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Social Ecology Working Paper 90

Local Material Flow Analysis in Social Context in Tat Hamlet, Northern Mountain Region, Vietnam

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ISSN 1726-3816

September 2006

Schandl, Heinz; Marieke Hobbes and Rene Kleijn (editors); 2006:
Local Material Flow Analysis in Social Context in Tat Hamlet, Northern Mountain Region, Vietnam.
Social Ecology Working Paper 90. Vienna.

Social Ecology Working Paper 90
Vienna, September 2006

ISSN 1726-3816

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Local Material Flow Analysis in Social Context in Tat Hamlet, Northern Mountain Region, Vietnam

Local level report of the project Southeast Asia in transition (SEAtrans)

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Preface

The present report presents a case study carried out by environmental scientists from Vietnam and the Netherlands. It focuses on Tat, a village in the uplands of the northern mountain region in Vietnam. The study took place within the scope of a research project called "Southeast Asia in transition" (SEAtrans) which was funded by the European Union.

The general objective of the project was to explore the sustainability aspects of the modernisation of Southeast Asian societies. The SEAtrans research project was carried out in four Southeast Asian countries, namely Thailand, Laos, Vietnam and the Philippines. A total of 10 research institutions participated, 6 from Southeast Asia and 4 from Europe, with IFF (Austria) as the lead partner. Country studies were conducted in the four Southeast Asian countries.

SEAtrans has been based on the insight that the sustainability of countries and regions is strongly connected with the flows of materials and energy ('society's metabolism'). These flows create pollution, for instance. And negative balances of material flows and energy flows in a society, obviously, cannot be sustained for ever.

In SEAtrans, part of the country studies focused on the flows of materials and energy on the national level. Another part of the research project concentrated on the material and energy flows on the level of the villages. These material and energy flows are connected with the major land use activities of farmers. A special feature of the village level studies has been that attention has been paid to the explanation of why farmers choose for these land use activities. We have used the Action-in-Context (AiC) framework for that purpose. It is on the basis of that explanatory understanding that we can draw up scenarios for the future and effective policy recommendations for sustainability.

The fieldwork concentrated in the period from August 2001 to December 2001. Several researchers of the institute of environmental sciences, Leiden University, the Netherlands (CML) worked together with researchers of the Centre for Natural Resources and Environmental Studies, Hanoi (CRES) in the research site that was selected for the local case study. This village of Tat in the northern uplands was selected mainly because of its diversity of land use types and sustainability problems.

The local studies resulted in three main reports, one on Material Flow Analysis (Stalpers, 2002), one on Energy Flow Analysis (Heezen, 2002) and one on Action-in-Context (adapted from Kooijman 2002). The present report consists of a compilation of two of these reports. Part I describes the Material Flow Analysis (MFA) and Part II the Action-in-Context (AiC) analysis.

Parts I and II interconnected in various ways. At the local level, all the material flows and material stock are measured through observations, measurements and interviews to determine the inflows, outflows and growth of the economic system in terms of mass according to the MFA methodology. Special attention has been paid to the environmentally problematic material flows that result from extraction of biomass by the villagers. The AiC explained the problematic material flows in their social context, by means of

analysing the decision-making process of the main actors that cause the flows in the MFA. Moreover, this decision-making is further contextualised by linking it to decisions of other actors such as traders and government agencies. This was the first time that MFA has been linked to a social scientific tool that allowed to develop future scenarios and policy recommendations. Hobbes et al (in review) elaborated on the connection between MFA and actor based explanatory research. Hobbes (2005) used the data of this report for comparing indicators that she developed on the basis of data gathered for an MFA concerning market incorporation, material productivity, material intensity, material incorporation and food security. The overview of revised data used for this paper are taken up in the references.

We would like to thank all people who made this research possible. First of all, appreciation goes to all the researchers that were involved in the local level SEAtrans research in Vietnam, who are also authors of the various chapters in the present report, namely Dr. Le Trong Cuc, Dr. Phan Thi Anh Dao, Le Thi Thu Thanh, Trinh Khanh Chi, Serge Stalpers, Patrick Heezen, Jiska Kooijman and Wouter de Groot. We are especially grateful to our to all our respondents in Tat hamlet for their hospitality and the valuable time they gave to us to co-operate with the research. Heinz Schandl and Clemens Grünbühel (IFF) we thank for inviting us as partner in the research project and for publishing this report.

Leiden,

The editors

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Acronyms

AiC	Action-In-Context. An actor-oriented research method used to investigate the social context of problematic activities (in Part II present report).
CML	Institute of Environmental Sciences, Leiden University.
CRES	Centre for Natural Resources and Environmental Studies, Vietnam National University, Hanoi.
DD	Deliberate Disposals. A material/energy flow from the social system to the Domestic Environment where the disposal has utility (the flow results in economic value or contributes to maintenance of society's stock) for the actor involved.
DE	Domestic Extraction. A material/energy flow from the Domestic Environment to the social system.
DMI	Direct Material Input. The sum of DE and Imports.
DMO	Direct Material Output. The sum of DD, WE and Exports.
EE	External Extraction. A subset of imports. A material/energy flow where an actor belonging to the social system under study extracts materials from a foreign territory outside the Domestic Environment and imports it directly to the social system under study.
EFA	Energy Flow Account/Analysis. The analysis of the energy throughput of a social system.
EXP	Export. An energy flow to another social system from the social system of interest.
HD	Heat Dissipation. This flow includes all the heat produced by the social system of interest and will flow to the surroundings
IF	Internal Flow. A material/energy flow within the social system.
IMP	Import. An energy flow from another social system to the social system of interest.
MFA	Material Flow Account/Analysis. The analysis of the materials throughput of a social system (in Part I present report).
NAS	Net Addition to Stock. The difference between the closing and the opening size of society's stock.
NTFP	Non-Timber Forest Products. All forest products other than timber.
SEAtrans	Southeast Asia in Transition.
VND	Vietnamese Dong (10,000 Vietnamese doings = 0.65 US dollars).
WE	Wastes and Emissions. A material/energy flow from the social system to the Domestic Environment where the disposal has no value for the actor involved.

Part I: Material Flow Analysis (MFA) in Tat Hamlet

Serge I. P. Stalpers, Trinh Khanh Chi, Phan Thi An Dao and Patrick Heezen

Abstract

The physical aspects of the environment of rural upland regions in Vietnam are poorly understood, which makes it difficult to evaluate policy options for socially and environmentally sustainable development in these regions. This study attempts to gain insight in the physical aspects of these regions through a Material Flow Analysis (MFA) case study of a village in Vietnam's Northern Mountain Region.

The MFA, which characterises the material metabolism of the village, has been compiled mainly through interview data. The MFA leads to a better understanding of the linkages between livelihood activities and material flows, which together with the Action-in-Context study carried out in the village gives insight in the effectiveness of possible policy options for sustainable development of rural upland communities such as promoting alternative sources of income.

The metabolism shows that the village is mostly a self-sufficient subsistence economy with almost ninety percent of the material needs being met through extraction of materials by the villagers. However, market integration is apparent in the MFA as ten percent of the material inputs are met through imports. The Direct Material Input (DMI), an indication of the material dependency of Tat, is 5.4 t/cap/yr.

There is evidence of unsustainable material flows in the high extraction of forest and swidden products, leading to resource depletion, deforestation, soil degradation and erosion. Half of the forest products are extracted from areas outside the village territory, testifying to overexploitation of the Domestic Environment. These flows are a large part of the metabolism of Tat hamlet, and they are important for the livelihoods of the people of Tat. The driving forces behind these unsustainable flows are population growth and market integration. The sizes of these flows are also influenced by the material connectivity with livestock and fishpond keeping.

Policy options for sustainable development focused on reducing these unsustainable flows need to consider the creation of alternative sources of income for Tat villagers. When considering policy options the material connections between these unsustainable flows and other parts of the society's metabolism, as well as the social context of the society's metabolism as explored in the Action-in-Context research in Tat hamlet (Part II) need to be taken into account.

1 Introduction

1.1 The local level MFA

This report is the local MFA study of Vietnam, comprising a case study of a hamlet in Vietnam's Northern Mountain Region. The fieldwork was carried out from August to December 2001 and the analysis until January 2003.

Objective and research questions

In Vietnam 32% of the population, or 24 million people, live in rural upland regions. However, the economic, social and environmental aspects of these regions are complex and poorly understood (Jamieson *et al*., 1998). The problem definition of this research is related to the environmental and resource use patterns of these regions: Although a large portion of the population in Vietnam lives in rural upland regions, the environmental aspects of these regions are poorly understood, making it difficult to formulate environmentally and socially sustainable policy.

A case study of a material flow analysis of a rural upland village in Vietnam can increase the understanding of these regions. Applying the MFA methodology to a village is the main objective of this research: The main objective of this study is to gain insight in material metabolism, i.e. the extraction, use and emissions of materials using a systems approach, and in the transition in this metabolism, of an upland rural community.

This research is of an interdisciplinary nature. The MFA explores the physical relation between people's actions and environmental impact. The Action-in-Context research (AiC) studies the social context of the people causing the flows in the MFA and how policy influences their actions. Together, the MFA and AiC make visible the relation between policy and environmental impact, so that an indication may be given of the environmental impact of policy on a local level. Although the linking of the local AiC and MFA is a part of the second phase of the SEAtrans project, this research should allow such linking, so the following secondary objectives are formulated:

- to allow the linking of the results with the Action-in-Context study carried out in the same village.
- to present the MFA data in such a way that it can be used for comparison with other local level case studies.
- to gain insight in the methodological and practical problems when doing an MFA on a local level.

The following lists the main *research questions*, which are derived from the main objective and secondary objectives:

i) How should the MFA theory be adapted to a local level?

ii) What methods can be used to collect data on a local level?

iii) What MFA indicators can be identified on a local level and what are their values?

iv) What are the main social and economic characteristics of the social system under study?

v) What is the material (metabolic) characterisation of the social system under study?
   a) Characterisation of the input side?
   b) Characterisation of the output side?
   c) Characterisation of the stock and net additions to stock?

vi) What is the quality of the data collected?

vii) What material flows are linked to income generating activities and in what amounts?

viii) What main unsustainable flows can be identified?

ix) What trends and transitions can be expected in the material metabolism of the social system under study?

Methods

To answer the research questions and achieve the main objective, the following research method is used. Literature on MFA methodology is reviewed. The MFA methodology is adapted for use on a local level. Socio-economic data and MFA data is collected in the village under study. Specific focus is given to flows related to soil degradation and deforestation because these are important environmental problems in the region of the hamlet in particular, and in Vietnam's Northern Mountain Region in general. An MFA database is constructed (Stalpers, 2002) where the data gathered in the field is entered and processed. The MFA database organises data in a systematic manner and links field observations with the flows and stocks in the MFA. The resulting MFA is analysed in detail, relating flow sizes to socio-economic data, activities and environmental effects.

1.2 Tat Hamlet

The community studied in this research is Tat Hamlet, one of ten hamlets of Tan Minh commune, in the north of Hoa Binh province. Tat Hamlet is situated about 140 kilometres west of Hanoi, in Vietnam's Northern Mountain Region. Almost all houses in the hamlet are situated along a 4-kilometer stretch of road, in a valley. A small river runs through the valley parallel to the road, along the banks wet rice paddy fields have been made on the flat areas of the valley floor. The mountain slopes along the sides of the valley are steep, often 45 to 60 degrees.

Figure 1: **Location of the research site.** The research site, Tat hamlet, is indicated on the map. © 1997 Magellan Geograpix, reprinted with permission from maps.com.

The inhabitants of Tat hamlet are of the Tay ethnic group, the largest minority group of Vietnam. They are largely an agricultural community, making a living from a combination of wet rice paddy fields and swidden (shifting) cultivation, together with keeping livestock and collecting products from the forest. Tat Hamlet is the administrative centre of Tan Minh commune. Since May 2001 electricity has become available, and in the last half of 2002 the dirt road has been asphalted.

The hamlet is an ongoing research site for the Agricultural University and the Centre for Natural Resources and Environmental Studies (CRES), both of the Vietnam National University in Hanoi. Agricultural, social, economic and cultural data on Tat is available through research prior to this case study.

2 MFA theory

Environmental science is the study of society-nature interactions and the potential problems in this interaction (Udo de Haes, 1994). From a systems perspective, human society can be understood as a part of the larger ecosystem. Material Flow Analysis considers the social system as embedded in the biogeosphere system, and looks at the society-nature interactions in terms of material flows between these two systems by accounting for the throughput of materials through the social system (Bringezu and Moriguchi, 2002). Taking the systems approach one step further, the concept of metabolism, which is used to characterise the throughput of material and energy through a living being, can be applied to a societal system (Schandl and Schulz, 2000). The Material and Energy Flow Analyses of a society give societal metabolism, the metabolic characterisation of a society (*ibid.*).

The underlying concept of the MFA is that every material flow between the societal and natural system is related to an environmental impact. Flows of materials from nature to society (for example mining and harvests) are directly related to environmental problems such as soil degradation, resource depletion and disturbance; flows from society back to nature are related to

environmental problems such as acidification, eco and human toxicity, disturbance, and global warming through emissions of greenhouse gases. The MFA measures these flows in terms of tons per year. In general the larger the flows are, the greater the environmental impact will be. But the quality of these flows is important, so the types of materials involved in the flows should also be considered.

As a systems approach the MFA considers the social system as a whole. There is no special focus on one single flow or environmental problem, rather each flow is seen in the context of the whole MFA, giving a holistic picture of the physical society-nature interaction.

2.1 System components and flow categories

In an MFA the social and natural system are divided into system components, and material flows are categorised according to the system component they originate from and flow to. The definition of the system components and flow categories used in this research are taken from the SEAtrans MFA toolkit (Schandl *et al.*, 2002).

2.1-1 System boundaries and stocks

The first step in a material flow analysis is the delineation of the social system under study. The shaded area with the dashed boundary in represents the boundary of the social system. This boundary defines what is part of the society under study and what is part of foreign societies.

The social system comprises of the human population, their livestock, and artefacts that require labour to be maintained (for example buildings, roads, household goods). All objects remaining longer than one year in the social system are part of society's stocks. For practical reasons agricultural plants are not included in society's stocks because of the complexity of material flows through living plants.

The second step in the MFA is to delineate the Domestic Environment (DE) of the social system. This is the geographical territory where the population lives on and which it exploits. The boundary of the Domestic Environment defines what is the local territory and what are foreign territories. The Domestic Environment includes built-up areas (roads, buildings), agricultural land, pastures, forests and water bodies. Agricultural plants are also considered a part of the Domestic Environment.

The MFA is defined over a specific time frame during which the flows are accounted for. Usually this is one year. The size of the stock can be measured at the beginning of this time frame (opening stock), or at the end (closing stock). In this research all stock sizes quoted are the values of the closing stock unless specifically stated otherwise.

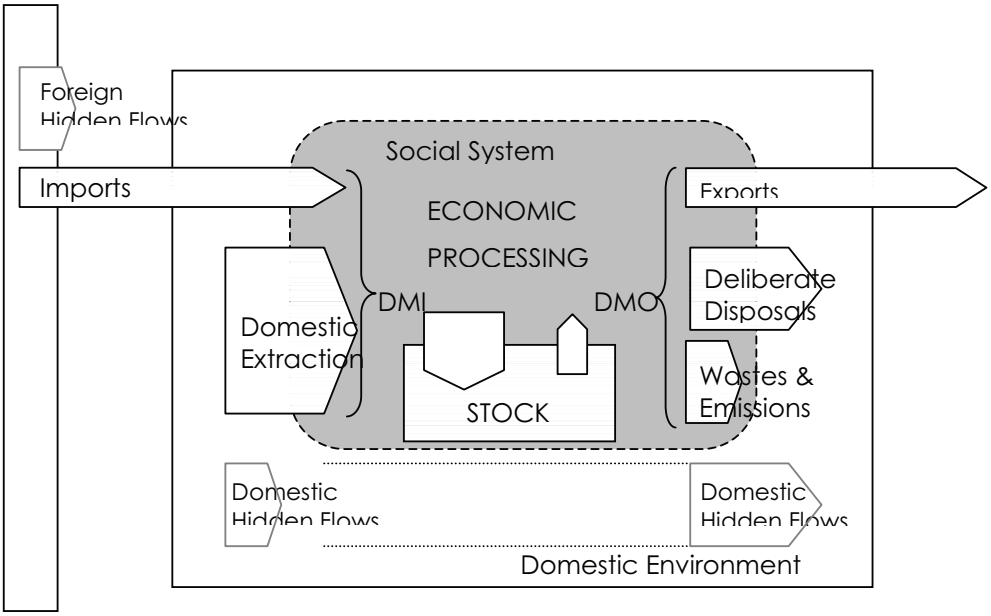

Figure 2: **Material Flow Analysis: System components and flow categories**. External Extraction is a subcategory of Imports, and is not drawn in this figure. Adapted from Matthews et al. (2000).

2.1-2 Flow categories and accounting rules

A material flow in the MFA is defined as a displacement of material where labour is involved. Natural flows such as rain-fed irrigation, i.e. where no labour is involved, are not accounted for. This is the labour-criteria for material flows. Materials flowing into the social system are called inputs. Inputs can originate in the Domestic Environment or in foreign territories. If a material flows from the Domestic Environment (for example harvests or mining products) the flow is called a Domestic Extraction (DE). If it comes from a foreign territory it is called an import. It will become apparent that in Tat Hamlet a significant portion of the imports are in fact materials that are extracted directly from the Domestic Environment of neighbouring hamlets by Tat villagers[1]. The flow category External Extraction (EE) is introduced to make a distinction between these flows and the import of goods via the market. External Extractions are not part of an economic transaction, the actor involved in the extraction process is a member of the social system being studied, and the origin of the flow is geographically near the Domestic

[1] This MFA study is location oriented, it defines the border of the Domestic Environment as a geographical border so that the EE is an Import. Another approach, discussed in Heezen (2003), is the actor oriented MFA in which the Domestic Environment is not geographically defined, in which case the EE is a Domestic Extraction.

Environment. Other imports are part of an economic transaction, the actor involved is not a member of the social system under study and the origin of the flow could be anywhere in the nation or even in the world.

Outputs from the social system can flow into a foreign territory, in which case the flow is categorised as an export, or to the Domestic Environment. Flows to the Domestic Environment are divided into two categories, Deliberate Disposals (DD) and Wastes and Emissions (WE). A Deliberate Disposal is a flow where the actor causing the flow disposes of the material with a sense of purpose, such as sowing seeds or fertilising plants. Wastes and Emissions are other flows to the Domestic Environment, such as throwing away trash and burning firewood.

Input	Domestic Extraction
	External Extraction
	Import
Internal Flow	Internal Flow
Output	Deliberate Disposal
	Export
	Wastes and Emissions

Table 1: **Flow types** in the MFA

If an object is exported and re-imported in unaltered form within the MFA time frame, it is not considered an export and import. On a local level this accounting rule is important to avoid accounting for the daily movements of persons across the village boundary when they visit another area. This rule does allow accounting for export of a raw material that is processed and imported again as a final good.

Flows within the social system are Internal Flows. They include consuming meals, feeding of livestock, building infrastructure and houses (after the extraction or import of materials has taken place) and transport of goods within the social system.

Another category of flows that have not been accounted for in this study is hidden flows. Hidden flows are related to Domestic Extraction, Wastes and Emissions or Deliberate Disposals, but do not enter the social system. Examples are overburden from mining and erosion in forests and of agricultural land. Accounting for these hidden flows gives a better picture of the environmental impact of the social system on domestic and foreign environments.

When taking a more detailed look at the materials comprising the MFA flows, they can be categorised into material groups. The first distinction is between water, air and materials. The category 'Water' is liquid water and water vapour[2], but not water contained in materials. The category 'Air' includes of

[2] In this local case study water vapour is included in the category 'water'. Often in national level MFA's water vapour is included in the category 'Air'.

combustion and respiration processes and gaseous components of the atmosphere[3]. The category 'Materials' is all other materials, including water and gasses contained in these materials. The category 'Materials' are further divided into raw materials and (semi-) final goods, and raw goods are divided into biomass, mineral materials and fossil materials (Schandl *et al.,* 2002). This categorisation leads to the material categories shown in table 2. For a subsistence community such as the focus of this case study, most materials are biomass so it is useful to further divide this category into material subcategories (see table 2). Forest products are categorised as wood (timber), mature bamboo and other non-timber forest products (including bamboo shoots). The subcategory 'Land products' includes all agricultural land products and by-products. The subcategory 'Livestock Products' are the eggs, meat, milk and leather of livestock, and animals are the livestock and other animals. The subcategory 'Humans' is the human population.

