi to the Northeast. The North side is Backan province, the Eastern side is Binh Xuyen district, Southern sides are Socson and Melinh districts, Hanoi city and the Western side is Lapthach district. There is national road number 21 and the Red River goes through Tamduong district center, which is favorable for transport to and from the district. Socio-economic characteristics are given in the following (Table 7.1).

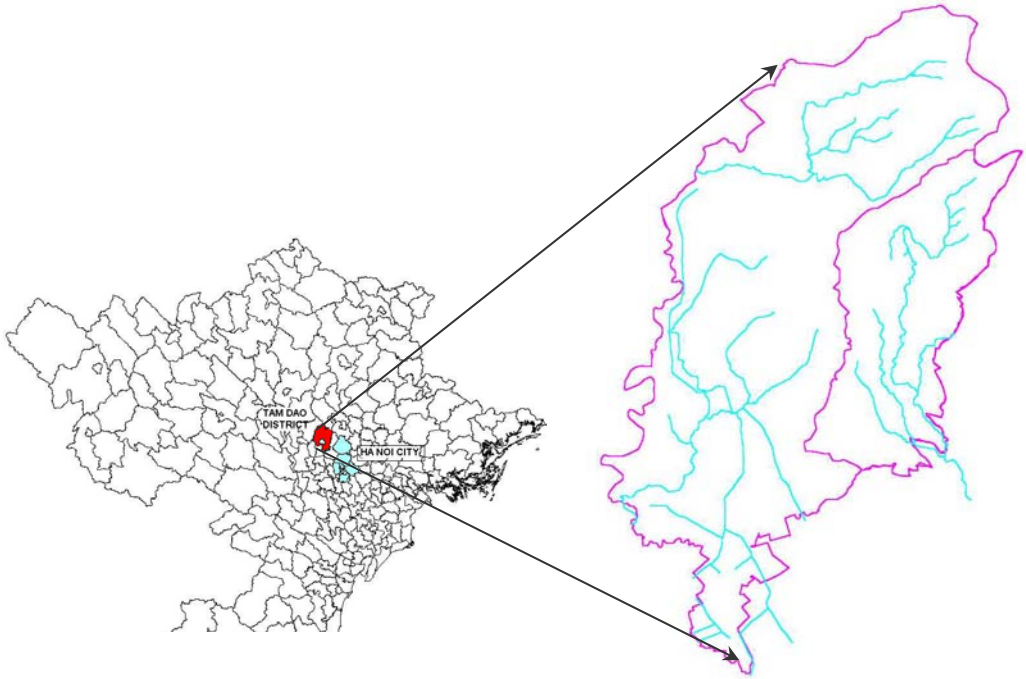


Figure 7.1: Location of Tamdao (red) and Tamduong district in close-up with sub-watersheds

Table 7.1 General information in Tam Duong

Number of communes	17
Number of communes in mountainous area	7
Population number (1999)	120832
Male	59449
Female	61383
Population density (person/km^2)	614
GDP (1999 – 10^9 VND):	2331.3, in which
Agriculture, forestry and fishery	850 (36.5%)
GDP/capita (10^3VND)	2.1
GDP/capita (10^3USD)	175

Agriculture is the main activity of the district's population. Annual crops (Table 7.2) are dominating with the following main rotations: Rice – rice, Rice – rice – cash crop, Rice – cash crop, Rice, and Cash crops. Cash crops are becoming more and more important during the last years because of urbanization and industrial development. Tamduong district supplies flowers and fresh vegetables to Hanoi city (about 60 km to the South), and to other industrial zones within the district and in the Phutho province (about 20 km to the North).

Perennial crops and fruit crops are mostly planted in the gardens, hill- or forest-gardens with relatively low productivity. Pasture-land is generally located in the High Mountain area with rock outcrops, eroded bare soil or uncultivated soil. Plantations and natural forests are found in the Tamdao range with very high elevation (1400 m above sea level) and steep slope. Some parts of the plantation forest are scattered over the hilly lands that are eroded, badland or uncultivated lands due to overexploitation in the past (e.g. eucalyptus or for material for paper mill).

Table 7.2: Land use in the Tam Duong district

Land use	Area (ha)	Relative area %
Total	19779.9	
Agriculture land	8045.04	40.7
Annual crops	6147.22	31.1
Perennial crops	1691.82	8.6
Grass land		
Fish culture area	206	1.0
Forestry land	6744.4	34.1
Natural forest	2431.8	21.8
Plantation forest	4312.58	21.8
Special land[1]	2504.29	12.7
Residential land	857.44	4.3
Unused land	1628.79	8.2

[1] Special land: Transportation, irrigation systems, army office, construction material, cemetery and others.

Soil and soil type

There are eight main soil types in the district :

- Acrisols, in most hilly and mountainous areas;
- Cambisols, in the valleys and at the foothill of mountain;
- Gleysols, in the valleys where water logging occurs and soils are poorly drained;
- Fluvisols, in the southern part of the district, low land and annually effected by Red River alluvial regime;
- Plinthinsols, in the hill slopes and interchange between mountain and valleys, where soils are strongly eroded, water table is fluctuating with time, big differences in water table between wet and dry seasons occur and hence, lateritic processes strongly take place. With a high resulting content of oxides, mainly Fe_2O_3, Al_2O_3 and Mg_2O_3;
- Some other soil types such as leptosols occur in small patches scattered over the area.

Table 7.3 Mean values for some soil chemical characteristics in the study area (Son and Chien, 2002) (mean value of 12 samples from 12 sites)

Soil property	Clay	Org.C	Total N	CEC	K	Ca	Mg	Olsen-P
	(%)	(g/kg)	(g/kg)		(mg/kg)			(mg/kg)
	11	10.8	1.23	5.1	0.13	2.8	0.2	10.3

7.1.4 Methodology

Research methodology is focussed mainly on:
- Assessment of yield gaps and climate-induced risks;
- Generation of technical coefficients for future production activities.

Technical coefficient generator (TechnoGIN)

To generate technical coefficients, the following steps are taken:
- Calculating target yields for the main crops by applying crop growth models and expert systems for the specific condition in the study area;
- Application of Quantitative evaluation system of the fertility of tropical soil (QUEFTS) for calculating fertiliser demand;
- Calculating nutrient cycling and nutrient balance;
- Calculating yield-related efficiency factors and correction factors for fertilizer, biocide and water use;
- Calculating water balance for study area;
- Applying fertilizer cost model in combination with farm survey data to calculate input-output for future production activities.

Runoff, Soil and nutrient losses

For runoff, soil and nutrient loss by erosion, the spatial and temporal distribution over the whole study area need to be determined. This can be done by applying several models such as USLE (Wischmeier and Smith, 1978), RUSLE (Renard et al, 1991, Renard et al, 1997), WEPP (lane and Nearing, 1989), EUROSEM (Morgan et al, 1998), PERFECT (Littleboy et al 1989), EPIC (Sharpley and Williams 1990), CREAMS (Knisel 1980), CENTURY (Parton et al 1989), ANSWERS (Beasley et al 1980) and LISEM (De Roo et al, 1996). In general, these models calculate well the degree of soil erosion, however, each model has its advantages and disadvantages, differing with respect to data requirement, described processes, time step and spatial scale, etc. Soil erosion is also determined in field measurements (Lanh, 1997; Thu et al, 1997; Phien et al, 2000; Phien et al, 2001), which results can be applied to areas by interpolation. However, this method is time consuming and mainly suitable for field and plot scales. It does not take into account the off-site effects and topographic effects.

Recently, scientists have studied soil erosion, nutrient balances and the environmental effects of erosion at the watershed scale (McDowell et al, 2001; Sharpley et al, 2002; Wallbrink et al, 2003; Ritchie and Mc Carty; 2003). For example, Bhuyan et al (2002) successfully used remote sensing, GIS, and Agriculture Non-point Pollution Source AGNPS model (Young et al 1989) to assessment runoff and sediment yield in the study watershed. Walling et al (2003) used ^{137} Cs measurements to validate the application of the AGNPS and ANSWERS erosion and sediment yield models in two small Devon catchments. He reported that catchments outputs simulated by both models are reasonably consistent with the recorded values, although the AGNPS model provided the closer agreement between observed and predicted values. AGNPS model provided more meaningful predictions of erosion and sediment yield under UK condition than the ANSWERS model.

7.2 Specific FHH model application for Omon district, Vietnam

The rapid development in this agricultural district since Doi Moi ("renovation" - Doi Moi started 1986/87) triggered substantial structural changes : from co-operatives as basic production unit to farmhouseholds. From a study in China (e.g. Jikun Huang & Scott Rozelle, 1996. Journal of Development Economics 49: 337-369) in which agricultural technologies were found to be the main drivers for rural development, the question came up if for the Mekong Delta in Vietnam the same applies. In other words, was agricultural technology innovation (e.g. mechanization, new crop varieties) or other factors (e.g. market conditions) of main importance for rural development ?

The proposed research approach is:

1) Screen farm survey data for the Omon district from the 1980s to present.
Farm survey (household) data are available for Omon since 1996/97 for each year (Mega Project, SysNet (1998/99) and IRMLA data (2003)). For information on the current situation, the results from the National Programme on Integrated crop management are useful.

2) Develop and apply a Farmhousehold (FHH) model to evaluate the situation in the past, using Omon, Cantho as a case study area. Next, this calibrated FHH model can be applied for analysing the constraints that are most limiting for rural development in the future.

Background information on land use reform

In the seventies, the socialist economy was extended to whole Vietnam. Agricultural production was controlled by cooperatives, ownership of all land was collectivized, and production distributed to workers according to a labor-point system. However, Vietnam was unable to grow enough rice to feed itself. The economy continued to deteriorate – and early in the 1980s Vietnam witnessed a serious economic crisis which culminated in an almost collapsing economy by 1986 with the annual inflation rate rising to 775 %

At the December 1986 Sixth National Congress, The Communist Party announced adoption of a program of market socialism called Doi Moi ("Renovation")
While this date is earmarked as the beginning of the reform, the state had begun earlier on with formulating policies in support of improved cooperative system. Some policies that influenced agricultural production were:

- Resolution that initiated agricultural reform process
- Decree that resulted in allocation of land-use rights for paddy fields based on number of persons in a household – each household was required to contribute a quota of rice to the cooperative, but could keep any surplus
- Resolution about decollectivitzation of agriculture. Allocated long-term land-use rights on paddy lands according to the number of productive workers in a household. Households became free to keep all production . Households replaced cooperatives as the elementary unit of production
- Forest protection and Development Code (1991) which started the process of allocating land-use rights on hillside lands and forest lands.

These and subsequent reforms have transformed the face of Vietnam's economy and society . Vietnam's GDP growth rate averaged 7.2% during the 1990s . Poverty has been reduced considerably , from 58% in 1993 to 37% in 1998. Since 1997, Vietnam has been the world's second /or third largest exporter of rice.

(Source : Castella, J-C. & Dang Dingh Quang, Eds. 2002. Doi. Moi in The Mountains. The Agricultural Publishing House, Hanoi, Vietnam)

7.3 Examining various decision criteria in multi-agent models

This research is carried out by Marrit van den Berg and is focussed on a methodological issue: ***representative farm household models versus empirical multi-agent models***

Most economic models assume that people behave as if they maximize a certain objective function. Interactions between different people are organized through markets (that may be missing or imperfect). For example, within IRMLA the farm household is modeled as a decision unit that maximizes utility (or a derived objective) subject to technology, resources and market constraints. Models of representative households are aggregated into a regional model through imposition of demand constraints and market equilibria. The standard economic assumptions structure models, make them transparent, and give them theoretical validity. However, the models are only valid in the context of the assumptions.

Multi-agent systems models, which origin from artificial intelligence research, are increasingly used to model economic behavior. Contrary to more traditional economic models, many of these models do not assume optimization and market exchange. Agents behave according to decision rules, which are not necessarily based on theory. MAS models can therefore be very flexible and close to intuition. However, the behavior of the models is sensitive to assumptions about decision rules and the order in which these

rules are applied. Designing the rules therefore requires scrutiny, if not theoretical then empirical. However, the validity of purely empirical models is difficult to judge by outsiders.

It may seem as if the economic models as used within IRMLA contrast with MAS models. In reality, they can be considered a special case of MAS modeling, in which the decision rules are based on economic theory. Hence, we can go from a representative farm household model as used in IRMLA (stepwise) to a purely empirical MAS by abandoning theoretical assumptions. This is a means of assessing the impact of the assumptions of equilibrium and optimization on the model outcomes regarding the alternatives of standard MAS. This is usually not done, as MAS models are mostly used by a different scientific community than the more standard economic models.

References

Castella, J-C. & Dang Dingh Quang, Eds. 2002. Doi. Moi in The Mountains. Land use changes and farmers'livelihood strategies in Bac Kan, Vietnam. (VASI – IRD – IRRI). The Agricultural Publishing House, Hanoi, Vietnam, 283 pp.

Jikun Huang & Scott Rozelle, 1996. Technological change: Rediscovering the engine of productivity growth in China's rural economy. Journal of Development Economics 49: 337-369.

Pingali, P.L. & Xuan, V-T. Vietnam: Decollectivization and Rice Productivity Growth. EDCC, 1992 (pages 697-718).

8. Summary of progress made

Table 8.1 lists the individual workpackages, responsible contractors, time allocated to carry out the required activities and number of deliverables. The current status with respect to the various deliverables (completed; in progress, started, not yet tackled) is summarized in Table 8.2.

Work on packages 1-4 and 6 is ongoing and a number of deliverables has been produced in line with the proposed schedule.

Table 8.1 Description of workpackages, contractors, start and end of workperiod, and deliverables for the different workpackages within the IRMLA-project

WP no.	WP title	Contractor no.	Start month	End month	Deliverables
1	Regional analysis of conflicts in resource use	1	2	10	D1-5
2	Analysis of yield gaps and climate-induced risks	6 & 5	3	15	D6-7
3	Technical coefficient generation	8 & 2	6	30	D8-13
4	Farm household model development	7 & 3	13	36	D14-21
5	Multi-scale optimization and analysis	1 & 4	31	42	D22-25
6	Project management and dissemination	1	1	48	D26-28

Due to high research capacity and academic ambitions of some teams, specific in-depth studies have been defined. That means, additional deliverables can be expected (for details, see Chapter 7). On the other hand, high interest of individual scientists (and participating institutions) in mastering the complete set of methodologies and tools has led to extended investment in training activities (such as the specific training in LUPAS methodology, held September 17-21, 2002 at Beijing, and the hiring of a regional training officer, Dr Lu Changhe, for the training and design phase).

