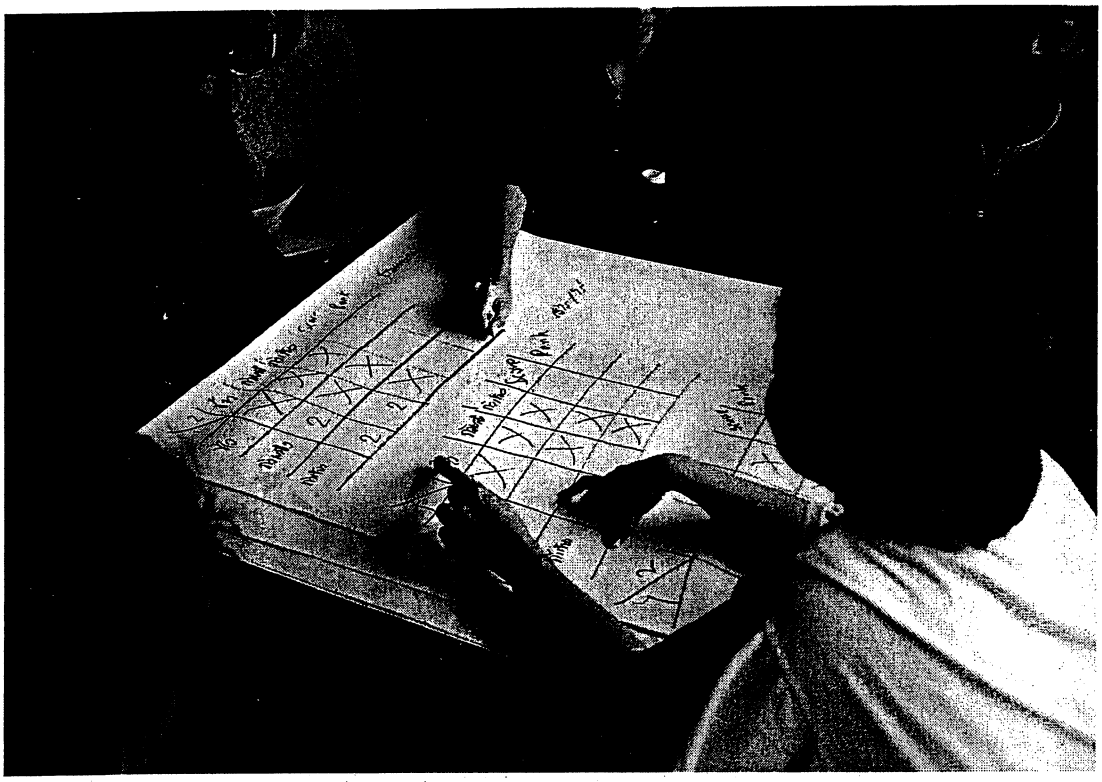
Location 3 - group 2



Ban Haui Khum, Thailand.

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Introduction to Northern Thailand

Thailand has experienced a rapid economic growth since the 1950's. The growth was initially related to the use of natural resources, but has become increasingly dependent on urban-based manufacturing industry. In 1994 agriculture's share of GDP had declined to only 12% despite the fact that it employs 60% of the labour force (Fairclough & Tasker 1994:22).

Thailand once relied heavily on timber as a source of foreign exchange but since the 1970's Thailand has been a net importer of timber. In the period from 1950 to the end of the 1970's the rice production increased by more than two thirds. This increase in production was based on expansion of farmland into the forest areas surrounding the central plains (Hirsch 1993:27-31).

Another factor contributing to the deforestation was the construction of roads to remote and isolated areas, which opened up for clearance of farmland and logging. In 1963 the area covered by forest was estimated to be 53% but in 1986 the official estimation was 25-29% and unofficially 15%. This is the main reason why more than one quarter of the land in Thailand is considered to be heavily affected by soil erosion today (Hirsch 1993:15).

For the ruling elite, the issue of environmental degradation is related to the question of how long the resource base can sustain a continued industrial and commercial development. The environmental degradation has caused concern and resulted in changes within the national environmental policy. An example is the aim of leaving 25% of the land area as commercial forest and 15% as natural forest. This is pursued through different policies as afforestation programs, attempts to stop further encroachment through resettlement programs or granting of usufructuary rights, and not least supporting a change from extensification towards intensification of farming practices as expansion is no longer desirable (Hirsch 1993: 15,16,20).

The building of larger and smaller dams in the northern part of the country is part of this intensification. It has resulted in an increase in the water supply, leading to higher yields in particular areas (Cohen and Pearson 1998). The integration of the farmer into the market through intensification and change from subsistence production to cash production has forced the farmer to be part of a cash economy. This is causing problems for many poor farmers, as there is not equal access to financial support. One factor limiting access to loans is not having title deeds because title deeds are often necessary to obtain loans from banks. Nevertheless there exist other ways of obtaining loans for example the Bank of Agriculture and Agricultural Co-operative (BAAC), agricultural co-operatives (AC) or private moneylenders.

More than 60% of the peasants in Thailand are estimated not to have legal titles to their land. Included in this group are hill tribes like Karen, Yellow Leaf or Hmong. Besides poor land rights they often have limited citizen rights or none at all, which causes these people to be badly treated in conflicts with the Thais. As a result they often live under different conditions than the Thais (Hongladarom, 1999).

Since the 1980's the government has had development programs aiming at improving the living conditions for the poorest sections of the rural population through projects improving basic infrastructure and employment opportunities (Phongpaichit & Baker 1999:64). Also, there have been developmental programs focusing on instruction of farmers on farming practices.

In spite of the goal of a more equal geographically distributed development, most industries remain situated in the area around Bangkok, which in 1991 produced 52% of GDP, though it only contains 15% of the population (Fairclough & Tasker 1994: 22). The income gab between rural and urban Thailand has made hundreds of thousands of rural people migrate on a seasonal or permanent basis in order to support their families at home or leave agriculture behind them for good.

Study area

The above mentioned aspects are reflected in our investigation which was carried out in The Mae Yom Watershed, in between the 19th and the 29th of October 1999.

The Mae Yom Watershed is situated in the Yom River basin in the sub-humid tropical climate zone. There are three seasons, the rainy season, the cold season and a hot season. The rainy season is between the middle of May to the end of October. At the Yom Watershed Research Station, the average annual rainfall was measured to 1216mm in the years 1990-96. Almost 90% of the rain fell in the rainy season with intense rainfall in August and September. The rainy season is followed by the cold period which is also characterised as dry, from November to February, and from March it gets warmer again and there is more rain, but it is still relatively dry (Rungrojwanich, 1998).

In the Northern part of the Mae Yom Watershed, surrounded by forest, the highland villages Na Luang and Tha Wa are situated. The villagers are primary farmers dependent on rainfed maize cultivation. Both villages face the problem of isolation but are affected by different forest classifications; the forest around Na Luang is classified as National Park whereas the part surrounding Tha Wa is classified as National Forest Reserve.

In another part of the highland is Ban Pak Huai Oi situated. Here exist a Thai village and a Hmong village close to each other. Still, their living conditions are very different, which influences their agricultural and livelihood strategies.

In the irrigated lowland three different villages, Ban Klang Thung, Ban Huai Khum and Ban Wang Din, are situated. The cultivation of irrigated rice is the main agricultural activity and the water supply is, or has been, a scarce resource. The water supply in Ban Klang Thung and Ban Huai Khum has been improved due to the building of two medium scale dams. This has led to a larger crop variety and a possibility to grow two or three crops a year. In Ban Wang Din this is not the case, and all the fields lay fallow during the dry season.

Outline of the report

The report is divided in six parts, which correspond to the six villages studied. The first two parts discuss to which extend the livelihood-strategies of the farmers in Ban Tha Wa and Ban Na Luang have been effected by official restrictions on use of natural resources. This question is elaborated from different angles. The Na Luang part focusing broadly on livelihood-strategies and the Tha Wa more specifically on agriculture. The third part discus the possibilities for farmers in Ban Wang Din to increase their income in a sustainable way. Both, on-farm and off-farm income generating activities will be analysed. The fourth part discusses sustainability through the impacts the medium scale Mae Song Reservoir has had on the land use strategies employed by the farmers in Ban Klang Thung. The fifth part discusses how different land use patterns are sustainable, in an area with two different kinds of population groups. The sixth part is an analysis of the effects of the Mae Tang Dam on the agricultural production and of the changes in relation to sustainability.

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Abstract

This study focus on the effects of the Mae Tang Dam on the agriculture production in Ban Haui Khum, and in which degree these effects are lasting and sustainable. The dam has caused increased and more secure water supply to the irrigated lowland fields, which has led to an intensification of the agricultural production. A consequence is depletion of soil fertility, if not met by sufficient inputs. Such nutrient imbalance was found. The farmers in Ban Huai Khum are supported by different organisations that can help overcome this problem. They have become more dependent on the Agricultural Co-operative and the newly introduced contract farming. This is linked to the increased need of a higher input to the agricultural production and the farmers total household income, which have not increased significantly. The intensification in the lowland fields, do not seem to lead to a decreased cultivation in the uphill fields and a lower level of erosion. The management of the water supply has not changed yet, but is assumed to be intervened by the government. The effects of the dam have in certain respects influenced the sustainability of the agricultural production.

Acknowledgements

First of all we would like to thank DANCED for making this interdisciplinary SLUSE Joint Basic Course possible - it has been a very rewarding experience that we would not have been with out. We would also like to extend our thanks to The Royal Forest Department (RDF) in Phrae for all the help they have provided and thereby making the field work possible - hereby also for the hospitality and facilities that were placed to our disposal. We would also like to thank the Maejo University, Chaing Mai University and Kasetsart University in Bangkok for their commitment and help. All the Thai teachers that has been with us during the field work should also be mentioned for their engagement. Further more we would like to accentuate the headman of Ban Huai Khum for whom the field work would not have been possible, and who provided not only valuable information but also spend a lot of time and effort helping us, especially by putting his house at our disposal. Lastly, the effort of the many others who cannot be cited here - are highly appreciated.

Introduction

The aim of the field study is to apply, in practice, the wide spectrum of introduced methodologies and thereby train us in field work in a tropical country. For us, the primary purpose with the field work have therefore been to try out some of the research methods, and obtain experience in these. This will also be reflected in the outline of this report, which will widely focus on methodology.

Another aim of the course is interdisciplinary and intercultural co-operation, therefore this field study was conducted together with a group of Thai students. The nine person research team consisted of five Danish student from the following fields of study: biology, agronomy, economy, development studies and anthropology, and four Thai students from geography, soil science and zoology.

The field study took place in the village of Ban Huai Khum in the Phrae province, which is placed in the Mae Tang watershed, a part of the larger Mae Yom watershed. 667 persons are registered in Ban Huai Khum, divided on 146 households. Of the 146 households, 90% are involved in farming[1], the households also have home gardens and small orchards.