Material category	Material subcategory
Biomass	Wood
	Bamboo
	NTFP (non-timber forest products)
	Land products
	Livestock products
	Animals
	Humans
Minerals	Minerals
Fossil fuels	Fossil fuels
Final goods	Final goods
Water	Water
Air	Air

Table 2: **Material Categories** used in the analysis

2.2 Indicators

To allow comparison between different societies on an aggregated level, MFA total indicators have been defined. These indicators are calculated from size of the flow in the different flow categories. They give an indication of the resource use and environmental effects of the society.

Although water is important, 'free' water[4] is usually a large flow that drowns out the contributions of other materials to the MFA it is excluded from the indicators, rather it is reported separately. In national MFA's the material category 'Air' is also not included in indicator values. However, this local case study does not include the category 'Air' for lack of data on respiration and chemical conversions during combustion. Combustion processes are seen

[3] In this local case study no data is included on respiration and the chemical conversion in combustion processes, so the material category 'Air' is not used. Combusted materials are still considered part of the category 'Materials'.

[4] 'Free' water is water that is not part of another material; it includes both the liquid and vapor states of water.

here as an emission of materials (fuels and the smoke and ash fraction of wood and bamboo) to air[5].

All indicators can be expressed in per capita values to allow comparison between social systems.

2.2-1 Inputs

The Domestic Extraction is an indicator for the material dependency of the society met by the Domestic Environment and of the related environmental impact on the Domestic Environment.

The sum of the inputs is equal to the direct material input (DMI) indicator (Bringezu and Schütz, 2001; SEAtrans, 2000): DMI = Imports (including EE) + DE

The DMI measures the material input of the economy, and is an indicator for the material dependency of the society and of the total environmental impact of the society's inputs. The DMI does not take into account the hidden flows. A related indicator is DMI per GDP, which is an indication of the material intensity of an economy.

2.2-2 Outputs

On the outputs side the total of materials used by the society and returned to the Domestic Environment is called the domestic processed output (DPO) indicator: DPO = DD + WE

The DPO is an indicator for the environmental impact of the society's outputs on the Domestic Environment, excluding the impacts of hidden flows. The sum of all outputs, including exports is the direct material output (DMO) indicator: DMO = DPO + Exports

The DMO is an indicator for the total environmental impact of the society's outputs since exports eventually become Wastes and Emissions in other societies.

2.2-3 Others

The net additions to stock (NAS) measures the net physical growth of the society. The law of conservation of mass implies that the MFA must be balanced in mass. This means that the NAS should be equal to the inputs minus the outputs (ibid.): NAS = DMI – DMO

The domestic material consumption (DMC) measures the material consumption of a society, what the society "uses up" in a year. It is an indicator of the proportion of the material dependency for own use, and is equal to the DMI minus exports (Bringezu & Schütz, 2001): DMC = DMI – Exports

The physical trade balance (PTB) is equal to exports minus imports; it measures the physical trade surplus or deficit of the society (ibid.): PTB = Exports – Imports

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[5] Combustion processes in this case study are therefore included in the indicator 'wastes and emissions' and care should be taken when comparing the results with national level studies.

3 Data collection and processing methods

This chapter describes the methods used for collecting the data in the field and for processing the data using the MFA database. The research plan for making this MFA of Tat hamlet comprises of the following steps:

- Determine the MFA time frame.
- Delineate the boundaries of the social system and the Domestic Environment.
- Make an inventory of the main flows and stocks in Tat hamlet.
- Gather general socio-economic data of the village.
- Gather data on the sizes of flows and stocks.
- Gather data on conversion factors.
- Process all the data using the MFA database.

3.1 Data collection methods

There are six methods used to collect MFA and socio-economic data in the field:

- Initial survey
- Household questionnaire
- Semi-structured interviews
- Unstructured interviews
- Direct measurements and observations
- Estimates
- Furthermore, literature (general and specific on research carried out in Tat hamlet) is an extra source of data used in this research.

Each of these methods is described in the following sections.

3.1-1 Initial survey

The initial household survey covers general data on the socio-economic and demographic makeup of Tat by asking every household in the hamlet about its members, land use, assets and sources of income. The initial survey also serves to introduce the researchers to the local people. The survey provides a list of households and houses that serves as a basis for the sampling for the household questionnaire and for the measurements of the houses. Appendix D contains the question list for the initial survey.

A household is defined in this research as a group of people living together in a house that share meals and household chores. If a household has more houses and the household members use both houses, it is considered as belonging to one household; if household members tend to keep to one house it is considered as two separate households.

In two teams of two or three people the researchers visit each house in Tat. While visiting the households a map of Tat is sketched locating all houses. If the household members are absent the researchers come back another time or get the information from their neighbours.

3.1-2 Household questionnaire

The household questionnaire is used to gather data from 30 households chosen from the list of households made during the initial household survey in a random manner.

This questionnaire focuses on the main flows and stocks related to household activities. Categories include personal data, flows related to farming, livestock, hunting, forest use, other sources of income, construction of the house, household artefacts, and energy use.

Respondents are asked to estimate the sizes of household related flows. Often respondents quote flow sizes in units other than weight, such as the number of baskets of produce, the number of palm leaves or the dimensions of bamboo poles collected. These values are recorded using the units quoted by the respondents and in the database these values are converted into mass using conversion factors. Most household activities are organised along a gender division of labour, and Ireson and Ireson (1996) show that knowledge is also gender-dependent. Where possible the questions are asked to a male or female member of the household, depending on which gender is more knowledgeable on the subject.

The household questionnaire is the most important data source for the MFA, since most flows in a rural community are related to household activities.

3.1-3 Semi-structured interviews

The semi-structured interviews are interviews where a predetermined set of questions needs to be answered, and use an interview guide. The semi-structured interviews focus on specific flows that need special attention, i.e. non-household flows (for example road construction, items sold in shops and items traded by middlemen) or those household-related flows that cannot be accurately measured using the household questionnaire (for example electricity use and weights of people).

Weight of Human Population
During the research period there was a free health examination for all the villagers, during which they were weighed. When returning from the examination respondents were asked what weight they were. This data list is coupled with the data from the Population Department to know the age of each person, resulted in a list of 71 persons of whom the age and weight is known. Although this sample was taken based on who the researchers happen to come across and as such is not strictly a-biased, the male-female ratio and average age of this sample does not differ from the whole population of the village[6] and therefore it is assumed this sample is representative.

Population and Education
An official from the population department of Tan Minh commune supplied a list of the age, sex, year of birth, education level, marital status and ethnicity of all the people living in Tat hamlet.

Electricity use
The administration of the electricity manager of Tat hamlet was copied to give information on the electricity use in Tat hamlet[7].

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[6] The percent women and men in the sample (n=71) are 50.7 and 49.3 percent and their average ages are 23.6 and 25.9 years, respectively. For the whole hamlet (n=466) this is 50 and 50 percent, and 24.5 and 24.7 years.

[7] The electricity use is not part of the MFA but is reported in the EFA of tat hamlet, see Heezen (2002).

Water use
The thirty households from the random sample taken for the Household Questionnaire were asked how much litres of water they used in a day, on average in a whole year, and for what purposes. Useful data was collected for twenty households.

Shops
The shops in Tat are small, most consisting of a few shelves of goods in the main room of the household and sales are done through the window. A few are special rooms or separate houses built for this purpose. Most shops sell finished foods, beverages, rice wine and small household goods. Some also sell fertilisers and farming tools.

To estimate the flows through a shop, the shopkeeper was interviewed. For each item sold in the shop the shopkeeper was asked how many usually were sold in a month, what the price was, and where they obtained the item. Each item was weighed using a scale.

Shop items consisting of materials that are an important part of the MFA, such as agricultural products, were categorised separately by specific material. Other items were categorised as 'Final Beverage Products', "Final Food Products", 'Food consisting of biomass (raw material)', 'Detergents', 'Other Consumables' and 'Other Durables'. Durable goods are items that are expected to stay in the system for longer than one year; hence they are accounted for as imports and Additions to Stock. Consumables are items that are expected to be used up or worn out within one year, hence they are accounted for imports and Wastes and Emissions.

Middlemen
The middlemen in Tat trade in non-timber forest products such as bamboo shoots and agricultural products such as cassava roots and Canna. Each middleman specialises in up to four products that he or she sells to a trader who visits the hamlet. The middlemen were asked which products they traded in, whom they bought it from (from inhabitants in Tat hamlet or from outside) and how much and to whom they sold the products.

Road construction
The engineer overseeing the road construction in Tat hamlet supplied a data on the amount of asphalt, gravel, stones and cement needed to build the road and the amount of firewood needed to boil the asphalt.

Conversion factors
If no samples of these items could be obtained to be measured directly, data conversion factors were gathered by asking key informants to estimate average masses of these items. These include the weights of a basket of different agricultural and forest products.

3.1-4 Unstructured interviews

Unstructured interviews are interviews where the data collected cannot be predetermined, so that the line of questioning develops during the interview. The hamlet leader, policeman and several farmers were asked what they perceived as being the boundary of their hamlet and what is the official administrative boundary. This data is used to determine the boundary of the Domestic Environment. Experienced farmers were interviewed about farming methods to identify key flows related to farming, and an experienced livestock

and fishpond keeper was asked about the flows related to keeping livestock and breeding fish.

3.1-5 Direct measurements and observations

Stock of Houses
Four categories of houses can be identified in Tat: cement houses; traditional Tay style wooden houses on stilts; Kinh style wooden houses built directly on the ground; and wooden houses built on a concrete foundation. For the wooden houses the dimensions of all 30 houses in the questionnaire sample were measured the dimensions of the house. Dimensions measured are the width, height and thickness of the walls; the width, length and thickness of the floor; and the dimensions of the stilts if the house has them. The data from the initial survey listing all the houses in Tat hamlet is used to extrapolate the data from this sample to the whole village. Four houses have been measured thoroughly to obtain conversion factors from house dimensions to the stock of each house (the weight in kilograms). These factors are the weight of the supports used for the wooden walls per square meter of wall area; the weight of the wood and bamboo supports used for the wooden floors and roofs per square meter of floor area; and the number and weight of palm thatch segments per square meter floor area. For one wooden house with a cement floor the inputs for the floor were obtained from the owner and are used to estimate the mass of the cement floors for the other houses. The four cement houses and one house on the ground were measured and processed separately.

Stock of other structures
The four concrete structures housing the public toilets, the 69 cement electricity poles and the electricity transformer have been accounted for by measuring the dimensions, calculating the volumes of each material and converting this to mass using conversion factors.

Household wastes
The wastes of selected households are measured by asking households to collect their wastes in a plastic bag for a period of several days and then weighing the different components of the wastes.

Food consumption and water use data
Food consumption and water use data is obtained by observing a five households through the course of one day and measuring the amount of water used and the weights of the ingredients prepared[8].

Conversions
The mass or densities of items for which conversion factors are needed are weighed directly using a mass balance. The water content of forest and agricultural products are also measured directly if it is possible to obtain a fresh and a sun-dried sample of the product.

[8] The data on food consumption for five households for a single day was deemed not representative for the whole village during the course of the whole year, because the seasonal variations and the variations between households is large. Therefore this data is not used in the MFA.

3.1-6 Estimates

For some conversion factors it was not possible to make a measurement to calculate the conversion during the research period and respondents could not give an estimate of the value of the conversion factor. If the conversion factor cannot be obtained through existing literature, the conversion factor is estimated by comparison with similar conversion factors.

The amount of fuel used in Tat has been estimated by estimating the number of times the motorcycle owners need to go to the regional markets of Tu Ly (25 km from Tat) and provincial market of Hoa Binh (45 km from Tat). Three groups of motorcyclists were identified: normal households, shop owners and a fresh vegetable and meat merchant, each frequenting the markets according to their needs.

3.1-7 Literature

Several studies have been carried out in Tat hamlet. These are Cuc and Rambo (1999), Duong (2001), Ireson and Ireson (1996), Jamieson et al. (1998) and Cuc and Rambo (2000). These publications provide background information on Tat hamlet from which the main flows and stocks may be identified, and in some instances they contain socio-economic data and data on flow sizes.

Preferably conversion factors such as mass conversions and water content are obtained from field measurements or accurate interview data. If these factors cannot be obtained in the field, factors quoted in literature and Internet resources are used.

3.2 Data groups: methods and sampling factors

The data collection methods described in the previous section are used to collect the data for the data group shown in table 3.

method / data group	initial survey	household questionnaire	semi-struct. interv.	unstruct. interv.	Obs. & measurements	Estimates	literature on Tat	general literature
Delineation of the social system and Domestic Environment				X	X			
Inventory of the main flows and stocks				X	X		X	
Main socio-economic data of village	X	X	X				X	
Flows and stock sizes	X	X	X		X	X	X	
Conversion, process and water content factors			X		X	X		X

Table 3. **Data collected and methods used**

3.2-1 Delineation of the boundaries and inventory of main flows and stocks

Through observations during walks through the hamlet territory, and through key informant interviews with the hamlet leader, local police representative, and several experienced farmers the boundaries of the social system and the Domestic Environment are determined. Interviews with key informants are also carried out to get detailed information on aspects of paddy and swidden agriculture and keeping livestock to gain insight in the flows related to these

activities. Together with observations these interviews are used to make an overview of the relevant flows in Tat hamlet. Publications of previous studies carried out by the Agricultural University and CRES in Tat are used to supplement this list.

3.2-2 Main socio-economic data

The socio-economic data used in this study are from the initial survey, the household questionnaire, semi-structured interviews and publications based on research previously carried out in Tat hamlet.

3.2-3 Data on flows and stocks

Table 4 gives an overview of each data source and the flows and stocks for which sizes are calculated using the data from that data source, and the related sampling factor. For samples based on households the list of 111 households from the initial survey is used[9]. For samples based on individual people, such as the weight of people, the population of Tat is of 466 is used as given by the population department. For the stock of houses the sample is based on the list of houses made during the initial survey.

Data source	Sampling Factor	Flows and Stocks
Household Questionnaire	3.83 (n=29 households)	Paddy and swidden fields inputs, production and product use
		Number of livestock, livestock feed and production, livestock sold, bought and deaths
		Animals hunted
		Collection and use of common Non-Timber Forest Products
		Input and production of handicrafts
		Firewood collection
		Bamboo collection for fire and construction
		Household artefacts: stock and additions to stock
		Lamp oil, batteries and candles used
Measurements of houses	3.88 (n=16 houses)	Wooden houses on ground: stock and additions to stock10
	7 (n=2)	Wooden houses with cement floor
	3 (n=11)	Wooden houses on stilts
	1 (n=4)	Cement houses
Measurements of other structures	4 (n=1)	Public toilets, cement (all 4 are identical)
	1 (n=1)	Transformer for electric power lines

[9] See related footnote.

[10] One house on ground is measured separately, and put in the MFA using a sampling factor of 1

Data source	Sampling Factor	Flows and Stocks
	69 (n=1)	Electric power line poles, cement (all are identical)
Other Measurement	93111	Household wastes
Interviews on water use	5.55 (n=20 households)	Household water use for cooking, washing dishes and drinking
	16.2 (n=6 pigs)	Water use for feeding pigs
	48.5 (n=2 pigs)	Water use for washing pigs
Interviews with shop owners	1.73 (n=11 shops)	Goods imported via shops12
Interviews with middlemen	1	NTFP's collected and exported via middlemen, that are not included in the household questionnaire.
Interview with engineer	n/a	Road and road ditch construction inputs and stock
Interview with electricity manager	n/a	Electricity use
Other interviews	6.55 (n=71 persons)	Weight of human population
(Duong 2001)	n/a	Logging of timber

Table 4: **Data sources and sampling factors used in calculating the Flows and Stocks of Tat Hamlet**. Although a data source may have more information on the flows and stocks than is listed, the most accurate data source is used to calculate the MFA data. The sampling factor used is followed by the number of items in the sample, n.

Limitations of the flow and stocks data

Due to time and resource constraints not all flows could be measured with equal accuracy. Water used for washing pigs is based on only two interviews. Household wastes has a large sampling factor reflecting the inaccuracy due to the small sample of 6 households measured and the additional error due to the expected seasonal variations in household wastes. No data has been collected on the gasoline for motorcycles, so this has been estimated. 13 shops were randomly sampled but due to time constraints only 11 were interviewed, this introduces an extra data uncertainty because of an unknown bias. Where possible data from the household questionnaire is used in preference to the data from the shop interviews. Because of the large heterogeneity in the types of products in which the middlemen trade, the data on the eight middlemen are not representative of all eighteen middlemen in the village. Data from the household questionnaire is used for the main agricultural and forest products, for less important items the available data from the interviews with middlemen is used without applying a sampling factor because they are not representative and represent relatively small flows.

Initial Survey

[11] Data was collected for 6 households for 6 to 8 days with an average of 7.25 days. The sampling factor is composed of a sampling factor of 18.5 to extrapolate from the 6 households measured to the whole population, and a sampling factor of 50.3 to extrapolate from the average of 7.25 days measured to the whole year, making the total sampling factor 931.

[12] Data on fertilisers, insecticides and herbicides imported through shops are also available from the household questionnaires so the household questionnaire data is used in the MFA because it is more accurate.

The data from the initial survey and the data of Population Department of the Tan Minh commune do not agree on the population size. In some cases when respondents considered two houses as belonging to the same household, according to the definition used in this research they are considered as belonging to separate households. In these cases respondents, when answering the question "how many people are there in your family", included the family members living in the other dwelling. This causes double counting of people in the initial survey.[13]

The data from the Population Department is used for demographics and flows related to the number of people. All other data collected was based on the household list from the initial survey, because the samples were also taken from this list.

3.2-4 Conversion, process and water content factors

There are several types of factors. One type is the conversion factor that converts from the units in which the size of flows and stocks are measured (e.g. volume) or the units in which respondents answer questions (e.g. bags of rice, baskets of produce or number of bamboo poles) to mass. Another type is process factors used to estimate the sizes of flows involved in a process (such as harvesting of land products, collecting wood) by converting the primary measured flow (such as rice harvested) to the associated flow (such as rice husk). The third type of factor is the water content of each (biomass) material.

Limitations of conversion factors: Livestock

The weights of livestock are estimated from data of a few respondents who knew the weights of their livestock, taking into account the age of the animal using the formula:

(Weight) = (Starting Weight) + (Growth Rate) x (Age).

See appendix C for these factors. These estimates should be refined to make the livestock flows and stocks more accurate.

[13] The initial survey includes 111 households and 485 people. According to the data from the Population Department there are 105 households and 466 people in Tat. Thus six households identified in this research are considered as part of another household in the Population Department statistics and in the view of the local people.

3.3 Data processing: the MFA database

All the data sources that provide information on the MFA flow and stock sizes and socio-economic data are included in the MFA database. The initial survey, household questionnaire and other interviews and measurements are represented in the MFA database by one or more tables.[14]

The advantage of using a database is that it keeps all the data in one environment, it is possible to trace the values of the final MFA indicators back to the raw data, the data is processed in a consistent manner, and a database allows the data to be analysed in different ways.

3.3-1 How data is recorded in the database

Fields	Flow data	Stock data
MaterialID	the material that is accounted for (what 'flows')	the material that is accounted for
Source	the source (the system component where it flows from)	The part of the system to which the stock belongs
Target	the target (the system component where it flows to)	Not used
Category	the category of the flow	The category of the stock
Size	the size of the flow, in units of kg/yr	the size of the stock, in units of kg
Conversion	If the flow size in kg/yr is not known: the size and units used to convert the data into kg/yr	If the stock size in kg is not known: the size and units used to convert the data into kg

Table 5: **Fields** used in the MFA database

Each record (interview question, observation or measurement) represents one or more flows or stocks. To account for these flows or stocks, each table contains several extra fields where flows and stocks can be recorded. A single flow is characterised by the six fields in the database as displayed in table 5.

The system components comprising the sources and targets of flows are shown in table 6; the flow types are listed in table 1. A list of material types and conversion factors is given in the appendix.

System components	
Atmosphere	Middleman from outside
Fishpond	Middleman in Tat
Forest	Outside markets/shops
Grasslands	Public structures
Ground (DE of stone, gravel, sand & soil, WE to)	Paddy fields
Home/tree gardens	Shop
Household	Storage of seeds etc. for next year
Household assets	Swidden fields
Houses	Water bodies
Human population	Other components inside Tat
Livestock	Other components outside Tat

[14] These data tables can be accessed in the database through the special MFA menu under the item 'Data'.