Table 8.2 Status of the deliverables from the different workpackages within the IRMLA project at present (May 2003)

No	Deliverable title	Status (at month 18)
	WP 1 Regional analysis of conflicts in resource use	
D1	Land evaluation and resource supply and demand analysis carried out for study area : Pujiang county, Zheijang province, China.	**Land evaluation (GIS) carried out**
D2	Regional model output on resource use analysis generated and documented for study area: Batac and Dingras municipalities, Ilocos Norte Province, Philippines.	**Batac is completed, Dingras in progress – output available for province as a whole**
D3	Regional model output on resource use analysis generated and documented for study area: Omon district, Can Tho Province, Vietnam.	**output available for province as a whole – Omon analysis requires refinement**
D4	Land evaluation and resource supply and demand analysis carried out for study area: Tam Duong district, Vietnam.	**Complete set of output available**
D5	Major resource conflicts and constraints for the four study regions identified, interpreted and documented (project report).	**Documentation – draft report is largely realized ->editing**
	WP 2 Analysis of yield gaps and climate-induced risks	
D6	Potential and actual production levels for relevant production systems in the four study regions assessed and their temporal and spatial variability quantified (database).	**For 3 out of 4 regions data on actual prod. available (farm surveys) – temp. variability quantified for rice**
D7	Main yield–limiting factors (bio-physical) under prevailing climatic conditions identified; frequency analysis of adverse climatic events carried out and farmers' adjustment. strategies to climate-induced risks assessed.	**Yield-limiting factors identified for all; frequency analysis carried out for Batac/Dingras and Omon**
	WP 3 Technical coefficient generation	
D8	Pujiang county: Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	**Input – output database for current systems established – some checks on data quality required**
D9	Batac /Dingras : Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	**Input – output database for current systems established for Batac/Dingras– some checks with sample farmers required**
D10	Omon district: Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	**Input – output database for current systems established**
D11	Tam Dao (Tam Duong district) : Input–output relations for actual production systems (and average farmers' practices) established and farm types identified; models, data structure and algorithms for generating technical coefficients for future, alternative (crop & livestock) production systems and techniques identified/developed.	**Farm survey on input – output relations carried out – data need to be entered**

D12	Technical coefficient generators for Pujiang, Batac, Omon and Tam Dao developed, tested and applied; input-output database generated.	**Technical coeff. generator for Batac developed – testing is in progress**
D13	Technical coefficient generators for Pujiang, Batac, Omon and Tam Dao documented with detailed description of theoretical background and application for one case, Batac/Dingras (Technical Bulletin).	**Prototype Technical coeff. generator for Batac/Dingras – documentation version Jan 2003 completed**
	WP 4 Farm household model development	
D14	Pujiang county: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed .	**No**
D15	Batac and Dingras municipalities: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed.	**In progress**
D16	Omon district: Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed .	**In progress – base model Omon is available**
D17	Tam Dao : Farm household modeling framework developed for different farm types, required data collection and analysis for model development completed.	**Started**
D18	Different farm types, Pujiang county: Objective functions defined, resource availability and quality quantified, additional technological options defined and integrated, socio-economic environment defined, and FHM results generated under current policy.	**No**
D19	Different farm types, Batac municipality: Objective functions defined, resource availability and quality quantified, additional technological options defined and integrated, socio-economic environment defined, and FHM results generated under current policy.	**No**
D20	Different farm types, Omon district: Objective functions defined, resource availability and quality quantified, additional technological options defined and integrated, socio-economic environment defined, and FHM results generated under current policy .	**Started**
D21	Different farm types, Tam Dao : Objective functions defined, resource availability and quality quantified, additional technological options defined and integrated, socio-economic environment defined, and FHM results generated under current policy.	**No**

D28	Project progress reports (annual), technical reports, brochures, research reports and case study synthesis report published; scientific papers (2-3) submitted.	***So far: 1st annual report, 1 planning workshop proceedings, 1 technical report, 2 papers submitte, IRMLA website completed,1 in-country workshop report)***

Available tangible outputs (associated with deliverables 1-5, 6, 8-10, 12-13, 16 and 28) include:

- Documentation on conflicts in land use objectives and resource use for Ilocos Norte and Cantho Province – and presentations for Batac, Omon and Tam Duong
- Spatial (GIS) databases and maps on resource availability and quality for Pujiang, Tam Duong, Batac/Dingras and Omon

- Climatic databases for all and daily weather databases for Pujiang, Batac/Dingras and Omon
- Potential yield estimations (crop simulations) for Batac/Dingras and Omon
- Databases (in Excel) on actual yields and input – output relations for Pujiang, Omon (series of years) --- raw data (farm surveys) for Tam Duong and Batac/Dingras
- Soil databases for Batac/Dingras (Ilocos Norte), Omon and Tam Duong
- Prototype technical coefficient generator (TCG) and documentation for Ilocos Norte
- Prototype regional IMGLP for Pujiang and Tam Duong (and regional models for Ilocos Norte and Cantho – programmed in XPRESS-MP)
- Prototype farmhousehold (base) – programmed in GAMS - model for Omon.
- Scientific Papers completed by IRMLA team members in reporting period:

:

1. Van Ittersum, M.K. et al. A systems network (SysNet) approach for interactively evaluating strategic land use options at sub-national scale in South and South-east Asia (Submitted to Land Use Policy)
2. Van den Berg, M.M. & G Kruseman, Studying technological improvement in smallholder farming in less-favoured areas - to be presented at Durban/South Africa, August 2003.
3. Lu Changhe et al., A scenario exploration of strategic land use options for the loess plateau in northern China (submitted to Agricultural Systems)
4. Roetter, R.P. et al, Integration of systems network (SysNet) tools for regional land use scenario analysis in Asia (submitted to Environmental Modelling and Software)
5. Wassmann et al., Risk of flooding due to anticipated expected climate change (in prep.)

Annex A Field trip documentation

During the in-country workshops, field trips were conducted in Tam Duong, Omon and Batac/Dingras case study regions to gain better understanding of the biophysical conditions, farming systems and, especially, farmers' problems. Here two examples are provided for visits of farmers in Omon district. A comprehensive photo documentation of the three field trips is contained in the photo archive (Annex B) on CD-ROM.

Field trip to a village in Omon District, Cantho Province, Vietnam

Farmer A

The farm is 2 ha in size, 1 ha used for rice cultivation, and 1 ha for fruit tree cultivation (guava, durian, mango, diverse types of plums, sapodilla, pomelo). The farmer inherited the land from his mother, more than 16 years ago. He started with less than 1 ha, and for more than 6 years cultivated rice only (double rice). Then he gradually started with a cultivation of few fruit trees. First with a few mango trees on beds in between rows of rice. After 8 or 9 years he expanded his farm to 1.5 ha, reserved some area for mango and shifted to triple rice.

The returns from selling mangos were invested in buying another 0.5 ha and introducing pomelo and another fruit tree, after about 10 years. Returns were again invested in establishing a fish pond and increasing number of poultry (mainly chicken) and pigs.

Knowledge and skills required for fruit tree cultivation were gained by learning from neighbouring farmers – and by experimenting. Own experimentation led the farmer to reduce plant population density in rice (which reduced pest incidence and necessity to spray). Since two years the farmer stepped over from triple to double rice cropping – and, in the mean-time has reduced biocide use to a minimum – unlike his neighbours. Double rice cropping allows earlier planting and harvest (and to sell at a higher price for the rice crop than with triple crop – the rice is entirely sold (a.o. due to good price and for saving money that would be required for construction of storage facilities). Due to his preference for better quality of fruits (which he and his family also consume) which on local market also yield a higher price than prayed fruits, he also abandoned pesticide applications to fruit trees. In the long run the the farmer is thinking about the possibility to generate income by attracting tourists who pay for a guided fruit tasting tour on his farm.

Due to gradually expanding and diversifying the cultivated area by systematically investing little savings (initially also through off-farm work by his wife), the farmer has reached an above-average welfare, which is reflected by the recent building of a solid family home – just next to his former, semi-permanent, grass roof farm house.

Farmer B

The farm is about 0.55 ha in size, used for rice cultivation only and mainly (60% of the work done) managed by wife and children. The male head of the family generates income through working in a nearby rice mill, and as hired laborer in construction work for 60% of his time. Farm and off-farm activities ensure that the family does not go hungry and school fees can be paid. Other farmers in the neighbour with less income are not able to pay school fees for all their children.

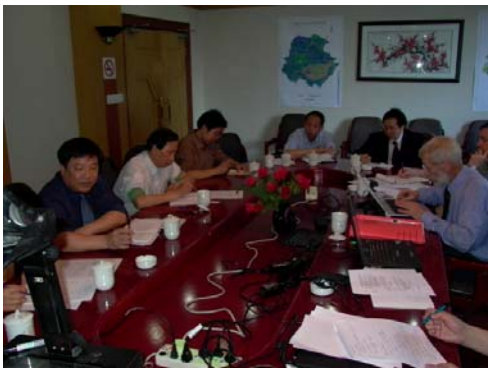
Annex B Photo archive with annotations

The four in-country workshops contained four major elements:

- Stakeholder consultations with presentations and plenary discussions about each case study
- Group discussions (stakeholder – scientist) on selected topics/components
- Group working sessions to review databases and get familiar with certain techniques and computer-based tools
- Scientist planning sessions

To check mental maps against reality, in addition, field trips were conducted in Tam Duong, Omon and Batac/Dingras case study regions (Pujiang case had been visited earlieron). The field trips were organized such as to provide a quick overview of the diversity in biophysical conditions, farming systems and, especially, farmers' problems.Comprehensive photo documentation is available for each of the workshop elements at the different locations, and for the three field trips (see, the various sub-directories under photo archive on CD-ROM).

Annex A gives some impressions from a field trip in Omon district. To give some flavor of the various workshop elements, a few examples are presented below.



1. Stakeholder consultation – Pujiang case

2. Group discussion at NISF, TamDuong case

3. Team working session at MMSU, Batac

4. Planning session at CLRRI, Omon case

Annex C Report of NISF workshop

IRMLA workshop on Multi-scale Land use analysis and Planning in Tam Duong district, Vinh Phuc province, Vietnam

Held at NISF, Hanoi, Vietnam, 4 to 8 April 2003

Minutes, Day 1, April 4: Stakeholder Consultation

1. Welcome by Dr. Bui Huy Hien , NISF (Director)

Gives an introduction about the role of the IRMLA project for land use planning in Vietnam and the intended use of IRMLA approach within NISF.

2. Presentation by Dr. Tran Thuc Son, NISF (Vice-Director; IRMLA Teamleader)

Provides a brief introduction to IRMLA's objectives, institutional context and time schedule, main activities carried out so far, expected project outputs, objectives of workshop and the programme.

3. Presentation by Dr. Reimund Roetter (IRMLA project coordinator)

Illustrates what kind of information (decision support) can be provided to policy makers and planners by the IRMLA approach, and what kind of analytical tools and data are required to generate meaningful results. Focus is on the research approach, with emphasis on the components of the Interactive Multiple Goal Linear Programming approach (IMGLP) and their integration, and the type of scenarios that can be analysed.

These presentations were followed by two presentations on policy views and rural development plans from the provincial and district perspective, respectively . Presentations were not kept formal but allowed clarifying questions and discussion during and after the presentation.

4. Presentation by Van Quy (Provincial Head, Agric Station)

This presentation is available as ppt presentation: *Vinh Phuc Report.ppt* (see Annex G). Some information from this presentation on the land use, the cropping and animal production systems, and the socio-economic characteristics in the Vinh Phuc province is given in Tables C6, C7, C8 and C9.

The main limitations for agricultural development are presented:

- Limited development in processing and preservation industry of agro-forestry production;
- Limited mechanization of agricultural production;
- Income of farmers in remote areas completely depending on agriculture;
- Low yield and low quality of agro-forestry products;
- High production costs;
- Small range of commodity products (and with weak competitiveness);
- Budget to support projects for production increase and changes is limited.

The main objectives for agricultural development after year 2005 are presented to be:

- Increase in agro-forestry and fishery production by 5.5 to 6 % per year;
- Total grain production of 400 000 ton per year;
- Rice yield of 5.3 ton/ha and corn yield of 4.0 to 4.5 ton/ha;
- Effective exploitation of 3000 ha mulberry;
- Establishment of specialized zone of about 500 ha for flower and bonsai production;
- Vegetables should be produced in a safe way;
- Increase in area with fish cultivation by 1500 to 2000 ha;
- Total income from agro-forestry and fishery is 2313 billion VND;
- Total income per hectare is more than 26 million VND;
- Export-import value of agro-forestry and fishery sectors is 10 millions USD.

The main advantages of Vinh Phuc province are presented to be:

- Limited distance to cities and industrial centers;
- Rather large area of uncultivated land;
- Large diversity in land and climate types which allows diversity in agricultural production systems;
- High labour potential.

The main limitations for agricultural development in Vinh Phuc province are presented to be:

- Limited agricultural land area per capita: 400 $m^{2.}$;
- Poor starting point for development: due to poor management, poor scientific and technical level, and poor developments in the non-agricultural sectors;
- Commodity products will face a severe competion when Vietnam starts to participate in AFTA and WTO.

The following measures are planned for the Vinh Phuc province:

- Appropriate decrease in food cropping areas;
- Increase in areas for cultivating commodity crops: vegetables, fruit trees, flowers, bonsai, industrial crops, grass cultivation for animal husbandry, and fishery;

- Establishment of specialized areas for rice, mulberry, fruit tree, fishery, and cattle husbandry.

Provincial plans on agricultural development and land use

The national government makes a plan based on statistics from previous years. The autonomous provinces make their own plans that must be approved by the central government. Planning specialists set the provincial targets based on provincial statistics. The provincial targets can therefore deviate significantly from the national targets.

Vinh Phuc province should produce rice for food security, not for export. The central government wants to decrease the rice growing area and stimulate other agricultural uses which are assumed to be more profitable (vegetables, flowers, animal husbandry). The provincial government wants to keep the agricultural area at the current level of 66000 ha. They want the area for roads and industry to increase by 6000 ha. This will come from land that is currently not used.

The central government wants to decrease the share of agriculture in income and employment generation. So industry should withdraw labor from agriculture. This objective is adhered to by the provincial (as well as the district) governments.

Infrastructure & trade

There are three main roads in Vinh Phuc province. As two provinces have limited access to these roads, two new roads are planned.

Trade is private, but the government sets regulations. Moreover, the government affects direct demand by starting processing plants (see district plans).

Irrigation

There are water shortages. The present irrigation systems were constructed 40-50 years ago and should be renovated. Moreover, water needs have increased over the past decades due to multiple cropping and tree cultivation.

Farmers pay for irrigation water. The price depends on the electricity price, which is region-specific. The price ranges from 5-10 kg paddy per $360m^2$. For winter crops, irrigation is free.
Large systems are managed by the province, small systems by the district.

Employment

90% of the people in Vinh Phuc province are registered in rural regions. These people are considered to be employed in agriculture. Tam Duong district has 88.7% (?) employment. This number refers to total days worked in the district divided by total work days available from people residing in the district (based on 8 hours day, 365 days).

Many farmers have only little land. So they can perhaps work 50 days per year on their own land. The rest they do other jobs, for instance in the city. (Note: work in the city is considered unemployment in the district!).

Minimum income

To survive, you need 300 kg rice per person per year: Price of rice is VND 3.0/kg, needed: VND 900 per person per year (VND 75 per capita per month).
The average family owns 0.05 ha. With yields of 4.5 t/ha paddy, this results in 270 kg/year (with single cropping). This is barely enough to feed one person. So the family will have other sources of income.

5. Discussion

Question from Director B.H. Hien: how will the district achieve a 4.5 % increase in monetary value from agricultural production while MARD recommends just 2.3 % increase ?

Response: this was considered a feasible increase after consultation with provincial planning specialists of the Planning and Investment Department. One has to take into account that the province is at the low end within the country in terms of production levels and value. Hence, this is to catch up with other districts in the province.

Further questions with respect to the coordination of planning processes among national, provincial and district level.