In 1996 the construction of the Mae Tang dam was accomplished. The dam is situated 2½ km. upstream from the village and has formed a large reservoir in the upstream valley. The Mae Tang Dam is a medium scale dam without electricity production.

Objective

In Northern Thailand there have been a degradation and depletion of the water resource partly from overuse (TDRI 1990: 1), which has lead to the construction of a developed system of dams, reservoirs and irrigation canals that has been an important factor for the agricultural production, especially in the dry season (Rigg 1995: 23).

In our study area the newly constructed dam has led to an improved water supply to the village, which means the farmers have intensified their agricultural production, which has influenced the livelihood strategies. This situation is the point of focus for our study and our interest is therefore on the consequences and effects of the construction of the dam for the farmers in Ban Huai Khum. We find it interesting to investigate what these changes has meant for the sustainability of the agricultural production, and to investigate what the dam will mean in a future perspective.

Many definitions of sustainability have a broad approach and lack accuracy and action instructions (Redclift 1991:36). It is therefore important in every discussion to make clear what shall be sustainable, for how long, to who's advance and to what price. But also on what level and based on which criteria. To be able to answer these questions it require an assessment and weighing of values and ideological convictions. To investigate if something is sustainable you have to make the concept operational.

We have based our understanding of sustainability on the Brundtland-commissions definition: *"Sustainability development is development that meets the needs of the present without compromising the ability of the future generations to meet their needs"* (quoted in Lélé 1991: 611). This definition gives us the ability to focus on the aspect of sustainability that we think are the most important and this is the ability to handle stress. These can be either 'continuous', as declining resources, or more 'sudden' as floods (Chambers & Conway 1992: 14). We limited ourselves to work with the 'continuos' aspect of the stress ability. For the farmers to be able to handle stress we find it important that they have a stable and secure agricultural production, but also a level of flexibility. This means that the agricultural production should not degrade the land and the out-put of plant nutrient needs to be met with coherent input. Further more the agricultural production have to be economic sound. At the same time the farmers have to be able to be flexible in their income possibilities and ways of obtaining support for their production.

We have therefore chosen to investigate 3 broad aspects; respectively institutional, economic and agricultural. These reflect our different fields of science, but also indicate what the effect from the dam means for a sustainable agricultural production.

The outcome of these considerations have brought us to the following objective:

What are the effects of the Mae Tang Dam on the agricultural production in Ban Huai Khum ?
- are there a lasting perspective in these effects and are they sustainable ?

1 Interview with the headman in Ban Huai Khum, 19.10.1999.

We have further more outlined the following hypothesis:

The agricultural aspect:

- Increased water supply leads to an intensified of the agricultural production[2].
- The intensification of the agricultural practice will lead to depletion of soil fertility if not met with coherent inputs.
- Increased production in the lowland leads to decreased cultivation of the uphill fields, resulting in less erosion.

The income aspect:

- The intensification of the agricultural production changes the farmers household income and ways of generating an income.

The effects of the dam will depend of the choices the farmers makes between different ways of generating an income. If the farmers is choosing other sources of income the effects of the Mae Tang Dam may be small in the overall household income.

The institutional aspect:

- The management of the communal irrigation system is influenced and changed by the Mae Tang Dam.

This is based on the assumption that the communal irrigation system is locally managed and a change of this might affect the water supply negatively.

- The dam has changed the interaction between the farmers and the institutions connected to the agricultural production.

This hypothesis derives from the assumption that changes in the agricultural pattern could render new opportunities to the farmers and that these might have influenced the existing institutions.

2 Intensified agricultural production is defined as increased output pr. unit area / pr. year.

Methodology Description

In the following part we will present our methodology and the different data collection methods. The methodology was separated into a three-step approach, to give us an overview of the progress of the fieldwork and to be able to keep a common perspective because of the size of our group.

Step 1 consisted of an interview with the headman and a participatory workshop. Step 2 was structured interviews with farmers in the village and step 3 was semi-structured interviews with different farmers and key-informants, as a further in-depth study.

During the workshop and in step 3 we divided up into 3 sup-groups (agriculture, institutions and income), that are based on our different disciplines in relation to the objective.

Step 1 (Headman and Workshop)

The purpose with the interview with the headman and workshop was to give us an overall picture and knowledge about the village and of aspects connected to the agricultural production because of the limited information and knowledge we possessed.

The purpose with the participatory workshop was to get information from the farmers. It was also done to introduce ourselves to the village and inform them about our investigation. A further purpose was to gather information quickly that would be important in identifying and selecting the topics for the structured interviews. finally is was also an opportunity to try the participatory methods.

The interview with the headman was a combination of an informal conversational and a semi-structured interview (appendix 1). Another purpose was to identify the grouping of farmers for the workshop.

The workshop was divided up into 3 stations, where we used institutional venn-diagram, agricultural pairwise matrix, scoring and ranking and an income matrix scoring and ranking. The farmers rotated between the three stations with the different methods.

15 farmers were selected by the headman and divided into three groups; 1) farmers who only farmed land in the lowland, 2) farmers which farmed land in the uphill area as well as in the lowland, and 3) farmers who used to farm land in the uphill area, but now have stopped to do so. The division was based on a simple criterion that was relatively easy for us to pinpoint in the village. From the interview with the headman we knew, that fewer farmers did uphill farming after

the construction of the dam. We therefore found it important to see if there were any difference between these three groups of farmers in the understanding and perspectives related to the dam.

The outline of how the following methods were carried out is described in the discussion.

Venn-diagram

This method was chosen to give us a picture of the importance of, and relations between the different organisations and institutions in the village. We also wanted to identify the most important organisations that our further survey could be built upon and to identify key-informants.

Pairwise matrix, scoring and ranking

The matrix was a crop matrix made on 10 different aspects in relation to the different crops. These aspects were: use of fertiliser, demand of water, input cost, profit, hardest to harvest, use of pesticides, labour demand, grown for marked or consumption, area grown and best for green manure.

Income matrix

The purpose was to get an understanding of the different income sources that the farmers has and the main criteria for choosing these sources. This was done to be able to get an understanding of the different income sources importance and role for the farmers.

Step 2 (Structured Interviews)

The purpose with this step was to gather a big amount of data that for some part could be quantified (especially on the agricultural part), but it was further more done to help us select farmers and identify key-informants for step 3.

The interviews were standardised open-ended interviews, based on an interviewguide (appendix 2). The households interviewed were selected by systematic random sampling (Mikkelsen 1995: 204), among farming households. The house numbers in Ban Huai Khum are based on when the houses where build starting with the low numbers for the oldest houses. We selected the household to interview by taking house number 5 - 15 - .... - 145, this of course encountered some problems. Sometimes the household was not at home and sometimes the household did not do any farming. To overcome this we also had another number series that we used (8-18....etc.). To make the sample representative we conducted 18 interviews, which is 12,3 percent of the households

Step 3 (In-depth Study in Sub-groups)

The method in this step was an investigation separated into the 3 sub-groups used during the work-shop – agricultural, income and institutions. The sub-groups used semi-structured topic-focused interviews with farmers and key-informants as a common method. For the agricultural part we also used soil samples, pesticides test and field observation.

The semi-structured interviews conducted with 3 selected case-farmers, additional farmers chosen because of their relevance for our investigation (like connection to different organisations) and key-informants[3] from different organisations.

Soil samples

The purpose with the soil samples was to study the soil quality in the three separate areas, lowland, upland and uphill but also the soil quality within the slope on the uphill fields. 3-5 samples were taken in each field from the 3 case-farmers and mixed before analysing the soil. On the very steep uphill fields three samples were taken on three different sites: top, mid-slope and bottom and analysed separately. This was done in order to determine the level of erosion. The procedure of the soil test were as follows: The soil samples were air dried and afterwards grained and sieved. From hereon the samples were analysed according to the Kasetsart University N, P, K soil test kit manual to estimate the concentrations of available nitrogen, phosphorous and potassium and pH. Furthermore the pH-values of the soil samples in a 1:2 suspension that equilibrated for 20 min. were measured with an Oakton Pocket pH-meter to support the pH measurement from the test kit. The electric conductivity was measured with a Milwaukee pocket EC-meter in a 1:2 solution.

Pesticide test

There were taken 3-5 plant samples in each field from the 3 case-farmers on the same spot as the soil samples were taken. On the very steep uphill fields three plant samples were taken on three different sites: top, mid-slope and bottom and analysed separately. The analyse was made with a Insecticide Test Kit from the National Research Institute of Thailand, and categorised in 3 categories: "not detectable", "detectable and safe for life", "detectable, but not safe for life". The criteria for the definition "safe for life" are FAO standards. The plant material were divided in 2: the eatable part and the not eatable part to match the objective of the test kit of whether the eatable part was "safe for life" or not. The purpose with the pesticide test, was primarily to try out this field method and if possible, secondly, see whether there were a pattern in the levels of the insecticide

3 In our study a key-informant is a person that has special knowledge on a given topic because of a certain position or relation, for example the contact person for the contract farming in the village. A farmer that does contract farming is therefore not considered a key-informant.

content in the plants between the different field types and thereby get a rough picture from empirical data of the insecticide constraint on the different field types.

Field observations

Field observations were used in the uphill areas to determine the level of erosion and will be used in comparison with information gained through semi-structured interviews on erosion and the results from soil tests. The occurrence of erosion will be estimated by observation and test of soil physical and chemical properties in respect to the following indicators: rills, gravel on top soil, greater clay and phosphorous content in the bottom of the slope, increasing plant size and pH-values down the slope.

Methodology Discussion

In the following the methodology and the choice of data collection methods will be explained and discussed. The focus will be on why the different methods were used and what experiences and problems we encountered, but also on the changes that we did.

Theory of Science

The approach used in this field study is the empirical-analytical theory of science. The reason for this is first of all, because the study is part of a field course, which of course means that the approach will be very empirical based. Secondly then our objective based on a study in a village makes the empirical-analytical approach the most appropriate. The study is therefore fundamentally guided by the inductive logic and reasoning, that is based on and directed by the empirical evidence and knowledge and not on theory (Andersen 1994: 79-84).

This can be a problem because we don't have a theoretical frame to guide our investigation. But on the other hand then a more theoretical guided approach can be inexpedient if the choice of theory is misleading. The reason for this approach is not only the above mentioned, but also that we wanted to be open to possible factors that could have influenced the agricultural production in connection to the dam.

Discussion of Step 1

The reason for the combination of interview techniques in the interview with the headman was to be able to benefit from the strengths of the informal conversation - like questions emerging form the context (Mikkelsen 1995: 102). But at the same time overcome the shortcomings by making sure that we comprehensively covered certain subjects that could have been left out in an informal

conversation (Mikkelsen 1995: 102), especially because all of us (9 students, 2 interpreters and some teachers) were present during the interview.

This method worked well. All topics planned were covered, and were able to follow up on topics that emerged during the interview. But because of the high number of persons presents, it was some times rather unstructured and chaotic. This taught us to limit the number of persons present during the further interviews.

Workshop

We chose to work with PRA methods even though they original are developed as a tool in development project planning in order to include the stakeholders in the planning process, where we only used it to gather information.