Table 6. **Components of the MFA of Tat hamlet**. This table shows the possible sources and targets of flows.

A stock is characterised by the material, the 'source' (interpreted as the object to which the stock data belongs to) and the category of the stock: Human Population, Livestock Population or Buildings and Artefacts. The same fields are used as for the flow, the size of the stock is given in kg if known, if not known an estimate is given.

3.3-2 Calculations

All the data is eventually grouped together into a single table, the 'Totals' table.[15] This allows analyses of all the flows in the village at once. A simple query applied to this table is enough to get a complete MFA of the village.

The totals of all the stocks and flows are calculated using a piece of program code[16]. The form 'Define Source Data Tables'[17] contains a list of the data tables (or queries) that are used in calculating the totals. In essence, the program takes each flow described in the source tables (the fields description, material, flow category, source, target, flow size, conversion) and adds it to the 'Totals' table. The 'Totals' table also includes a field that identifies the original data table from which the flow originates, and a field with a record number to identify from which record in the source table the flow is taken. This allows the tracing of a flow back to the original data.

3.3-3 Sampling factors

Some data is collected using sampling as listed in table 4. In these cases, the data must be multiplied by a sampling factor to extrapolate it for the whole population. Such a sampling factor can be given in the form "Define Source Data Tables". The program multiplies the original data by the sampling factor before putting the data into the 'Totals' table.

3.3-4 Estimates and Conversions

When the size of a flow needs to be estimated, a conversion factor is used. Each flow can be defined using a conversion identification number (specifying what is to be convert to kg) and the value to be converted. The program multiplies the value to be converted by the conversion factor and writes this in the 'Totals' table as the flow size.

Examples of conversions are baskets of cassava roots, a typical plastic chair, a cubic meter of timber. A complete list of conversions factors used and how they were obtained is given in the appendix.

3.3-5 Processes

The MFA contains flows that are part of processes. In some instances there is only primary data for one flow in the process. For example, for rice harvesting there is data on the number of kg rice harvested, but not on the amount of

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[15] The 'Totals' table can be accessed in the database using the special MFA menu, under 'Data', 'Totals table'.

[16] The code can be found in the module 'Calculate Totals' of the database. The MFA calculations can be carried out by clicking 'Totals', 'Calculate Totals' in the MFA menu.

[17] MFA menu: 'Totals', 'Source Data Tables'

straw harvested, the water evaporated when the rice was dried before weighing, and on the products: rice grain, bran, broken rice, and husk. In the MFA database a process can be defined related to each type of flow to calculate the flows associated with it[18].

The program selects a category of flows (for example, DE of rice) and adds the flows included in the process. It adds all of these flows together and uses this to calculate the sizes of the related flows. These related flows are added to the totals table.

When a process defines an associated flow (such as straw extracted with the rice), a new flow is created. When an existing material is modified, the material is recorded as a flow from the source to the processing, and the products are recorded as flows from the processing back to the original source. An overview of the processes used in the MFA database is given in the appendix.

3.3-6 Water and Energy Contents

Each material has its associated water and energy content. These values are defined in the table listing the materials[19]. The program multiplies the size of the flows (and stocks) with these values and places the resulting values in the Water and Energy fields of the totals table.

The values for the water contents are shown in appendix B; the values for energy contents are used for the local EFA of Tat hamlet in Heezen (2003).

3.4 Checking for errors

The DMI, DMO and NAS in the MFA should be balanced because by definition the NAS is equal to the difference in DMI and DMO. For national level MFA's this relation is usually used to calculate the NAS. Because for the local level MFA it is possible to measure the NAS directly, this relation can be used to check for errors in the database. For the local MFA of Tat, the socio-economic components of households, middlemen, and shops do not function as storage of materials for a period longer than the MFA time frame of 1 year. This allows a secondary, more detailed check for errors by making sure that the net flow through these three system segments is zero. The data in the database has been scrutinised and errors corrected until the balance difference in each segment is less than 1 percent per material category.

4 Results and discussion

This chapter presents the research results, starting with basic socio-economic data of Tat hamlet to characterise the Tat community. Then the scope and limits therein are set forth in section 4.2. In section 4.3 the main MFA results are presented and discussed. After this the details of the MFA flows are dealt with so the reader may put them into the perspective considering the main

[18] These processes can be viewed by selecting in the MFA menu: 'Conversions and Processes', 'Transformation Processes'.

[19] MFA menu: 'Conversions and Processes', 'Materials: water and energy contents'

MFA results and the socio-economic context of Tat. The results in this chapter are aggregates of the MFA data and selected details; for information on specific flows see the original data in the MFA database (Stalpers, 2002). Weight values in the results given in tons refer to weight in metric tons.

4.1 Basic Socio-Economic Data of Tat Hamlet

4.1.1 Demographics

Population

The data in Table 7 shows the population and number of households in 2001 compared with previous years. The population growth rate over the period 1998 to 2001 is 2.6 percent per year, 0.9 percent less than it was in the period 1996 to 1998. The average household size is also decreasing. These figures reflect the success of the family planning policy of Vietnam. According to the statistics from the Population Department of Tan Minh commune 86 percent of women between ages fifteen and 44 used some form of birth control.

Year	Population	Growth /yr	Households	Growth/yr	Avg. household size
1993	389		69		5.6
1996	402	1.1%	75	2.8%	5.4
1998 (August)	432	3.7%	91	10%	4.7
2001 (September)	466	2.6%	105 [20]	4.9%	4.4

Table 7: **Population and Household Trends**. The growth percentage is the average yearly growth rate over the stated years. Source of data from 1993-1998: Family Planning Clinic as reported in Cuc & Rambo (1999). Source of data from 2001: Population Department of Tan Minh commune.

Of the 29 people that were interviewed in the household questionnaire 90 percent were born in the hamlet. Only three of these families migrated to Tat, and none in the past year. In terms of material flows the current effects of migration are negligible.

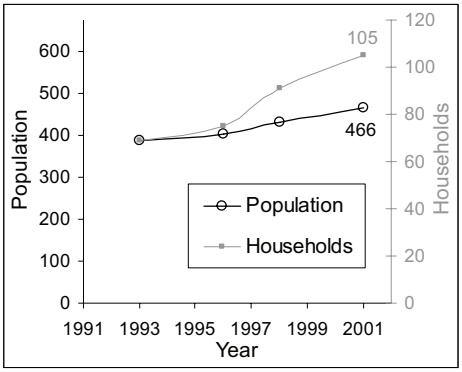

Figure 3: **Population and Household Trends**.

[20] These 105 households do not correspond to the 111 households from the Initial Survey because the definition of household used in this research differs from that used by the population department, see also section 0.

Household size

Households in Tat varies have between one and ten members, with a mean of 4.4 and mode of 4 members, as can be seen in figure 4. This indicates that most families are now having only two children in accordance with the Vietnam family planning program. This conclusion is supported by the data on the generational distribution data of the Household Survey, which shows that on average a household has 2.2 children; two children is the mode (35 households), followed by one and three children (both 26 households).

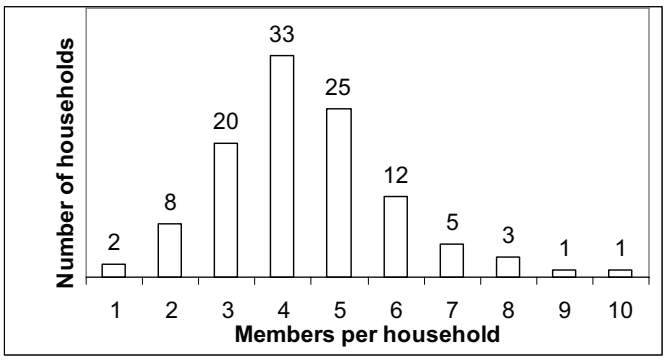

Figure 4: **Household distribution in Tat Hamlet**. Source: Household Survey[21].

Age Distribution

Figure 5 shows the age distribution in the hamlet. The age category zero to nine years has less persons than the category ten to nineteen years. This shows the effects of family planning in the hamlet. Half of the population is twenty years old or younger. The average age for women is 27.2 years and for men this is 27.1 years.

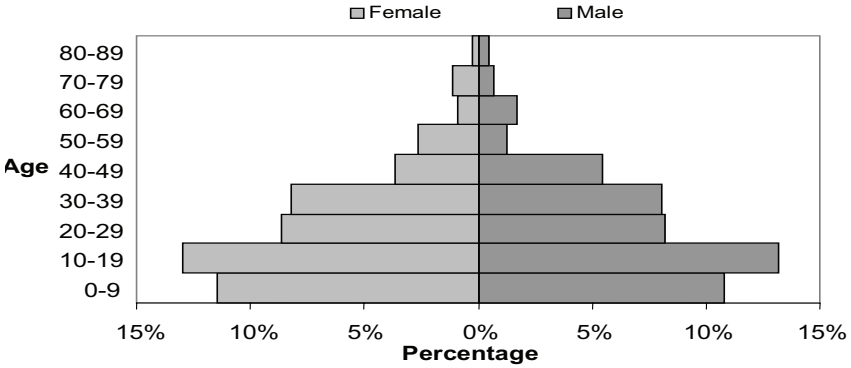

Figure 6: **Age distribution in Tat Hamlet.** Source: interview with officer of the Population Department of the Tan Minh commune. Of six people the age is unknown, this data represents 460 out of 466 people in the hamlet, or 98.7 percent

[21] Due to a different interpretation of the question 'how many people are there in your household' the data from the Household Survey do not correspond with the data from the population department; probably some people are seen as belonging to more households causing double counting. For population statistics the data from the population department is used but to get an idea of the household distribution the data from the Household Survey is used.

Ethnic make-up

Tat hamlet is essentially a Tay ethnic minority hamlet. Of the Tat hamlet population 95.9 percent (447 persons) is Tay. Nine persons are Muong, eight are Kinh (the largest ethnic group in Vietnam) and two persons are Dao.[22] The non-Tay persons are well integrated into the hamlet, there is a large amount of intermarriage between ethnic groups and all non-Tays belong to families that include Tay members.

4.1.2 Income

Income from Agricultural Land

The main source of income in Tat hamlet is farming, 89 percent of the households have an income from agricultural land. There are two types of agricultural land in Tat. On the paddy fields wet rice is grown on land kept inundated under a shallow layer of water. The paddy rice requires regular fertilising and spraying. Swidden fields are forest areas on the steep mountain slopes that are cleared for shifting cultivation, producing such crops as cassava, swidden rice and ginger. Although some fields are sprayed with insecticide, herbicides and rat poison, it is not possible to fertilise these fields because of the steep slopes. 59 percent of the households in Tat have both paddy and swidden fields, 26 percent of households have only paddy fields and five percent have only swidden fields (see table 8).

12 households (11 percent) have no agricultural fields at all. One decade ago land was redistributed among the households. The families with no land have migrated to the hamlet after the land redistribution (Hobbes *et al*., 2003). Of these twelve households, three are relatively well off, having large shops and no direct need to work on the land. The other eight households are (extremely) poor; one of these households is headed by a divorced woman who resorts to hard labour in order to survive.

	No swidden fields		Some swidden fields		**Total**
No paddy fields	12	11%	5	5%	**17**
Some paddy fields	29	26%	65	59%	**94**
Total	**41**		**70**		**111**

Table 8: **Agricultural Land Use in Tat hamlet**. This data includes all 111 households of the initial survey.
Source: Initial Survey.

Since the 1970's very little new rice paddy has been created in Tat. The lack of flat land with sufficient water access in the valley where Tat is situated prevents new paddy fields to be made, despite the increase in demand for paddy fields due to population increase since that time (Ireson and Ireson 1996). In 1998 Tat had 7.6 hectares of paddy fields according to Tan Minh village statistics.

There is an enormous diversity in the amount of swidden and paddy fields that each household uses. Of the households which have paddy or swidden fields, the Initial Survey[23] shows that the paddy areas range from 70 m^2 to

[22] Source: Population Department of Tan Minh commune.

[23] The initial survey data totals to 10.1 hectares of paddy fields in Tat hamlet. The official statistics report 7.6 hectares. This difference is in part explained by the underreporting since newly made paddy fields are not included in official statistics.

3300 m^2 with an average of 1160 m^2 and a standard deviation of 750 m^2. The swidden field areas vary from 100 m^2 to 5500 m^2, with an average of 1770 m^2 and a standard deviation of 1600 m^2. The large ranges and standard deviations in paddy and swidden field areas reflect the heterogeneity in land use between the households.

Before the land redistribution over ten years ago, land was managed by co-operatives. The redistribution of the size of paddy fields was done on the basis of household size. The Initial Survey shows no relation between paddy size and number of household members. This can be explained because in ten years time the sizes of the households have changed due to marriages, migration and natural births and deaths. Also, households have exchanged paddy fields and some households have built new paddies.

Timber and non-timber forest products

The people in Tat rely heavily on the selling of forest products for obtaining an income. An estimated 78 percent of the households participate in logging, of which almost all is for selling (Duong 2001). Of the 29 respondents interviewed using the Household Questionnaire 69 percent collected bamboo: 7 percent collected bamboo for own use, 14 percent for selling and 48 percent for both own use and selling. 86 percent of the households collected other non-timber forest products (NTFP's), 3 percent for own use, 21 percent for selling and 62 percent for both own use and selling.

Livestock

Buffalo are kept for their traction power and as meat storage. Cows are sometimes used for traction power as well, but are more valued for their meat and to breed and sell. Pigs are also kept for breeding and for their meat. They are either kept as free ranging animals that require little maintenance, or as pen-kept animals that need to be fed and cleaned but grow much faster. A few goats are kept for their meat and for breeding, but they are less common than pigs, cows and buffalo. Chickens and ducks are usually kept as free ranging animals but there have been some experiments in Tat with chicken farms. Dogs are often kept for guarding and hunting.

Animal	September 1998	August 2001	Change
Buffalo	50%	56%	6%
Cows	45%	51%	6%
Pigs	71%	47%	24%

Table 9. **Household ownership of livestock**. The data from 1998 is extrapolated from a random sample of 42 households of the total of 91 households at the time. The data from 2001 covers all 110 households. Source: 1998 data is from Cuc & Rambo (1999), 2001 data is from the initial survey.

Table 9 shows the household ownership of the most important livestock: buffalo, cows and pigs, and compares the 2001 figures with those of 1998. Currently, 80 households (72%) have cows or buffalo, with 18 percent of the households owning 52 percent of the cattle in Tat. 91 households (83%) have buffalo, cows or pigs.

Income from Services

38 households (34%) have a source of income from services (Initial Survey). Seven households participate in wage labour, varying from working in other people's fields or shops to working as a carpenter. 12 households have

government jobs, including jobs as teachers, nurses and village officials. Eight households have other sources of income, including running a bar with pool table, weaving baskets and getting money from helping researchers from the Hanoi Agricultural University.

Seventeen households (15%) run a shop. The shops in Tat sell food items, drinks, detergents, cigarettes, and sometimes clothes, spare bicycle parts and the like. Seventeen households (15%) are middlemen, buying non-timber forest products and agricultural products from villagers and selling these to traders. It is convenient to run a shop and be a middleman, so eight households (included in the 17 shops and 17 middlemen) combine these two activities.

Source of Income	% of households
Agricultural land	89%
Paddy fields	85%
Swidden fields	63%
Logging timber	78%
Collection of bamboo	69%
Collection of NTFP's	86%
Livestock (pigs, cows or buffalo)	83%
Services	34%

Table 10: **Income sources for households**. Source of data: For paddy and swidden fields and for the services the data is from the Initial Survey. For the logging of timber the data is quoted from Duong (2001). For collection of bamboo and NTFP's the data is from the Household Questionnaire.

Overview of incomes

Table 10 summarises the different sources of income for the households in Tat hamlet. All activities except services are done by a majority of households; there are few households that specialise in one activity and most households engage in a combination of activities. A minority of households engages in services.

4.1-3 Education

The literacy rate in Tat is 88.4 percent (Cuc & Rambo 2000). The data from the Population Department of Tan Minh Village shows that of the people in Tat over six years of age, 87.4 percent (278 out of 318 persons) have had least one year of formal education. For the 96 children between ages seven[24] and eighteen this is 97 percent. In general young people have had more years of education, with the age group of about fifteen to twenty-five having the highest education levels. Older people over twenty-five years of age had less chance during their youth to gain access to formal education. (Source of education data: population department of Tan Minh Village).

[24] Seven is chosen as the starting age because many parents keep their children at home until that age.

The three children older than six years who have had no education are all girls. But on average there is no difference between boys and girls: although between the ages seven and eighteen boys have had an average of 4.0 years of education and girls an average of 4.8 years, the girls in this group are on average 0.8 years older than boys.

4.1-4 Housing

The type of structures used for housing is of significance for the general social-economic characterisation of the hamlet because the size and style of the dwelling is an indication of the wealth of a family. Also the materials used for housing are of significance for the stocks and flows of the MFA. There are three types of houses distinguishable in Tat Hamlet: the traditional Tay style house which is a large wooden house built on approximately 2 meter high stilts with a palm thatch roof; the wooden Kinh style house with thatched roofing built directly on the ground, usually with stamped earth serving as the floor but sometimes with a cement or wooden floor; and the modern house with brick walls, cement floor and clay tiled roof. The houses on the ground are called Kinh style after the major ethnic group in Vietnam that live in such houses in the lowlands.

In Table 11 the house types and materials in Tat hamlet are shown for 1998 and 2001. In 1998 there were 91 houses, and in the intervening 3 years 30 new houses have been built bringing the total number of houses in 2001 up to 121. Note that some households have more than 1 house making the number of houses greater than the number of households. From the data in Table 11 it is apparent that most families live in wooden Kinh style houses with a dirt floor; almost all new houses built are of this type. The use of split bamboo woven into sheet segments in place of wooden planks as wall material is becoming more common. The decrease in brick walled houses from about 6 in 1998 to 4 in 2001 is probably in part a statistical error in the extrapolation of the 1998 data. In part it is a real decrease: one cement house in Tat was destroyed by it’s owner because it was facing the wrong direction, thereby upsetting his ancestors and bringing him bad luck.

	Dec. 1998 No. of houses (%)			Aug 2001 No. of houses (%)		Approximate Change[25]
House type	**Sample**	**Extrapolated**				
On stilts (Tay)	15	32.5	(35.7%)	33	(27%)	+ 0.5
On ground (Kinh)	25	54.2	(59.5%)	78	(64%)	+ 23.8
Cement (modern)	2	4.3	(4.8%)	4	(3%)	- 0.3
Unknown[26]				6	(5%)	
Floor						
Wooden planks	15	32.5	(36%)	35	(29%)	+ 2.5
Cement	7	15.2	(17%)	18	(15%)	+ 2.8
Dirt	20	43.3	(48%)	61	(50%)	+ 17.7
Unknown				7		
Wall						
Wooden planks	33	71.5	(79%)	80	(66%)	+ 8.5
Split Bamboo	6	13.0	(14%)	11	(9%)	+ 18.0
Wood and bamboo				20	(17%)	
Cement and Brick	3	6.5	(7%)	4	(3%)	- 2.5
Unknown				6		
Total	**42**	**91**		**121**		**+ 30.0**

Table 11: **Housing in Tat Hamlet**. The data from 1998 is extrapolated from a sample of 42 taken from the 91 houses that were in Tat at that time; for each category the original number in the sample, percentage, and the estimated extrapolation to 91 houses is shown. For 2001 the number of houses and percentages are shown. The difference between the number of houses in 2001 and in 1998 is given as an approximated change. Data source: 1998 data from Cuc & Rambo (1999), 2001 data from the household survey.

4.2 The scope of the MFA

The scope of the MFA is firstly determined by the delineation of the boundaries of the social system and Domestic Environment, and the time frame in which the flows are accounted for, and secondly by the flows and stocks accounted for.

4.2-1 MFA boundary and time frame

The selected time frame of the MFA is from October 2000 until September 2001. The boundary of the social system includes livestock, the human population their artefacts and buildings but not fishponds and agricultural plants.

Respondents indicated that what they perceived as belonging to the territory of the hamlet is identical to the official administrative boundary so the administrative geographical boundary is used to delineate the Domestic Environment. However, the community buildings in Tat hamlet (post office, tax office and medical centre) and their related flows have been excluded because this MFA focuses on Tat hamlet as a rural community and not on it's function as an administrative centre.

[25] The approximate change is the difference in the number of houses in 2001 not taking into account the missing data, and the number of estimated houses 1998 extrapolated from the sample of 42 houses. Therefore this change should not be considered as an exact quantity.