Response: People's committee coordinates all the planning. The process is as follows:

- Estimating gross value of agriculture production and its increase is difficult (and deviates from MARD), because production growth has been strong in the Vinh Phuc province as originally being at a low level;
- Objective of plan is to reduce relative employment in agriculture from 90 to 70% in 2010) as encouraged by the national government;
- Integrated planning: no appropriate mechanisms so far.

Question on land use planning /allocation of land: how to avoid conflicts with other sectors if agriculture wants to expand ?

Response: the province comprises 7 districts with in total 66000 ha of agricultural land. Until year 2010, this agricultural land area can still increase by 6000 ha from currently unused land.

Relative shares of GDP are at present: 42% from industry , 21 % from other services; only 27% from agriculture. Contribution from agriculture is expected to decreased and to become 19% in year 2010. For industrial expansion, ten zones have been defined.

Question: How is it possible to make such detailed land use plans for specific acreages for different commodities ?

Response: the Planning follows a three step approach : set out strategy, define target, and pave road. This means that current figures are just indicative, reflecting rough targets and first ideas. The figures are based on past trends as derived from statistics in

combination with a strategic perspective. It is well known that there will still be several corrections in the course of elaboration (paving the road)

Question: given that the strategies have already been translated into very specific measures /programmes e.g. for expansion/change of land use , is such procedure in line or is it guided to some extent by a national plan ?

Response: 6.7% increase in income, for instance, is a target for the nation in 2003 (but the province wants to achieve10% increase). Such a deviation is possible, since each province can determine its own strategy. In other words , a province is autonomous in setting its own targets.

Question: what is the (scientific) basis for formulating commodity – specific targets and, if there is little coordination between national and provincial governments, how to avoid undesired conflicts in plans at different levels?

Response: there is some coordination mechanism that looks at such possible conflicts, however, this still can be approved. For example, in addition to provincial land use plans, there is also a master plan for the Red River Basin, which imposes task to various provinces.

Self-sufficiency in food (rice) is a priority of the Vinh Phuc province.

Question: One of objectives for the period after year 2005 is that all vegetables are produced safely. How this will be attained and how food safety will be monitored ?

Response: Measures and mechanisms to achieve and monitor food safety, is a hot item, currently much under scientific and political debate.

6. District presentation (Nguyen Van Ngoc, Head Dep. Agric. & Rur. Dev.)

This presentation is available as ppt presentation: *Tam Duong Report.ppt*
Information from this presentation on the land use, the agricultural production, the objectives for agricultural development over the coming 20 years, and the socio-economic characteristics of the Tam Duong District is given in Tables C11, C12, C13 and C14.. For information on the planned land use changes over the coming 20 years and the water management system in this district, see the mentioned ppt presentation.

7. Discussion on district presentation

Question from Huib Hengstdijk: Are the water resources limited ?

Response: there is water shortage because of crop intensification from intensity 1.2 to almost 2.5. This conflicts with water use by tourism. The irrigation systems and reservoirs are still from 1954 and needs modernization.

Question from Huib Hengstdijk: Is there water pricing ?
Response: yes. However, that is not always the situation. For instance, for winter crops there is no charge.

Question from Reimund Rötter: food grain production (rice & maize) is assumed to increase until 2020 by 25 % (i.e. from 58,000 to 80,000 t), hence more than 1 % per year ?

Response : This will be achieved by raising grain yields per unit area from 4.6 to 6.5 t/ ha.

Question from Reimund Rötter: Employed versus unemployed is 88.7% versus 11.3%. What do these figures mean?

Response: assume that from 100 people only 80 have work, unemployement is 20 %. However, working time per year is defined as : 8 hr times 365 days a year (??).

Response: If somebody works 50 days per year on a farm, he is counted as employed in agriculture because he is registered in a village. However, in terms of cash income, the city contributes more, also in rural areas.

Question from Marrit van den Berg: Where does the income come from for the farm families (off-farm –versus on-farm) ?

Response: Minimum income amounts to 120,000 Dong in agriculture per month per capita. If lower income, then one should look for other job. Currently the income is 22.500,000 (?) millions VN Dong per ha per year.
(6 $ per month per capita = 90,000 Dong per month) For example: 5 children, 1 woman, 450,000 VN Dong --- 70,000 Dong)

Price is 3000 VN Dong per kg rice. This means that 1,000 000 VN Dong per year is sufficient to survive.

Question from Reimund Rötter: In Table 6, the annually cultivated land area declines up to 2010 and then increases ?

Response: the figure for year 2020 is wrong, and should decrease.

Question from Marrit: do figures indicate what you want farmers to do. If so, how do you stimulate them? Please, give an example?

Response: this depends on the situation. For example, your garden does not yield enough money – so farmers are stimulated to try something new to improve the situation (government provides some supportive funds e.g. 50% of the seedling).
Farmers are affected by different policies, sometimes conflicting policies make life hard.

Question from Reimund Rötter: How is the planning for the district organized ?

Response: Different departments work together under the leadership of the People's Committee. Requests are made for advice from provincial departments, but approval of final plan/project is required from and rests with the Provincial People's Committee.

Note, not all departments available at the province are also installed at the the district level (for instance, whereas the province has a department for planning and investment, the district has only a planning but not an investment department).

8. Outcome from discussions on main problems and objectives for the Tam Duong district

Group A

Problems:
- Poor soils
- Limited irrigation systems
- Poverty
- Low education
- Marketing
- Land/labour ratio very low (500m^2 per capita)
- Post harvest
- Policy
- Bad quality of vegetables

Objectives:
1) Improved irrigation systems
2) Improve quality of product so that it can be exported
3) Marketing cooperatives
4) Training especially for INM & IPM

Group B

Objectives at
Province level:
- Same aggregate of food crops and animal types but with increased income per ha. For this purpose, the following six crops: rice, maize, vegetables, fruit trees, flowers, mulberry and the following three animals: cow, pigs, poulty.
- Irrigation

District level:
- even a larger increase in cash income per hectare than planned by the provincial government. The same crop species and animals as at province level, plus fish.

Group A

List of objectives/problems:

- decrease crop production but increase livestock production
- 6 main commodities (rice, maize, mulberries, vegetable, fruit tree, flower)
- to produce 400,000 t grain food per year (i.e. mean yield level of 5.3 t/ha for rice and 4.1 t/ha for maize)
- 3000 ha of mulberries in total (increase from current: 2000 ha)
- 500 ha flower and bonsai
- 60-100 ha with environment-friendly produced (organic) vegetables
- 1000 ha tree cultivation (forestry)
- 1500- 2000 ha for fish and shrimp with 20,000 t total annual production
- 10,000 cows and 10,000 pigs in 2020
- 2313 billion VND income value per year from agriculture and fishery after 2005
- change from 64% of relative income from crop production to 48 - 50% after 2005

Table C-1 Objectives for structural changes in agricultural production

	Year 2001	Year 2005
Crop production (%)	64	48
Livestock (%)	25.6	35-38
Fishery (%)	2.9	7-8
Forestry (%)	7-8	15
Cash (US/ha)	280	350-400?

Table C-2 Problems and regional objectives

Overall strategy	Direct objectives	Comments
- Develop sustainable agricultural system - Industrialization/modernization - Diversification/specialization within the region	- Increase income (farmers' and regional) - Increase production and quality of products - Improve quality of natural resources - Reduce poverty	- Economical growth - Food self-sufficiency - Environmentally sound practices - Environmental protection - Poverty eradication
PROVINCE		
1. Increase income	Increase in fishery and animal husbandry	Step by step decrease in cropping area
2.		
3.		
DISTRICT		
Objectives/problems	Indication/brief description	Comments

Remarks about land use analysis:

1. Minimum use of agricultural lands for other purposes → put in a value for actual non-use of land areas;
2. Agricultura production toward Industralization & Modernization (specialization and large plantations?);
3. Establish three economic zones: a) mountainous (tree plantation, forest protection, industrial tree, fruits, food crop, big live stocks); b) middle areas (industrial crops, rice for food, fruit, live stockes), and c) deltas areas (rice for food, rice - maize, soybean-vegetables, pig, fishery,) with their specialities of crops and lives stocks;
4. 6 main crops: rice, maize, soybean, peanut, fruit trees, vegetables;
5. Transfers of 20-25 % of low yield rice lands into non-rice crops of high cash values;
6. Rice areas only (8000-8300 ha) with target yields: 6.0-6.5 ton/ha (2005); 7.5-8.0 tones/ha (2010) → total rice production: 80.000 tones;
7. 500 m^2 of land area per capita; 3600 m^2 per farm house; cash input VN$ 2.000000-3.000.000 for rice-maize;
8. big farming (2ha-8 ha) → 30 total (up lands);
9. Credit: 20 mil./farm house holds.

Table C-3: Tam Duong : Current situation and plans for future land use[1]

Index	2001	2010	2020
Natural land	19,799.99	19,799.99	19,799.99
I. Agricultural land	8,035.91	8,124.46	8,024.46
a. Annual crop cultivation land	6,137.60	5,780.76	5,940,76
1. Rice + Rice and upland crop		5,419.39	5,374.34
- 3 crop land		1,467.05	1,467.05
- 2 crop land		3,898.08	3,848.08
- seedbed land		54.26	54.26
2. Perennial plant cultivation land		561.37	
- Multiple plant garden	1,055.59	179.69	174.69
- Perennial tree cultivation land	636.28	2,333.50	2,173.50
II. Forest land	6,844.07	7,454.44	7,445.44
III. Land for special purpose	2,511.64	2,782.31	2,882.31
IV. Resident land	861.16	927.28	1,047.28
V. Unused land	1,627.71	400.5	400.5

[1] the change in land use at present is given in Table C-16.

Information on the land use, the agricultural production, the objectives for agricultural development over the coming 20 years, and the socio-economic characteristics of the Tam Duong District is given in Tables C11, C12, C13 and C14..

The list of participants of the IRMLA workshop is given in Table C4. Table C-5 gives a short overview of the distribution of main responsibilities within the IRMLA project. Table C-6 gives a summary of the Tam Duong case study within the IRMLA-project. For each policy objective, such as increase economic growth or decrease erosion, the instruments to achieve such objective, the side effects of the required measurements and the constraints (e.g. lack of technology or investment budget) are discussed.

Based on presentations during the workshop, as mentioned above, information on land use and agricultural production systems in theVinh Phuc province and on the socio-economic characteristics are given in Tables C7 to C10. The same type of information for the Tam Duong district is given in Tables C11 to C14.

Table C-4: List of participants (stakeholder consultation at NISF)

11 persons – representatives from Vinh Phuc Province and Tam Duong District

19 persons from NISF; 1 person from VASI; 4 persons from Wageningen UR

LOCAL STAKEHOLDERS

No (group)	NAME	INSTITUTION and Function (group)	
1 (A)	Nguyen Van Quy	Vinh phuc Province, Head Agronomic Station, Div. Agriculture & Rural Development	Director
2 (B)	Do Hai Trieu	Province, Scientist Agronomic Station	Vice-Director
3(A)	Nguyen Van Nam	Province, Scientist Agronomic Station	Head, Department Soil Environment
4(B)	Nguyen Van Loc	Prov., Vice – Director, Division Land Management	Head, Department Soil Genesis/Classification, GIS
5(A)	Nguyen Thi Thanh Huong	Province, Scientist Division Land Management	Head, Department Planning & Science Management
6(B)	Nguyen Trong Niem	Province, Scientist Division Land Management	Head, Department Land Use Planning
7(A)	Nguyen Hong Quan	Province, Scientist Division Agriculture & Rural Development	Deputy Head, Plant Nutrition
8(B)	Nguyen Viet Xuan	Province, Scientist Division Agriculture & Rural Development	Deputy Head, Soil Properties(physiscs, chemistry)
9(A)	Nguyen Van Ngoc	District Tam Duong, Head Department Agric. & Rural Developm.	GIS, Land Evaluation
10(B)	Nguyen Quoc Oanh	District Tam Duong, Scientist Department Agric. & Rural Developm	GIS, Land Evaluation
11(A)	Vu Phi Hung	District Tam Duong, Extension Service	Economics (under GIS Department) GIS

SCIENTISTS

No	NAME	INSTITU-TION (group)	POSITION	LUPAS Exper.
1	Bui Huy Hien	NISF (A)	Director	x
2	Tran Thuc Son	NISF (B)	Vice-Director	x
3	Pham Quang Ha	NISF (A)	Head, Department Soil Environment	x

4	Ho Quang Duc	NISF (B)	Head, Department Soil Genesis/Classification, GIS	x
5	Bui Quang Xuan	NISF (A)	Head, Department Planning & Science Management	
6	Nguyen Cong Vinh	NISF (B)	Head, Department Land Use Planning	
7	Nguyen Van Chien	NISF (A)	Deputy Head, Plant Nutrition	
8	Nguyen van Truong	NISF (B)	Deputy Head, Soil Properties(physiscs, chemistry)	
9	Vu Manh Quyet	NISF (A)	GIS, Land Evaluation	x
10	Nguyen Van Dao	NISF (B)	GIS, Land Evaluation	
11	Nguyen van Ga	NISF (A)	Economics (under GIS Department)	
12	Luong Duc Toan	NISF (B)	GIS	
13	Pham Duc Thu	NISF (A)	Economics	
14	Le Thi My Hanh	NISF (B)	Economics	
15	Tran Thi Minh Thu	NISF (A)	GIS	
16	Vu Dinh Tuan	NISF (B)	GIS	
17	Nghiem Thu Hien	NISF (A)	GIS	
18	Nguyen Quoc Hai	NISF (B)	Soil Properties (physics, chemistry)	
19	Le Thi My Hao	NISF (A)	Plant Nutrition	
20	Vu Nguyen	VASI (B)	Mathematics /GIS	
21	Reimud Roetter	WUR (A)	Alterra, IRMLA Project Coordinator, Land evaluation and Soil Science	
22	Lu Changhe	IGSNRR & WUR (B)	IRMLA Regional Training Coordinator, land use modeling	
23	Marrit Van den Berg	WUR (A)	PPS & OE, IRMLA, Economist	
24	Huib Hengsdijk	WUR (B)	Plant Research International, Agronomist and modeller	

Table C-5: Responsibilities (bold italic = NISF people in charge; bold = district liaison/key stakeholders)

Resource eva. (A)	Input/output (B1)	Tech. coeff. generat. (B2)	IMLP (opt.) (C)
N.V.Dao	***N.V. Chien***	***Nguyen Q.HAi***	***V.D. Tuan***
V.M.Quyet	Pham Duc Thu	N.CVinh	V. Nguyen
Tran Minh THu	Le Thi Hanh	N.V. Truong	N.Thu Hien
N.Thanh Huong	**N. Q. Oanh**	**Vu Phi Hung**	PQHA
	Le My Hao	***Tran THuc Son***	Luong Duc Toan
Reimund	Huib	Huib & Reimund	Marrit & Lu (GAMS)
		MV Trinh	