A problem with the sampling method was that the headman selected the farmers. This was primarily done because of time limitation, but also because we believed that the discussions would partly overcome the bias this selection method could create. If that was the case is difficult to say, but by triangulate the information form the workshop with the structured and semi-structured interviews we tried to minimise the bias.

Further more the sampling method meant that there was only one woman present. To avoid this we should have requested an equal gender selection.

Venn-diagram

The advantages of the venn-diagram are said to be that it is very much a method that opens up for discussions and that often gives additional information (Mikkelsen 1995: 80). But our use of the method revealed some problems. First of all it works with several dimensions at the same time: the importance (shown in size), the relations (shown in distance from the centre) and the inter relations between the organisations. This was difficult to explain and seemed confusing for the participants and made it difficult for them to understand what we wanted them to do. We therefore tried to overcome this by letting the participants make a priority list of the organisations prior to the drawing, which partly solved the problem. The second disadvantage was that it was very difficult to do with an interpreter. Both when we initiated the process but also during discussions between the farmers. We tried to change this by letting one of the Thai students be the initiator and only got a translating of the debate between the farmers. All of these changes helped, but meant that we got some very different diagrams that are difficult to compare.

Sometimes it was the case that there was no debate and it was the same person that talked for the whole group. The biggest disadvantage was that it requires a visualisation of institutions by the informants according to our definitions, which makes is a difficult method to use.

Still, we got some relevant and useful information that we would not have reviled through the interviews.

Agricultural pairwise matrix, scoring and ranking

As a field method, we found that the method was very useful, as it is fast, simple and enjoyable for the participants, and during the scoring and ranking a lot of additional information was revealed through the discussions.

In the preparation of the pairwise matrix, we learned, by trying it out ourselves, that the method only can be used on one simple, clear issue at the time, and only on items that are comparable, for example weighting two different crops against each other.

In the beginning the paper turned upside down, which meant that the farmers could not really participate. We moved around so the writer was sitting among the farmers, which clearly showed a visible change by the more enthusiastic faces and the increased discussion. This way they were a greater part of the process, which is the aim of the method (Mikkelsen 1995: 128).

The farmers preferred us to do the writing. Using drawings or grains of the crops could have solved the problem of illiteracy[4], but it is a delicate matter to determine the level of approach towards the farmers. This was not a problem, because it was repeated several times and the process were initiated by the Thai-students.

We found that a good way of optimising the gathered information was to sum op results from the scoring and ranking on the spot, and hereby get the farmers to help validate the information. The results gave base for further discussion with the participants giving additional information.

Income matrix

In the beginning the aim with the matrix was to find out what sources of income the farmers have and the criteria for choosing these sources. This did not work very well. The farmers could not really understand the questions and it took more time than we had planned, because the farmers listed over 20 sources of income and more than seven different criteria which meant that we did not

finish the first matrix. We therefore reduced the questions to the six main sources of income and asked them to give the main criteria for choosing these. This worked well but still took too long time and meant that the results from the three groups can not be compared, since the matrixes are not the same. This is also caused by the fact that in one group the farmers rejected to do a scoring individually, only on group basis.

Another aspect of the time problem was that we in the first matrix asked the farmers to draw the different sources of income. This took a lot of time, so we changed it into words, but because of illiteracy this influenced the participation level.

Even though the direct information and results from the matrices can not be used to compare the different group of farmers, we got a lot of additional information about the different income sources and the criteria the farmers find important for choosing a specific source of income.

Evaluation of workshop

The participatory methods have many advantages. First of all they minimise the hierarchy between the outsider (interviewer) and insider (participant) - the outsider is only initiator. Secondly the participatory methods are done in co-operation and therefore opens up for a discussion and debate which are seen as less threatening compared to a direct interview with an outsider (Laier 1999: 40 and Mikkelsen 1995: 61ff). This was to a certain degree also true during our workshop. We got a lot of additional information that properly would have taken us a long time to reveal and collect through interviews. But on the other hand it varied how much discussion there were between the farmers in the three workshops.

An another problem was the time factor. We had planned to use one hour on each group in the three stations. But because of the difficulties with explaining and proceeding the whole workshop ended up taking 4-4½ hours. This was a constraint because in the end we had to rush through one of the stations. Because of this extra time we told the farmers after three hours that they could leave if they wanted. All the farmers expressed that it had been fun and that it was not a problem that it had taken such a long time. A better way of doing a workshop like this, would properly have been if we had planned to use the hole day (with lunch to the farmers) and thereby not making the time an issue by having to rush through some of the methods.

[4] A problem the Thai student pointed out to us.

Some of these problems properly reflect that it was the first time that we tried these methods, and therefore had to adjust them along the way as we got more acquainted with the procedure.

We experienced that the PRA methods used in this context was still useful and gave a basic knowledge for further procedure. Especially it was also a good introduction of our fieldwork to the villagers.

Discussion of Step 2

The systematic random sampling based on the house numbers meant that we interviewed households more or less in the whole village and therefore think that we reduced the bias, this kind of sampling cause, like any zoning that could have been in the village.

We chose this method because it was the most appropriate when we wanted to make a high number of interviews and be able to compare the answers when we only had limited time. But also the most appropriate when we wanted to combine our different disciplines. By making the questions standardised we were also able to use all of us as interviewers and hereby try to limit the effect and bias of the interviewer and interpreters as it is the case with less structured interviews (Mikkelsen 1995: 103), especially when a lot of interviewers are used. In our case this was especially pronounced because we as potential interviewers come from different disciplines.

Another aspect of this was that the different interviewers were posing questions outside their own field of knowledge and therefore did not know what could be relevant to enlarge during these questions. We had foreseen this and tried to avoid it by informing each other on the different topics. It still turned out to be an occasional problem and sometimes lead to misunderstandings and true mistakes. Further more, when complicated explanations arose outside the interviewers field of science, there sometimes were a tendency of these being simplified or simply left out, so the validity of some of the answers can be questioned.

Changes and test interviews

In Denmark we had planned some questions, but after gathering more information in step 1 we made a lot of changes. First of all it was possible for us to focus our questions more towards the objective from the knowledge we had gathered. Secondly we reduced the amount of questions to limit the time of the interviews. Thirdly to reduce the effect of the interpreters we went through all the questions with the interpreters and got the questions translated into Thai - hereby we wanted to make sure that the same questions that were asked. It also helped us with the wording of the questions because some of the words were not understandable when they had to be translated.

Words like 'problems' and 'conflicts' were changed, because they could be understood differently, to 'good things' and 'bad things' that are more controversial.

After conducting three test interviews we evaluated and discussed possible changes coursed by difficulties and problems. The evaluation focused on whether the difficulties were due to interview technique or questions posed. As a result we focused our effort on changing the interview technique, because it was the main problem, and only making minor changes in the questions. A major change in the questions would take a long time, which we did not posses. The changes were mainly making sure that everybody understood and asked the questions the same way.

Adding questions in the social science field (on the institution and income part) was to get a quantified picture of aspects under these disciplines. This part of the interviews worked well. But we also wanted to get more qualitative information - like how the organisations functioned according to the farmers. This posed some problems, and we did not get any useful results from these questions. Everything turned out to 'work fine' – 'no problems'. These questions should probably have been asked differently. Maybe the confidence was not there to give any valid answers, or maybe we were looking for problems that did not exist.

We found that some of the questions did not fit into the perceptions of the farmers, this was pronounced in the income part. The farmers could not always divide their expenses into the four groups made by us (se appendix 2), or were not able to sum up in per year figure. We were often told that the farmers did not know these figures, because they used the money the same day they were earned. We should properly have been more critical after the test interviews and made some more changes.

The agricultural part of the structured interviews (se table in appendix 2), was useful in collecting quantitative data, as the data was standardised and therefore easy to analyse. It was though sometimes a problem that it took a long time to fill in, especially if the farmer grew three different crops a year in several different fields.

Evaluation of structured interviews

Generally the structured interview as a method worked as a good way of collecting a great amount of data. The comparability is high because of the standardised questions, as has been pointed out (Mikkelsen 1995: 103).

The problem we found was that the standardisation of the wording of the questions limited the flexibility and relevance of the answers, and that the interviewer-effect was some times noticeable. To do such a structured interview under these conditions we believe it is necessary to have a good common knowledge of the subject investigated, or else the responses will not be valid. The answers will not correspond to the question asked and important data will be missed because of misunderstanding.

We also experienced that our structured interview was rather time consuming, which is a problem if it gets too tiresome for the respondent.

Discussion of Step 3

The problem with semi-structured topic-focused interviews can be that important and salient topics may be inconsiderably omitted (Mikkelsen 1995: 103). But by having an interview guide and at the same time being two persons doing the interviews we do not think this was a problem.

Another problem could be that some of the questions are based on an assumption about relations between different element, which is not necessarily true in the particular context. We do not think this was a problem, because this kind of interview is fairly conversational and situational and therefore very flexible, it is possible to revise and adapt changes and to follow up on important answers and topics during the interview (Mikkelsen 1995: 103, 224ff).

Economic Semi-structured Interviews

The economic semi-structured interview guide included an pairwise matrix ranking and scoring of the different agricultural products as a source of income. The farmer was asked to compare the crops and compare it to work as labour, because we believed that doing labour was the best alternative to do farming. The pairwise matrices worked well, the farmer understood the questions, but sometimes found it difficult to compare the different crops. The information from the pairwise matrices was validated during the interview, and gave us the possibility to ask why the farmers did not do the activity they preferred most. This gave us a lot of data on the constrains, a farmer is facing in generating an income, and how they adapt to these constrains. The discussions between the farmers was lost, and it worked more as outsiders testing their assumptions of the insider preferences.

We also asked the farmers to draw a pattern of when they did different activities. This did not work well. The farmers were often passive under the making of this, and we had to probe hard to get answers and then check if the answers we got were correct. This gave us the impression that the

answers was depending on the questions asked by the interviewers, and not the answers given by the farmers.

Case-studies

The three case-farmers were selected from the structured interviews based on the criteria that they under respectively economic, institutional and agricultural aspects were representative. The purpose with selecting these cases was that we would like to combine our knowledge from the different fields of science to an all round picture of the farmers and thereby being able to give an interdisciplinary conclusion.

The selection was based on the grouping of farmers used in the workshop, to be able more thoroughly to see the effects of the dam on these different groups. But also in order to see what the effects would be in a single case study[5], by taking all aspects into consideration.

Problems did though occur, which methodologically can question the usefulness of these cases. Firstly the selection method has some restrains. Because we did not have time to make an in-depth analysis of the information from the structured interview, the criteria are very much based on our overall understanding that we got from these interviews and therefore do not necessarily have to be the right criteria for a representative farmer.

Secondly it was very difficult to find farmers that fitted to the criteria of the sub-groups. This meant that we had to compromise in the selection of the case-farmers and that the cases did not meet all of the criteria from different sub-groups, which probably are impossible. To make it more valid we should have made a more thorough analysis before selection the case-farmers and taken two or three farmers from the three different groups instead of the one that we did.