[26] Due to time constraints it was not possible to collect data for all houses.

4.2-2 List of flows and stocks in Tat Hamlet

The focus of the research, as agreed upon in the SEAtrans Vietnam Country Study Research Plan, is on soil quality degradation, deforestation, water use and human food intake. The main flows in the MFA are related to each of these issues, they are Domestic Extraction of agricultural harvests, Domestic Extraction of timber and non-timber forest products including bamboo and bamboo shoots, and Domestic Extraction of water.

Soil quality degradation is caused by intensive Domestic Extraction of agricultural harvests, especially from the swidden fields, and by erosion that is caused in turn by deforestation and by the use of swidden fields. Deforestation is caused by Domestic Extraction of timber and bamboo and also by extraction of bamboo shoots if the intensity of extraction exceeds the carrying capacity of the bamboo forests.

According to respondents and previous research in Tat (Cuc and Rambo, 1999; Ireson and Ireson, 1996), water is a problem in Tat in so far as water quality is affected by free ranging cattle polluting some water sources. There is ample water in Tat hamlet, the annual rainfall is 1840 mm/year (Vien, 1996). Water quantity is only a limiting factor in the building of new rice paddy fields. Although water quantity is a large component of the MFA in terms of flow size, it is not important in understanding unsustainability in the material metabolism of Tat hamlet.

Human food intake is directly related to Domestic Extraction of harvests and non-timber forest products, the Internal Flow of livestock products, and import of foodstuffs. Import of foodstuffs is in turn indirectly related to exports as people export goods (agricultural products, livestock, timber and non-timber forest products) to obtain cash to buy rice, meat and other foods.

Tables 12 and 13 give an overview of the flows and stocks in Tat which are relevant to the MFA. They are important either because the magnitude of the flow is large, they are related to an environmental problem, or because they are an important part of the local economy. This list has been compiled from observations and interviews and from existing literature of research carried out in Tat hamlet.

Flow category	Flow type	Material category	Description of flow
Input	Domestic Ex traction	Biomass	Paddy rice harvest
			Swidden harvest (rice, cassava, canna, ginger)
			Vegetables & fruits from home gardens, swidden fields, tree gardens
			Fish from fishponds
			Timber from forests and tree gardens
			Bamboo from forest and tree gardens
			Other non-timber forest products (bamboo shoots, broom grass, medicinal plants)
			Grazing of livestock
		Minerals	For construction and repair of buildings
			Local gravel and sand used for road construction
		Water	For household use
			For livestock washing and drinking

Flow category	Flow type	Material category	Description of flow
	External Ex-traction	Biomass	Timber, bamboo shoots and medicinal roots
	Imports	Biomass	Livestock products and other foodstuffs
			Live animals
			Seeds bought from outside
			Immigration
			Fresh foods sold in shops (meat, vegetables etc.)
		Final goods	Chemical fertilisers
			Motor bikes
			Tools
			Other goods sold in local shops (including processed foods)
			Durable household goods (TV, radio, etc.)
		Fossil mater.	Fuel (for transport, road construction, lighting)
		Minerals	Gravel, sand & stone for construction and repair of buildings
			Gravel, sand and asphalt for road construction
Internal Flows	Internal Flows	Biomass	Harvests (rice, cassava, canna, ginger, fruits etc.)
			Livestock products (meat, leather, eggs, manure)
			Natural population growth
			Natural livestock growth
			Feed for livestock
		Final goods	Goods bought in local shops
Output	De-liberate Dis-posals	Biomass	Seeds for paddy and swidden
			Natural fertilisers
			Feed for fishponds, small fish released in ponds
		Final goods	Chemical fertilisers, insecticides and herbicides
	Exports	Biomass	Timber
			Non-timber forest products
			Livestock products (meat, leather, eggs, milk)
			Live animals
			Emigration
			Harvests (rice, cassava, canna, ginger, fruits...)
		Final goods	Export of (broken) durables (TV, radio, motorbike, etc.)
	Wastes and Emis sions	Biomass	Human and livestock feces
			Incineration products from household fires
			Household and agricultural wastes burnt or dumped
		Final goods	Disposed durables (TV, radio, motorbike, etc.)

Flow category	Flow type	Material category	Description of flow
		Fossil mater.	Fuel combustion emissions
		Mixture	Household wastes burnt or dumped
		Water	Wastewater, water vapour from drying agricultural & forest products

Table 12: **Important material flows identified in Tat**. Source: own observations and interviews in Tat Hamlet (2001), Cuc and Rambo (1999) and Ireson and Ireson (1996).

Stock type	Material category	Description of stock
Artefacts and buildings	Biomass	Wooden furniture
		Wooden parts of houses, shelters
		Palm thatch roofing
	Final goods	Durable household goods (TV, radio, etc.)
		Motorbikes
		Transformer of electric grid
		Tools
		Water generators
	Minerals	Mineral component of houses and buildings
		Metal component of tools
		Asphalt, sand and gravel of road
Human Population	Biomass	Human population
Livestock	Biomass	Buffalo's, cows, pigs, goats, dogs, chickens, ducks

Table 13: **Important material stocks identified in Tat**. Source: own observations and interviews in Tat Hamlet (2001), Cuc & Rambo (1999) and Ireson & Ireson (1996).

4.2-3 Limits to the scope of material flows

Human and animal respiration and excretions

No calculations have been made to estimate the respiration and the production of manure and urine by livestock and humans for lack of conversion factors. These flows are not accounted for, except manure production of livestock when it is used as fertiliser. It should be easy to include these processes by multiplying estimation factors per capita or head of livestock with the number of persons and livestock in the hamlet.

Combustion and the 'air' material category

The intake of oxygen and emissions of carbon dioxide and water due to combustion processes has not been accounted for. For the data presented in this table the combusting material (wood, gasoline) has been emitted 'as is' into the air without accounting for chemical transformation. When conversion factors for these combustion processes are available these can be added to the database as a process.

The exclusion of oxygen intake and carbon dioxide output of respiration and combustion processes means that this MFA has no complete inputs and outputs for the material category 'air'. Since the local MFA considers

combustion emissions as an emission of 'materials', these are included in the material indicators[27].

Harvest by-products

When harvesting swidden rice the rice stalks are cut, bundled and set out to dry. When dried, the rice is removed from the straw using a thresher. When harvesting paddy rice the rice stalks are also bundled and carried to a thresher next to the field to remove the rice grains before drying. The straw carried with the rice is considered a Domestic Extraction because although the straw is unused in Tat but thrown away, it is a process based harvest residue: labour is involved when removing the straw from the field and the straw enters a process (drying and threshing) so it enters the material economy[28].

Other harvest by-products can be removed directly on the field (field-based harvest residues) and do not enter a process so they are only considered a Domestic Extraction if they are physically taken from the field used, such as cassava leaves which serves as livestock feed.

Grazing and scavenging of livestock

For lack of conversion factors the grazing of cattle has not been accounted for. The buffalo and cows in Tat hamlet graze for on the grass plains on the mountain slopes. They are fed when they return to their owners once every two weeks, and for a few days each year when they are used for plowing fields or pulling logs. This extra feeding is accounted for in the MFA. The scavenging of free ranging pigs is not accounted for; the feed for penned pigs is included.

Water

The material flows of biomass are measured in terms of actual weights including the water contained in the materials. Water vapour and 'free' liquid water (water not contained in materials) is accounted for but conform MFA convention these are not included when calculating the values of MFA indicators.

The rainwater which feeds the swidden fields do not constitute a material flow since no labour is involved. Strictly speaking irrigation water for the paddy fields and fishponds should be included in the MFA because although the transportation occurs by gravity, the man-made irrigation system requires labour input for maintenance. The paddy fields in Tat are connected with each other via irrigation holes in the paddy bunds so that rainwater from the mountains flows through the paddy fields. The fishponds are also watered using rainwater from the mountain which is directed through bamboo or PVC pipes and ditches to the ponds. For practical purposes these water flows are not included in the MFA since measuring this flow is very difficult and since water availability is not a problem in Tat hamlet. The water extractions accounted for are household water use and water for washing pigs, however

[27] When comparing total material indicators of the local and national level, this difference in accounting methods must be taken into account, i.e. applying the methods of the national level to the local level results in lower emissions of materials than reported in this document.

[28] This method corresponds to the national level study: process based residues are considered a Domestic Extraction and field based residues are a hidden flow.

these data of 'free' water flows is a rough estimate based on a small sample (see table 4).

Fishponds

About eighty percent of households in Tat have a fishpond. For practical reasons the fishponds are not considered as a part of society's stock but a part of the Domestic Environment because similar to accounting for the flows through plant roots, it is difficult to account for the flows between fish and their aquatic environment. Since the fishponds belong to the Domestic Environment, fish feed and young fish put into the fishpond are considered Deliberate Disposals and harvesting of adult fish is considered a Domestic Extraction[29].

Foodstuffs

Due to time constraints no data has been collected on agricultural food products that households buy directly at the market. The research focused on foodstuffs that households produce themselves and buy via the local shops; these flows have been accounted for. An agricultural products balance for the households reveals that 76 tons per year more agricultural products are used than households produce or buy in the local shops. The flow of foodstuffs through households is balanced by an import of 76 tons of unspecified 'generic' foodstuffs from the market, but this is not a good estimate of the actual import of foodstuffs[30].

Road construction

The road construction is a one-time event which happens to have occurred during the MFA time frame, so it is not representative of the social metabolism of Tat hamlet and therefore all related flows are not included in the aggregate indicators. For demonstrating the effect of the road construction, the material flows and addition to stock of the stones and asphalt used and the cement (mortar and sand) and rocks used for building the rainwater ditch next to the road are reported, as is the firewood burnt for melting the asphalt. Other flows associated with road construction and not accounted for are the fuel used by the trucks, earth movers and steam rollers, the old car tires burnt for melting the asphalt, and the earth moved for constructing the road.[31] The MFA also does not include the migration of road workers and the additional imports of goods sold by the local shops to the road workers.

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[29] For the national MFA's in the SEAtrans project the fishponds are considered a part of society's stock, this must be taken into account when comparing the national and local level.

[30] The purpose of this correction is to get the flows through the households balanced. Estimating the actual import of foodstuffs in this manner is unreliable, because agricultural products balance does not include human excretions and human food consumption. The food consumption of 5 households was observed for one day. These observations served to get an impression of the nutritional quality of the diet and are not representative for the food intake flow size of the whole hamlet for a whole year.

[31] Earth moved for road construction is a hidden flow; no hidden flows are accounted for in this study.

4.2-4 Limits to the scope of material stocks

Bamboo pipes and fencing

The bamboo pipes for irrigation and bamboo and wooden fences of gardens, paddy and swidden fields have not been included because they constitute a small part of the biomass stock in comparison with the houses, and they are difficult to estimate.

Paddy fields and fishponds

Although they require regular maintenance and therefore formally are considered a part of society's stock, the paddy and fishpond bunds (the earth walls which keep the water contained), the irrigation canals and dams have not been included in the MFA due to the difficulty in estimating the amount of earth involved. The soil used to repair them has also not been included as material flows in the MFA.

4.3 Aggregate values of flows and stocks

All values of flows and stocks in the MFA presented in this paper are calculated using the MFA database. The calculations in the database are carried out using exact values to avoid propagation of rounding errors. When the results are presented the values are rounded off to two significant digits to reflect the accuracy of the data[32]. The values of stocks reported in this document refer to the closing stock on September 2001 unless stated otherwise.

An overview of the inputs and outputs of the MFA in Tat hamlet, including 'free' water, is shown in figure 6. External Extraction (EE) is accounted for as part of the imports in this figure. The construction of the road is a one-time event and not very important in terms of understanding the material metabolism of Tat hamlet; the data is presented here to show the impact of the road construction. For the remaining results in this paper the flows related to road construction are left out, unless stated otherwise. On the inputs side of the MFA the DE is 4300 tons per year, or 9.2 tons per capita per year. Of this amount, 2600 tons per year is extraction of 'free' water, 1700 tons per year (fresh weight, 3.6 t/cap/yr) of non-water materials are domestically extracted. The imports are 820 tons per year (1.8 t/cap/yr) but a large part of this import (560 t/yr or 1.2 t/cap/yr) is External Extraction, only 250 tons per year (0.5 t/cap/yr) is actually imported via economic transactions from other regions.

[32] The figures in the tables in this chapter may not add up exactly to the totals shown in the tables because the totaled values were calculated using exact numbers.

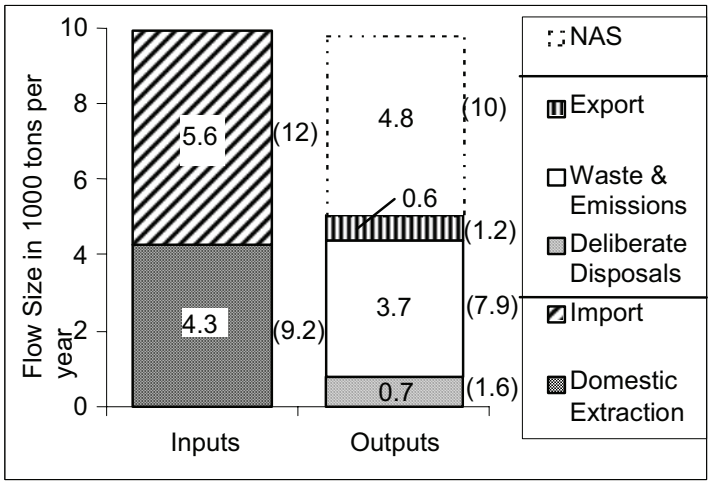

Figure 7: **Inputs, outputs and NAS of the MFA of Tat hamlet**. Flows are given as fresh weights, in thousands of tons per year. The values in brackets are the sizes of the flows per capita, in tons per capita per year. Imports include External Extraction. NAS is the measured net additions to stock. This data includes fresh water use. Source: MFA database, compilation of different data sources.

Most of the outputs are Wastes and Emissions. 'Free' water not contained in another material is the largest contributor to the Wastes and Emissions with a total contribution of 3230 tons per year; 2600 tons of extracted water is thrown away each year and another 630 tons per year of water evaporates from biomass containing water. This leaves only 390 tons per year (fresh weight, 0.83 t/cap/yr) of materials being wasted to water and land and emitted to air. The other outputs are Deliberate Disposals (740 tons per year, 1.6 t/cap/yr) and exports (580 tons per year, 1.2 t/cap/yr).

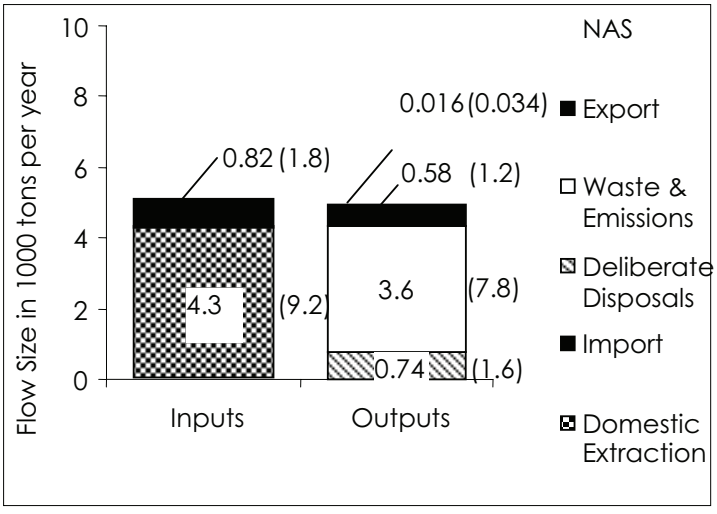

Figure 8: **Inputs, outputs and NAS of the MFA of Tat hamlet, without flows related to road construction**. Flows are given as fresh weights, in thousands of tons per year. The values in brackets are the sizes of the flows per capita, in tons per capita per year. Imports include External Extraction. NAS is the measured net additions to stock. This data includes fresh water use. Source: MFA database, compilation of different data sources.

4.3-1 Indicators

Aggregate indicators characterise the social system in terms of the sizes of different material flow types. To allow comparison of Tat with other social systems studied in the SEAtrans project, values are quoted in tons per capita per year. Table 14 shows the aggregates of flows for each flow type, with and without 'free' water. From the values excluding 'free' water the aggregate indicators may be calculated. The significant digits in the table do not represent the accuracy of the data, but they are used in the calculations to avoid carrying through rounding errors in successive calculations.

Input Indicators

The Direct Material Input (DMI) is equal to the sum of the material flows on the input side. For Tat this is 5.4 tons per capita per year. The ratio between the imports and extraction (domestic and external) components of the DMI says how much of the direct material requirement is met through the market. This gives an indication of the market dependency of a society. As stated above, a part of the imports is actually External Extractions. The total extraction (domestic and external) is 4.8 tons per capita per year, accounting for 90 percent of the DMI. Only 10 percent of goods come into the Tat Hamlet social system via the market[33]. The large role of extraction in the material metabolism is typical for a subsistence community like Tat: most of the resources used in the local economy come directly from the surrounding environment.

	Including 'free' water, t/yr (t/cap.yr)		Excluding 'free' water, t/yr (t/cap.yr)	
Domestic Extraction	4,285	(9.2)	1,689	(3.6)
Imports	818	(1.8)	818	(1.8)
of which External Extraction	563	(1.2)	563	(1.2)
Wastes and Emissions	3,617	(7.8)	386	(0.83)
Deliberate Disposals	743	(1.6)	743	(1.6)
Exports	581	(1.2)	581	(1.2)
NAS	16	(0.034)	16	(0.034)

Table 14: **Aggregates of flows and stocks for Tat Hamle**t. The values exclude the flows associated with road construction. Data is shown including and excluding 'free' water (liquid water or water vapour). 2596 tons of water was extracted (DE) and subsequently thrown away (WE) and 635 tons of water evaporated (WE) through drying and burning of materials. Source: MFA database, compilation of different data sources.

The ratio of the External Extraction (EE) to the DMI says how much of the direct material requirement cannot be met using the Domestic Environment (and imports) and needs to be extracted outside the Domestic Environment. For Tat hamlet this is 22 percent, which is a large amount considering that in Tat, extracted goods must be carried by hand or using animal labour; External Extraction means people have to carry their goods further than if they extracted it in the Domestic Environment, and people also risk territorial disputes with neighbouring villages. Assuming people prefer to meet their material requirements locally, and considering that all of the materials

[33] The data on imports of foodstuffs is incomplete so that the actual imports will be slightly more than 10 percent of the DMI.

externally extracted are indigenous to the Domestic Environment, the large ratio of EE to DMI indicates that the Domestic Environment is overexploited.

Output Indicators

The Direct Processed Output (DPO) of Tat Hamlet is 2.4 tons per capita per year. The Direct Material Output (DMO, i.e. the DPO plus exports) is 3.7 tons per capita per year.

Stock Indicators

The Net Additions to Stock (NAS) is 16 tons per year, or 0.034 tons per capita per year. To give this indicator for the physical growth of the society more meaning, the rate of growth of the stock is calculated. The size of society's stock in Tat Hamlet is 1600 tons (3.3 tons per capita), so the rate of growth is 1.0 percent per year. The population growth rate in Tat is 2.6 percent per year. The seemingly low growth rate of the society's stocks as compared to population growth is explained by the fact that the four cement houses and the cement electricity poles are 1150 tons (77%) of the stock, but no new cement structures have been built in this year. Since there are only four cement houses, new construction of a cement house is an event that does not happen very often, and by chance did not happen during the MFA time frame. Leaving cement houses and cement electricity poles out of the calculation results in a stock growth rate of 4.0 percent per year, which is more representative of the metabolism of the hamlet. At this rate the stock will double every 18 years.

Including the road construction the NAS is 4800 tons per year giving a stock growth rate of 320 percent over 2001. As stated before the road construction is a one-time event, but this figure shows the impact of road construction on the MFA.

Other Indicators

The Direct Material Consumption (DMC) of Tat is 4.1 tons per capita per year. The Physical Trade Balance (PTB) shows a deficit of 320 tons per year, or 0.69 tons per capita per year. In terms of mass, Tat Hamlet exports more products than it imports. In fact, the total weight of exports is 2.3 times as much as the weight of imports. In part this is because the economic value per kilogram of the goods exported (raw forest and agricultural products) are less than the economic value per kilogram of the goods imported (final goods). Another important factor playing a role here is the transportation costs for the goods being imported and exported. As a mountain village, the transportation costs to and from the regional markets are high, making imports expensive and the price at which exports can be sold low. This effect plays a role in most village economies in Vietnam's mountain regions (Jamieson *et al.,* 1998). A third factor playing a role here is that Tat villagers mainly derive their cash income from exports of material goods, and this cash is used not only for purchasing imported material goods, but also for services such as school, electricity and taxes.