Table C-6 Summary Tam Duong case study : Policy objectives and instruments

	Policy objective	Instrument	Side-effects/constraints	Comments/questions
1.	Maintaining the area of agricultural land in 2010 at 66.000 ha (Vinh Phuc), while urban area may increase with 6.000 ha. For Tam Duong, the target is 19.799 ha of agricultural land in 2010.	??	- Unused land is reclaimed, thus this may include the use of nature areas (loss of biodiverity?). -	- Can this law be maintained considering current rate of urbanization?
2.	Economic growth (national and provincial level) to fight poverty OR PROBABLY BETTER: Reduce poverty by stimulating economic growth	Stimulating industry and services by various sectoral instruments	- Rural migration to urban areas→ is urban infrastructure sufficiently developed to accommodate rural people? - Increase in part time farmers, which have less time for farming (requiring less labour demanding cropping systems?→define as MGLP-objective: minimize labour use in agriculture??).	- instruments are not known (need to be known?). - Identified side-effects are not considered a problem; seem to be encouraged as off-farm employment/income is an important means to reduce poverty.
3.	Decrease grain/rice area (or consequence of objective 4?) (Vinh Phuc). For Tam Duong the target is 5.419 ha (in 2010) from about 11.700 ha currently (Table 4 and Table 6 in presentation Nguyen van Nqoi seem inconsistent due to double cropping??).	Market forces?	- May endanger food self-sufficiency? - See also objective 6 to avoid this problem.	- Mekong area produces for export and should be maintained. But the area around Hanoi is not a major (export) rice producing area.
4.	Increase farm income to more than 26-27 Mln VND/ha (national). In	Technical support/training/improve input	- Uncertain effects: will farmers change production? What will	- Marketing should be improved. In the discussion

	Tam duong target is set at 35-40 mln VND/ha in 2010→see objective 2	access (e.g. seeds) to diversify current cropping systems (mulberry, shrimp, cattle, vegetable, pigs); output contracts (e.g. mulberry) as most processing units are government owned.	- be the market implications of wide change (overproduction→see coffee)? - See objective 8 - Processing and marketing should be developed ('enabling' policy)	groups mentioned as an objective, but probably an instrument to realise this objective and objective 2. - Current farm income is 23 mln VND/ha in Vinh Phuc, 22.5 mln/ha in Tam Duong. In Vinh Phuc in 2010: - Overall growth in cattle and sows is each 10.000, - Increase fishery area with 1500-2000 ha, - Overall income from agroforestry and fishery should increase to 2.313 billion VND, - export-import value of agro-forestry and fishery is 10 mln USD, - 3000 ha mulberry, - 60-100 ha safely produced (organic) vegetables.
5.	Improve safety and quality of agricultural production taking into account the environment ('sustainable production') (national)	Farmer demo's have started and are under investigation. Discussion of what 'sustainable' production means has not yet settled. From the discussion group, it should include new varieties and training of farmers	- Will farmers follow recommendations? -	- Not yet clear (see discussion under 'instrument'). - Analyse farm survey to gain insight in current input use.

		(e.g. on Integrated Nutrient Management)		
6.	Increase rice productivity to 5.3 t/ha and corn to 4-4.5 t/ha to realize an overall production of 400.000 t/y (Vinh Phuc) and in Tam Duong 68.000 t in 2010.	Technical support/training of farmers		- Current rice yield is 4.22 t/ha in Vinh Phuc
7.	Reduce erosion	Reforestation of fragile land?	- Who is paying and responsible for maintenance?	- Erosion is no major problem in Tam Duong - Forest area in Tam Duong increased already last years considerably.
8.	Improve irrigation system (from group discussion)	None: Government should bear renovation costs and new investments, but has no concrete plans	- Water is in some parts (upland) limited available and may constrain, e.g. perennials and three annual crops per year. → may constraint the realisation of objective 4	- 50% of upland only irrigated
9				

Conclusions: Few agricultural policy instruments seem available for policy makers: technical support of farmers, and supplementary instruments applied in other sectors that may trigger (desired) changes in agriculture (migration, income increase).

With respect to the incorporation of these policy objectives into the MGLP the following goals and constraints can be considered (time horizon 2010?):

1. Maximize economic surplus (total and per labour unit)
2. Constraint on the agricultural area (minimum area)

3. Constraint on the area with rice/grain crops (minimum area)
4. Minimize emission of environmental harmful substances (which depends on farm survey analysis)
5. Constraint on irrigation water availability (defined per land unit?)
6. Increase grain productivity (minimize area with grains?→set to constraint 3)
7. Translate the production and area targets defined under objective 4 for Vinh Phuc as (minimum) constraints for Tam Duong
8. Minimize labour use in agriculture (to show available labour force available for other sectors)

Table C-7 Land use in Vinh Phuc Province

Component	Area ha	%
Natural land	137148	-
Agricultural land	66660	48.6
Forest land	30439	22.2
Land for special use	18780	13.6
Unused land	16094	11.7
Resident land	5349	3.9

Table C-8 Area of different crops in Vinh Phuc Province

Crop	Area in 2000 (ha)	Area in 2002 (ha)	Increase %
Annual industrial crops	9020	10100	12.0 -
Vegetables and beans	7200	9400	30.5
Fruit tree	5400	7700	42.5

Table C-9 Animal husbandry and fishery in Vinh Phuc Province

Component	**Number** in 2000	Number in 2002	**Increase** %
Cattle	99300	108200	9.0
Pigs (relative)			12
Poultry (relative)			33
Area of fish cultivation (ha)	3624	3900	7.6

Table C-10 Socioeconomic features in Vinh Phuc Province

Total population	1 125 415
Population density	812 per km^2
Rural / total population	89 %
Increase of GDP in 2002	12.5 %
Increase of agricicultural Production	5 %
Increase of services	18 %
Increase in food production (in rice equivalent)	6.8 %
Total income per capita	240 USD

Table C-11 Land use in Tam Duong district

Component	Year 1998 ha	Year 2001 ha	Increase %
Natural land	19683	19780	0.5
Agricultural land	7653	8035	5.0
Rice and Rice-upland crop	5536	6138[a]	4.2
Other annual crop	356		
Multiple plant garden	720	1056	46.7
Other tree land	858	636	-25.9
Under water land	182	205	12.6
Forest land	4987	6744	35.2
Land for special purpose	1986	2512	26.5
Unused land	4313	1628	-62.3

[a] total annual crop land area

Table C-12 Cropping areas and agricultural production in Tam Duong district

	Area / production
Total cultivated area	15401 ha
Food crop area	13246 ha
Rice crop area	9483 ha
Maize crop area	2239 ha
Rice yield	4.65 t/ha
Maize yield	3.32.t/ha
Foodstuff crop area	1143 ha
Production	10500 t
Short duration industrial crop	1200 ha
Total production of grain food crop	50000 t
Quantity of grain food / capita	400 kg
Income per ha of arable land	22.5 million VND

Table C-13 Targets for agricultural production in Tam Duong district

Year Index	2005	2010	2020
Agricultural growth rate (%/year)	5-6	4.5-5	4
Agricultural income per total income (%)	47	44	40
Production of grain food (t)	58000	68000	80000
Income per capita (USD/year)	280-300	350-400	550-600
Income per ha arable land (million VND)	28-30	35-40	50-60
Coverage by forest (%)		35	40

Table C-14 Socio-economic characteristics at present in Tam Duong district

No. of village	16
Small town	1
Population	123 670
Population density	625 persons / km^2
No. of ethnc groups	10
Kinh and San Diu ethnic groups	99.4 %
Population growth rate	1.98 %
Poor households	13.5 %
Malnutrition of children	29.7 %
Working labor per total labor rate	88.7 %

Annex D Report of CLRRI workshop

IRMLA Workshop on Multi-scale Land use analysis and Planning in Omon district, Cantho province, Vietnam

Held at Cuulong Delta Rice Research Institute
(CLRRI), Omon, 9 to 10 April 2003

Minutes, Day 1, April 9 : Stakeholder Consultation

1. Welcome by Dr Bui Chi Buu (Director of CLRRI)

Dr Buu stressed the importance of the new methodology and tools for multi-scale land use analysis and underlined the appreciation of continuation of fruitful previous collaboration between CLRRI and WUR through IRMLA.

2. Presentation by Dr. R Roetter (IRMLA project coordinator)

Gives an introduction to IRMLA project, workshop objectives and schedule.

3. Presentation by Dr. NX Lai (IRMLA teamleader of CLRRI) and Dr. R Roetter

Present the IRMLA approach to land use policy support. This presentation illustrates what has been achieved by a previous joint project (SysNet) on land use optimization for the province and what additional information (decision support) can be provided by the IRMLA approach. An example was given of required analytical tools and data to generate meaningful results. A review of outcomes from previous SysNet study and the new analytical steps presented was then made to serve as a structure for the following discussions and presentations

4. Presentation by Nguyen Van Dien (Representative of provincial planning department)

Presents the changes in policy views, rural development plans and policy measures during the period 1998-2003 for the Cantho Province.
Note: the complete provincial plan 2001-2010 is available in Vietnamese (ask for copies from the CLRRI teamleader, Dr NX Lai).

Cantho Department for Planning and Investment has elaborated a land use & development plan for the province, period 2001-2010 and submitted this to agricultural and financial departments at the national level . Such plan is required to receive funds from national government for investments in infrastructure (and

development programmes?). Moreover, the province also developed plans up to 2010 for 5 out of the 7 districts (however, so far not including Omon).
The province has received funds for elaboration of such so-called 'socio-economic development plans'.

Apart from this, there are specific plans for establishing/expanding irrigation systems within the province as part of Mekong Delta irrigation development programme, which also includes projects in Omon.

Some basic data for Cantho province:

- Economic development up to 2002 (GDP – 9.5% increase per annuum) ; agricultural & forestry production by 10.54 %
- Current annual income per capita is 382 US$
- All sectors together generated an regional income of 8334,000,000,000 VND (8334 billion) of which 28.6% were generated from agriculture, 34% from industry, and 39% through services
- Employment ?

Recent trends show that the share of agricultural production in generating income decreased slightly (still the absolute production in monetary terms increased).
The price for 1 kg of paddy rice in 2003 amounted to 1700 VND.
Irrigated area (now: 131,000 ha) has doubled within the last 5 years – yet, projects have not been fully completed.
The total production area in the province is about 180,000 ha – and about 70% of this is under irrigation.
73 % of the households have electricity, and 60% have drinking water coming from pipes.

Goals and targets of Cantho province:

- Rice production (to produce at least 2 Mio tons per year) – current level is 2.2 Mio tons; (rice exported was 600,000 t and rice for local consumption amounted to 1,6 Mio tons)
- Environmental : Food safety (less pesticide residues) - > reduction of input use (biogas is promoted); improved waste treatment
- Employment: Increase employment in general and maintain certain level of job opportunities in agriculture (try to restrict movement from rural to urban areas) Note: there is hope to reduce problem of unemployment by 2010; currently there are some contrary tendencies: for some areas, introduction of new technologies (mechanization) will decrease employment opportunities; however, still in other areas the introduction /or switch to high-intensive , high values agricultural activities will increase job opportunities

5. Discussion

Unemployment is currently a problem. However, there are plans to reduce this by 2010. In some remote areas of the province, there are still water supply problems, although huge investments have been made (e.g. the establishement of wells – 1 well per km^2.

6. Presentation by district officer of Omon district

Presents information on Land use activities and resource management issues in Omon district.

Current land use Omon:
(status: data available by Oct. 2002)

Total land area	54 541,36 ha
Agricultural land	47 364,44 ha (87% of total land area)
Forest	1.25 ha (0.2 %)
Specific uses	3 416 ha (6.26 %)
Residential area	1 470 ha (2.69%)
Not used	2 288.55 ha (4.19%)

Annual crops cover 40 356 ha, of which 39 812 ha used for rice-based systems; other crops (such as sugarcane ?) cover 534.42 ha

Perennials: 6 941 ha, > 6000 ha fruit trees, mango, pomelo, orange, sapodilla, industrial plants,
Mandarin < (decreased), orange, sapidilla, pomelo > (increased)

Main difficulties/problems are:

- Knowledge of farmers > change structure of planting
- There is not yet a land use plan up to 2010 for Omon

Recent developments are the rice shrimp cropping system with two systems:
1. rice rice shrimp; 2. rice shrimp, and further
3. rice fish.
Most popular system is: rice – non-rice food (upland) crop system

Main livestock is: pigs, poultry, and milk cows

7. Presentation of objectives as specified in socio-economic and security development plan for theOMON district up to 2005

Programmes:

a) High quality rice, export
b) Hybrid corn, mungbean, soybean
c) Sterilized citrus, orchards

d) Cows (milk, meat)
e) Fishery
f) Transportation, housing
g) Rural industrialization
h) Environmental conservation
i) Tourism and services

***Major goals*:**

- Industrialization
- Change in production style: domestic and export
- Increase interactions between different sectors

People's Committee approved the stated development goals in March 2003
One of major aims: to increase diversity in land use.

Detailed Plan for up to 2005
Agriculture:

- Share of crop production in agricultural activities to be reduced
- Develop high quality rice production
- Agricultural production: increase 4-5% per year
- Fishery: increase 18-20% per year

Agricultural Goals for up to 2005 of Omon district

a. High quality rice programme *(mainly for export)*

2003: 10 000 ha
2004: 20 000 ha
315000 tons/year
rice export: 160 000 tons/yr, 35M USD
2005: 31 320 ha

b. Hybrid corn, mungbean, soybean: *4200 ha*

2003: 5000 ha (hybrid corn, mungbean, soybean: 2200)
2004: 5700 ha (hybrid corn, mungbean, soybean 3400)
2005: 7500 ha upland crops (hybrid corn, mungbean, soybean 4200 ha)

c. Healthy citrus, orchards

Improved from unbeneficial orchards in the past, size wont be improved
2003: 2100 ha (good quality)
2004: 2800 ha
2005: 7000 ha (beneficial orchards)
Citrus: 2500
Mango: 1000

Longan, rambutan etc.\: 1500
Others: 2000

d. Cows (Milk and Meat)

(2002: ~ 500 local cows)
2003: 590 heads
2004: 921
2005: 1355 in all (302 milk cows only)

e. Fishery

(2002: 2500 ha)
2003: 2964 ha (shrimps: 200, catfish: 150 ha, tillapia: 5), fish pond: 609, rice fish: 2000, floating cage for raising fish: 40
2004: 4009 ha (shrimps: 600, catfish: 250, tillapia: 50, pond: 609,rice fish: 2500, floating cage for raising fish: 40. Thoi Thanh village: intensive shrimp production area
2005: 5509 (shrimps: 1200, catfish: 500, tillapia: 200, pond: 609,rice fish: 3000, floating cage for raising fish: 40

f. Changing in economic structure, irrigation system, transportation, housing

All the above mentioned factors will affect the rice based production

- Transportation: newly built roads, more intensive up to hamlet level
- Irrigation system: maintain enough water for irrigation
  2 irrigation projects:
  Thot Not-Omon 28 000 ha
  Omon-Xano 36 000 ha
- Housing: 1250 houses safe from annual flood
  Total: 11 locations (3.5 ha each)

g. Rural industrialization
h. Environmental conservation
i. Tourism and services

Table D-1 **Total investment needed for achieving all goals up to 2005 (3 yrs)**

	Total money needed	Granted by central government (provincial)
1	18351000000	633000000
2	721000000	571000000
3	57256000000	18759000000
4	3722000000	709000000
5	288000000000	28800000000
6	34790000000	19765000000
7	111162000000	20930000000
8	5400000000	5400000000
9	71250000000	23943000000
Grand total	590652000000 (~39,000,000 USD)	119510000000 (~8000000 USD)

Approx.: USD 9 /person/yr

8. General Discussion

Specifics on the nine programmes :

d. Cow programme (milk & meat) :
subsidies, tools , equipment --- processing factory exists in Cantho – demo station & training programmes established

e. Fishery: largely established – training programmes exist

Question from R. Rötter: Responsibility (departments within district) for carrying out 9 programmes and 7 projects ?