Another problem was that we did three different interviews (plus the structured interview) with each case-farmer. To limit the amount of interviews and draw from each others knowledge, we should preferably have made one interview with each case-farmer where one person from each sub-group was present. Further more we did not have a common strategy for what to ask into in the different interviews which have made it difficult to analyse and use the information interdisciplinarily. After having elaborated on the cases, we found that the material gathered was not thorough enough to give the additional coherence needed for a case. Instead the cases will be part of our data material as in-depth interviews.

[5] "A case study is an empirical inquiry that investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." (Yin 1994: 13).

Soil samples

The test kit is fairly easy to use in the field, as it can give a fast estimate of the chemical properties of the soil. The result of the soil test is however only given with limited accuracy, as the results are given as intervals. pH-values measured with the test kit is generally lower than the coherent values from measurement with the pH-meter. However, in two samples the test kit values are higher than the values from the electrode measurement. These results are still within the given interval (+/- 0,5) of the results from the test kit, and do not differ from the pattern of coherency between the two methods.

Pesticide test

The method was quite difficult to use due to problems with translation of the manual. Besides this, the step by step approach with premixed chemicals makes the method possible in the field. The method is not very precise, since the content of pesticides are not quantified, but estimated to one of the three very broad categories described in the method section. Secondly the method is only appropriate if the research is concerning the health of human beings and therefore do not consider the environmental aspects of different pesticides contents, which is our focus. However, our experience is that the test kit can be used as an easy way of determining whether pesticides are present in the plant samples.

Field observations

We found that field observation was a good alternative to more quantitative methods since there is many indicators of erosion that are visible for the eye and also because of time limitation, since valid measurements of erosion must be done over a longer period of time. Observation is however subjective data that can not be quantified, which include the possibility of our results varying from the general consensus. We still find that field observations is a very good method to give a general picture of the situation and useful in combination with interview with the farmer on site.

General Evaluation on Methodology

In this part we will comment on working with interpreters and working both interdisciplinary and intercultural.

Working with interpreters

The interpreters were two students, who did interpretation for the first time. A major constraint, in almost all phases of the fieldwork, was the language barrier which made us very dependent on the interpreters, and made the whole process very time consuming. Another problem that we experienced was that the quality of the translation varied. We realised this when the translation

occasionally was corrected. To minimise misunderstandings we informed the interpreters about the subject and terminology within our different fields and also went through the structured interviews with them. But even though there were still some misunderstandings when issues of special scientific topics showed up. Part of the language problems between the Thai and the Danish students could probably have been avoided if we had put bigger effort in trying to understand each other without interpretation.

Working interdisciplinary

The interdisciplinary approach were used to create a more general picture of the village studied. Working in this manner was very time consuming and misunderstandings between the disciplines did occur, which resulted in long but also rewarding discussions. This was mainly due to the fact that the disciplines have different approaches to the study, but also different ways of gathering and interpreting information, which was to be combined.

Generally, working interdisciplinary was very rewarding and we think that we managed not to jeopardise the special strengths and contents of the single disciplines by turning us all into generalists, that are said to be the pit fall in working interdisciplinary (Mikkelsen 1995: 218). Of course we had to compromise, but we more or less covered all of our disciplines satisfactorily.

Working intercultural

The benefits of working Thai's and Danes together are apparent. The Thai students know their country and the culture, and can share this knowledge with us. This had great impact during the collection of data. The Thai's knowledge about their own country, culture and local scientific features were used in formulating the questions for the structured interview guide and to make the in-depth interviews understandable for the farmers. Secondly, the Thai's knowledge of their country was very important when the data had to be understood and analysed.

A constraint of working intercultural became evident when defining the approach to the scientific work. The Thai students were more descriptive, whereas we were more problem and method oriented in our approach. This probably relates to our different schools of science and pronounced during whole process.

Final Remarks and Discussion

One of the major problems in our method of data collection was that our objective was based on a investigation over time. This was very difficult to fulfil, because it was difficult to get valid information on the situation before the dam. It took a long time just to investigate how the situation

was presently, which did not leave time for further questions on the situation before the dam. This means the data in respect to the time perspective are limited, which has influenced our analysis.

The use of the three-step method helped us to maintain an overview of the process of the fieldwork and at the same time aim for a common goal. This approach combined the work so the issues worked with were based on common criteria. For example the farmers selected for in-depth interview were found through the workshop and the structured interviews, hereby giving us the possibility to triangulate some of our data. Triangulation can contribute to validate our results. The triangulation meant that we discovered the sometimes inconsistent information.

Findings

The findings will be separated into two parts. First a part that look into the agricultural aspects of the dam and secondly a part that look into the income and institutional aspects.

Agriculture

Farmers generally expressed that the water supply has increased after the dam. Farmers used to grow rainfed paddy rice but after the construction of the dam they have changed to irrigated paddy rice (structured interviews). Two of the farmers (Structured interview no. 12 & 1) stated that the dam has meant less flooding of their fields. Furthermore it resulted in increased yields and thereby a higher security of their agricultural production. The change in water supply has meant a change in farming practice in the paddy rice fields, now most farmers grow 3 crops per year in contrast to only 1 crop before the dam. Before they only grew rice; now rice, soybean and mungbean are grown (Structured interview and interview with headman).

Area description and cropping systems

The fields in Ban Huai Khum are distributed in different areas around the village, see fig. 1. Three distinct types of fields can be identified, which are named A, B and C -fields for convenience. The placement of three types are shown in fig. 1. Average cultivated area per household in Ban Huai Khum is 7,4 rai. The paddy rice fields are denoted as A-fields. B-fields are almost at the same elevation as A-fields, but sloping and rainfed, hence not used for paddy rice. C-fields are very sloping (up to 50%) and situated at a higher elevation in a hilly area app. 3 km from the village.

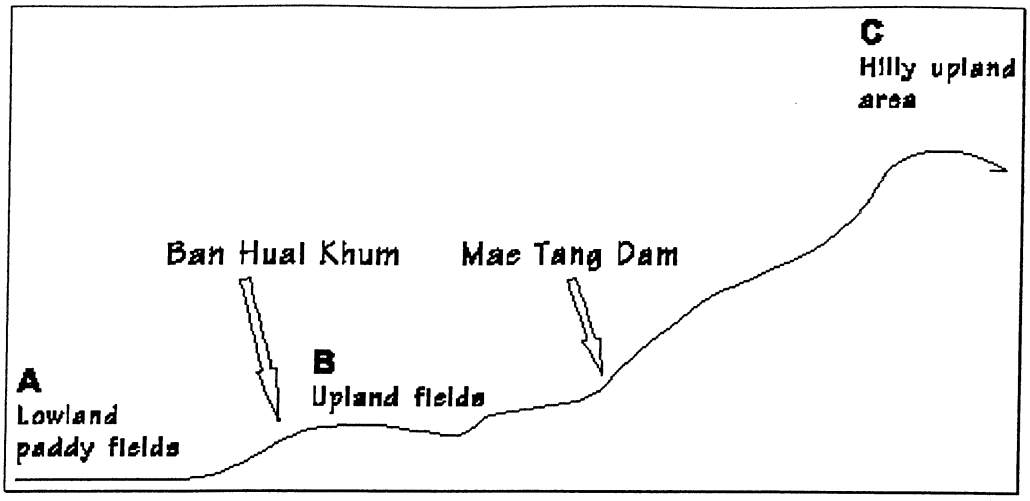

Figure 1 Location of the different types of fields grown by the farmers in the village

A-fields, have an average size of 3,2 rai, and are grown by 17 of the 18 households interviewed. 13 practised the 3 crop cycle mentioned previously. Two farmers grew rice followed only by soybean (Structured interview no. 13 and 16) and two farmers grew only rice (Structured interview no. 10 and 17). A-fields are normally grown in a three crop cycle with rice from July to November, followed by soybean from December to March, and mungbean from April to June. B-fields, have an average size of 3,8 rai, and are grown by 6 of 18 farmers. Normally two crops per year are grown in the B-fields, e.g. mungbean, soybean, maize, chilli or eggplant and there is no pattern in the cropping cycle. C-fields, have an average size of 6,8 rai, and are grown by 7 of 18 farmers. According to interview with the headman, app.10 farmers have C-fields The farming pattern are almost the same from farmer to farmer, six of seven grow soybean from May to July, and mungbean from August to December (Structured interviews).

Findings of Chemical Properties

In the following part the findings of chemical properties are presented based on the results in appendix 3.

Texture

The texture of the soils are found to be ranging from sand over clay to silty clay. On A-fields the texture is either clay loam or silty clay, on the B-fields the texture is ranging from sandy loam, sandy clay loam and clay. On C-fields the texture is ranging from sand over sandy loam, sandy clay loam and clay loam to clay.

pH

The pH of the soils are found to be within the range 5,6 to 7,2 (pH-meter), range in A-fields :6,0-7,2; range in B-fields: 5,6-5,8 (only two samples); range in C-fields: 6,3-7,2.

Electric conductivity

The EC of the soils are measured to be within the range 0,06-0,66 dS/m. A-fields: 0,21-0,36 dS/m; B-fields: 0,06-0,09 dS/m; C-fields: 0,06-0,66 dS/m.

Soil organic matter (SOM)

The soil organic matter of the soils are measured to be within the range 2,84-5,75 % SOM: A-fields : 4,24-5,68 % SOM; B-fields :2,84-4,20 % SOM; C-fields: 3,50-5,75 % SOM.

Nutrient content, N, P and K

A-fields: NH_4^+ was "very low" in all samples. NO_3^- was "very low" in all samples. P_2O_5 was found to be in the range "very low" to "very high". K_2O was "low" in all samples.

B-fields: NH_4^+ was "very low" in all measurements. NO_3^- was "very low" in all samples. P_2O_5 was found to be in the range "low" to "very high". K_2O was "low" in all samples.

C-fields: NH_4^+ was measured to be in the range "very low" to "low". NO_3^- was measured to be in the range "very low" to "low". P_2O_5 was measured in the range "low" to "very high". K_2O was "low" in all samples.

Artificial fertiliser

The use of artificial fertilisers have increased after the construction of the dam, according to three of the interviewed farmers, which in some case have substituted the farm manure and in other cases is applied to increase the yield (Semi-structured interviews). The most commonly used fertiliser in the rice crop in the A-fields is the 46-0-0, but also 16-0-0 and 16-20-0 are used. Some interviews give the impression that the farmers do not really know which fertilisers are most appropriate, resulting in choosing the cheapest available fertiliser, and therefore use e.g. 16-0-0 instead of 46-0-0. The later crops in the rotation, soybean and mungbean, was applied with fertiliser with a lower nitrogen content, but more composite fertilisers as 12-24-12 and 15-15-15. The fertilisers used on the B-fields are 46-0-0, 12-24-12, 21-0-0 and hormone (liquid fertiliser). C-fields 12-24-12 and 15-15-15 and hormone are applied. The general picture from the workshop showed that the paddy rice are applied with most fertilisers followed by soybean and mungbean.