Summary of indicators

Indicator	Value, t/yr (t/cap.yr) or %		Indicative of
Input Indicators			
DE:Domestic Extraction	1.700	(3.6)	The material dependency of the society met by the Domestic Environment, the environmental impact of the society's inputs on the Domestic Environment.
DMI:Direct Material Input	2.500	(5.4)	The material dependency of the society, the total direct environmental impact of the society's inputs
Ratio Imports to DMI[34]	10%		The market dependency of the society, the material needs met through foreign societies
Ratio External to total Extraction	22%		Resource depletion in the Domestic Environment
Output Indicators			
DPO:Direct Processed Output	1.100	(2.4)	The direct environmental impact of the society's outputs on the Domestic Environment[35]
DMO:Direct Material Output	1.700	(3.6)	The total direct environmental impact of the society's outputs
Others			
NAS:Net Additions to Stock	16	(0.034)	The net physical growth of the society
Ratio NAS to Stock	1.0%		The rate of physical growth of the society
DMC: Direct Material Consumption	1.900	(4.1)	The material consumption of a society
PTB:Physical Trade Balance[34]	-320	(-0.69)	The physical trade surplus of the society

Table 15: **Summary of MFA indicators and values in Tat Hamlet**. The values of indicators are in tons per year, or if the indicator is a ratio between two values it is stated as a percentage. Values in brackets are in tons per capita per year. The indicators are calculated excluding 'free' water. Source: MFA database, compilation of different data sources.

Balancing of the MFA

According to the law of conservation of mass, the Net Additions to Stock must equal the Direct Material Input minus the Direct Material Output, corrected for the evaporation of water contained in materials: NAS = DMI – DMO – water evaporated.

In drying and combustion processes 635 tons of water contained in materials evaporated (source: MFA database). The corrected DMI – DMO is equal to 165 tons per year (0.35 t/cap.yr). The NAS, which was calculated directly based on observations and interviews, was calculated at 16 tons per year (0.034 t/cap.yr). The difference between the calculated and observed NAS is about 149 tons per year, or 6 percent of the DMI. This difference is attributable to the accuracy of the data and due to missing data.

[34] The value of Imports for this indicator excludes External Extraction

[35] Excluding the impacts of hidden flows

4.3-2 The inputs side

The aggregated values presented in the previous paragraphs do not by themselves give sufficient insight into the societal metabolism of Tat hamlet. More detailed information on the composition of the flows per material type is needed. Figure 8 shows the quality of the input side of the MFA of Tat hamlet using the material groups as given in table 2. Water accounts for 52 percent of the input side. The remaining 48 percent of the input side constitutes the DMI, which is made up of biomass (47% of DMI), final goods (1.0% of DMI) and a small amount of fossil fuels (0.1% of DMI). The large contribution of biomass and small contribution of final goods is typical for a subsistence economy.

Water

Of the 30 households interviewed on water use, 60 percent use water from a stream, carrying it from the stream or transporting it via a bamboo or PVC water pipes directly to the home. 40 percent carry water from the public water tanks. Informants say that bathing, washing clothes and cleaning vegetables are done in stream or directly at the public water tank; the quantity of water used for these purposes has not been measured. Water for making wine is included separately in the MFA.

Useful data on the quantity of water used was collected for 20 households. The ratio of water use from the stream and public tanks is the same for the 30 households in the household questionnaire (which is a random sample) so it may be assumed that the water use data on these 20 households is representative for the whole village.

The 20 households together use 696 litres of water on average each day, or 254,000 l/yr. Using a sampling factor of 5.55 (20 households in the sample, 111 households in the hamlet) an estimated 1,400,000 litres of water is used for cooking, drinking and washing dishes each year.

Taking care of white pigs, which are kept in a cage, is an important water flow: one respondent says washing her 2 pigs takes about 60 litres of water per day. Another respondent has been observed to use 10 litres per day to feed her 6 pigs. This comes to a total of 32 litres per pen-kept pig per day. There are about 97 white pen-kept pigs in Tat[36], so the total water use for all pigs is an estimated 1.100.000 litres per year.

[36] There are 136 pigs in Tat (Source: Initial survey), of which about 71% are cage-kept white pigs (Source: Household Questionnaire) so there are an estimated 97 pen-kept pigs.

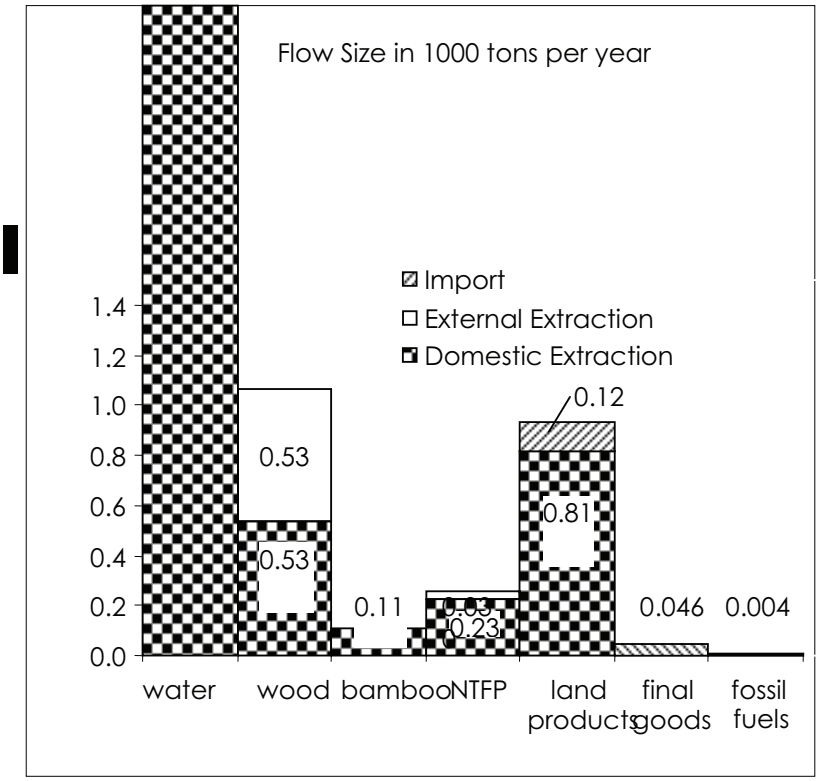

Figure 9: **The Inputs Side of the MFA of Tat hamlet**. Excludes flows related to road construction. Flows are given as fresh weights, in thousands of tons per year. External Extraction is taken separately from Imports. Source: MFA database, compilation of different data sources.

Wood

The largest component of the DMI is wood at 1060 tons per year. This consists of 530 tons of firewood and 530 tons of wood for construction per year. Smaller trees and branches used as firewood are still abundant in Tat and are collected in the Domestic Environment; the firewood constitutes a Domestic Extraction.

For construction of houses large, straight trees are needed. According to several key informants only a few of these trees remain in the Domestic Environment of Tat Hamlet. Almost all of the timber for construction, about 520 tons per year, is logged by Tat villagers in neighbouring hamlets and is accounted for as External Extraction, as can be seen in figure 9. The remaining 10 tons of construction timber is smaller timber used for making furniture, which can be found within the Domestic Environment. The EE/DMI indicator for wood, which indicates the amount of overexploitation, is equal to 50 percent.

Bamboo

Bamboo is also still readily available in Tat Hamlet although villagers are worried whether this will remain the case in the future because of the overexploitation of bamboo and bamboo shoots (Hobbes *et al.,* 2003). Of the 112 tons per year of bamboo collected, 95 tons are used as fuel for cooking and 17 tons per year are used for construction.

Non-timber forest products

Other Non-Timber Forest Products (NTFP) collected are palm leaves, broom grass, bamboo shoots, green manure, and plant roots. Palm leaves are used for roofing of houses, shelters and sheds, and amount to 120 tons per year of fresh palm leaves collected. Palm trees are sufficiently available in Tat hamlet, and many families plant palm trees in forest gardens in the hills. Broom grass is a weed (*Thysanolaena maxima*) that can be made into brooms. 65 tons per year are collected.

Each year 60 tons of bamboo shoots are collected. Bamboo shoots are an important source of food in Tat, and are known as a delicacy in Vietnam. Half of the bamboo shoots collected (30 t/yr) are of a large variety that can be sold at the market. This large variety is not available anymore in Tat hamlet and is externally extracted. The EE/DMI indicator for bamboo shoots, which indicates the amount of overexploitation, is equal to 50 percent.

Green manure is a combination of leaves, grass and cattle manure collected on the hillsides that is used as fertiliser for paddy fields and fishponds. 9.1 tons per year of green manure is collected. It is hard work to carry the green manure to the fields and fishponds, and in Tat villagers use it only if they do not own enough cattle themselves to use the manure of, and cannot afford chemical fertilisers.

Plant roots are used for medicinal purposes and for eating. Roots collected include a variety called 'Cu Li' which is edible, of which 2.3 tons per year are collected, and medicinal roots, of which 0.90 tons per year are collected. 'Cu Li' is available in the Domestic Environment of Tat hamlet, but half the medicinal roots are collected in forests outside of the Domestic Environment and constitute an External Extraction.

Land products

After water and wood, land products form the third largest component of the DMI at 930 tons per year. The 120 tons per year of land products imported are food imports[37]. Land products imported include rice, vegetables, fruits and livestock feed. 810 tons per year of land products are produced locally in the paddy and swidden fields, home gardens and fishponds. Table 16~~Table 16~~ lists the sizes of the Domestic Extractions of the main land products. Important cash crops are cassava, canna and ginger roots. Canna ('*Dot*') is a root that is exported to factories to make canna noodles. Rice, corn, vegetables and fruits are grown mostly for own use. Cassava stems are harvested to be re-planted during the next harvest. Cassava leaves constitute 34 percent of the Domestic Extraction of land products, they are used with grass, banana stems and leaves, forest leaves, and water vegetable ('*Taro*') as livestock and fish feed. The material connectivity of land products explored by Hobbes *et al.* (2003) are visible in the Domestic Extraction and uses of agricultural by-products, especially for cassava plants and banana trees.

[37] No data has been collected on foodstuffs which households buy directly at an outside market and import themselves; this figure is based on a food balance of households (see 0) and as such is not accurate.

Product	Main Product (t/yr fresh)	By-products (t/yr fresh)			Total (t/yr fresh)
		Leaves	Stem	Straw	
Cassava root	47	277	49		373
Grass	116				116
Rice (with husk, dry)	97			9.5	107
Banana	2.3	12	41		55
Water vegetable	54				54
Canna root	41	1.8			43
Potato	5.3	15			21
Ginger root	5.7				5.7
Fruit	2.7				2.7
Corn	2.0				2.0
Sugar cane	1.2				1.2
Other	34				34
Total	**408**	**All by-products: 405**			**813**

Table 16: **Domestic Extraction of main land products in Tat Hamlet**. By-products are those products that are actually removed from the field and thus constitute a Domestic Extraction. Source: MFA database, compilation of different data sources.

The imports of land products are shown in table 17. Land products are either imported through shops or by the households themselves buying goods at a market. Households import cotton to weave clothes, and corn and rice seeds themselves. Foodstuffs[38], fruits and vegetables are bought at local shops for consumption. Fish feed and potatoes (for planting) are land inputs that are bought at shops. The 14 t/yr of rice grain are imported by the shopkeepers to produce rice wine, which is then sold.

Product (t/yr fresh wt.)	household	shop	total
Cotton	0.01	-	0.01
Fish feed	-	0.62	0.62
Foods (non-processed)	-	3.1	3.1
Fruits	-	0.15	0.15
Rice grain (dry)	-	14	14
Seed: corn	0.02	-	0.02
Seed: potato	-	0.08	0.08
Seeds: rice (with husk, dry)	1.4	-	1.4
Seeds: other	0.16	-	0.16
Vegetables	-	16	16
Known food imports	5	-	5
Balancing term (dry)	76	-	76
Total	**83**	**34**	**117**

Table 17. **Import of land products in Tat hamlet**. Source: MFA database, compilation of different data sources.

The data on import of foodstuffs by households themselves is incomplete. The known data is shown as 'known food imports'. Analysis of the land products

[38] This table includes only non-processed foodstuffs which can be considered belonging to the material category 'biomass'. Processed foods are considered final goods.

flowing through households indeed shows that this flow is not balanced: more land products leave the households each year than they produce or import. See appendix E for the calculations.

Livestock products

Meat and eggs are imported by the shopkeepers and sold in the shops[39]. In total, 2.6 tons of meat and 0.49 tons of eggs is imported each year (Source: interview with shopkeepers).

Final goods

Final goods that are imported amount to 46 tons per year (0.10 t/cap.yr). Table 18 gives a specification of the import of final goods. Chemical fertilisers include 7.3 t/yr of phosphate fertiliser, 1.6 t/yr of nitrogen fertiliser, 1.2 t/yr of potassium fertiliser and 0.3 t/yr of phosphorus fertiliser. Imported salt is mainly used as lick-salt for the cattle. Minerals are not imported in pure form, but as a component of a final good (such as an iron tool) and are categorised as such.

Item	Import	
	(t/yr)	(kg/cap.yr)
Beverages	17	37
Synthetic fertiliser	11	23
Foods	6.1	13
Salt	5.0	11
Detergent	2.2	4.7
Motorcycle	1.9	4.1
Electrical appliance	0.44	0.94
Battery	0.43	0.92
Tools	0.37	0.79
Bicycle	0.18	0.39
Insecticide	0.036	0.076
Herbicide	0.016	0.035
Rat poison	0.0014	0.0030
Other	1.7	3.7
Total	**46**	**100**

Table 18: **Imports of final goods**. Source: MFA database, compilation of different data sources.

Fossil fuels

Fossil fuels account for an import of 4 tons per year. This is fuel for motorbikes (2.9 t/yr), petroleum for lighting (0.87 t/yr), lamp oil (0.37 t/yr) and lubricant oils (0.19 t/yr).
Of the fuel used for motorbikes 0.9 t/yr is bought by households through local shops and households import an estimated 2 t/yr themselves. The data for fuel import through shops is calculated from interviews with shop owners. The amount of fuel households import themselves is based on an estimate of the total fuel consumption of 2.9 tons per year, as follows. In total there are 31 motorcycles in Tat. They are mainly used for buying goods at the nearby market of Tu Ly (distance 25 kilometres) and the larger district market of Hoa Binh (distance 45 kilometres). One man goes to the Tu Ly market every day to by fresh vegetables and meat to sell in Tat. It is estimated that the 17

[39] It is not known whether, and if so how much meat and eggs are bought buy people directly at outside markets bypassing the shops.

shop owners need to get supplies at the Hoa Binh market every week, and the other 13 normal households go to the Tu Ly market every week. In total an estimated 2530 kilometres is travelled every week, or 130 thousand per year. The fuel consumption of a motorcycle depends on the type of motorcycle and ranges from 2 to 4 litres per 100 kilometres; an average of 3 litres per 100 kilometres is used for this estimate (Heezen, 2003). This is 3900 litres per year, or 2.9 tons of fuel (the specific gravity of gasoline is 0.74 ton/m3 (Schandl *et al.*, 2002)).

4.3-3 The outputs side

The characterisation of the output side of the MFA per material group is shown in Figure 9. The output side excluding water constitutes the Direct Material Output (DMO). The values of biomass materials on the output side can not be directly compared with the values of the input side because they include the water contents of the products as they cross the system boundaries, and for some products evaporation during the time they entered and left the system alters the weight of the product. Products that are dried while in the social system include rice, timber, bamboo shoots and palm leaves.

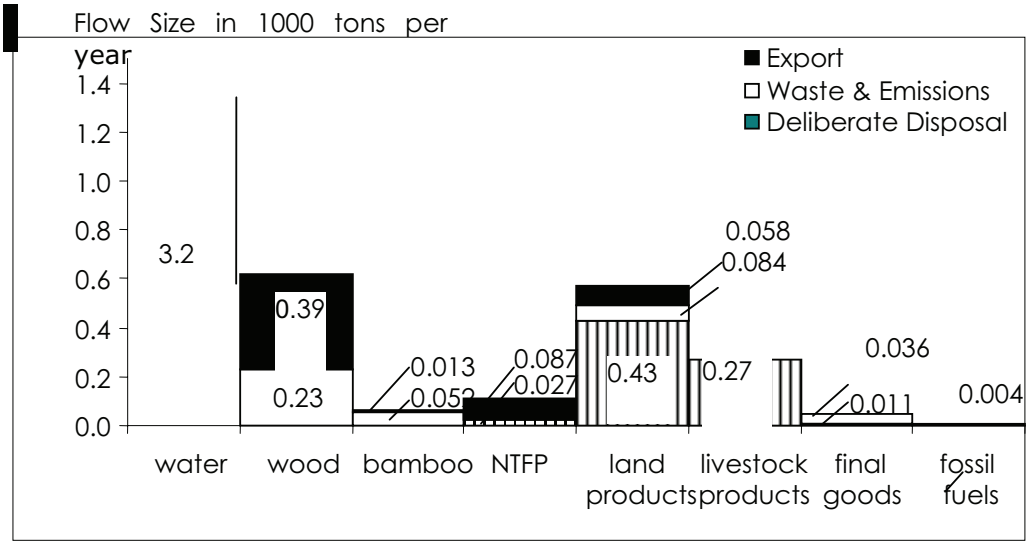

Figure 10: **The Outputs Side of the MFA of Tat hamlet**. Excludes flows related to road construction. Flows are given as fresh weights, in thousands of tons per year. External Extraction is taken separately from Imports. The scale is the same as in Figure 8. Source: MFA database, compilation of different data sources.

Water

Water forms the largest category of outputs at about 3200 tons per year. About 2600 tons of water is extracted and thrown away each year, and another 630 tons per year of water has evaporated from biomass containing water.

Wood and Bamboo

Wastes and Emissions of wood (230 t/yr) and bamboo (52 t/yr) represent combustion processes when these are used as cooking fuel. The exported bamboo (13 t/yr) is used for construction. No bamboo and wood is exported to be used as cooking fuel; all the exported wood (390 t/yr) is timber for

construction, which is significant because all this construction timber must be externally extracted.

Non-timber forest products

Export of the NTFP's includes bamboo shoots (34 t/yr), palm leaves (34 t/yr), broom grass (15 t/yr) and 'Cu Li' (2.0 t/yr). Deliberate Disposal of NTFP's are palm leaves and broom grass that are used as fish feed (6.6 and 12 tons per year, respectively), and green manure (9 t/yr) which is used as fertiliser on paddy fields.

Land products

Deliberate Disposals of the 430 tons per year of land products are mainly cassava leaves (270 t/yr), grass (46 t/yr) and rice bran (30 t/yr) which are used as fish feed, and cassava stems (49 t/yr) which are sown on the fields. The wastes of land products are household biomass wastes and food leftovers (49 t/yr[40]), and rice straw that is thrown away after harvesting (9.4 t/yr). The exports of land products are shown in table 19.

Product	Amount Exported (t/yr fresh wt.)
Cassava Root	22.0
Vegetable, fruit	18.0
Banana	0.6
Canna Root	36.0
Ginger Root	5.2
Total	**84**

Table 19: **Export of main land products grown in Tat Hamlet**. Source: Household questionnaire, based on a sample of 29 households.

Livestock products

The Deliberate Disposal of livestock products shown in figure 9 is almost wholly manure (270 t/yr) which is used on paddy fields and home gardens as fertilizer and thrown in the fish ponds as fish feed.

Final goods

The Deliberate Disposal of final goods (11 tons per year) constitutes the use of the synthetic fertilisers, insecticides, herbicides and rat poison which have also been imported. Wastes and Emissions of final goods (36 tons per year) are the use of non-durable or disposable final goods imported through the shops such as detergents, batteries, candles and salt. Also rice wine produced locally and plastic household wastes are included in this category.

Fossil fuels

The Wastes and Emissions of fossil fuels are the combustion of motorcycle gasoline, lamp oil and petroleum for lighting.

[40] The estimate of household wastes is based on a small sample size of only 6 households and is not very accurate, see section0.