Answer: responsibity with Chairman of People's Committee (approves final plan; actually planning takes places within divisions and in a committee (see, below));
Various division Heads responsible for individual programmes;
Vice-Chairman (general manager of socio-economic and security development plan)
These divisions are:

- Agriculture & Rural Development (incl. Fishery & Extension)
- Planning & Investment
- Land administration (incl. transport, infrastructure)
- Industry
- Health Care (incl. drinking water)
- Education
- Commerce, Trade & Environment

Planning Process: district organizes a committee – members are heads of divisions – in case of conflict among divisions --- problem will be resolved among members (committee headed by PC chairman) - no advisory members needed /invited

Agricultural Research institutes administered by MARD;
Universities work independent – directly administered by MOE (Ministry of Education)

District Budget for investments in development (according to plan) – annual , i.e. 2003: see table in land use plan omon.doc)

Minimum government salary : 290,000 VND month/capita (USD 19)

Definition of poor : 120,000 VND (rural)
180,000 VND (urban)

9. Discussion on problems, objectives and priorities

List of problems (selected from a list of possible problems)

- Unemployment
- Poor soils (only in remote areas 5%)
- Pests and diseases
- Limited availability of good drinking water
- Low education
- Marketing
- Little land per capita (< 1 ha per household)
- Post harvest losses (in wet season)
- Bad quality of agricultural products
- Unhealthy food crops (vegetables , some fruit trees)
- Farmer health problems due to biocide use (spraying)
- Bad roads
- High variability in input prices (fertilizer, pesticides, fuel – depends on international market) and output prices
- Insuffcient investment capital/credit
- Knowledge about new technologies (with farmers)

List of objectives (selected and ranked from a list of possible objectives)

- *(1) The province/district should produce enough food for its people (Mekong Delta should produce rice for Vietnam – includes Omon) --- fertilizer price subsidies, low export tax, encourage rice storage)*
- The region should produce healthy food
- Each individual should have enough to eat, either through own production or through market purchase with cash income
- *(2) Income per capita should increase through higher income per hectare*
- *(5) The poor should become richer*
- Drinking water should be clean
- *(4) Agricultural production should not be harmful (drinking water, farmer health, soil productivity, healthy food)*
- *(3) There should be employment for everyone*
- Production methods should not harm the health of the farmer

10. Discussion on distribution of tasks with CLRRI – IRMLA Team

Review data requirements (check- list) for LUPAS and FHM
(plenary) and determine people in charge of 3 LUPAS teams; and form groups for (a) training on TechnoGIN and (b) MGLP/FH modeling (Dr NX Lai)

Table D-2 gives an overview of the distribution of main responsibilities within the IRMLA project.

Table D-2 Responsibities within the CLRRI team of the IRMLA project

Tasks	1. Resource balance/GIS	2a. Yield estimation	2b. Techn. Coefficients	3 MGLP/FHM
In charge	**Nguyen Xuan Lai**	**Tran Thi Ngoc Huan**		**Nguyen The Cuong**
Deputy	Nguyen Van Quyen	Hoang Dinh Dinh		Nhan Hong Hoa
Member	Ngiyen Hong Thao	Ho Xuan Thien		Nguyen Duc Hanh
Member		Truong Thi Ngoc Chi		
Member		Nguyen Huynh Phuoc Nguyen Duc Loc		

11. Other activities during afternoon sessions

- Cuong: Status of current work (slide show available)
- Marrit : data requirements FH modeling;
  basic difference FH model – regional MGLP : there is only 1 objective (utility; but many more constraints than in MGLP)

- Start training sessions:
  Groups 1,2a,b :TechnoGIN
  Group 3 (with additionally 1 person from Groups 1 & 2): MGLP/FHM (Gams)

Table D-3 Scientists distributed over training sessions

	1. Resource balance/GIS	*2a. Yield estimation*	*2b. Techn. Coefficients*	*3 MGLP/FHM*
In charge	**Nguyen Xuan Lai**	**Ho Xuan Thien**		**Nguyen The Cuong**
Deputy	Nguyen Van Quyen	Hoang Dinh Dinh		Nhan Hong Hoa
Member	Ngiyen Hong Thao	Tran Thi Ngoc Huan		Nguyen Duc Hanh
Member		Truong Thi Ngoc Chi		
Member		Nguyen Huynh Phuoc Nguyen Duc Loc		

12. Results of work carried out

Review component 1 : Land Evaluation/GIS (plenary)

Currently: 25 biophysical units (soil, water flooding, flooding duration) -- this is good starting point ; however: will be wise and feasible to further reduce/generalize number of units (now: some very small units)

Transport /accessibility zones: 3 zones, depending on intensity /resource endowments (9 types of farm households)

Farm survey data: 1500 planned, start with 300 households

Cropping systems, in total 10 (these will be expanded) :
(rice varieties: all from IRRI-CLRRI breeding programmes IR64 , Omon series 85 to 105 days)
Rice-Rice, Rice-Rice-Rice, Rice-Hybrid corn-Rice, Rice-Mungbean-Rice,
Rice-Soybean-Rice, Rice Vegetable, Rice-Shrimp, Rice-Rice+Fisch/Shrimp,
Sugarcane, Fruit trees (information on fruit trees : longan, rambutan, citrus (pomelo…), sampodilla, mango; loamy to clayey soils not really suitable for fruit tree production)

Livestock systems not yet considered

Still to be done: define technologies 1,2,3 for rice (as a reference)

Table D-4 List of participants (stakeholder consulation at CLRRI)

International Scientists:

No.	Name	Position	Organization
1	Dr. Reimund Roetter	Project coordinator	Altera, the Netherlands
2	Dr. Marrit van den Berg	Economic Specialist	Wageningen, the Netherlands
3	Mr. Micheal Crestani	Ph.D. scholar	Melbourne University, Australia
4	Mr. Daniel Kayser	M.Sc. scholar	Utrach, the Netherlands

Local stakeholders:

No.	Name	Position	Organization
1	Nguyen Van Dien	Deputy head of Eco. Office	Deprt. of Planning and Investment
2	Nguyen Tan Hung	Deputy head of General Cooperation Office	Deprt. of Planing and Investment
3	Le Minh Lam	Economic specialist	Omon People Committee
4	Ngo Hong Yen	Head of Agri. Section	Omon District
5	Huynh Thanh Han	Agri. In Charge	Thoi Long Village, Omon District

CLRRI - Project Team Members:

No.	Name	Position	Organization
1	Nguyen Xuan Lai	Head	Agricultural Economics Deprt.
2	Nguyen The Cuong	Computer Specialist	Sci. Man. & Inter. Coop. Deprt.
3	Nguyen Duc Loc	Agri. Economist	Agricultural Economics Deprt.
4	Nguyen Hong Thao	GIS & Land Management	Agricultural Economics Deprt.
5	Nguyen Huynh Phuoc	Agri. Economist	Agricultural Economics Deprt.
6	Nhan Hong Hoa	Computer Specialist	Sci. Man. & Inter. Coop. Deprt.
7	Hoang Dinh Dinh	Deputy Head	Extension Department
8	Nguyen Van Quyen	Agronomist	Fert. and Agronomic Deprt.
9	Ho Xuan Thien	Plant Pathologist	Plant Protection Department
10	Nguyen Duc Hanh	Computer Specialist	HCM National Technology Center
11	Truong Thi Ngoc Chi	Social-economic	Farming Systems Department
12	Tran Thi Ngoc Huan	Agronomist	Fert. and Agronomic Deprt.

CLRRI scientists:

No.	Name	Position	Organization
1	Bui Chi Buu	Director	CLRRI
2	Duong Van Chin	Head	Farming Systems Department
3	Luong Minh Chau	Head	Plant Protection Department
4	Nguyen Van Tao	Head	Rice Seed Production Deprt.
5	Phan Van Tuan	Computer Technician	Director Office
6	Truong Thi Minh Giang	Research Assistant	Farming Systems Department
7	Huynh Hong Bi	Research Assistant	Farming Systems Department

Annex E Report of Zhejiang University workshop

IRMLA Workshop on Multi-scale Land use analysis and Planning in Pujiang county, Zhejiang province, China

Held at Zhejiang University, Hangzhou, P.R. of China, 31 March to 4 April 2003

Minutes, Day 1, March 31: Stakeholder Consultation

1. Welcome by Prof. Huang Changyong, Scientist of Soil and environmental chemistry (former Dean of Zhejiang University)

2. Introduction by Prof. Wu Cifang (Deputy Dean of College of Environmental and Resource Sciences, ZU): useful meeting for learning about land use planning; Zhejiang : high population, limited land resources. Land use planning for sustainable land use.

College of Environmental and Resource Sciences, ZU: study focus is on environmental management; more than 100 scientists, 40 professors; strong research capacity. Resource use planning/resource management; long history of research in land use planning/management; key field of research in Zhejiang University
Expectations: Objectives of workshop to be attained, and opportunity to foster cooperation between ZU and WUR.

3. Presentation by Prof. Wang Guanghuo (IRMLA teamleader of ZU)

Provides a brief introduction to IRMLA's objectives, institutional context, main activities carried out so far, expected project outputs, objectives of this particular workshop and the programme.

4. Presentation by Dr. Reimund Roetter (IRMLA project coordinator)

Illustrates what information (decision support) can be provided to policy makers and planners by the IRMLA approach, and what kind of analytical tools and data are required to generate meaningful results. Focus is on research approach, with emphasis on components of the Interactive Multiple Goal Linear Programming approach (IMGLP). Objectives of IMGLP-analysis are : a. Economic/Production;
b. Social; c. Environmental.

Type of questions and output from operational system LUPAS are illustrated using case study Ilocos Norte Province, Philippines, as an example. Stakeholder

involvement: today's meeting is step in this interaction, in form of stakeholder consultations.

4. Prof. Xiao Dongsun , Deputy Director, Zhejiang Agricultural Bureau

The proper use of the agricultural land is task of the Bureau of Land Management, from provincial to township level. Both for current situation and future developments in Zhejiang province.

Characterization of agriculture of Zhejiang Province:

- 100 000 sq km 70% hilly, 20% paddy, 10% other agricicultural use
- 50 million population
- 0.3 ha per capita cultivated land; lowest land/man ratio of the country
- long history of agriculture: started 7000 years ago

Currently, agriculture is under rapid development and change. In year 2002, the output from agriculture yielded 110 billion Y; average income per person (rural population) was 4900 Y.
Major products from agriciculture are specified in Table E-1: total area and total production per type of product in Pujiang county.
Processing (in agricultural enterprises): operation not clear; quality and safety important.
Famous 'local' products: silk, dragon tea, oranges, bamboo; wine; ham
Institutional: research, extension, education
Technology development; again quality
Cropping index (intensity) is over 200%

Environmental concern: harmony between agricultural production and environmental protection → sustainable agriculture!!

Legislation: a) land law; b) agricultural law, recently approved by National Parliament and effectuated 1 March 2003: proper land management; land tenure; national legislation: implementation provincial; ecological protection; c) land use law: protection of agricultural land; rural (spatial) planning.

Agricultural Demonstration areas: There is one in each county; long-term quality; responsibility: natural resources Office (under the Ministry of Land & Resources); national and provincial (Office in each province); land consolidation: village level; maps reflecting land use plans are being prepared

Land use plan at county level(?):
Standardized farm land 68000 ha facilities 66 000 greenhouses, etc.; protection against flooding and drought 15 million ha.

Demonstration zones: 139 sites at township and village level; technology demonstration: tissue culture, ornamentals; potted plants; public/private financing: (collective) – size of demonstration areas ranges between 10 and 100 ha.

Areas unsuitable for agriculture (e.g. hilly, sloping): reforestation for example→ ecological agriculture'

Non-point pollution: ecological practices; pesticide use: basically recommendations; however, for very toxic substances , by law banned; (question: is there any fertilizer/pesticide authority ? yes)

Improved fertility: balanced fertilization; organic fertilizer application.

Crop location system; double cropping;
Cropping systems: breeding, crop improvement; import of new varieties; organic fertilizers; integrated crop management.

Private enterprise --- central planning--- extension service well established (30.000 staff in province) – provision of training, information through various media.

Surveys on soils are carried out to provide sound basis for new land evaluation – furthermore, monitoring of soil and water quality and management of polluted soils are conducted

Ecological sustainability economic viability: improved efficiency; incentives for farmers; structure of agricultural production??
Land allocation to crops; special products; high quality; 'comparative advantage'??
Agro-ecological zonation; canola; silk in lowland??
Coastal areas, peri-urban: vegetables for urban population and exports out-of-the county;
South-east mountain: mushrooms; forest for conservation;
Along infrastructure (railway, roads) floriculture; potted plants, ornamentals; oranges, citrus.

Need for improved land evaluation and planning is recognized - acknowledgement of importance by Agricultural Bureau

Policies by government (national, provincial)
Farmers improved livelihoods; long-term leases, 30 years (land contracts).

All organised by Agricultural Bureau (and financed from governmental sources: at provincial level, in Zhejiang about 90 county level bureaus).
County agricultural bureaus financed by the county structurally.

5. Presentation by Mr. Huang Ting, Director agricultural bureau Pujiang

Land use issues and natural resource management in Pujiang county

Some characteristics of Pujiang county:
916 sq km, W. of province

70% hilly; rest plain; in the basin; pop. 380.000; 12 townships and three street districts (urban).
1.8 000 ha, land cultivated 0.47 mu/capita
GDP 3.3 bill. Y; 10% agriculture, industry 70%; services rest

0.61 bill. Y gross agric. prod. per year
Average annual net income 3575 Y per person
29 NL 119 EL; 5300 dC divide for three crops crosses Pujiang
precipitation 1200 – 1500 mm

Crops: fruits, tea, husbandry, floriculture (4500 mu), mandarins, vegetables: 15000

Five agro-ecological zones:
hilly : forestry (bamboo), tea (5000 mu) organic 1500, fruits
mountain: mountain vegetable zone – basically small areas
sub-urban: tourist zone/ recreation
basin-edge: fruits/vegetables
basin: fisheries; ornamentals, rice

Animal production:
Pig farm: export to Hongkong 10.000
piglet production: partially exported
total pig population 350.000
ducks/chickens: 180.000
cows: 100---dairy
rabbits……
goats/sheep: 5500

28 (leading) agricultural processing enterprises

Farmers' associations (commodities): tea, vegetables, fisheries, husbandry, forestry, fruits, flowers; 3 collectives (cooperatives)

Crop production:
50% food crops and oilseed crops; remainder:
fruit production (grape/plum);
husbandry: chicken, pigs;
floriculture/forestry ; nuts, bamboo; gingko (nut, medicinal);
vegetables including fruits (e.g. strawberry);
tea: high quality.

Planning additional for 2003: 10,000 mu (extra area to be allocated to):
5000 mu fruit, 1000 tea, 2000 floriculture, 2000 vegetables.

Technical (and financial) support from government institutions (extension). Investments from outside agriculture ('enterprises'); many farmers 'part-time' farmers with substantial off-farm income → transformation.

6. General discussion

Wang: what is suitability of the proposed crops for the area; what are expectations of farmers?
'Instability' in the system, due to weather variability and price variability: try to reduce variability by 'control': plastic covers over grapes. Price uncertainty remains; what do we do about that in the analysis??