Pesticides

The use of pesticides were increased after the construction of the dam (3 semi-structured interviews). Weeds in the fields were previously hand weeded, but are now sprayed with herbicides

(Semi-structured interview, no.63). Insecticides were found to be in the range "not detectable" to "detectable, but safe for life" in the plant material.

Erosion

Following indicators of erosion were observed on C-fields: In spite of the dense plant cover clearly visible rills, were evident on all C-fields. Greater clay content are found on the bottom section of the slope on all C-fields. The plant height was found to be increasing down the slope. No general pattern was found on the phosphorous content along the slope. The expected pattern increasing phosphorous content down slope were only found on one field. pH-values do not follow the expected pattern of increasing pH-values down the slope was only found on one field.

Analysis of Findings

As 17 of 18 farmers have A-fields with paddy rice, the analysis and discussion of data on these fields will be most comprehensive and furthermore we find these the most interesting. We will therefore present the properties of the A-fields more thorough than the other fields, however the C-fields is discussed in context of erosion. B-fields are not analysed due to minor relevance and lack of data. Data for the particular soil types, found around the village, are quoted from Soil Maps of Phrae Province (Ministry of Agriculture and Co-operative, 1979) are in the following used as reference for analysis of data.

Texture, pH, SOM and nutrient content

A-fields: The soil type is determined as Aeric Tropaqualfs, a subgroup of the order Alfisol The texture analysis as well as the measurements of potassium and pH corresponds well to the properties for this soil type in the reference. In contrast, measurement of SOM and available P did not match the reference, as SOM in our samples were about 4 times the reference value. Available P fluctuates from 0 to 12 ppm in the samples, whereas the reference value is below 3 PPM.

C-fields: The soil type is determined as Paleustults which is a subgroup under the order Ultisol. The texture analysis corresponds well with the reference, while the measurements of available P match to a lesser extend. SOM, available K and pH do not fit the reference, as SOM in our samples are three times higher. Available K is three times smaller than the reference value and our measured pH is higher than reference. The reference states that the range slope on areas with this soil type is 2% to 16%. Our measurements of the slope showed a range from 20% to 45 %.

Fertiliser use

The average amount of nitrogen applied to the A-fields during the first crop (rice) are calculated to be 9,2 kg/rai. On a yearly basis the total amount of N applied on the A-fields is 12,4 kg/rai. C-fields are on average applied with 4,1 kg N/rai/year. Output of nitrogen were calculated on average basis in the rice fields and showed that the are deficit in input of nitrogen. Calculations of potassium and phosphorous were not made.

Erosion

The visible and physical indicators showed clear signs of erosion. Clear signs were however not found in the chemical properties.

Discussion

pH

Tropical soils, generally have problems with acidification and following problems of decrease in soil cation exchange capacity and aluminium and manganese toxicity (Ahn, 1993) but our measured values of pH indicate that this is not an urgent issue on these fields. This pH-range offer good growing possibilities for most plants (e.g. optimum for rice growth is pH 6-7, soybean is pH 6-6,5, maize is pH 5,5-8, (Rehm, 1991)) since the cat-ion exchange capacity of the soil is fully base saturated at the natural soil pH and there should be little exchangeable aluminium and manganese (Walker, 1996).

Electric conductivity

The measured EC values are multiplied by 2 to get the saturated value of the extract (P.C. with Dr. Torsten Müller; Landon, 1991). The values are quite low compared with values from the literature (Walker, 1996) as they are measured to be within the range 0,06-0,66 dS/m and thereby characterised as only "slightly saline" (Walker, 1996). Salt imbalance is a frequently occurring problem in irrigated fields due to insufficient drainage (Ahn, 1993). Generally we can conclude that salt imbalance is not a problem in fields of Ban Huai Khum.

Pesticides

There is not seen a general pattern of the presence of insecticide between the fields and the results will not be used in the following discussion.

Artificial fertiliser

The use of potassium containing fertilisers are difficult to interpret from the data, as only a small number of farmers use potassium fertilisers and no calculations and discussion are therefore made

on potassium. The reason for using fertilisers with low nitrogen content, could be due to the farmers knowledge about the ability of the legumes to fixate nitrogen from the air, a hypothesis however not proved by the interviews. However an indication emerged during the workshop, where the farmers in all three groups ranked the soybean and the mungbean to be the crops given the least fertiliser. Comments to the ranking were that mungbean do not need fertiliser, but only small amounts of hormone.

This example shows that the management of the nitrogen balance, taken artificial fertilisers, legumes fixation and actual plant uptake into account, is not very successful, since the output is app. 1/3 greater than the input. Especially the growing of rice and maize contributes to the imbalance, whereas the growing of soybean and mungbean have a positive effect on the nitrogen balance. From the literature it is found that soybean are able to fixate app. 82,5 % and mungbean fix 89,5 % of their nitrogen requirements (Giller & Wilson, 1991), reference values from Thailand.

Box 1

An example of management of the nitrogen balance in a A-field in Ban Huai Khum:

On this field there is an output of 23,2 kg N/rai that is matched with an equal input of 33,2 kg N/rai.

Input:	*rice (fertiliser):*	*3,1 kg/rai*
	maize (fertiliser):	*2,2 kg/rai*
	soybean (fertiliser and fixation):	*15,4 kg/rai*
	mungbean (fixation):	*2,5 kg/rai*
	Total:	*23,2 kg/rai*
Output:	*rice (grain)*	*10,5 kg/rai*
	maize (grain)	*5,0 kg/rai*
	soybean (beans)	*14,9 kg/rai*
	mungbean (beans)	*2,76 kg/rai*
	Total:	*33,2 kg/rai*

The input and output of nutrients are important to sustain the productivity of the soil. Especially the amount of nitrogen supplied by fertiliser have to meet the output. In this part a calculation of the input contra the output of nitrogen is conducted, the input and export level of the two other nutrients measured with the soil test kit are not calculated, as the farmers use very different fertilisers containing different amounts of these nutrients.

When looking on the yield of the paddy rice fields, the average yield are 668 kg rai, of the asked farmers the highest yield recorded was 1400 kg/rai and the lowest 133 kg/rai. Rice grain contains 7,5 % of protein, and protein 16 % N, resulting in an average removal of 8.25 kg N/rai in the rice.

Another calculation based on other figures from the literature shows that the export of nitrogen in the rice grain is 7,28 kg/rai. In both cases the nitrogen applied seems to meet the requirement, except that the uptake rate of rice is found to be around 40% in field trials (Ahn, 1993). This means that of the applied nitrogen only 5 kg will be taken up by the plants, and there could be a lack of nitrogen in the rice fields.

Potassium level in the fields are according to the soil samples low, which means that the level of potassium is lower than 40 ppm available potassium in the soil. Rice plants take up more potassium than both nitrogen and phosphorous, but most of the potassium goes into the straw, so if the straw is left in the field, then only 5% of the potassium taken up is exported (Ahn, 1993).

Erosion

A decrease in erosion due to the construction of the dam could not be detected, because of contradictory statements on the level erosion over time (Semi-structured interviews). However our observation clearly proved erosion on the C-fields.

Box 2

From semi-structured interview with Mr. Sherd:

Part one : *Q: " Do you have erosion on your fields?*
A: " No".
Q: "How have the yield been since you started growing this field ?"
A: "The yield have decreased every year due to the decrease in rain".
This part of the interview shows that the farmer has the perception that it is solely due to the decreased rainfall that his yield has declined. The possible negative effect of erosion on the yield is not included in his understanding of the connection between yield and soil fertility.

Part two : *Q: "Why do you not perform soil erosion protection or go to the Water Research Station to see the demonstration ?"*
A: "Because the plants the grow do not benefit me, I can not sell them. Anyway, there is no problem with soil erosion on my uphill field."
Part two include the possibility that there is a misunderstanding of the purpose of the erosion control project by the Watershed Research Centre, which, if true, is problematic as the...

Some farmers are aware of the problems of erosion, but take no actions to prevent it. This could either be due to lack of knowledge (part one of grey box) or misunderstanding (part two of grey box) of the purpose of erosion control proposed by the Watershed Research Centre. The lack of initiatives of erosion control can have consequences for the soil fertility and thereby the future sustainability of the uphill farming. The increased use of herbicides instead of ploughing may have a positive effect on soil degradation by erosion.

Income and Institutions

In the following we present and discuss the findings on the income and institution investigations.

Income

Our main focus in this part is to investigate if there have been any major change in the income for the households due to the construction of the dam.

From the diagrams in appendix 4, it is clear that the changes in income occur in different years. The reasons for this is not clear. Some farmers mentioned better income possibilities from labour as a reason, other mentioned the drought. These changes are though all an effect of the way the farmers income is generated (See appendix 4).

The possibility of a higher income from agricultural production seems not to differ significantly between farmers with different types of fields. An explanation could be that the farmers with only A-fields, have between 1-6 rai (with the average of 3.2 rai) to grow, and the income from agricultural production is general a minor part of the total household income. Secondly all the farmers, except one, are growing A-fields (Structured interviews).

Farming practices with the aim of growing crops for consumption (especially rice) are undertaken by most of the farmers. But they have also other sources of food supplies, like the forest where they pick mushrooms and bamboo shots. A few households are though depending on the forest as a source of income, which contributes with up till 60% of the total household income (Workshop, Structured interviews).

The structured interviews showed that the households of the farmers in Ban Huai Khum are depending on several sources of income. They generally earn 30-50 % of their income on agriculture, where as the rest is earned from labour, contributions from relatives or other, for example selling food at the nearby road or mushrooms from the forest (Structured interviews). The structured interviews also showed that the 50 % of the households have a household income below 26100 bath, with 8800 bath as the lowest and 87000 bath as the highest. This difference seems to be depending on how much of the income is coming from agricultural production. Farmers with income coming from relatives or other income sources have generally a higher income (Structured interviews).

Another reason for these very varied income sources could be that the farmers do not use all the time available too them on agricultural production. The agricultural production takes the full time of the farmers only during shorter periods of the year, and the farmers generally have time left, which

they use on other income generating activities (Workshop; Semi-structured interviews). In the semi-structured interviews the farmers with different combinations of A,B and C fields, expressed that the activity pattern in relation to different activities have not changed after the construction of the Mae Tang Dam (Semi-structured interviews).

The activity pattern of the farmers, have not changed after the Mae Tang Dam (Semi-structured interviews). The intensification of the agricultural production in the A-fields, have though increased the demand for labour in periods where the farmers with B and C fields previously were working in the fields (Workshop; Semi-structured interviews). This leads to an even higher demand for labour in periods where the farmers is depending on the help of other farmers (See institutions).

It is interesting to notice that 2 farmers do not use the full agricultural potential, and grows less crops than possible. This could be an indication that other income generating activities is preferred to farming. One farmer had chosen to work instead of doing farming, another farmer preferred to sell products at the market, another had planted a type of crop which is harvested only once a year (Structured interviews).