Wastes and Emissions

Material group	Air (t/yr)	Ground and water (t/yr market wt.)
Wood	217.0	12.0
Bamboo	51.0	1.3
NTFP		1.0
Land products		58.0
Livestock products		1.0
Animals		4.6
Final goods	0.6	36.0
Fossil fuels	4.2	
Total	**273**	**113**

Table 20: **Emissions to Air and Wastes to Ground and Water Bodies**. The table excludes Wastes and Emissions of 'free' water (liquid water and water vapour). The Wastes and Emissions to air of wood and bamboo are the non-ash components of the wood and bamboo that are emitted as smoke and gasses, the remaining ash is thrown away as waste to the ground. Source: MFA database, compilation of different data sources.

That gives an overview of all Wastes and Emissions, subdivided between emissions to air (combustion processes) and wastes to ground and water. For many materials it is not known if they are thrown away on land or into water bodies such as ponds and streams, so this data is grouped together.

Waste and emission of 'free' water is not included in the table. 630 tons per year of water is evaporated from the system and emitted to air, and 2.500 tons per year is wasted to water.

4.3-4 Society's Stock

At 75 percent the road is the largest part of the society's closing stock as shown in figure 10. The building of the road has increased the stock fourfold. Excluding road construction gives figure 12.

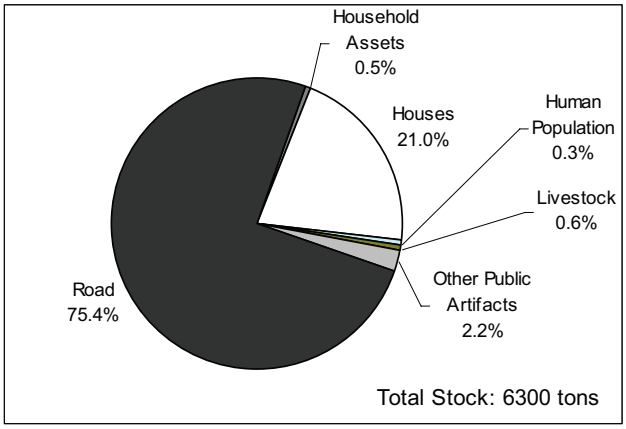

Figure 11: **Society's stocks of Tat Hamlet, including the road**. This is the closing stock, on September 2001. Source: MFA database, compilation of different data sources.

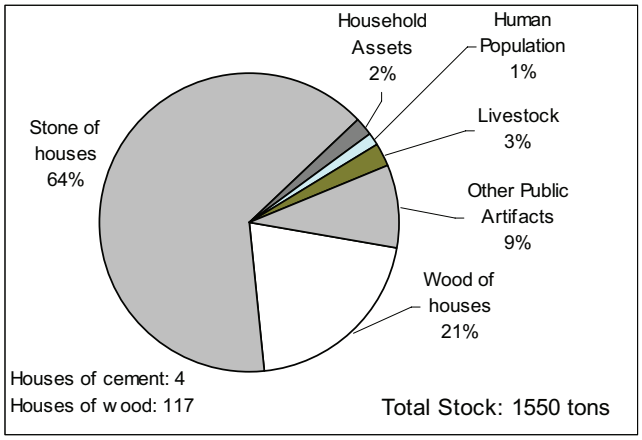

Figure 12: **Society's stocks of Tat Hamlet, excluding the road**. This is the closing stock, on September 2001. Source: MFA database, compilation of different data sources.

Public Artefacts

The 'Other Public Artefacts' in the figure represent the cement electricity poles in the hamlet, and together with the cement houses constitute the mineral part of the stock.

Livestock

Livestock, human population and household assets account for only a small part of the stock. The weights of livestock was calculated based on the number of animals and their age as reported in the household questionnaire, and converted to weights using approximate conversion factors obtained from estimates by knowledgeable farmers.

The resulting stock is shown in table 21. The initial survey also contains data on the number of buffalo, cows and pigs but it is more consistent to use the data from the household questionnaire because this questionnaire includes data on livestock age, buying and selling, deaths and births, feed and products.

Animal	Closing stock	
	Head	Total weight (t)
Buffalo	107	30
Cow	138	7.6
Pig	214	1.6
Chicken	1600	0.19
Dog	46	0.15
Goat	8	0.23
Duck	65	0.02
Total		**40**

Table 21: **Livestock in Tat**. This is the closing stock (September 2001). Source: Household Questionnaire, based on a survey of 29 households.

The initial survey data counts 113 buffalo, 148 cows and 136 pigs. Considering the sampling error in the household survey the values for buffalo and cows are reasonable. For pigs the difference between the household questionnaire data and the initial survey cannot be attributed to a sampling error. The discrepancy of about 80 pigs can be attributed to pigs having been

born or bought between the time the initial survey took place and when the household questionnaire took place, about one month later. In that month, about 7 pigs in the household survey were bought, 27 were born, and 2 were sold. There is no data on the date of deaths, but 23 died in the whole MFA year, which gives an average of about 2 pigs per month. This leads to an estimated net increase of 30 pigs in the time between the initial survey took place and the household questionnaire was taken; extrapolating to the whole village (using the sampling factor 3.83) gives about 115 more pigs in that month, closing the discrepancy.

Household assets

Table 22 shows the household artefacts in Tat. In terms of mass, most of the household assets are wooden furniture, which is usually made by hand using locally available wood. Electrical appliances include radio's, VCR's, DVD players, electric fans and televisions.

Item	number		total weight (t)
	sample	total	
Bicycle	20	77	0.92
Electrical appliances	60	230	1.88
Furniture glass & wood	3	11	0.23
Furniture mixed	75	287	0.48
Furniture wood	119	456	22.8
Motorcycle	9	34	3.45
Tool	166	636	2.27
water generator	8	31	0.31
Total			**32**

Table 22: **Household artefacts**. The number in the sample of 29 households in the household questionnaire is given, and the total when extrapolated to the whole village. Source: Household Questionnaire, based on a survey of 29 households.

Table contains some household assets which where included in the initial survey. These are compared with data from 1998, which gives an idea of the yearly growth rate in these items. Many motorbikes have been purchased. With the coming of electricity in the village people have invested in electrical appliances such as televisions, video cassette players and fans. Before March 2001 there was no electricity and often households had miniature hydroelectric generators as a source of electricity. Many households already had battery-operated radios and the advent of electricity did not increase this amount.

Asset	September 1998	August 2001	growth/yr
Motorbike	9	30	51%
Television	30	42	11%
Video cassette player		12	
Fan	20	46	33%
Radio	30	30	0%
Audio cassette player	22	27	8%

Table 23: **Household artefacts from initial survey**. The data from 1998 is extrapolated from a random sample of 42 households of the total of 91 households at the time. The data from 2001 covers all 110 households. Source: 1998 data is from Cuc & Rambo (1999), 2001 data is from the initial survey.

Human Population

The weight of human population was calculated based on the data given by 71 respondents during the semi-structured interview on human weights. The total weight of the 71 people in the sample is 2798 kg. There are 466 people in the hamlet, so the total human population weighs 18.4 tons. The average weight of an adult man, age 18 or older, is 53 kilograms, and of a woman it is 44 kilograms.

Houses

Houses constitute the largest part of the stock, when not taking the road into account. There are 4 cement houses in Tat Hamlet which amount to 65 percent of the stock, while the 117 wooden houses account for only 20 percent of the stock.

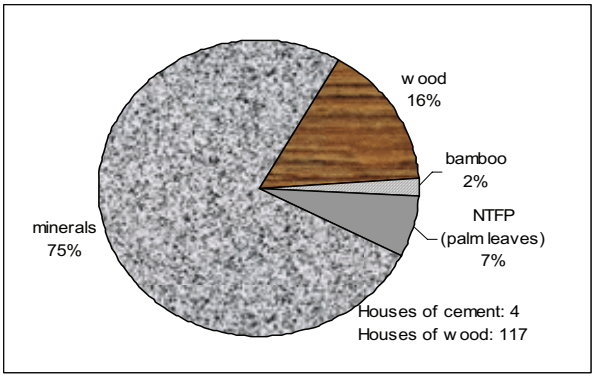

Figure 13: **Stock of houses in Tat Hamlet, by material type**. Source: direct measurements of house dimensions, converted to mass using the MFA database conversion factors.

Figure 13 shows the stock of the houses per material type. Again the cement houses dominate, in terms of mass most of the house materials are minerals (cement and some iron). There are two types of wooden houses in Tat, the 33 'Tay' style houses on stilts and the 84 smaller 'Kinh' style houses built directly on the ground of which 14 have a cement floor.

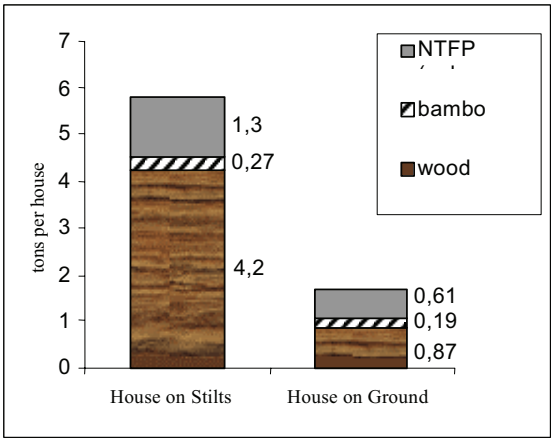

Figure 14: **Comparison of stock for a house on stilts and a house on the ground with an earthen floor**. Source: MFA database, compilation of different data sources.

Traditionally wood is used for building houses, but because in recent times there is less suitable timber available in the forests, less durable bamboo is used as wall material for new houses and to repair old houses. The NTFP's in figure 13 are the palm leaf roofing. Figure 14 shows the materials needed to build a stilt house and a house on the ground. The stilt houses use 4.2 tons of wood on average; this is 5.2 times the amount of wood needed for a house on the ground with an earthen floor. The amount of palm leaves needed for a stilt house is 2.2 times the amount needed for a house on the ground, but this is because the average floor area of a stilt house is 2.2 times the average floor area of a house on the ground. Houses on the ground use more bamboo relative to wood because they need less large support beams than stilt houses and because most stilt houses were built at a time when good timber was more easily available.

4.3-5 Net Additions to Stock

The Net Additions to Stock, including road construction, are shown in Figure 14. The road construction greatly dominates the additions to stock. Leaving road construction out of the picture gives

Final goods

The final goods added to the household artefacts include motorcycles, farming tools, plastic furniture, electrical appliances and other durable goods. Since the advent of electricity in Tat hamlet the desire to purchase televisions, VCR's and other electrical appliances has greatly increased. A few respondents even said they sold their buffalo in order to pay for the electricity connection and electrical appliances. Other additions to the household artefacts include wooden and bamboo furniture.

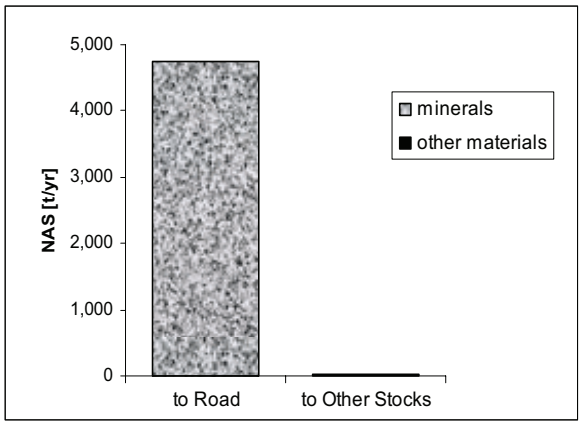

Figure 15: **Net Additions to Stock, including road construction**. Source: MFA database, compilation of different data sources.

Houses

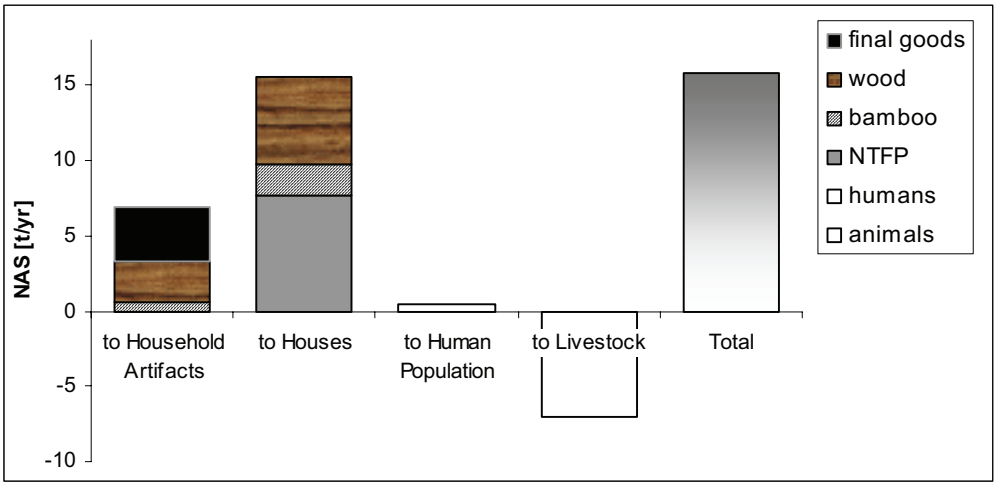

Figure 16: **Net Additions to Stock, excluding road construction**. Source: MFA database, compilation of different data sources.

The additions to the houses are mainly the building of four new houses on the ground, and a few repairs. A part of the palm leaves (NTFP's in Figure 15) is needed to build new houses and a part is needed for repairing the roofs of existing houses. According to key informants, the palm thatch roof of a house needs to be replaced about every eight years, or every twelve years if there is an open fireplace in the house because the smoke protects the thatch.

The transition in the materials used for building houses is caused by wood scarcity as can be seen by comparing the material ratios of the NAS and the existing stock for houses. For the new houses on the ground the ratio of bamboo to wood (as seen in the NAS, figure 16) is about 2:5, whereas for the existing houses on the ground this ratio (as seen in the existing stock of houses on the ground, figure 13) is about 1:5. As wood is getting scarce relatively more bamboo is used in the new houses was used compared to existing houses. All stilt houses have been built a long time ago, and comparing the initial survey data with data of Cuc and Rambo (1998) revels that since 1998 twenty new houses have been built, all of these were of the type built directly on the ground. Respondents said that in order to build a house they need permission from the forestry department to log wood. They get a permit to log a certain volume of wood needed to build a house, which limits the possibility to build large stilt houses. Also stilt houses require large straight trees, which are scarce now.

Animal	Opening Stock (Sept. 2000)		NAS		contribution to NAS, in number of head		
	number of head	Total weight (kg)	number of head	weight (kg)	died	sold	bought
Buffalo	119	33800	- 11	-3900	8	4	-
Cow	161	9000	- 23	-1400	8	23	8
Pig	303	3900	- 88	-2300	123	54	88
Chicken	2400	230	- 766	-46	774	-	8
Dog	50	230	- 4	-77	4	-	-
Goat	8	230	-	-	-	-	-
Duck	360	60	- 291	-38	245	69	23
Total		**47000**		**-7700**			

Table 24: **Opening Stock and contribution to NAS of livestock**. The opening stock is the number of head of livestock and respective weights at the beginning of the MFA time frame, calculated as the difference between closing stock and NAS. The Net Additions to Stock is the change in number of head and respective weights due to livestock deaths and the buying and selling of livestock. Source: household questionnaire, based on a sample of 29 households.

Livestock

During the MFA time frame livestock experienced a net removal of 7.7 tons. This negative NAS is due to a combination of livestock deaths and the buying and selling of livestock. Table shows the contribution of each of these to the NAS. For all animals the number of head has decreased during the MFA time frame. In terms of mass, buffalo, pigs and cows contribute most to the negative NAS. Only 6 percent of the buffalo died and 4 were sold, but their contribution to the NAS is large because of the large mass per head. 41 percent of the pigs died, 33 percent of chickens and 69 percent of ducks, almost all due to disease. The high incidence of disease among livestock in Tat is, according to some respondents, due to the lack of knowledge on how to take care of the livestock and the prohibitively high prices of preventative medicines. From data on the buying and selling of livestock it is apparent that the investment strategy is changing, people are investing in chickens and pigs despite the high disease rates. The people in Tat seem also to have given up on raising ducks and sold some of their cows.

Human population

The net addition to the human population is the population growth, which is 2.6 % per year.

4.4 Activity related Flows and Stocks

4.4-1 Land inputs and production

Input (t/yr dry wt.)	Paddy fields	Swidden fields	Home Gardens	Fishponds
Rice seed	1.9	0.6	-	-
Other seeds	-	23	0.41	0.96
Synthetic fertilisers	11	-	-	-
Manure	47	-	2.2	179
Other natural fertilisers	5.0	-	-	104
Herbicides, insecticides and rat poison	0.050	0.0032	-	-
Total inputs	**65**	**24**	**2.6**	**285**

Table 25: **Land inputs for different land types**. The values are in dry weights, in tons per year. Source: household questionnaire, based on a sample of 29 households.

Land inputs (Table 25) shows the inputs used for the different types of land. Paddy fields require synthetic and natural fertilisers, herbicides, insecticides and rat poison. Swidden fields require much less inputs, the most inputs are the seeds, especially cassava stems, which are collected again at harvest time. No fertilisers are used on swidden fields, according to a key informant this is because the swidden slopes are too steep so that the fertiliser would wash off. Swidden fields also require only six percent of the herbicides, insecticides and rat poisons compared to the paddy fields. Home gardens require a little bit of manure as fertiliser. The fishponds require a lot of manure; most fishpond owners build a pigsty over the fishpond so that the pig manure drops directly into the pond. Other natural fertilisers for fishponds include leaves and grasses. Young fish used as input for the fishponds are categorised as 'seeds' in Table 25.

Land production

Table shows the outputs of products and by-products for the different land types in terms of dry weights, and the amount and percentage exported, which is the ratio between exports and Domestic Extraction. Ten times as much rice is harvested from the paddy fields as from the swidden fields. The swidden fields are mainly used to produce cassava, canna, corn and ginger. The by-products of the cassava plant are important both in terms of mass and in terms of functionality as livestock feed. The by-products of the banana plants grown in the home gardens are also important. Other products grown in the home gardens include potatoes, sugar cane and vegetables. Besides for raising fish, the fishponds are used to grow water vegetable, which is used as pig feed.

Land Outputs	Paddy	Swidden	Home Garden	Fish pond	Exported	
Rice (grain and husk)	78	7.2	-	-	0.39	0.45%
Straw	7.8	0.72	-	-	-	-
Canna root	-	7.0	-	-	6.2	89%
Cassava Root	-	8.0	-	-	3.7	47%
Cassava Leaf	-	25	-	-	0.17	0.7%
Cassava Stem	-	22	-	-	-	-
Corn cobs	-	1.7	-	-	-	-
Cotton	-	0.11	-	-	-	-
Ginger root	-	0.74	-	-	0.67	91%
Tea leaf	-	0.019	-	-	-	-
Banana	-	-	0.56	-	0.15	28%
Banana leaf and stem	-	-	9.2	-	-	-
Potato	-	-	1.2	-	-	-
Potatoes Leaf	-	-	1.4	-	-	-
sugar cane	-	-	0.57	-	-	-
Other home garden products	-	-	2.5	-	2.0	80%
Fish	-	-	-	0.27	-	-
Water vegetable	-	-	-	4.9	-	-
Total Outputs	**86**	**72**	**15**	**5.1**	**13.3**	**7.4%**

Table 26: **Extraction and Exports of agricultural land products**. The values are in dry weights, in tons per year. Source: household questionnaire as reported in the MFA database, based on a sample of 29 households.

The biggest exports, canna root, cassava root and ginger root, are all swidden products. Swidden farming causes the environmental effects which are the focus of this research: deforestation and soil erosion. The data in table shows that most swidden products are produced mainly as a cash crop, which means that the market influences the environment via these crops. However, swidden products such as rice and cassava are also direct sources of food for Tat villagers, and cassava is also grown for its root and by-products as livestock feed.

Most of the home garden products are also exported. No rice grains are exported, because Tat Hamlet does not produce enough rice to feed itself. The small amount (0.39 tons) exported is the husk and bran obtained after drying and pounding the rice. According to Cuc and Rambo (1999) about a quarter of the income of people in Tat goes to buying rice.

According to Vien (1996) swidden cultivation is sustainable at a population density of 5 to 10 people per square kilometre of forest; at this density the forest should be able to regenerate. Tat comprises an area of 737 ha (7.37 km^2) of land of which less than half (314 ha) is forest and another 391 ha are bush and grassland (Cuc and Rambo 1999). Swidden agriculture is not the

only source of income; table shows that in terms of material flow size, swidden fields account for 40 percent of the total income. Assuming forest, bush and grasslands can all be used as swidden land (which is an optimistic estimate), and 40 percent of the income in Tat is from swidden fields, the current carrying capacity of Tat is 176 persons, (7.05 km^2 * 10 people/km^2 / 0.40). The current population is over two and a half times as much, which indicates an unsustainable use of forests.