Long-term lease: rights of use can be transferred. Ownership of land remains with villages, government. When use rights are transferred, farmers get paid a certain amount for transfer; even between villages use rights can be transferred !!!
But: No possibility to use land as collateral security for borrowing money from banks.

China Daily dd. March 31, 2003, quoting People's Daily:

> *Stop illegal land use*
>
> *Pushing forward with agricultural industrialization is key to boosting agricultural competitiveness. However, it should be conducted in a scientific manner.*
> *Unfortunately, it has been noticed that some local officials have seized farmers' lands against their will and then rented them to agricultural enterprises in the name of expediting agricultural industrialization or scale farming.*
> *The free land transfer is an important right enjoyed by farmers under the household contract responsibility system, which the central government has guaranteed will remain intact. So it is clear that only farmers themselves can decide whether or not to rent out their land.*
> ……
> *Enterprises are encouraged to engage in agricultural business and develop non-arable land.*
> *But at the same time they should be strictly prohibited from occupying too much arable land, which is the lifeline of farmers and guarantees their basic living necessities.*
> *The household contract responsibility system is a safety net guarding the fundamental interests and rights of farmers, so it must be maintained.*
> *Attempts to deprive farmers of their land in the name of agricultural industrialization must be stopped.*

Credit: commercial banks are operational, but for credit, interest rates are high.
For limited credit lower interest rates (but then control whether loan is indeed used for agricultural investment). A maximum total credit volume of 12 million Y annually is made available for all farmers in county.

Processing enterprise/relation to producers?
Own production plus processing additional production from other farmers; risk: total production too high: market saturation: price reduction;
Contract system:
Introduction of new crops, expansion of certain crops (i.e. the 10.000 mu referred to earlier); government support for technical assistance and financial.

However, there are too few such enterprises, and farmers desperately wait for more contracts.

Organization/decisions on work/tasks of extension service is finally controlled by responsible officer of Bureau at county level.

RR: development objectives?
Huang Ting (Director, Pujiang Agric. Bureau) personal top three:

- increase farm income (most important)
- improve quality of agricultural production
- environmental quality; reduce impact of agriculture on the environment

Governmental targets ("10 characters"):

- high quality
- high efficiency
- high yield
- high safety
- high ecology

Specific (quantitative, measurable?) environmental targets: national standards recommendations, not compulsory (enforceability).

Food security: targets at provincial/county level?
Self-sufficiency is a target; additionally 5000 tons for stock formation for emergency situations. Total rice production in Pujiang county: 120.000 ton annually

Situation comparable to Europe in 1950's: production increase, income increase at the 'expense' of the farming population; not really a problem: the rest of the economy can absorb the overflow.

7. Presentation of team achievements (by Dr Wang Jiangdi, ZU):

a. Resource assessment/land evaluation
b. Soil map
c. Isoline map (DEM)
d. Slope (→ AEU-→ LU ---→ 36)
e. Administrative map – townships
f. Current land use -- 1998 [available for '92?, Land use change?, analysis]

8. Agreements on exchange of data on Pujiang, model results (persons in charge and indicative time schedule)

a. Resource evaluation; land suitability map (qualitative): before middle of JUNE-- this means in time for use in Wageningen workshop 23-28 June (?)

b. Information of specific rules and regulations that may affect future land use options:
   - Land use act: which areas 'reserved' for agriculture;
   - Environmental protection recommendations/standards: which 'biocides' not permitted anymore;
   - Land use planning: (some) peri-urban areas to be (co-)developed for recreation/nature development;
   - Sloping land above a certain steepness to be taken out of production, reforested.

c. Annotated list of data requirements and information needs will be further checked by IRMLA team (April, 1) and info requirements be specified by the end of workshop and then communicated by Prof Wang Guanghuo to liaison officers at Pujiang county (Mr. Huang Ting, Mr. Wu Wenyi,……..)

Table E-1. Crop, livestock, fishery and fruit production and production areas in Pujiang county in year 2001.

	Sowing area/heads (ha)	Total production (t)	Amount for sale	Amount for family consumption	Comments	
Rice	17436	104742				
Corn	433	1937				
Potato	798	2715				
Soybean	1483	2550				
Oilseeds	1937	2662				
Vegetables	1762	56615				
Sugarcane	112	5894				
Wheat	206	35779				
Barely	463	1405				
Cotton	515	455				
Fruit	2065	9303				
Orange	501	2858				
grape	102	1431				
Plum	1132	4274				
Pear	122	131				
Bamboo		$45x10^4$shoots				
Tea	2215	1350				
Mulberry	530	219				
Fish		2595				
Shrimp crab		23				
shellfish		15				
Pigs		152695				
Goats/sheep		5557				
Chicken						
Duck						
… …						

Annex F Report of MMSU workshop

IRMLA workshop on Multi-scale Land use analysis and Planning in Batac and Dingras districts, Ilocos Norte province, Philippines

Held at Mariano Marco State University (MMSU), Batac, Ilocos Norte province, Philippines, 7 to 11 April 2003

Minutes, Day 1, April 7, Stakeholder Consultation

(Note that the complete minutes are given in : *MinutesWorkshopMMSUAPRIL2003.doc)*

1. Welcome by Dr. S. Ocampo (President MMSU)

Gives a brief introduction about the growing concern for participation of stakeholders in land use planning and the need for participants to get across to legislative & executive branch.

2. Presentation by Prof. H. van Keulen (Wageningen university)

Provides an introduction to the objectives of the IRMLA workshop:

- To consult with the stakeholders on land use and resource management issues, with particular attention to regional development goals, priorities of different stakeholders, policy views and measures, future scenarios, objectives and constraints;
- To present capabilities of the methodology and data requirements and discuss the procedure of exchanging data and results;
- To foster collaboration between the Philippine and European IRMLA teams by working together on the design and integration of the components of a decision support system for multi-scale land use planning.

3. Presentation by Dr. M. van Ittersum (Wageningen university)

Gives an introduction on the IRMLA approach for Land use analysis and Planning, and the possibilities for providing policy support on land use planning to policy makers and planners.

4. Presentation by Dr. E. Agustin (IRMLA Teamleader at MMSU)

Presents the main issues and changes in land use in Ilocos Norte which are: 1) Crop diversification; 2) Intensification; 3) Application of high doses of pesticides; 4) Application of (very) high doses of (N) fertilizer in some vegetables (e.g. pepper); 5)

contamination of groundwater resources (e.g. wells with more than 20 ppm N in Magnuang).

5. Presentation by Dr. Samson (member of the Municipal Agriculture & Fisheries Council Batac and the Municipal Development Council)

Indicates a number of main points: 1) approach too technical and need to be simplified (however useful); 2) results should be practical and useful; 3) results should be be implemented, otherwise useless; 4) suitable LUT's for a specific site should be identified; 5) give recommendations & convince farmers that they should adopt this crop/technology (centrally planned?).

6. Presentation by Dr. Agcaoili (Provincial Planning Office (PPDO), Laoag)

Presents information from the Provincial Physical Framework Plan (PPFP)
(complete information in PPT-file).
The main information on Land use is: 1) 1950 ha forest; 2) crop area 70,664 ha suitable for rice, tobacco, garlic, onions, tomatoes & high value commercial crops (HVCCs); 3) Laoag City is envisioned as an "economic zone"; 4) Northern Luzon Group for collective implementation of programs under the office of the president; 5) vision for the province: transformation into an industrialized province and tourist destination with a well-managed environment as its main attraction; 6) alternative spatial strategies developed with AusAid assistance: a) 2002 trend or "Do Nothing"; b) Alternative 1 – agro-industrialization; c) Alternative 2 – eco-cultural tourism; d) Alternative 3 – agroforestry; e) preferred strategy combination of alternatives a, b & c.

Other information: 3%-8% slope land with annual & high yielding crops; including livestock and poultry; sustainable management - conservation of forests; enhanced tourism in the province – upgrade facilities; employment in agro-industry will be increased; wise use of land – conversion of agricultural land will be limited to allowable limits; reclassification is easier than conversion;
SAFDC areas – strictly no conversion; 10% of total agricultural areas may be converted in 1st class municipalities and 5% of total agricultural areas may be converted in other municipalities;
food self-sufficiency Ilocos Norte; 300% self-sufficient in rice - want to maintain; no serious environmental problems; use of organic fertilizers promoted; major producer of HVCCs: garlic, tomato, tobacco.

Land use information: land use plans (see PPT-file); Provincial land use committee approved 5 plans; conditionally approved; public hearings; finalizing maps: 9; approval Batac & Dingras land use plans in progress.

Comparative advantage of Ilocos Norte over other countries in producing high value commercial crops (HVCC's):
- can grow year-round
- much more diverse than other provinces because of distinct dry & wet season

- good quality garlic (more pungent) but small
- tobacco – dry climate – moisture content is lower than that produced in Japan & US
- mangos: require distinct dry & wet; number of trees – 2nd/3rd province in the Philippines
- disadvantage: labor cost per day is higher than in other provinces in the country
- for Ilocos Norte – family labor
- labor migration: migrate to other countries

Land use in Dingras:
- shift from rice cultivation to other crops
- expanded area of corn - before 500 ha.
- rotations: rice-rice; rice-rice-rice, rice-cotton; rice-mungbean; rice-HVCCs (tomato, eggplant, cabbage, minimal garlic & onion due to fungal disease)
- labor cost – Farmer field schools (FFS) on IPM vegetables: less use of pesticides; use of biological control, weeding reduced through plastic mulch, etc.; reduction of labor resulting in higher income for farmers; labor saving technologies
- alternative opportunities for employment? Utilize time in other livelihood projects to boost their income
- moving towards farm mechanization – small tractors for rice

7. Presentation by Engr. Jesse Matac (MPDO Batac)

Gives information on land use activities and resource management issues in Batac district.

Information on: agro-industrialization; putting up of agri-based industries & ready market for produce; producer-consumer interaction→ chain approach; dairying: peri-urban?; land resources with total area of 16,100 ha, agricultural area of 8,313 ha, firewood/pasture area of 5,100 ha, and forest & forest reserve of 461+1,575 ha.; off-season tomato 10 ha.

Water resources consist of Small water impounding projects (SWIPs, 4); four Lakes, seven dams, 29 diversion dams, and 737 Small Farm Reservoirs (SFRs).
Batac is getting richer in fishery resources because of construction of SWIPs and SFRs, also lakes – could be used for production of tilapia fingerlings.

Farmers do not avail of loans from banks, too much paper work and high interest – resort to traders, middlemen, private individuals – can get loan immediately at equally high interest, but without paper requirements.
Agric loans: in form of input loans, pre & post-harvest facilities, animals – not cash!
BSWM, DA regional office, PGINs, LGUs, cooperatives.

Environmental legislation or recommendations from municipal government:
a) Farmers field schools (FFS) to promote less pesticide use & reduce health hazards
b) Rice – farmers are using less pesticides (no pesticide unless the crop needs them)

c) Vegetables – IPM vegetables – eggplant & tomato – fruit borers – tricograma (control)

Animal production:
a) DA A09 cattle dispersal & loan dispersal – projects in municipality & whole province
b) livestock – hog raisers - have difficulty selling their produce – oversupply of pork in Batac & Ilocos Norte
c) also some cattle raising but more swine. Hog raising can be more practically done, virtually every farm family has some pigs.
d) meat processing plant in Batac - if Batac will meet requirements.
to solve overproduction of hogs in Batac & IN
e) Organize hog growers. Gov. Marcos has scouted potential markets abroad.

Environmental concerns:
- Environmental issues: MMSU: high nitrate concentrations in groundwater in vegetable-growing areas due to application of urea and ammonium sulphate
- Foliar fertilizers
- Sweet pepper: three crops per year: 500 kg fertiliser(?)/crop
- Biocides: residues on vegetables in the market, appears to be very high
- Biocide use – high usage

Monetary return – no incentive for organically produced crops in Ilocos Norte

Magnuang is now shifting to other vegetables which do not require much fertilizer – eggplant, mango, corn.
According to AT, Magnuang farmers said that they will use recommended levels of inorganic fertilizers.

Technologies developed under RLRRC:
- N catch crop, April-June; combination of corn+indigo (Tayom)
- labor: additional 17 mandays for cutting & plowing indigo, but return will be high in terms of yield
- farmers find commercial fertilizer easier to apply & moreover effects are more instantaneous
- organic fertiliser: timing of release is a problem

8. Presentation by Engr. Noel Salvatierra (Municipal Planning Officer)

Gives information on general and development issues in Dingras district.

General information:
Total population 33,000; total area 17,362 ha; agricultural area 9,549 ha; 12,013 farmers; ratio: 1 farmer/ha of agricicultural land; potential for food processing; projected to become a secondary urban area at annual rate of urbanization 0.64%.

Strategies for development:

1) do nothing; 2) food production strategy; 3) agri industrialization; 4) agroforestry "green strategy"; 5) growth center strategy; 6) preferred strategy : agriculture & industry development

9. Presentation by Engr. Cesar Derrada (Municipal Agricultural Office)

Presents information on resource management issues in Dingras district.

Main crop rotation in Dingras:
rice-rice-rice, rice-rice-corn; rice-rice-tobacco; rice-rice-mungbean; rice-watermelon
Major crops: rice, corn.
Previous years "rice-rice-rice", now: crop rotation & diversification.

Fish production – 14 ha (fishwater ponds, SFRs, etc.): >100% self sufficient in fish – tilapia
Freshwater fish species: tilapia, catfish, mudfish, carp

Animal production:
Cattle, carabao, swine & goat; price of pork went down to P35/kg; municipality→ price setting: minimum price, vendors do not comply!

10. Discussion

Question: Movement towards scale expansion?

Response: Financial capability will be a problem; topographical condition of the farms still have lots of areas which can be expanded- where they plant rice once.

Question: Any possibility to grow crops other than rice in the wet season?

Response: no alternative crop– too much water except in rainfed areas. Contour farming is expensive. Additional costs are involved when shifting to other crops – farmers do not have money for this.
Usually farmers choose crops that provide highest return:
a. Watermelon; b. Corn; c. Tobacco
Risk to farmers: in Dingras flooding and in Batac drought.

Question: what are the burning problems of farmers?

Response: in Dingras high inputs & low prices for products; in Batac high inputs & low prices for products, lack of labor force (forced to hire from nearby municipalities), use of farm machines, and peak labor requirements, and overproduction of crops.

Other problems and needed changes in the agricultural system:

a) expansion of market; b) possibility of analyzing markets; c) food processing plant – tomato; post harvest; d) buffer capacity through processing; e) existence of post harvest facilities (e.g. meat processing in Batac, rice mill is now operational, feedmill now operational but not enough corn); f) government support price for rice; g) farm decisions are based on prices of last year; h) organizing HVCCs crop growers; i) put up trading post in Batac; funding is already available.

MMSU in collaboration with Taiwan government is establishing in Ilocos Norte a fruit & vegetable zone; establishment of trading centers, market matching (institutional buyers).

Sugarcane – 6 major producers in Ilocos Norte (incl Laoag & Paoay); 9-10 months to grow compared to 1 year.