The prices on the agricultural products paddy rice which have and soybeans have declined, while the price of mungbeans and maize have risen. Some of the changes, both the declining and increasing in prices.[6] These prices reflects the prices set by the government, since the market price adjust to this price (Interview with Executive of District Co-operative). The effect on the income from this therefore not possible to estimate.

The farmers are met by several constrains towards an intensification. The most often expressed constrain is the price of inputs needed for the agricultural production. The Farmers spends up to 30% of the total household income on agricultural inputs (Structured interviews). This leads to that the farmers choose between different income activities, depending on the cost of inputs and labour requirement, even though they can earn more on other activities (Workshop; Semi-structured interviews). Further more it could be the reason for some of the farmers to buy inputs on credit, and repay after the harvest. It also turned out that farmers used loans to buy inputs to the agricultural production, which indicates that the inputs are a major expense that can be difficult to pay (Semi-structured interviews).

6 A quantification of the prices have not been possible because the amount of data on the different crops was small, and different prices were given. (Semi-structured interviews)

Another constrain for changing the pattern of crops grown could be stemming from the knowledge of the farmers. Some Farmers are not able to change their pattern of crops because they do not know how to grow other crops. This is also the case with the contract farming where a person from the company comings and look at the crops and gives them advises on how to grow the crops, and the farmers found this positive (Workshop; Semi-structured interviews).

A third constrain is an effect the farmers expressed that, even if they wanted to, an extension based on land, was not possible because all low land is used. Secondly the possibility in general to change to an another form of production as chicken farming or industrial production was not possible due to the lack of available lowland (Interview with Headman; Semi-structured interviews).

Discussion

The effects of the dam on the total household income is not clear because of the combination of the different field types used by the farmers, and the relative importance of agriculture production as a source of income. But we have generally found that the changes in total household income does not seem to change as a effect of the dam.

It is difficult to say if there is a lasting perspective. It will depend on the prices on agricultural products and inputs. Another example is that if the demand for labour is rising the effect on the agricultural production will be less in the future, because of the preference for this income possibility (see Box 3).

Box 3

Structured, semi-structured interviews, household 63

This household grows 4 rai of A-fields and 3 rai of B-fields. Agriculture as source of income is contributing with 13000 bath/year out of a total household income of 34000 bath/year.

Her income have changed as result of an investment in a tool to harvest rice. She has sold the tool because the demand was not big enough, and used the money to buy inputs, as fertiliser and seeds, and improve the house. She owes the co-operative 16000 bath.

The cost of inputs to agriculture is 8500 bath/year. This have risen compared to before the construction of the dam, because she now uses pesticides against the weeds, instead of hand weeding, and the increased use of artificial fertiliser. The inputs she buys in the co-operative shop and pay back to the co-operative when she has harvested.

This leads her to prefer to work as a labour to do farming, because she is paid at once and she do not have to invest. The demand for labour is though not big enough to make a switch, to working, desirable. Secondly she prefers mungbean to all the crops she grows because the mungbean needs little attention and the inputs is very low, compared to soybeans and rice.

Another aspect influencing the future effects, is the farmers dependency on outside actors, like the government and Agro-companies. These actors provides the farmers with inputs to the agricultural production, which has risen due to the farmers use of pesticides and fertiliser. If the support to these inputs is stopped, it would lead to an increase in the amount of total household income spent on inputs, and a reduction of the amount of the total household income available to consumption.

The farmers are further more dependent on the choices made by these outside actors, because they set the prices for the output produced by the farmers. The government set a price, and the market price is normally just above this price. So if the government chooses to alter the prices downwards the effects of the dam, could not be lasting.

All in all the lasting effects of the Mae Tang Dam is hard to estimate because it depends on the choices made by the farmers and outside actors. This emphasise that an intensification of the agricultural production is not cause-effect relation, leading to a higher income for the farmers.

Institutions

We deal with the management of the water supply and the institutions directly connected to the agricultural production as two separate institutional aspects. We will first present our findings on the management of the water supply and secondly on the agricultural institutions. The two aspects will be commented coherently in a discussion.

Management of water supply

The irrigated fields in Ban Huai Khum have two water sources. One is from the Mae Tang Dam and the other is from the Mae Bong Khon Dam. These two dams supply the fields with water through two water ways that cover different areas of the fields. Our objective is focused on the Mae Tang Dam; and we will therefore analyse and focus on the farmers that use water from the Mae Tang Dam - which is the majority of the lowland fields in Ban Huai Khum.

There are elected a headmen to manage the water supply. The role of the headman is to distribute the water to the different areas. He has the authority to control the outlet of water to the fields of Ban Huai Khum.

More than half (56 %) of the persons interviewed are satisfied with the management of the water. Most of the farmers expressed that the distribution of the water was fair and that they are in a position to claim for more water if needed (Structured interviews). The headman of the water supply in the village confirmed this:

> *"The farmers can ask to get more water for their fields - if necessary and the farmer really need it then I open for the water. I know the farmers so I know if they really need the water"* (Semi-structured interview with Headman of water supply Mae Tang Dam).

The distribution and management of the water supply does not seem to be influenced by the government or any official organisation. According to the headman of the water supply, all the decisions are taken at village level, which have been the case the 14 years he has been in charge (Semi-structured interview with Headman of water supply Mae Tang Dam). The headman expressed that the management still is in local hands because the canals are not cemented by the government.

If the government provide a cementation of the irrigation canals, which they, according to the headman of the village, have taken initiative to do in the year 2001, it could mean an increase in water supply because of a minimised waste of water. This is supported by the information that presently only about 60 % of the water reach the fields because of ineffective canals (Interview with headman of Mae Bong Khon Dam). It has been the case in other places of Thailand that a 10 percent increase in water for irrigation has raised the agricultural production by 3,3 percent, and this was despite that the water was used inefficiently and wastefully (Phantumvanit & Panayotou 1990). This improvement could also be a benefit in the case of Ban Huai Khum, if they get cemented canals.

Agricultural Institutions

Our research on institutions and organisations took, into consideration what effects the construction of the dam have entailed on the interaction between the institutions and farmers.

From our initiating meeting with the headman of the village and from the workshop with the farmers we found three main organisations and institutions in this village, which we chose to take into further consideration: the Agricultural Co-operative (AC), which is the largest organisation, contract farming, because it is a recently introduced system, and 'loonkai', an old Thai way of helping each other during the harvest, which still have great importance in the village.

We found that the Agricultural Co-operative is a well established organisation in the village. It has been functioning here for approximately 20 years. The work shop revealed that it has a considerable position in connection to the agricultural production in the village. The co-operative has a great affiliation, 72 % of the farmers interviewed are members. The AC has several functions. The farmers can organise their purchase of seeds, fertilisers and pesticides, the selling of products and sharing of benefits from their sale. The AC also provide loans to the farmers at a low interest rate, offers funeral insurance and health care (Structured interviews).

50 % of the farmers mentioned the loan opportunity as the reason for becoming member. Further more the farmers expressed the opportunity for insurance, especially the funeral insurance was mentioned as a good thing about the co-operative. An important thing the co-operative has provided is the access to a marked nearby, where the farmers can sell their products. Formerly the nearest marked was situated 10 km away. The main reason stated for not being member was economic reasons, that the farmers could not afford a membership.

The farmers often use each other as guarantor for the loans, because they do not own enough land to use it as collateral. The reasons stated for obtaining a loan differs a lot. Both investment in inputs to the agricultural production and improvement of the house was mentioned. The co-operative has never rejected any farmers a loan. This have lead to app. 45 %[7] of the farmers have loans in AC, with an average of 22000 bath (Structured interviews). Some farmers have not paid back the last years. This is partly due to the draught and economic recession, but some farmers also mentioned the way of guaranteeing for each other. If they repay the loan they still have to guarantee for the others in the group, and in worst case repay their loans. Therefore they choose not to repay their loans.

Contract farming have taken place in the village for the last three years and that 17 % of the farmers interviewed do contract farming (Structured interview). Contract farming involves an agreement between a farmer and a private company for the production of a particular crop, in this area usually maize. The products, which have to pass a certain standard, is to be sold back to the company (See appendix 5). In addition, the company provide the farmer with seeds and fertilisers etc., and a guarantee price for the products.

The main reasons for doing contract farming were the guaranteed sale of the products at a certain price. Also mentioned was the advantage of no starting investment for the agricultural production, as the company provide the seeds, fertilisers and pesticides etc., which would then be drawn from their payment after the harvest. As contract farming have only been in Ban Huai Khum the last three years most of the farmers are in 1999 only doing their second harvest as contract farmers (Semi-structured interview).

We assume, that it is only after the Mae Tang Dam has been built, that the companies have had an interest in this village, because the water supply is now sufficient and stable enough to ensure a higher crop production. This we can only assume from the fact that contract farming have occurred the last three years and seems to be dependent on the secure and higher water supply.

Additionally we found that both the co-operative and contract farming are established and supported by the Government of Thailand (Burch 1996; TDRI 19--). There are local variations in the co-operatives, and they work as independent units, but they are all initiated by the Government, as result of the first National Economic and Social Development Plan from 1961. This was the first step of state involvement in the agricultural development. The farmers were offered support through the BAAC[8], which provided the first alternative to the private marked as source of credit.

Another aspect of the governmental development plan[9], was that it encouraged the growth of new Agro-industries by providing investment incentives. This resulted in the emergence of a number of companies with focus on the global export marked. It was explicitly stated in the guidelines for Development of Agro-Industries in the Sixth National Economic and Social Development Plan that contract farming would be one of the production systems to be encouraged by the government (Burch 1996:333). The point was to ensure a regular supply of raw materials for the export marked.

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7 App. 85 % of the farmers have loans, and 7 of 18 have loan in the AC. 5 farmers have not indicated where they obtain the loan. So the app. 45% could be higher.
8 Bank of Agriculture and Agricultural co-operative
9 The governmental development plan constituted later The Board of Investment.

The benefit for the farmers would be the existence of a guaranteed marked, and low-interest loans provided by the BAAC. This was also the main reasons to do contract farming given by the farmers, as mentioned above.

Where contract farming is a fairly new phenomenon in Ban Huai Khum, there are several other institutions in the village, which have existed for a long period. The AC is one of them, and as mentioned the co-operative is well established in the village. Another functioning institution is the 'loonkai', which is a kind of self helping system where farmers gather with the members of the family to help with the harvest etc. The farmers themselves call it an 'old Thai tradition', and it is a well known system in the country. The tendency is though, that many farmers instead hire labour and the system is rapidly declining. This is due to mainly two factors: first a synchronised rhythm in the agricultural work, which means that the farmers have to range beyond their village in order to get labour. Secondly a monetarised rural economy, which means that they can pay for the labour instead of exchanging labour (TDRI 19--: 29). The farmers from the work shop did although express the importance of this system and that they are still depended on it for the agricultural production.