Land productivity

Table shows the total inputs and outputs, given in terms of dry weights to allow comparison. The ratio between inputs and outputs can be seen as an indicator for the productivity of the land. The swidden fields are more productive than the paddy fields, reflecting the fact that swidden agriculture requires no extra inputs because the nutrients are already available in the ground as fresh forest area is cleared, whereas paddy fields are stationary and used for several decades. The home gardens are the most productive, presumably because small fertile plots of land are used. The fishponds have a very low productivity in part because the product, fish meat, is of a higher nutritional value than plant products are, and in part because harvests are small because about 26 percent of the fishponds all the fish died due to floods and disease.

Of the 21 households interviewed in the household questionnaire that had swidden fields, almost half (9 households, 43%) have never let their swidden fields fallow. The remaining households cultivate their swidden fields for an average of 3.1 years and then leave them follow an average of 4.8 years[41]. According to respondents yields are decreasing, as less forest is available for swidden agriculture due to deforestation and forest protection programs they are forced to use the remaining land more intensively, leading to further land degradation and soil erosion.

	Paddy	Swidden	Home Garden	Fishpond
Total inputs	65	24	2.6	285
Total outputs	86	72	15	5.1
Productivity	130%	300%	590%	1.8%

Table 27: **Productivity of the different land types**. The values are given in tons per year dry weight. The productivity is calculated as the ratio between the dry weights of the outputs and the inputs.

Rice balance

Households obtain rice through harvests of paddy and swidden fields, buying rice at local shops and importing rice from nearby markets. These flows comprise the input side of a household balance of rice. On the output side are the uses of rice: human consumption, livestock feed and use as seeds.

On the input side, 97 tons of dry rice with husk is harvested each year (table). Through local shops 14 tons of dry rice and 1.3 tons of rice with husk is imported (table 17) and an unknown amount of rice is bought by households at nearby markets. For the output side, dietary observations reveal that an

[41] 2 households could not say how long they left their fields fallow, so this data is based on data from 10 respondents.

estimated 100 tons per year of dry rice is consumed (Appendix H). 2.5 t/yr of rice is used as seed (Table 25). Livestock is fed 45 tons of cooked rice per year, and an unknown amount of rice in 62 t/yr leftovers and in 23 t/yr of mixed feed. These values are presented as dry rice equivalents, using conversion factors of 2.2 kg cooked rice to 1 kg dry rice, and 0.95 kg dry rice to 1 kg rice with husk.

A rough estimate of the amount of rice in mixed feed for livestock can be made. Of the 62 t/yr leftovers, 59 t/yr is wet feed for pigs and 2.8 t/yr is dry feed for ducks and chickens. If half of the feed for ducks and chickens is dry rice, and the wet feed for pigs is half water and a quarter of the remainder is cooked rice (pigs are not often fed rice) this comes to 1.4 t/yr dry rice for ducks and chickens and 7.4 t/yr cooked rice (3.4 t/yr dry rice) for pigs. Thus an estimated 4.8 t/yr of dry rice is contained in the leftovers. The 23 t/yr of mixed feed for livestock is dry rice, bran and corn fed to chickens and ducks. Assuming half of this is rice grain, 11.5 t/yr of dry rice is contained in the mixed feed. In total an estimated 37 t/yr of dry rice (4.8 t/yr in leftovers, 11.5 t/yr mixed feed, 21 t/yr cooked rice) is fed to livestock.

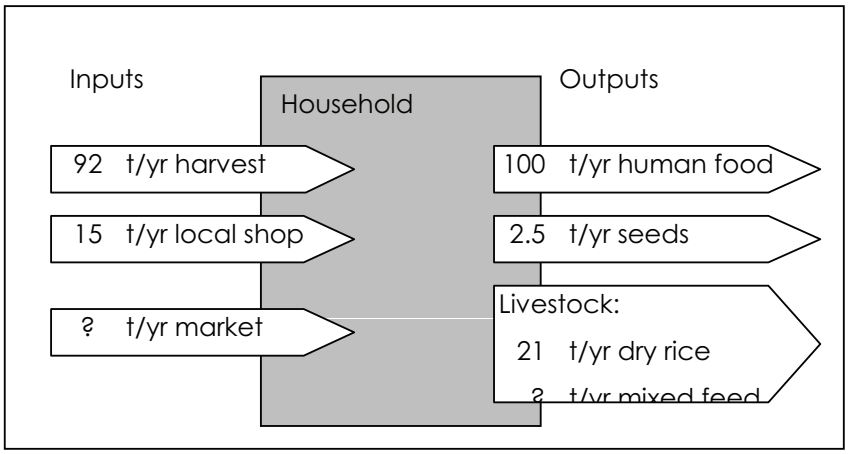

Figure 17. Household rice balance. Values are shown in tons per year dry rice equivalent. Human food intake is estimated from dietary observations of 4 households

Respondents said they do not store rice for future use because they do not harvest enough rice. Thus the inputs and outputs of rice in the household should be equal. The outputs total to an estimated 140 t/yr. The inputs total to 107 t/yr excluding the amount of rice imported via the market. Therefore the difference, about 30 t/yr of dry rice, is imported directly from the markets.

4.4-2 Collection of forest products

Table 28 gives the extraction and exports of forest products in terms of dry weights. Almost all the timber and bamboo for construction logged by Tat villagers is sold for extra cash income. The extraction of bamboo and bamboo shoots at rates faster than the natural regeneration of bamboo forests leads to decreasing bamboo forest areas. Most of the bamboo shoots and bamboo poles that are large enough for construction are exported. Along with swidden farming, logging and bamboo collection are the leading contributor to the environmental problems of erosion and deforestation, hence the market has a large effect on the quality of the environment in Tat via trade in timber,

bamboo and bamboo shoots. The extraction of palm leaves should be sustainable because Tat people harvest palm leaves from wild and planted trees and leave enough leaves to keep the tree alive.

		Extraction	Export	Ratio exported
Wood	for construction	242	236	98%
	for fire	239	13.5	6%
Bamboo	for construction	9.5	8.0	84%
	for fire	52	-	-
NTFP's	Bamboo shoots	3.2	2.3	72%
	broom-grass	20	15	76%
	palm leaves	46	34	73%
	other NTFP's	1.2	1.2	100%

Table 28: **Extraction and Export of forest products**. Values are in dry tons per year. Source: Household questionnaire, based on a sample of 29 households, and for wood the data is from Duong (2001) supplemented by the house measurements.

4.4-3 Keeping Livestock

Livestock feed

Table shows the amount of feed given to each type of animal in Tat hamlet. This is the feed actively given to the animals, and does not include grazing of the livestock. These flows are all Internal Flows; the Domestic Extraction of the materials is accounted for elsewhere as harvests or gathering of products.
Buffalo do not need to be taken care of much since most of the time they graze freely on the mountain slopes. They are only fed some cassava roots a few days a year when they are kept near the house for plowing and logging activities. Cows are similar except for that young calves are kept at home longer (up to a year) and grass is collected to feed them. Lick salt is given to cows and buffalo each time they return to the household every one or two weeks; they are kept for one night at the house and taken back to the mountain fields for grazing.
Chickens and ducks are fed leftovers from the meals. Usually more rice is prepared for each meal than the household eats themselves, and the left over rice is fed to the ducks and chickens. The diet is supplemented with rice bran, cassava flour and corn. Dogs are only fed some leftovers, mainly rice.
Pigs require the most care and feed, using more than half of the total animal feed. The number of pigs given in table includes both the pen-kept and free ranging pigs; the pen-kept pigs are completely actively fed. The amount of feed per pig ranges from 300 kg/head/yr to 5200 kg/head/yr. The diet of the pigs is more varied than the other animals reflecting the high amount of care these animals require. For pigs and chickens some of the rice bran is imported, sometimes in the form of high-power feed.
The data shows the material connectivity of crops. Cassava is important as a source of feed for pigs and cows. Rice is important for all animals (except buffalo and cows). The water vegetables planted in the fish ponds are an important source of pig feed.

Feed amounts (t/yr, fresh weights)	Buffalo	Chicken	Cow	Dog	Duck	Pig	Total
Banana stem					0.30	40	41
Cassava flour		0.70				27	28
Cassava leaf						9.8	9.8
Cassava root	7.7		15			13	36
Corn flour						2.2	2.2
Corn seed		0.28				0.28	0.56
Mixed feed[42]		21			2.1		23
Grass			70				70
Leftovers		2.			0.06	59	61
Potato						6.8	6.8
Potato leaf						15	15
Rice bran		0.84			0.03	35	36
Rice, cooked		18		22	2.1	3.1	45
Salt	0.10		0.10				0.20
Water vegetable					1.0	53	54
Total (t/yr)	**7.8**	**43**	**85**	**22**	**5.6**	**265**	**428**
No. of animals (head)	107	1,600	138	46	65	214	
Feed per animal (kg/head/yr)	73	27	620	470	86	1200	

Table 29: **Livestock feed per animal type**. The number of animals is the number present at the closing of the stock, on September 2001. Source: Household questionnaire, based on a sample of 29 households.

Livestock products

Table gives the used livestock products. Manure is counted in this table when it is used as fertiliser; an estimated 210 t/yr is used for the fishponds, 55 t/yr for paddy fields and 2.5 t/yr for home gardens (see also Table 25 which gives land inputs in terms of dry weights).

Product	Amount (t/yr fresh weight)
Eggs	0.038
Manure	270
Chicken meat*	0.26
Duck meat*	0.0056
Buffalo meat*	3.1
Cow meat*	0.57
Pig meat*	0.49
Goat meat*	0.11
Dog meat*	0.077

Table 30: **Livestock products used in Tat**. The items marked with an asterisk (*) are the weights of the complete carcass. Trading in live animals is not included. Source: Household questionnaire, based on a sample of 29 households.

[42] Mostly rice, rice bran and corn

Two households interviewed in the household questionnaire kept chickens for their eggs; they produced about 144 eggs each year. This comes to about 550 eggs for the whole village, or about 38 kilograms (the average weight of one egg measured in the shops in Tat is 68 grams). Compared with the estimated 490 kg of eggs imported through the shops each year, the production of eggs in Tat meets less than 10 percent of the domestic requirement.

The meat shown in the table is shown in terms of whole carcass weights. Normally buffaloes, cows and pigs are not slaughtered in Tat but exported as live animals where they are slaughtered by butchers. Meat is then bought at the market and imported. Only if these large animals get sick or die by accident are they slaughtered and sometimes eaten by the villagers. The manure is almost wholly produced by the pigs, including all the manure used in the fishponds. However, cow and buffalo manure is used indirectly since it is collected from the forests and grasslands as a part of the green manure, but in terms of the MFA system this constitutes a waste of manure (which has not been accounted for) and a Domestic Extraction of green manure.

Livestock balance

A preliminary balance of the flows related to keeping livestock can be made by combining livestock feed (table 29), livestock products used in Tat (table 30), and the changes in livestock (table 24), resulting in table 31 below. The balance is not complete because livestock grazing and scavenging is not included on the input side, and manure not used immediately is not included on the output side. Note that even if manure, grazing and scavenging were included, the balance should not equal to zero because the net addition to livestock is not zero.

Animal	Closing stock (t)	Input (t/yr)		Output (t/yr)			Balanced I-O (t/yr)
		Bought	Feed	Died	Sold	Product	
Buffalo	30	-	7.8	3.1	0.80		**3.9**
Cow	7.6	0.38	85	0.57	1.23		**84**
Pig	1.6	0.47	265	1.5	1.19	270	**-7**
Chicken	0.19	0.010	43	0.06	-	0.038	**43**
Dog	0.15	-	22	0.08	-		**22**
Goat	0.23	-	-	-	-		**-**
Duck	0.022	0.001	5.6	0.032	0.006		**5.6**

Table 31: **Livestock inputs and outputs**. This data is a combination of import the stock, buying, selling and deaths of livestock (table 24) converted to weights, livestock feed (table 29) and livestock product outputs (table 30). The product 'meat' in table is omitted because it is already counted as part of livestock deaths. Source: MFA database, compilation of different data sources.

The balance for each animal shows that inputs are greater than outputs, except for pigs. The pig balance is the most complete since it includes

manure, but still does not account for the scavenging of the free-ranging pigs that constitute approximate 30% of the pig population[43].

4.5 Analysis per household type

Because the household questionnaire supplies most of the data for the MFA, and the initial survey provides socio-economic data on each household, these two data sources can be linked so that the flows of the MFA can be related to socio-economic data. The large heterogeneity in the socio-economic status and land use of the households in the hamlet makes it important to look at the differences between different types of households. The household categories are based on whether or not the household owns paddy fields and swidden fields; it is the same categorisation as is used for the Action-in-Context Analysis for the SEAtrans local study (see Hobbes *et al.*, part II).

Figures 18 through 21 display the ownership of livestock, household items, and paddy and swidden field areas for different categories of households. The data is from the Initial Survey; four households have been left out because the amount of swidden and/or paddy fields used is unknown.

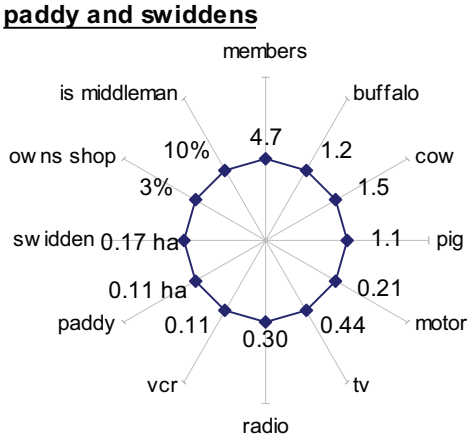

Figure 18: **Radar diagram of incomes and assets for households with both paddy and swidden fields** (n=61, reference case). The values are averages of the 61 households in this category. The units for household members, buffalo, cows, pigs, motorbikes (motor), televisions (tv), radio's and videocassette recorders (vcr) are number per household. The average area of paddy and swidden, in hectares, is given, and the percentage of households in this group having a shop or trading as a middleman. This diagram is the reference case so all values are scaled to fit on a circle.

Most of the village has both paddy and swidden fields. Because it is the majority of the village and because according to Cuc & Rambo (1999) the Tay of Tat hamlet historically had a composite swidden and paddy field agricultural system, this category represented by figure 17 is taken as the reference for comparison with the other household categories. It shows the relative data for poor households with no paddy and no swidden fields. This

[43] It is not possible to estimate the scavenging amounts for free roaming pigs as being equal to the feed of the pen-kept pigs, because pen-kept pigs are actively fed and grow much faster than free roaming pigs.

category has a shop 12 times as often as the reference category, which indicates that families who have no access to paddy and swidden fields use a shop as an alternative source of income. They have very little livestock, which can be explained by the lack of material connectivity: since they have no land they cannot produce livestock feed. It is inconclusive if this category is poorer relative to the reference category: they have more motorcycles but less televisions and videocassette recorders.

The households in the category with only swidden fields (figure 20) are decisively poorer than those in the reference category: they have no motorcycles, televisions, radios or videocassette recorders. This category of households has 1.3 times as much swidden area per household as the reference category. Because the families are 56% the size of those in the reference category, the swidden area per person is in fact 2.4 times the area per person in the reference category. This gives an indication of the extra swidden land needed to compensate for lack of paddy fields. Since this household category has no paddy fields they have no use for buffalo. They also have few pigs and keep no shops. Hobbes *et al*., found that swidden farming has low time connectivity with other activities: when working far from home in the swidden fields all day, it is difficult to perform other daily tasks such as keeping pigs and running shops (Hobbes *et al.*, see part II).

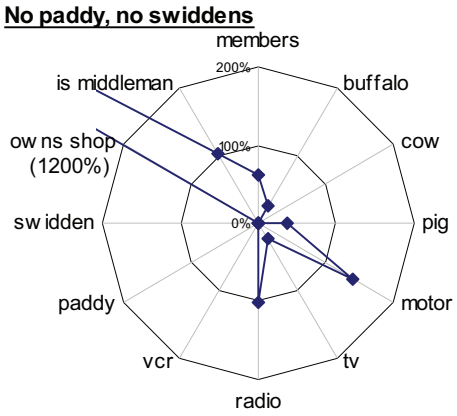

Figure 19: **Radar diagram of incomes and assets for households neither paddy nor swidden fields** (n=10). These are the households with no paddy and no swidden fields; two households are not included because they are very wealthy households while the rest of this group is normal to poor. The values are percentages relative to figure 17. Source: Initial Survey.

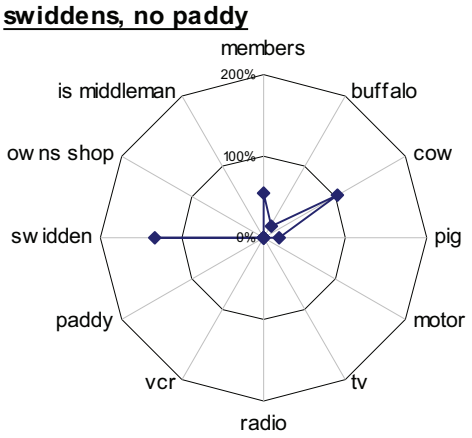

Figure 20: **Radar diagram of incomes and assets for households with only swidden fields** (n=5). The values are percentages relative to figure 17. Source: Initial Survey.

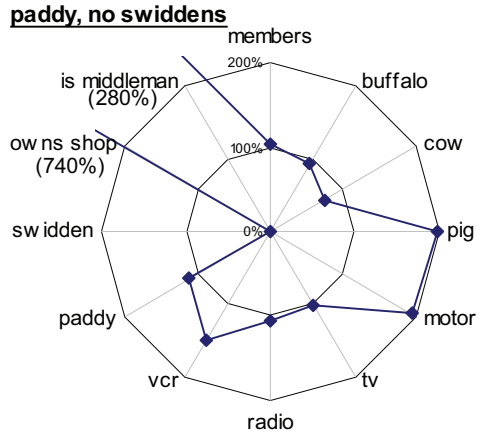

Figure 21: **Radar diagram of incomes and assets for households with only paddy fields** (n=29). The values are percentages relative to figure 17. Source: Initial Survey.

The data for households in the category using only paddy fields is shown in figure 21. They are wealthier than households from the other categories, with the most motorcycles and videocassette recorders. Their paddy areas are on average only 10 percent larger than the paddy area of the reference category. The data from the household questionnaire indicates that the paddy yields are not higher, but there are only four households in this household category that have been interviewed for the household questionnaire. This household category distinguishes itself in that it raises twice as many pigs, keeps a shop 7.4 times as often and is middlemen 2.8 times more often in comparison with the reference category. Hobbes *et al*., (2003) found that paddy fields have high time connectivity with daily chores such as raising pigs, keeping shops and functioning as middlemen.

Figure 18 shows what happens when Tat households have no land available: livestock is not an option because livestock feed cannot be grown locally and must be imported, so they are forced to get an income from services. This gives an indication of the future scenario if both swidden and paddy land becomes limited due to population growth and lowering yields of swidden fields due to soil degradation. The number of shops in Tat cannot increase

much more as Tat is already saturated. Figure 20 shows what could happen if households have full access to swidden fields but limited access to paddy, and no alternative source of income. This scenario is a probable fate of Tat hamlet as population increases while paddy land area remains constant, but the services sector of the local economy (shops, trading, and other services) does not grow. The visible trend is more use of swidden fields, with the associated erosion and deforestation. Probably households will also log more timber and collect more non-timber forest products to sell, leading to even more deforestation, but there is no conclusive data to support this trend. Finally, figure 21 shows a possible scenario for Tat if income from paddy fields remain constant, and through livestock breeding and services such as trading and keeping shops households can get enough income. The need for swidden fields declines and less swidden is used, leading to less deforestation and erosion. Presumably collection of non-timber forest products and logging of timber will also decrease. It must be noted that for this scenario, the rice production of paddy fields must remain constant per person, which means production must increase with population growth. Also, middleman currently only trade in raw non-timber forest products, and livestock feed comes mainly from swidden crops, so trading and livestock as sources of income are related to the deforestation and erosion causing activities of swidden farming and NTFP's collection. If it is possible to combine paddy farming with income from services and livestock, this group of households shows that a relatively high level of income is possible.