Technologies:
organic, IPM (biological control,…)
Batac – not yet purely organic – mixture of organic & inorganic

Water use:
- groundwater is fully recharged in wet season;
- Intrusion of salt water – if extracting too much water in the dry season (e.g. in Pagudpud & Pasuquin)
- Density of tubewells; recommended 100mx100m, but does not match individual farm holdings→ higher densities

11. Summary of Discussion

There appears not to be many conflicting objectives.
Major concern is the low prices for products and high costs of inputs; how can new markets be created and served (this requires processing, storage, etc.).

At regional/municipal vs. farm household level, the main points for discussion are:
- Sustainability vs. economic viability
- Long-term quality of natural/human resources vs. profitability of cropping systems
- Use of biochemicals (biocides/chemical fertilizers) – affect quality of natural resources, land, water, biodiversity

General impression is that environmental issues are (much?) more prevalent among the regional/municipal stakeholders than among the farmers. This a conflict between long term sustainability and short term & long term economic viability.

At Farm Houshold level the main point is to increase understanding of farmers behaviour – perception of farmers on profitability, risk (of losing profit, best out of land):
- Crop choice, why do farmers what & under what circumstances will farmers select specific crop-technology

- Feedback of FH result to regional level (municipal). Basis for policy formulation at the higher level: how to influence farmers towards selection of more sustainable crop technologies
- Input use efficiency – water, nutrients, biocides – mainly agro-technical questions

12. Presentation of MMSU Team Progress (powerpoint: IRMLA pres.ppt)

a) Briefing of MAOs of Batac & Dingras
b) Written communication to Mayors of Batac & Dingras
c) Presentation of the project and consultation workshop

	Batac	Dingras
Agricultural Technicians	7	11
Municipal Agr'l Officer	1	1
Farmer Leaders	21	12
MMSU IRMLA Team	6	7
TOTAL	35	31

d) Inventory of data on :
Socio-economic
Total population/population by barangay (Urban/Rural) – Dingras and Batac
Number of household by barangay, municipality (Urban/Rural) – Dingras and Batac
Land area by barangay – Dingras and Batac
Agricultural land area classified into rainfed/irrigated: upland/lowland
Labor force
Geographic location, climate, topography

Other Data
Maps taken from BSWM
Erosion
Soil
Slope
Land use
Map taken from NAMRIA
Topographic
Map taken from NSO
Barangay maps of Dingras and Batac

Available digitized maps
Barangay maps of Batac and Dingras
Administrative map of Ilocos Norte

e. Survey for defining technology:
Preparation and validation
Actual survey
Data format sheet (Marrit)
Encoding – 50%

Minutes, Day 2, April 8, field trip municipality Batac

IRMLA-MMSU-team, Municipal Agricultural Offcer (+Agricultural Technicians); Herman van Keulen/Martin van Ittersum/Tommie Ponsioen (Wageningen UR)
Village: **Colo**

13. Courtesy visit to Mayor of Batac, Atty. Jesus R. Nalupta Sr.

Mayor emphasizes:
- that Batac is an agricultural municipality, hence most of the economic proceeds originate from agricultural activities
- that a major problem facing farmers in Batac is that of (dependable) water availability; Batac does not have an irrigation system, so water supply is derived from shallow tubewells, surface waters, such as rivers, creeks, etc., and water harvesting facilities, such as small farm reservoirs (SFRs), small water impounding projects (SWIPs), etc.
- that another problem for the farmers is that of strongly seasonal production, resulting in peak supplies of such commodities as tomatoes, mangos, water melons, etc., with the inevitable consequence of falling prices; the major suggests that construction of (cold) storage facilities, or processing facilities might remove (part of) negative consequences for the farmers. Investments necessary
- that tree cutting in the highlands to provide fuelwood, especially for tobacco-curing (we heard about 6 m^3 per barn, not known how many 'barns' per ha) threatens sustainability of the system. Deforestation induces erosion, leading to flooding and siltation downstream
- that (over)use of agro-chemicals, such as chemical fertilizers and biocides, presents a threat to resource quality, especially land and water in the long run, while biocide residues may present health hazards to the population. He suggests that the use of organic fertilizers may reduce the problem, while especially Farmers' Field Schools may help in creating/increasing awareness among farmers of the negative impacts of the use of agro-chemicals and introduce them in he adoption of more sustainable Integrated Pest (and Nutrient) Management technologies.

14. Field visit

Ilocos Norte Province is characterized by two distinct seasons: *dry* November – April and *wet* May – December. Hence, this visit is at the end of the dry season.
In village Colo, all crops are thus irrigated, but the village is not part of the rainfed lowland rice area. The village is 'easily accessible', about 30 minutes by car from Batac.

Farmer 1 (also head of farmers' cooperative):
Tobacco: irrigated from tubewell; sown in November (seedbed) transplanted after 5-10 days; at the moment last batch of leaves in curing barn; crop is very labour-

demanding; profitability doubtful, especially when outside labour has te be hired for curing; labour costs ca. P 100/day (excluding food [and drinks!]);
Tomato: irrigated from surface water; at the moment no more water available, hence irrigation discontinued; tomatoes will be harvested green next week; picking by buyer, transport to Manila, will be ripe 'upon arrival'. Price P1/kg.

IPM-technology → natural enemies of fruit borer introduced in the crop: 250 samples/ha.

Near farm, *maize sheller* : bought by farmer cooperative with loan from the Municipal Agrcultural Office; following harvest of maize, machine is transported from farm to farm.

At the farm, *draught animal*; female animals to produce replacement young; no milk consumption; on and around most farms some (draught) animals were seen grazing on (sparse) crop residues, road sides, etc.

Farmer 2:
Egg plant : irrigated from river, pumped up; strictly IPM; weeding carabao + hand. Crop planted end of February.
Crop looks beautiful; 'good' price P10/fruit. Then net revenue will be about P200,000 for an area of about 0.5 ha (own guess)

Along the road
Maize: high density, dark green, grown as forage crop, fed fresh as high quality feed to draught animals.
Mungbean: food crop

Farmer 3:
Tobacco again: complaint about low price for the crop, especially in association with the high labour requirements.

On the whole, the village territory makes a prosperous impression; houses well-maintained; crops well-tended; farmers from Ilocos Norte are known for being very industrious. The visit provided, in our opinion, an illustrative picture of the situation of a 'Batac-village' towards the end of the dry season.

Minutes, Day 2, April 8, afternoon: Introducing the LUPAS/IRMLA methodic components

Demonstration and introduction of components of 'land use planning and analysis system':
a. resource assessment
b. technical coefficient generator
c. linear programming model

What questions to be answered:
what is the best tool considering the choice for 'lupas',

both regional, munipal and farm household model.

After lectures on Linear Programming (Martin) and Technical Coefficient Generators (TechnoGIN, Tommie), the team was asked to discuss, amongst themselves, what in their opinion the most prevalent issues are, following from the stakeholder meeting(s) and that may be tackled with the LUPAS methodology within IRMLA. After a 1 hour discussion the following issues (see points 15 and 16) came up (they have been grouped according to the hierarchical level at which the issues need to be tackled primarily).

15. Issues at farm level :

a) What if there will be a policy regulating the use of chemicals (fertilizers and biocides), how will this affect farmers' income and production level (targets)? (Municipal, Farm)

b) If there will no longer be fuel available for curing tobacco, what will be the effect on farmers' income? (Farm)

c) What is the implication of the promotion of fish culture on resource allocation (land, labor, capital)? (Farm)

d) What if animal production (livestock and poultry) is increased, how will this increase affect land, labor use and capital? (Provincial, Farm)

e) What is the effect of SWIPs to productivity and farmers' income? (Farm)

f) If we promote crop diversification during the wet season cropping, what will be the effect on production of staple food? (Provincial, Farm)

g) What is the implication of changes in price of input and output (land, labor use, production)? (Farm, Municipal, Provincial)

16. Issues at higher level – municipality/region

What is the implication of provincial industrialization to agricultural land use (land allocation, agricultural labor and water availability)? (Municipal, Provincial)

What if post-harvest facilities (cold storage, processing plants) will be introduced, how will this affect farmers' income? (Municipal, Provincial)

Based on these lists of issues and the fact that most issues revolve around the farm scale, it was decided to aim at farm household analysis (model) first and primarily. Next, cropping systems/agricultural activities were identified (Table F-1) that need be analysed for either Batac or Dingras, in view of the questions to be addressed.

Table F-1 Cropping systems and agricultural activities in Batac and Dingras districts (Yes= **Y**, No= **N), Ilocos Norte Province, Philippines.**

			Batac	**Dingras**
1	RwC	Rice-WhiteCorn	Y	Y
2	RyC	Rice-YellowCorn	Y	Y
3	RGa	Rice-Garlic	Y	Y
4	RMu	Rice-Mungbean	Y	Y
5	RPe	Rice-Peanuts	Y	Y
6	RTm	Rice-Tomato	Y	Y
7	RTb	Rice-Tobacco	Y	Y
8	RFa	Rice-Fallow	Y	N
9	2RI	Rice-Rice	Y	Y
10	RCt	Rice-Cotton	Y	N
11	RPo	Rice-Potato	Y	Y
12	RSo	Rice-Soybean	N	N
13	ROn	Rice-Onion	Y	N
14	RPp	Rice-Pepper	Y	Y
15	REg	Rice-Eggplant	Y	Y
16	RVe	Rice-Vegetables	Y	Y
17	Man	Mango	Y	Y
18	Sug	Sugarcane	N	Y
19	Roo	RootCrops	Y	Y
20	3RI	Rice1-Rice2-Rice3	N	Y
21	RGM	Rice-Garlic-Mungbean	Y	Y
22	RWM	Rice-WhiteCorn-Mungbean	Y	Y
23	RMe	Rice-Melon	Y	Y
24	RMY	Rice-Mungbean-YellowCorn	Y	Y
25	RSY	Rice-Pepper-YellowCorn	Y	Y
26	RTY	Rice-Tomato-YellowCorn	Y	N
27	ROM	Rice-Onion-Mungbean	Y	N
28	RYM	Rice-YellowCorn-Mungbean	Y	Y
29		Fish Culture	Y	Y
30		Rice-Pepper-WhiteCorn	Y	Y
31		Tomato-WhiteCorn	Y	N
32		Pepper-Pepper-WhiteCorn	Y	N
33		Poultry	Y	Y
34		Swine	Y	Y
35		Cattle	Y	Y

Minutes, Day 2, April 9 – Designing a FHM for a farm in Dingras

17. Group 1: Resource characterization and generation of technical coefficients

Statistical analysis of farm survey for resource evaluation: farm size, capital, irrigation, and land/labour ratio.

Steps in resource evaluation:

- Farm typology (classification of farms)
  criteria : (1)Farm size; (2) Water availability ; (3) Land/labour ratio;
  (4) Capital assets (in fact 'liquid' assets, i.e the available money for cash outlays, including assets, such as animals, that can easily be sold)

- Definition (quantification and characterisation) of resources and activities:
  a) Land resources (farm size and soil characterization)
  b) Endowments with water (specification of water resources to quantify the activities; surface irrigation or supplementary irrigation, which determines crop choice options)
  c) Available labour resources (family labour/hired labour; seasonal off-farm and non-farm labour)
  d) Capital resources (short term or annual investments; long term investments to be considered later)

- Important and possible crop rotations were defined.
- Technical coefficient generator requires yield estimation. Yield estimation based on expert knowledge and/or crop growth models

Farm typology as proposed by team:

a) Farm size: 0.0 – 0.5 ha
   0.5 – 1.0 ha
   1.0 – 1.5 ha
   > 1.5 ha
b) Water availability: Rainfed or irrigated
   Supplementary irrigation
   NIA (National Irrigation Administration; Dingras)
   Province
c) Land/labour ratio: Farm size/family size (adults as 1, children between 8 – 15 count as ¼ or ½; average family size: 4 adults + 2 children = 5; land-labour ratio: 0.1 - 0.2 - 0.3)
d) Capital:Farm asset ranges (kPesos; land ownership not considered)
   0 – 50
   50 – 100
   > 100

Ranges can be adjusted after statistical analysis; the number of ranges should be kept small.

e) Classification of soils: Very good
   Good
   Average

Poor soils will not be evaluated. Soil classification has to be checked with input/output data from the farm survey (yield, fertiliser applications, technologies used) and texture data (clay soils are expected to be equivalent to very good, loamy soils to good and sandy soils to average).

In the low altitudes the NIA schedules can be found, and in the middle and upper altitudes rainfed cropping systems can be found with supplementary irrigation from groundwater, creeks and SWIPs (Small Water Impounding Project).

'***New' Land Use Types*** (LUTS) or crop rotations, see Table F-1

rice-pepper-'green'corn:[2]
cropping calender:
rice: July 5-November 5
pepper: November 20-March 20 (from transplanting, seedbed three weeks earlier)
greencorn: March 10-May 15 (seeds dibbled in before final harvest of peppers)
yields: rice: 4.5 t/ha
pepper: 6.0 t/ha (dry)
corn: 4.0 t/ha

tomato-whitecorn
cropping calendar :
tomato: May 5-November 15 (seedbed preparation and seedling growth preceding transplanting by about three weeks)
whitecorn: December 1-March 25
yields: tomato 3.75 t/ha (dry)
corn: 5.1 t/ha

pepper-pepper-greencorn
cropping calendar:
pepper: August 25-Januari 15 (starting with land preparation, concurrent with seedling growth)
pepper: February 1-May 25
greencorn: May 15- August 5
yields:
pepper: 6.0 t/ha (dry)
pepper: 6.0 t/ha
greencorn: 4.0 t/ha

18. Definition of 'typical farms' for Batac and Dingras by IRMLA-team

[2] 'greencorn' is harvested at early stage, cobs are being sold for cooking

Dingras

Farm size	0.75 ha
Rainfed	a) NIA
	b) Sanjera
Crops	Rice-rice (upland)
Soil	Good soil (loam)
Slope	< 8%
Labour	a) land preparation
	b) crop establishment
	c) crop management
	d) harvesting
Family	6, 10-15: 2
	< 16: 2 → 5 man-days
	adults:2
Capital	50 kPesos
Livestock	a) poultry: 6
	b) swine: 2
	c) large animal: 1

Batac

Farm size	0.5 ha
Irrigated	
Crops	Rice-vegetables
Soil	Good soil (loam)
Slope	< 8%
Labour	a) land preparation
	b) crop establishment
	c) crop management
	d) harvesting
Family	6, 10-15: 2
	< 16: 2 → 5 man-days
	adults:2
Capital	50 kPesos
Livestock	a) poultry: 6
	b) swine: 2
	c) large animal: 1

19. Group 2: working with GAMS

GAMS was introduced and the group worked on the exercises as prepared by Marrit.

Design of prototype LP-model for Dingras

rice-rice (upland) means that part of the land resources can be irrigated both in the wet season and the dry season, while part only is irrigated in the wet season, hence

Land: LU1: continuous irrigation (0.5 ha)
LU2: irrigation in wet season only (0.25 ha)
Crop selection:
rice-yellowCorn (LU2)
rice-tomato (LU2)
rice-garlic (LU2)
rice-tobacco (LU2)
rice-pepper (LU2)
rice-fallow (LU1)
rice-rice (LU1)
rice-rice-rice (LU1)
Generation of technical coefficients (TechnoGIN):
specification and quantification of land use activities in terms of all inputs and outputs

Determine technical coefficients for selected crop rotations:
LUT (crop rotation) → 5 types selected → LMU (soil type) → good soil→ Yields→ averages for Ilocos Norte → technology--→ A & B--→ Calculation of outputs (see TechnoGIN-documentation)

These quantified land use types are (in LP-terms) ALL activities the farm household can select from, to realise its objectives.