Discussion

We can now derive that there has been a change in the interactions between the farmers in Ban Huai Khum and the institutions related to the agricultural production. In the following part we will discus if these changes have a lasting perspective.

Because the government seems to have initiated both the agricultural co-operative, the introduction of contract farming and the improved water supply, it could lead to the assumption that these opportunities for the farmers are all part of a development scheme from the government. In this reason of thinking the new opportunities that derives from the dam, are not total coincidences, but coherent phenomena.

This is further supported, by the fact that the AC turned out to have acquired an additional role in the resent years as 'middleman' between the farmers and the private companies. The AC identifies the farmers suitable for contract farming and earns a bonus of 0,15 Baht pr. kg. maize sold to the company by providing this contact (Interview Executive President of co-op). This indicates that the AC take up the new opportunities that occurs and adapt to them. It gives the co-operative a flexibility, which are a benefit for the farmers. The co-operative takes care of more and more of the farmers interest and have become more important. This is so, because the intensification in the

agricultural production have meant a need for higher input for the agricultural production and a need for higher access to and interaction with the marked because of the sale of more crops.

The contract farming give the farmers some new benefits with their agreements. The farmers get an agreed price for their crops and the companies supply the seeds and fertilisers. This is important for the farmers because they do not have to invest in these inputs (as mentioned in the income part). We know from the research on the farmers income that expenses on input account for up till 30% of their income. Both the co-operative and contract farming give the possibility for a limited investment in input, either by having lower prices, as the co-operative or by providing the input as just mentioned. On the other hand the farmers are more depended and limited by the standards the company demand, and one farmer states: *"If I have contract farming the fields would need a lot of attention"* (Interview household no. 105).

The prospects for 'loonkai' are not that good. If the farmers loose this system it will make them more depended on hiring labour. But at the same time it might provide further possibilities for the farmers that wish to gain a second income from doing labour, as discussed in the income part.

The situation for the water management is depended on whether government intervention will occur or not. If the government supported a construction of new irrigation canals, it would possibly mean that the management would transfer to governmental control. This is seen in other parts of Northern Thailand where the government has influenced the management of the communal irrigation systems or directly taken control of the water supply in connection with construction of reservoirs or new irrigation canals (Cohen & Pearson 1998: 109). This means that the local management loose their autonomy. If the government take the control over the water supply, the amount of water needed and the periods when there is a demand for the water would no longer be regulated at local level This could have consequences in the future on the amount of water available, because of interest conflicts with other areas or from urban centres. It is although the general opinion among the farmers (50 %), that the water supply would improve by cementing the irrigation canals (Structured interviews Ban Huai Khum), but this is properly due to the increase in water supply a cementing of the canals will provide.

Overall Discussion

This section is a further elaboration of the discussions made in the previous chapters. We now link them into a combined understanding of the connections between the different aspects covered by our interdisciplinarity. This leads to an understanding of the farmers perceptions and their situation after the dam in connection to sustainability and future perspectives.

As the dam has resulted in an increased agricultural production, we assumed that it has had a positive effect on the economical situation. This is however not proved by the investigation, which can be a explained with of a higher use of input and declining prices on output. The increased output is not sustainable from a soil fertility viewpoint, as the higher output could deplete the soil if not met by sufficient input. However, the outlined access to low cost input, credit and information from the different organisations could help to minimise this risk of soil depletion, as cheap inputs will encourage farmers to use the needed amounts.

There are no indication of the intensification in the lowland leading to decreased cultivation of the uphill fields resulting in less erosion. There are no indication that the cultivation in the uphill fields has significantly decreased. This can be a reflection of the farmers limited possibility to generate income from other sources. The cultivation of the uphill fields provides a higher variety in possibilities, but on the other hand implies a risk because the fields are rainfed. Tradition could be an other aspect as the farmers do not leave land uncultivated, but let other farm the land. This conservative thinking implied in the farming practice could also be a part of the reluctancy to obtain practises to prevent soil erosion. The issue of this conservatism is also seen in location 3.1, where the Thai farmers were much more reluctant to adapt new methods of farming practices.

The increased water supply could have triggered the changes found in interaction between institutions and farmers e.g. by apparently attracting contract companies to the area. We know from the investigations in the other locations that contract farming in general only has occurred in the area the recent couple of years (location 2.2). The relevant link would then be to the general development plan in Thailand, as we argue in the institution part, which makes the appearance of these two merging phenomena's coherent.

Contract farming can enhance the range of crops the farmer can choose to grow, as well as offering secure prices and low investment costs, which is positive from an economic and agricultural viewpoint. Contradictory, contract farming could also limit the choices by making specific crops more economically attractive. At present the farmers grow a cycle with two nitrogen fixating crops,

which is positive on a soil fertility perspective. But if the contract companies influence farmers to change the cycle to a rice, maize, mungbean rotation, with only one nitrogen fixating crop, the agricultural effect could be lower input from nitrogen fixation leading to possible nutrient depletion and which is not a sustainable situation. But the contract farming limit the farmers flexibility during the contract period.

It is difficult to link the dam to a change in interaction between the farmers and the co-operative. However there has been a development of the co-operative according to the intensification. This indicates the organisation's ability to adapt to the changing conditions, which provides a certain flexibility. This flexibility benefits the farmer, which gives the organisation a future perspective. This leads us to a broader discussion of sustainability of the agricultural production. At the present time the intensification are not met with coherent input, the change to three crops are resulting in more nutrients taken out of the farming system than applied. If this continues in a longer time span the yields will decline, which we think will be an unsustainable situation.

Contributing to this is that the intensification have not led to a significant increase in the farmers total household income, and thereby enable the farmers to change to other income generating activities. If the depletion result in a reduced yield it would render farming unprofitable. The depletion could also lead to an increased need of artificial fertiliser and increase the cost of growing the fields. This will reduce the possibility of the farmers to meet their needs in the future. The institutions are in the position to minimise this risk of unsustainability by supporting the farmers, e.g. by providing access to low cost inputs.

The situation of stress is expressed in the changing conditions of the agricultural production. Years back the situation of stress was the scarce water supply, which has been relieved by the dam. The present situation can lead to new stress situations, both economically and agriculturally, which there are different possibilities for relieving, as discussed above.

Conclusion

In the overall discussion the consequences and effects of the dam were discussed and it revealed that the issue can not be answered in an unambiguous way. The same conclusion were made during the initial discussion about the objective of the whole study, and this resulted in the development of the hypothesises from which we can make the following conclusions:

- The dam has meant intensified agricultural production.
- Depletion of the soil fertility was not proved, but indications of declining soil fertility was found through calculations of input/output combined with results of soil samples.
- Decreased erosion in the uphill fields could not be proved.
- A direct connection between the dam and changes in household income was not found.
- The management of the communal irrigation system has not changed after the dam, but are likely to happen in the future.
- A clear link from the dam to the changed interactions between farmers and institutions could not be found, but the dam could have an amplifying effect on the changes.

We can on our methodological approach conclude that it, in spite of the constraints, was suitable for investigating our objective. There is however a problem of replicability, as our findings ended up being more a situational picture than an investigation over time. Furthermore the validity, of our understanding of relations can be influence by the limited time of our field work.

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Interview guide - Headman Meeting

A) Demographic Basic information

1. - How many households
2. - How many inhabitants
3. - Birth rate / Death rate/ Growth rate
4. - Education level
5. - Gender

B) Occupation

6. - How many farmers
7. - How many have other occupation
8. - How many farmers have off-farm occupation
9. - Hired labour used in agriculture or working on own land
10. - Gender divided labour
11. - Immigration occupation level

C) Agricultural farming

12. - Kinds of crops grown in the area
13. - Which crops in which season
14. - Farming techniques
15. - Mapping of the area
16. - Agricultural area per household
17. - Homegardens and livestock
18. - From where do the farmers get the seeds, fertilisers and pesticides
19. - To whom do they sell their products

D) Organisations

20. - List of the organisations in the village, farm and off-farm
21. - The function and responsibility of the organisations
22. - Administrative structure

E) Water supply (before and after the dam)

23. - Water quality for consumption
24. - Water quantity for agricultural production
25. - Agricultural benefits /negative impact after the dam construction on village level
26. - Who manage water supply, for consumption and agriculture
27. - Conflicts due to water management (upstream downstream etc)

Interviewguide - Structured Interviews

Remember to introduce ourselves and talk a little about the farmers family, house etc

Interviewers ..... Date:.....

Housenumber..... Male..... Female.....Age.....

Introduction

How many members in the household .....Male.....Female.....Children.....

How long have you been living in the Ban Huai Khum ?.....

ECONOMY

(2541)

* HOW MUCH DID YOUR FAMILY EARN LAST YEAR ON THESE DIFFERENT ACTIVITIES ? (IN 1000 BATH)

ACTIVITY	0 - 5	5 - 10	10 - 15	> 20	SPECIFIC AMOUNT (IF KNOWN)
FARMING					
FOREST					
FISHING					
LABOUR					
CONTRIBUTIONS FROM RELATIVES					
OTHER					
OTHER					

* WAS THE INCOME IN 2540 LESS OR MORE THAN LAST YEAR (2541) ?

YEAR	2540	2539	2538	2537	2536
INCOME CHANGE					

(USE THE SYMBOLS : ↘ = LESS INCOME THAN IN THE YEAR 2541
↗ = MORE INCOME THAN IN THE YEAR 2541
= = THE SAME AS IN THE YEAR 2541

* HOW MUCH OF YOUR INCOME (CASH) DO YOU USE ON . . . . .

[redacted]

INPUTS TO AGRICULTURE : _____

LOANS : _____

SAVINGS : _____

CONSUMPTION: _____

Institutions

A. Are you a member of the *agricultural co-operative* ?.....

If No: Why not?.....(Go to B)

If Yes: .....For how long ?.....

Why did you join the agricultural co-operative?.....

What are the good things about being a member of the agricultural co-operative ?.....
.....

What are the bad things in being a member of the co-operative ?.....
.....

B. Are you doing any *contract farming* ?.....

If No: Why not ?.....(Go to C)

If Yes:.....For how long ?.....

Why do you do it ? .....
.....

What are the good things about doing contract farming ?.....
.....

What are the bad things in doing contract farming ?.....

C. Do you get any support from the *government departments* ?.....

If No: .....Why not..... .....(Go to Agriculture)

If Yes:.....What departments ?.....

What kind of support do you get ?.....

For how long ?.....

What are the bad things in this kind support ?.....
.....

Do you have any suggestions to how the support could be better ? .....
.....

Agriculture

How many rai of land do you have ?.....Rai

How much land is owned ? .....Rai

How much land is rented ? .....Rai

Other - specify .....Rai

How much land are used for fields ?.....Rai

How many fields do you have ? .....