For further information on the GAMS exercises during the workshop, see *MinutesWorkshopMMSUAPRIL2003.doc.*

Minutes, Day 4, April 10, Implementation of FHM for Dingras

20. Implement LP-model for Dingras as discussed April 9 (Group 2) - Alice and Martin

This group tried to implement the farm model for Dingras in GAMS. Each of the sections was introduced by Martin/Alice and then the group tried to do the implementation. After ca. 5 hours the running model (Alice/Martin) was given to the group for some scenario analysis (see presentation later).

LP-results were presented by Syder Galdores. For this, Tommie's table, as produced yesterday, with technical coefficients was used as input for the LP. A simple LP-model for the prototype farm in Dingras as developed and presented yesterday by group 2, was presented and discussed. Results of some sensitivity runs with the simple LP-model for Dingras are presented. For more information on these LP results, see *MinutesWorkshopMMSUAPRIL2003.doc*

21. Further treatment of TechnoGIN (Group 1) (Tommie/Herman)

The exercises with TechnoGIN as designed by Tomie Ponsioen, are done by the workshop participants.

Yield estimation

In the current TechnoGIN-version for Ilocos Norte yield estimates are included that were derived from the 1999 (?) agricultural survey in the province. Yields for current activities are set equal to the average yields reported in the survey. Yields for improved technology ('future-oriented') are set equal to the average of the highest 10%-percentile of the reported yields. Although for the time being, in the prototype model, these yields can be used, it is desirable that more structured, and more future-oriented yield estimates are included in the 'regional' models for Batac and Dingras, as well as for the FHMs.

Herman presented a *theoretical production ecological approach* for quantification of the input-output coefficients for agricultural activities. This approach is well-described in the 1997 van Ittersum & Rabbinge paper: *Concepts in production ecology for analysis and quantification of agricultural input-output combinations. Field Crops Res. 52: 197-208.*
Information on this approach is also given in: *MinutesWorkshopMMSUAPRIL2003.doc.*

The conclusion from the following exchange of views was largely similar to that derived in the Zhejiang University workshop, i.e. for a restricted number of annual crops WOFOST[3] (of which a copy is available at MMSU, from the SysNet CDRom) can be used, while for crops for which insufficient data are available, a LINTUL-type (but as simple as possible) could be applied.
There appears to be interest within the team, and particularly with prof. Joselito Rosario, responsible for yield estimation, to follow the proposed approach. Obviously, they need to familiarize themselves with the simulation approach in general, and with WOFOST and the LINTUL-type approach in particular.

22. Presentation by Ferdinand Agula (UP Diliman)

Presents a number of topics about 'stakeholder interactions' such as a) presentation of project to stakeholders; b) data presentated to stakeholders; and gives also comments on data requirements and approach of the IRMLA project. For more information on this presentation, see *MinutesWorkshopMMSUAPRIL2003.doc.*

23. Presentation by Herman van Keulen (Wageningen university) on Animal Production Technologies

One can ask why, when dealing with land use analysis, inclusion of animal activities is necessary. For example, at the farm level, when animals are kept in a barn and fed

[3] According to Tommie Ponsioen, within SysNet, WOFOST has been applied for approximately 10 crops in Ilocos Norte to explore the yield potentials for these crops and to estimate their yield gap in relation to the maximum yields incorporated in TechnoGIN. I (Herman) cannot remember that I have ever seen a report on these simulations, but obviously whatever has been documented with respect to these activities should be made available to the MMSU-team.

concentrate feeds acquired from an outside supplier, there is little interaction with the land use activities. Even in that situation, however, the animals require labor, they require capital outlays, and they may, when sold, generate revenue. Hence, they compete thus with other activities and may contribute to farm income.Thus, it is of interest to look at the input-output coefficients of animal activities.

Inputs:

- Feed – most conveniently described in terms of energy and protein, two indispensable components of feed. In this way it is also possible to include in the ration of the animals different types of feed, kitchen waste, crop residues, concentrate feed, etc. The quantity of feed required and the quality in terms of energy and protein, depend on the production objective: they vary for production of meat, or of draught power.
- Water – although absolutely necessary for animal production, quantities are very small compared to water use of cropping systems, and can thus be ignored.
- Veterinary care – most conveniently expressed in capital outlays
- Labor – needed for animal feeding, but when animals are grazing, labor may also be needed for herding, or for other forms of care (taking the draught animal to the creek, or a pool for refreshing)

Outputs:

- Animal products, such as meat, milk, eggs, etc.; this includes the production of young animals
- Draught power
- Manure

Animal species to be considered in Ilocos Norte are:
Cattle, Buffaloes, Pigs, Chicken, and Fish (different species ?)

Input-output tables should be provided for different animal species and for different production objectives (meat, draught power, capital asset, etc.).
Question: will different production 'levels' have to be considered?

Minutes, Day 5, April 11, Various issues and workplan

24. Workplan

a) Farm survey: data have to be further entered and analysed; outliers have to be identified; maybe necessary to re-visit farmers to check on information available.
Appears that these re-visits can be postponed till after the planned workshop in Wageningen.

Emphasis in the coming months will be on development of Farm Household Model, possible development of MGLP-models for the municipalities Batac and Dingras will have lower priority

b) Resource characterization + farm typology (for farm type, know the number of wells available; use groundwater – yes/no)

- ***land*** – land units, forming the resources in the municipal models and serve as inputs in yield estimation and TC-generation; prepare Batac and Dingras maps for land management units; land management units to be included in the FHM have been identified for Batac; needs to be checked for Dingras with survey data;
- ***water*** – quantification of the resource side (how much water is available- hard to quantify- in cubic meters) – in SysNet it has been assumed that in the irrigated areas there is water enough to grow double or triple rice; in non-irrigated areas: is rainfall in the wet season enough to grow an irrigated rice crop? do farmers use supplementary irrigation? water availability in terms of farm typology; should follow from analysis of availability of pumps for shallow tube-well irrigation; as can be deduced from the stakeholders presentations on Monday, considerable attention is paid to development of Small Farm reservoirs and Small Water Impounding Projects. The quantitative consequences of implementation of such projects on water availability at farm level should be taken into account; these consequences obviously are of importance for (some) policy makers;
- ***labor*** – no additional work to be done for farm level; for municipal level, also sufficient information seems to be available.

c) Yield estimation

- ***use WOFOST*** for a number of common field crops: rice, maize; possible other crops to be identified. For these yield estimations, first study and familiarize with crop growth simulation models in general and WOFOST in particular (books Van Keulen&Wolf and Goudriaan&Van Laar will be made available) and second, collect reliable data for Batac/Dingras/ Ilocos Norte from crop experiments (information on growth, yield, leaf area, growing conditions) ; these data should be used for a systematic calibration/validation exercise for the main crop variety(ies) in the region; best to start with rice, the most important crop; Support during these activities will be given by the Wageningen IRMLA team;
- **use LINTUL** for 'other crops' (see Table F-1); a concentrated effort (at least also involving Zhejiang University) should be made to develop the procedure and parameterize it for the most important crops. Data on leaf area development and yield are necessary for such an exercise, in combination with climatic data.

d) TC-generation

- ***Check cropping calendars*** for Batac and Dingras in current version of TechnoGIN;
- ***future oriented technologies*** should form an important part of the analysis; for rice (and also other commodities) reliable technical coefficients should be developed for such practices as Integrated Pest Management (IPM) (considered an important technology by decision makers to reduce the use of biocides) and

Site-Specific Nutrient Management; other interesting and/or promising crops/technologies should be identified;

- Verify the technical coefficients for Dingras.

e) LP

- Suggestion: ***start by defining 4-5 typical farm types for Batac***; the advantage is that a start can be made from the work of the M.Sc.-students Pradel and Bi;
- models should subsequently be made more comprehensive: more specific and more realistic; more complete list of cropping systems; development of definition of water resources at farm level.

f) Stakeholder interaction

As soon as preliminary, but relevant results from the farm model are available these should be discussed with the stakeholders.

25. Prioritization

Further elaboration and application of the prototype farm household model (FHM) developed during the workshop will have highest priority. Given the preparatory work carried out by two MSc students from Wageningen, it would be logical to start with a FHM for Batac. Data collection and further training will be necessary to achieve this primary aim. This results in the following priority list:

a) Further development of the LP/FHM model for Batac
b) Farm typology – Hands on training with Rey Villacillo using SPSS
c) Data gathering/literature review for the WOFOST model and LINTUL
d) Stakeholders consultation
e) (Further) development of the LP model of Dingras
f) Hands-on training in IRRI with GIS
g) Re-survey

The MMSU scientists who are involved in the IRMLA project are listed in Table F-2. Table F-3 gives a proposal for the distribution of main responsibilities within the IRMLA project. Table F-4 gives the list of participants in this IRMLA workshop.

Table F-2 MMSU Team members for the IRMLA project

IRMLA teamleader:	
Dr. Epifania O. Agustin	- Soil Water Management
Team Members:	
Prof. Charito G. Acosta	- Agrometeorology
Dr. Artemio B. Alcoy	- Agronomy/Farming Systems
Prof. Margarita P. Caluya	- Agricultural Economics & Environmental Science
Prof. Joselito I. Rosario	- Forestry/Agroforestry/Stat.
Prof. Facundo B. Asia	- Fisheries/Environmental Sci.
Mr. Isidro Galdores	- Economics
Mr. Reynaldo Villacillo	- Computer Science/Programming
Mr. Dionisio S. Bucao	- Agronomy/Agr'l Engineering/GIS
Ms. Criselda M. Balisacan	- Soil Physics/Agr'l Engineering
Ms. Susan G. Aquino	- Rural Development/ Agr'l Engineering
Municipal Agricultural Officers:	
Ms. Merylinne Gappi for Batac	
Engr. Cesar Derrada for Dingras	

Table F-3 Proposal for responsibilities within the MMSU team for the IRMLA project

Resource mapping/evaluation:	Prof. Joselito I. Rosario
Crop production/yield estimation	
TCG	Dr. Artemio B. Alcoy
FHM	Prof. Margarita P. Caluya (temporarily unavailable)
Team leader	Dr. Epifania O. Agustin

Table F- 4 List of participants (stake-holder consultation at MMSU)

Name	Organization
Dr. Saturnino Ocampo	MMSU
Dr. Stanley Malab	MMSU
IRMLA Collaborators	
Herman van Keulen	Wageningen university
Martin van Ittersum	Wageningen university
Tommie Ponsioen	Wageningen university
Ferdinand Aguila	UP Diliman
Alice Laborte	IRRI
Provincial level	
Pete Agcaoili	PPDO Provincial Planning Office
Percival Libed	OPAG Provincial Agricultural Office
Municipal level	
Batac	
Merryline Gappi	MAO Municipal Agricultural Office
Agricultural Technicians	
Farmer leaders	
Jesse	MPDO
NGO	
Jesus Garcia	
Dingras	
Cesar Derrada	MAO Municipal Agricultural Office
ATs	
Farmer leaders	

Annex G List of additional information (enclosed on CD-ROM)

In addition to the information presented in this report, various contributions from stakeholders and scientists to the in-country workshops have been compiled on CD-ROM. A short description of the items and associated files enclosed is given here.

	Description of item	File name
1	Presentation: Orientation of natural resources use in transferring of agricultural economy and rural development in direction of industrialization and modernization of Vinh Phuc province by Dr. Van Quy	Vin Phuc Report.ppt
2	Presentation: Present situation of land use and direction of natural resource use of Tam Duong district in 2010-2020 in relation to planning of Vinh Phuc province by Nguyen Van Ngoc	Tam Duong Report.ppt
3	Presentation: IRMLA approach to land use planning – an overview on project strategy and methodology components by RP Roetter	IRMLA_april03_LUPAS.ppt
4	Overview with exercises on basic farm household model & data (example Omon) by MM van den Berg	Omon model.ppt
5	Overview on data requirements for regional MGLP (LUPAS) and farm household model by H Hengsdijk & Lu Change	Data requirement omon.ppt
6	Introduction to the technical coefficient generator for Ilocos Norte (TechnoGIN) by T Ponsioen	TechnoGIN-workshop-reb20-03.ppt
7	Some preliminary results of regional MGLP model development for Tam Duong district by Tuan	TamDuong MGLP-Tuan.ppt
8	Preliminary results of land resource evaluation for Tam Duong district by Quyet	Landresourceeval_TD.ppt
9	Brief report on work carried out for Omon case study by Cuong	Work_done clrri 10april.ppt
10	IMGLP introduction with exercises prepared for Pujiang by Lu Changhe& H Hengsdijk	IMGLP specific training Pujiang.ppt
11	IMGLP modeling in GAMS – Introduction to IMGLP technique & LP problem formulation with exercises in GAMS by MM van den Berg	IMGLP basic training.ppt
12	Farm household modeling in GAMS – Introduction to FHM, problem formulation & exercises by MM van den Berg	FHM basic training.ppt
13	Revised IRMLA base farm household model written in GAMS, example Omon	BASISMODEL O MONnew.gms
14	Explanation to base farm household model Omon	Model refinement Omon.doc
15	Prototype TechnoGIN with training modules incorporated – status 25-03-03	TechnoGIN-25-03-03.zip
16	Annex H to the progress report containing results of land resource evaluation for Pujiang county, China, by Lu Changhe	Progress report IRMLA-2003-Annex H.doc
17	Annex I to the progress report containing a set of technical coefficients for alternative rice technologies as defined for Pujiang by Wang Guanghuo	Progress report IRMLA-2003-Annex I.doc
18	Annex B : Photo archive : Photos taken during workshop sessions and field trips conducted - for each of the four in-country workshops	See, subdir Photo archive on CD-ROM

Annex H Results of land resource evaluation, Pujiang

The IRMLA approach has been applied to Pujiang county in the Zhejiang province of China. This case study for Pujiang county has the following objectives:

- To identify and delineate homogeneous land units that have similar land qualities and suitability for specific land use types. The identified land units are used as a criterion for the definition of land use types (based on three criteria: a. crop rotation; b. yield level; c. production technology);
- To determine the areas of suitable lands for different land use types in the whole county and in each of the sub-units (township), which areas are used as resource constraints in the Multiple Goal Linear Programming model.

Results on the land unit delineation and resource evaluation of this case study can be found in file *Progress report IRMLA-2003-Annex H.doc*

Annex I Example of technical coefficients for rice, Pujiang

Tables have been sent to the different IRMLA-teamleaders with the request to collect data on :
- main crop types and their characteristics
- main crop rotations
- use of crop residues
- attainable yield level at different technology levels of crop production
- main land units and characteristics
- labour requirements for land preparation, crop management and harvesting
- labour costs
- fertiliser nutrient use and costs at different technology levels
- recovery fraction of applied fertiliser nutrients at different technology levels
- biocide use and costs at different technology levels
- fuel costs
- machinery costs
- farm gate prices for harvestable products

An example of such a data set can be found in file
Progress report IRMLA-2003-Annex I.xls

These data are for rice cultivation in Pujiang county, China and are used in TechnoGIN applications. TechnoGIN is the Technical Coefficient Generator which produces for the main crop production activities in a region the relations between the inputs and outputs. Such input-output matrices are used in regional-scale studies with the Land Use Planning Analysis System (LUPAS).