ELD	TYPE OF FIELD A = LOWLAND B = UPLAND BELOW DAM C = UPLAND ABOVE DAM	SIZE (Rai)	HOW MANY CROPS PR. YEAR	CROP 1 (NAME OF CROP)	SIZE (RAI)	YIELD (kg)	PERIOD	ARTIFICIAL FERTILIZER		ORGANIC FERTILIZER		PESTICIDES	
								COMPOSITION (N:P:K)	AMOUNT (kg / CROP SEASON)	TYPE (FARM MANURE GREEN MANURE OR COMPOST)	AMOUNT (kg / CROP SEASON)	NAME	AMOUNT (LITER/CR SE
1													
ORE THE DAM													
2													
RE THE DAM													
3													
RE THE DAM													
4													
RE THE DAM													
5													
RE THE DAM													

CROP 2 (NAME OF CROP)	SIZE (RAI)	YIELD (KG)	PERIOD	ARTIFICIAL FERTILISER		ORGANIC FERTILISER		PESTICIDES	
				COMPOSITION (N:P:K)	AMOUNT (KG/CROP SEASON)	TYPE (FARM MANURE, GREEN MANURE OR COMPOST)	AMOUNT (KG/CROP SEASON)	NAME	AMOUNT (LITER/CROP-SEASON)

CROP 2 (NAME OF CROP)	SIZE (RAI)	YIELD (KG)	PERIOD	ARTIFICIAL FERTILISER		ORGANIC FERTILISER		PESTICIDES	
				COMPOSITION (N:P:K)	AMOUNT (KG/CROP SEASON)	TYPE (FARM MANURE, GREEN MANURE OR COMPOST)	AMOUNT (KG/CROP SEASON)	NAME	AMOUNT (LITER/CROP-SEASON)

Water supply

What do you think about the Mae Tang Dam ?.....
.....

What are the good things of the Mae Tang Dam ? .....
.....

What are the bad things of the Mae Tang Dam ? .....
.....

Are there any problems with the water supply between the farmers ? .....
Explain.....
.....

Where there any problems before the Mae Tang Dam ?.....
-Explain.....
.....

Do you have any suggestions for making the water supply better ?.....
How.....
.....

Results of the soil and pesticide tests

	Texture	NH4+	NO3-	P2O5	K2O-	pH (testkit)	pH (elektrode)	EC	Insecticides
Mr Sherd, uphill field, mungbean									
top section	clay	low	very low	high	low	7,2	7,3	0,07	not detectable in plantmaterial, no beans
middle section	sandy loam	low	very low	very high	low	5,5	6,4	0,03	
bottom section	sandy loam	very low	very low	low	low	6	6,3	0,06	
Mr. See, upland field, mungbean									
	sandy loam	very low	very low	very high	low	5,5	5,6	0,03	detectable in the muangbeans, but not in the rest of the plantmaterial
Mr. See, lowland field, rice									
	silty clay	very low	very low	low	low	5,5	6	0,12	not detectable in grains or other plant material
Mr. Anan, lowland field, rice									
	clay loam	very low	very low	very low	low	6,3	6,9	0,06	not detectable in grains or other plant material
Mrs. Suriporn, lowland field (1 rai), rice									
	silty clay	very low (2nd test:very low)	very low (2nd test: very low)	very high (2nd test: low)	low (2nd test: low)	6,5	6,4	0,04	not detectable in grains or other plant material
Mrs. Suriporn, lowland field (4 rai), rice									
		very low	very low	very high	low	6	6,6	0,06	weakly detectable in both grains and other plant material
Mrs. Suriporn, uphill field, mungbean									
top section	SAND	low	very low	very high (?)	low	6,3	6,6	0,07	weakly detectable in plant material, no beans
middle section	clay loam	low	low	very high (?)	low	6,2	6,4	0,06	
bottom section	clay	low	low	very high	low	6,8	6,8	0,05	
Mrs. Suriporn, upland field, mungbean									
	sandy clay loam	very low	very low	low	low	5,5	6,4	0,03	not detectable in grains or other plant material

Mrs. Toiting, upland field, mungbean								
	clay	very low	very low	low	low	5,5	5,8	0,02 not detectable in the muangbeans, however detectable (but safe for life) in other plantmaterial
Mrs. Toiting, lowland field, rice								
	silty clay	very low	very low	low	low	6,3	7,2	0,06 not detectable in the grains, however detectable (but safe for life) in other plantmaterial
Mrs. Toiting, uphill field, mungbean								
top section	sandy loam	very low	very low	very high	low		6,6	0,02 not detectable in the plantmaterial, no beans
middle section	sandy clay loam	low	very low	very high	low		5,6	0,06
bottom section	clay	low	low	low	low		7,2	0,22

Calculation of input and output

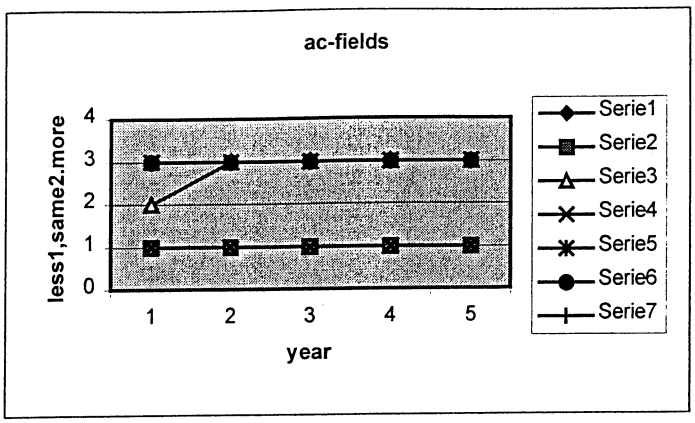
Input = amount of fertiliser applied × percentage of N × plant uptake + % fixation
Output = yield × protein content × nitrogen content in proteins

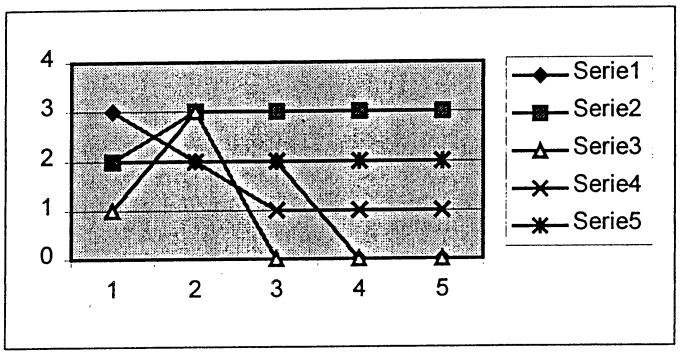
Plant uptake : 40 %
Protein content in different crops : soybean 40%, mungbean 23%, maize 9,5%
Nitrogen content in proteins : 16%
Fixation % : soybean 82,5% , mungbean 89,5%

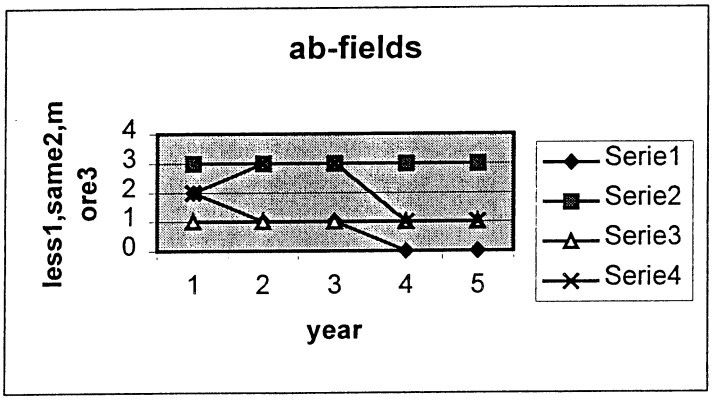
(Ahn, 1993)

Diagram with change in income over the last 5 years (basic year 1995) for farmers with different combinations of fields:

.







The change in income over time was not as expected. We had expected the patterns to similar in each group, because the farmers have the same combination of A,B and C fields. secondly we had expected the pattern to change upwards in the 1996, and remain higher than 1995 and 1994. This pattern is not confirmed and the reasons for this is given in income chapter.
(The x-axe is years ago, and the construction of the dam was finished at 3.)
The farmers were asked to compare their total household income to last year to the previous 5 years, and if it was the same as last year less or more. The diagrams is constructed by setting more=3, same=2 and less=1.
The year 1998 (2541) which is used as a base, was a year with low income due to drought, economic recession and rain storm which destroyed some of the harvest.

Amount of households with different cash income generating activities, relative to the total cash income:

Activity relative to total income/activity	]0-10]	]10-20]	]20-30]	]30-40]	]40-50]	]50-60]	]60-70]	]70-80]	]80-90]	]90-100]
Farming	2	2		2	3	1		2	1	
Forest		1				1				
Labour	2	3	1	2				1	1	1
Relatives					2		1	1		
Other	2					1	1			
Number of house-holds	6	6	1	4	5	3	2	4	2	1

The table shows from which sources the farmers total household income is coming from. The single sources contributions have been divided with the total household income.
It describes the relative importance of different sources, and if the sources are equally important or if one source is the most important.

The farmers have several sources of income, and there is no clear pattern in the importance of the different sources. The importance of farming as a source of income is not as expected. We had expected farming, in general, to be the most important source of income, and this is not confirmed.

All of the results is very imprecise because of; First the farmers had difficulties in estimating the total income per year, lot of them only knew per day or week, and the per year figure is made by asking the farmer how many days/weeks he though he did this income generation activity. (In cases where this haven't been done the amount per day is timed with 360, which properly is an over estimation. Similar with amount per month, the figure have been timed with 12). Other had difficulties with understanding the perception income per year.

A contract for contract farming (from household no. 26)

(Summary)

- The company give "good" seeds (both male and female).
- Cost 30 bath pr. kg for seeds.
- Company give fertiliser and pesticides at a "reasonable" price.
- Company give the bags for free.
- Give advice from an expert about how to grow, harvest, etc.
- The company buy the hole maize (not only the seeds) and not only the female maize.
- The maize has to pass a certain standard - the company only buy if it is "good" maize.
- Pay 8,5 bath pr. kg - no pay for bags and truck.
- Pay after 15 days after delivery.
- It is prohibited to sell maize that did not pass the standard to other persons and another places.
- Prohibited to grow another kind of maize closer that 200 meters from the fields with the contract maize.
- The farmer have to grow it an appropriate way, have to kill weeds, look after the area during the time where the maize are grown. This has to be done after the advice and supervision from the expert person from the company that comes around and look at the maize.
- Prohibited to sell seeds and fertiliser to another person.
- Have to follow all the advice from the company.
- Prohibited to put an other maize into the bags after the harvest.
- Have to pay themselves for the transport to the company collecting place.
- All the yield have to be delivered to the company on a certain day.
- The company only pay the profit - don't pay for the seeds, fertiliser etc.
- The contract are for a 6 month period.
- If disaster (floods etc) then the farmer have to pay for the seeds etc. to the company - what are not used can be giving back to the company.
- If the farmer do not treat the maize properly (according to the person from the company) then the contract is miss kept. Have to pay 3000 bath pr. kg. of the expected yield (decided by the company) => if this is not done then they can be taken to court.