5 General discussion and conclusions

5.1 General discussion

5.1-1 MFA total indicators

The Direct Material Input (DMI) of Tat hamlet is 5.4 t/cap.yr, which indicates the material dependency of the society. This means that on average a person in Tat 'uses' 5.4 tons per year. The Domestic Extraction in Tat hamlet is 3.6 t/cap.yr. This implies that 67 percent of the material dependency in Tat is met by the Domestic Environment. 10 percent is met through imports, indicating the importance of the market, and 22 percent is met through External Extraction.

The large contribution of the External Extraction indicates that the population in Tat is too large to be sustained by the Domestic Environment, caused by population growth and deterioration of and resource depletion in the Domestic Environment.

The Direct Material Output (DMO) of Tat hamlet is 3.6 t/cap.yr, indicating the total environmental impact of the society in material flow terms. Of this, 2.4 t/yr or 67 percent of these outputs are to the Domestic Environment (Direct Processed Output, DPO) and is related to the environmental effects in the Domestic Environment.

The stock of Tat hamlet is 3.3 t/cap. The physical growth rate of the hamlet (Net Additions to Stock divided by the stock) is 1.0 percent, or about 4 percent if an adjustment is made for the effect of the heavy mineral stocks.

The physical trade balance has a deficit of 0.69 tons per capita per year[44]. This is mostly due to the fact that final goods are imported and raw materials exported. Since exports are the main source of income for Tat villagers, they need to sell the raw materials that have a relatively low per kilogram economic value. This income is spent on services and the import of (mostly) final goods that have a relatively high per kilogram economic value.

5.1-2 Unsustainable flows

The MFA of Tat hamlet shows that the flows that are related to the environmental problems of deforestation and erosion are extraction of timber, bamboo and bamboo shoots, and swidden agricultural products. In terms of social (livelihood) sustainability, the large livestock deaths and low fishpond yields are problematic.

Increase in population while land area remains the same will lead to higher environmental pressures, especially in terms of erosion and deforestation. However, the effects of family planning are starting to become visible in Tat hamlet both in the age distribution and in terms of an actual decrease in population growth. As long as the population is increasing the environmental pressure due will increase, but family planning will help reduce the scale of erosion and deforestation.

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[44] External Extraction is not counted as a trade input.

Rice from paddy fields

The Domestic Extraction of rice from the paddy fields is not enough for the hamlet to be self-sufficient in this staple food, so the basic food requirements need to be met through swidden farming. Food is also bought from shops and markets; the income needed for this is obtained through farming of swidden cash crops and collection and selling of forest products, which lead to deforestation, soil degradation and erosion. Indeed, in 1998 27 percent of household expenditures went to the buying of rice, while 22 percent of the income came from swidden cash crops and 29 percent from forest products (Cuc & Rambo 1999).Paddy agriculture requires intensive inputs of manure and synthetic fertilisers, and the use of herbicides, insecticides and rat poison which effects human health and water quality.

Swidden products

Swidden products are an important part of the material metabolism of Tat hamlet and of the local economy, being used as food (rice and cassava roots), cash crops (canna, cassava and ginger roots) and livestock feed (cassava roots harvest by-products). Domestic Extraction of products from the swidden fields constitutes 40 percent of domestic extraction of land products.

There are two ways in which the market influences swidden crop production. Firstly, swidden crops are sold to buy rice and gain an income for buying services and goods. Secondly, swidden (by) products are used as livestock feed, and livestock breeding is a source of cash income.

A conservative estimate of the carrying capacity of the forest for swidden cultivation, based on data from Vien (1996), shows that the current population of Tat is two and a half times greater than the maximum carrying capacity. The pressure on swidden fields is high; almost half of households have never let their swidden fields fallow so that no regeneration can take place. This leads to soil degradation and erosion, and declining yields.

Extraction of forest products

The extraction (both domestic and external) of forest products is 2.3 times larger in terms of flow size than the extraction of land products, indicating the high dependence of forest products in Tat.

Overexploitation of the Domestic Environment is evident in the fact that almost all of the construction timber and half of the bamboo shoots are External Extractions, collected outside the Domestic Environment because there are not enough resources left within the territory of the hamlet. With decreasing forest size the supply of wood for construction is decreasing, apparent in the increased use of bamboo for the construction of houses.

Of each of the forest products, most of the extracted quantities are exported and sold at the market (except firewood and bamboo for fire, see table). This links the market to the environmental problem of deforestation; especially the selling of wood, bamboo and bamboo shoots is problematic.

Livestock and fishponds

The raising of pigs, ducks and chickens provide alternative sources of income. However, in the MFA time frame 41 percent of the pigs died, and 33 percent of chickens and 69 percent of ducks, mostly due to disease. Fishponds have also not been successful, in 26 percent of the fishponds all the fish died due to floods and disease, and in the other fishponds the yields are not very high.

According to respondents lack of knowledge and access to medicines are reasons for livestock and fish deaths. There are government loans available to invest in livestock and fishpond (Hobbes *et al*., 2003).

The material connectivity of livestock and fishponds is important, with swidden products being used as livestock feed and pig manure being an important input for fishponds.

5.1-3 Trends in the MFA

Population growth is an important driving force in the MFA. Especially for a rural community such as Tat, most flows are related to income producing activities that will increase with increasing population. The current population growth is 2.6 percent per year so that income related flows could be expected to increase at a similar rate.

The growth rate of the number of households is 4.9 percent per year. Flows related to the building and maintenance of houses can be expected to increase at a similar rate. The net additions to the stock of houses is 15 tons per year or about 0.03 t/cap/yr (figure 16) which is small compared to other flows such as the total wood extraction.

A trend in the keeping of livestock is visible; farmers seem to prefer raising pigs and chickens to raising other livestock Pigs and chickens are mainly fed banana stems, cassava roots and leaves, rice and rice bran (table 28). Unless food is bought at the market and imported, an increase in livestock keeping will lead to increased production of these crops. Especially the increase in cassava production will lead to increased erosion of the swidden fields and deforestation.

The advent of electricity has increased the demand for electrical appliances and will probably continue to do so, leading to increased imports of final goods. Cash needs to be obtained to pay for these goods and for the electricity bills, possibly leading to increased flows related to income generating activities (swidden cash crop farming, keeping livestock and fish ponds, collecting forest products).

The paving of the road has made access to the market easier, especially since it allows a bus to pass daily through the village. This will lead to increased market integration and probably a higher import of final goods. Whether the export of forest products and cash crops will increase is not predictable; transport to the market is easier making it more attractive to trade in these products, but the transportation and middleman costs may decrease which means that more profit can be made for the same quantity of exports.

5.1-4 Qualitative error analysis

Sources of error

The five factors that contribute to the error in the MFA are the fact that most of the data is collected through interviews, that (random) samples are used, that estimates had to be made, that some flows have not been measured, and that data may have been processed incorrectly.

It is not feasible to measure all flow sizes in the village directly for a whole year. Instead, data collected through interviews had to be relied upon. Interviews allow a lot of data to be collected in a short time and allow information of the seasonality of flow sizes throughout the whole MFA time

frame (1 year) to be known even if the researchers are only in the village for a part of the year. It is difficult to estimate the accuracy of respondent's answers to questions on flow sizes. For land inputs and production the responses will be more accurate because most farmers measure these amounts themselves. For most other flows the respondents were asked to answer in terms that make sense to them, for example baskets of produce, to achieve maximum accuracy. Direct measurements were used to obtain conversion factors to convert these responses to flow sizes in terms of tons per year.

The amount of water used for washing pigs, accounting for almost half of the total water extracted (and wasted), is based on only two interviews. The sample size for household wastes is small, and for shops the sample size is reasonable but could be biased.

An estimate had to be made on the flow size of the import and use (emissions) of gasoline, based on a rough estimate of the distance travelled by motorcycle owners and the efficiency of their motorcycles. Some conversion factors have been estimated, for the more important flows they are based on literature or on information given by key respondents. Again, the accuracy of such respondent data is unknown. The conversion factors of average weights or starting weights and growth rates for livestock is based on interviews with respondents and is not very reliable.

On the inputs side data on imports of foodstuffs, grazing and scavenging of livestock and input of oxygen in combustion processes is missing, and on the outputs side data on livestock and human respiration and excretions and the emission of carbon dioxide in combustion processes is missing.

Errors and double counting which may have occurred during data processing have been checked for by investigating balances of households, middlemen and shops and by examining the reasonableness of flow sizes. While using the data for the local level EFA Heezen (2003) has checked for errors in the MFA database. Still, due to the quantity of data involved (there are over 2300 raw data records in the MFA database identifying almost 500 material flows or stocks[45]) it is possible data errors have not been detected.

The difference between the NAS and the value of the DMI – DMO (corrected for water vapour) is an indication of the overall accuracy of the MFA. This difference is 6 percent of the DMI. The overall accuracy is probably less optimistic than this six percent gap suggests, because of the fact that many outflow sizes are estimated based on the sizes of inflows; these inflows and outflows are linked via processes so that the balance is per definition correct regardless of the accuracy of the data.

Representativeness of Tat hamlet

This research is a case study of one hamlet in the northern mountain regions of Vietnam, with its unique characteristics. It is representative, in a limited sense, for mountain villages. However, it is a Tay ethnic minority village that has its own housing and agricultural traditions differing from the Kinh ethnic majority of Vietnam. Because the hamlet is the administrative centre of the Tan Minh commune the villagers probably have more access to official jobs

[45] A specified material flowing from one component of the social system to another, or a specified material which is part of a specified stock.

and more access to government information. The village has been the location of ongoing research for the Agricultural University and the Centre for Natural Resources and Environmental Studies (CRES). The agricultural research programs involve farmers from Tat, which gives them access to knowledge on new farming techniques.

5.1-5 Evaluation of MFA research on a local level

The main problem that arose when applying the MFA methodology on a local level is the need to rely on interviews. Advantages of the MFA on a local level include the fact that it is a systems approach, so that the social system is viewed as a whole and the interconnectedness of flows becomes visible. At the same time this systems approach of taking into account all flows requires a lot of data, which takes a long time to collect. MFA is useful for finding policy solutions because it makes visible unsustainable flows; an example in Tat is the high amount of External Extraction of timber and bamboo shoots. Because MFA brings into view all flows related to an activity it can be used to estimate the effects policy changes will have on environmental impacts.

To make the link between policy and changes in activities it is crucial to link the Action-in-Context (AiC) methodology with the MFA. Indeed, the choice to link the MFA with AiC in the SEAtrans project proved a good method for an interdisciplinary case study. Also, the composition of the research team consisting of both European and Vietnamese researchers proved very valuable because the research subject could be evaluated from the different cultural perspectives.

Some adjustments had to be made on the MFA theory to apply it to a local level. The extra flow category of External Extraction was added to identify imports of goods extracted in a foreign territory by actors belonging to the social system under study. Goods exported and re-imported in unaltered form within the MFA time frame were not counted as exports and imports. This situation occurs regularly on a local level when for example a local bus passes through the system boundary every day. A more detailed subdivision of the material category 'biomass' was needed for the analysis of this subsistence village. The local level study does not allow for a time series in MFA data. A time series allows interpretation of the changes in indicator values giving the values more meaning. Because only one year was measured, extra indicators were needed for the local level study that have more meaning by themselves.

The data source of the local level MFA is primarily a comprehensive household questionnaire that allows most flows to be quantified but the accuracy is less since the questionnaire data relies on the estimates of respondents on flow sizes. However, the data quality is good enough for a characterisation of the metabolism of the village. Also, this method collects data on the household level, which allows for analysis to take into account the socioeconomic status of the households, which would not be possible if data was taken on a village level.

5.2 Conclusions and recommendations

5.2-1 Conclusions

Through the Material Flow Analysis of Tat hamlet, the material basis of the society is better understood, which was the main objective of this research. Tat hamlet can be characterized as a mostly self-sufficient subsistence

community with most flows consisting of biomass, but market integration is apparent in the MFA.

MFA total indicators give information on the metabolism and sustainability of Tat. 67 percent of the material requirement is met by extractions from the Domestic Environment, 10 percent through imports and 22 percent through External Extraction.

Extractions of forest and swidden products are unsustainable flows that lead to deforestation, soil degradation and erosion. The large External Extraction of timber and forest products testify to the degradation and resource depletion in the village, and a conservative estimate of the carrying capacity of forests for swidden cultivation shows swidden cultivation is not sustainable. These flows are a large part of the metabolism of Tat hamlet, and they are important for the livelihoods of the people of Tat. The driving forces behind these unsustainable flows are population growth and market integration. The sizes of these flows are also influenced by the material connectivity between swidden products and livestock keeping, and the availability of other sources of income such as paddy farming, livestock, trading and incomes from services.

All the secondary objectives as presented on page 2 have been met. Through the household and activity oriented analysis it is possible to link the MFA with the Action-in-Context research. The data presented in this paper, supplemented by the MFA database, allow comparison of the material metabolism of Tat hamlet with the other case studies in the SEAtrans project. The main differences in applying the MFA methodology on a local level compared with a national level MFA, is that the flow category 'External Extraction' has been added, the material category 'biomass' has been divided into subcategories and that extra indicators have been introduced. For data collection the most practical method was to gather most data through interviews, which allows efficient gathering of data, including flow sizes for the whole MFA time frame when researchers were not present, and allows for a household and activity oriented analysis. The disadvantage of relying on interviews is that data is less accurate than direct measurements. Gathering data on a local level takes a lot of time so that not all flows could be measured and some flows were measured using small samples, affecting the data quality.

5.2-2 Options for a sustainable material metabolism

One existing policy option is continuing the family planning program to decrease population growth and the related environmental impacts.

All the aforementioned flows related to erosion and deforestation are an important part of the metabolism of the hamlet. These flows are also an important part of the local economy. The sizes of these flows, and hence their environmental impact, cannot be diminished unless the villagers of Tat hamlet get access to an alternative source of income, as explored in Hobbes *et al.* (see part II).

There are some possibilities for alternative sources of income, such as intensification of paddy rice agriculture, livestock or fish farming, exporting finished products instead of raw materials, and moving towards a more differentiated, service oriented economy. However, when formulating policy to this end, the flows related to each of these activities need to be taken into

account. Intensification of paddy rice agriculture requires the related inputs of fertilisers and chemical insecticides, herbicides and rat poison to increase. Money is required to purchase fertilisers and chemicals, and unless paddy rice farming increases above a subsistence level this money will need to be obtained through other means, which could lead to more swidden farming and collection of forest products. Intensification of livestock requires more livestock feed, and one important related flow is the production of cassava for livestock feed, which will lead to an increase in swidden farming and hence an increase in deforestation and erosion, unless feed is imported. In order for livestock and fish farming to be successful people in Tat hamlet will need more knowledge in care-taking methods and better access to preventative medicine in order to avoid the high death rates currently visible in Tat hamlet.

Reduction of the transportation costs to and from the mountain region could be another method to effectively increase the income of Tat villagers. As mentioned in this paper, the high transportation costs lead to high import prices and low profits for exports. Manufacturing and exporting of final goods instead of raw products has a double advantage. Firstly the price of the finished product is higher than that of the raw product, and secondly because of the lower weight of finished products the transportation costs will generally be less. This will lead to higher incomes with less environmental impact.

Reduction of the erosion associated with swidden farming is possible using intercropping methods; in Tat research on erosion mitigation using this method shows dramatic reduction in erosion rates (Vien 1996). Making a switch to perennial cash crops such as fruit trees could also help reduce erosion.

5.2-3 Suggestions for Further Analysis

A brief trend analysis can be made of the MFA to get more insight in to the transition in material metabolism of Tat hamlet. This analysis can be made by estimating the relation between flow sizes and population and household growth. With a continuing population growth of 2.6 percent the pressures leading to deforestation and soil erosion will increase. Also flows related to specific activities (livestock, fishponds, swidden fields, paddy) can be used for the trend analysis and to develop scenarios. For example, it is possible to estimate what would happen to the MFA if more people start to invest in livestock as seems to be happening now, and estimate the changes in pressure on the environment. The baseline data from 1995 in Cuc and Rambo (1999) is especially useful for this trend analysis.

The MFA database can be adapted quite easily so that it can be used to make nutrient balances. In the light of the positive Physical Trade Balance (exports are greater than imports) it would be interesting to see if Tat hamlet is experiencing a nutrition deficit.

The missing flows of human and animal respiration and excretions, combustion processes and grazing and scavenging of livestock can be estimated using conversion factors based on human and animal population and the chemical processes related to combustion of wood, bamboo and fossil fuels. Estimates used in the database can be improved upon, especially the estimates of livestock weights.

Part II: Action-in-Context of the Problematic Material Flows in Tat

Marieke Hobbes, Jiska Kooijman, Le Thi Thu Thanh, Wouter T. de Groot and Phan Thi An Dao

1 Research focus of Action-in-Context

1.1 Main flows and problematic activities

The present section describes the results of the Action-in-Context (AiC) research for SEAtrans in Vietnam for which the fieldwork took place from August to December 2001 in Tat hamlet. A large part of this report is taken from Kooijman (2001). The other members of the AiC research team were Phan Anh Dao, Le Thi Thu Thanh and Marieke Hobbes.

Using the AiC methodology, the Material Flow Analysis (MFA) is put in its social context, going deeper into the decision-making processes of the actors causing the flows in the MFA and linking them to other actors. The flows under study are related to the environmental problems of soil degradation and deforestation, as these problems are important problems in the region in general and in the hamlet itself. Stalpers *et al.* (see part I) describes and analyses the identified unsustainable flows of extraction of timber, bamboo and bamboo shoots, and swidden agricultural products. These flows form an important part of the metabolism of the hamlet and of the local economy (*ibid.*). The AiC analysis focuses on the explanation of the latter, exploring access to these and other sources of income by analysing decision-making processes, explaining them in their socio-economic and cultural context. A causal chain of factors and other actors influencing the decision-making of the villagers will become visible, by which possible policy solutions can easily be probed. The SEAtrans project is the first endeavour to link MFA and AiC research methodologies in order to make an interdisciplinary case study.

Point of departure for the AiC research are the environmental problems as analysed by the MFA (see part I). The environmental problems of soil degradation and deforestation are caused by three main activities in Tat hamlet related to the unsustainable flows of extraction of timber, bamboo and bamboo shoots, and swidden agricultural products.[46]

[46] Overexploitation of the Domestic Environment is evident in the fact that almost all of the construction timber and half of the bamboo shoots are External Extractions, collected outside the Domestic Environment because there is not enough resources left within the territory of the hamlet (Stalpers et al., see part I). Of each of the forest products, most of the extracted quantities are exported and sold at the market (except firewood and bamboo for fire), linking the market to the environmental problem of deforestation Especially the selling of wood, bamboo and bamboo shoots is problematic (ibid.). Swidden products are an important part of the material metabolism of Tat hamlet and of the local economy. Domestic Extraction of products from the swidden fields constitutes 40 percent of domestic extraction of land products (ibid.). A conservative estimate of the carrying capacity of the forest for swidden cultivation, based on data

Deforestation is caused by logging. It is not a case of large-scale commercial logging with chainsaws and bulldozers. Logging happens in small teams consisting of 4 to 5 men, with 1 or 2 buffaloes carrying 1 or 2 logs. Men of many households in Tat supplement their income with logging. There is no primary forest left in the forest area of Tat hamlet, thus people go to further places, where the forest is deteriorating fast as well. Chapter 4 briefly describes logging as important income source and implementable option.

The second problematic activity is collecting bamboo and bamboo shoots on a large scale, causing overexploitation. The Tat inhabitants mention the strong decline in bamboo forest and predict worse for the future. The problems occurring with bamboo collection is described in the sections on collection of Non Timber Forest Products (NTFP) as implementable options in Chapter 4, and in Chapter 5 an alternative way for bamboo production is described.

The third activity, swidden farming, causes problems because short fallow periods of the swiddens exhaust the soils in and around Tat. The soil degradation is alarming. Respondents estimate a 20 to 50 percent decline in production of the swidden in the last 2 years. Despite the low quality of the soils, many households still practice swidden farming. Cash crops are planted in the swiddens to earn a little extra money, needed to complete subsistence needs. Swidden farming is described in Chapter 3.

1.2 Research methods

1.2-1 Action-in-Context

"Action-in-Context" (AiC) offers an actors-oriented explanation of observed transitional changes of society-nature interactions, in our case changes of material flows at the local level. This is done by researching the decision-making processes that bring about the transitions in its complexities of economic, social, demographic, geographical and cultural patterns and change. AiC thus explains why the farmers choose for the livelihood activities related to the flows of the major products found by the MFA research in the research sites. The AiC takes this actor-oriented approach, while linking the actors' decisions to each other and to system-level factors.

One characteristic element of AiC is the "actors field", which describes how the decisions of actors are connected to each other. The AiC framework guides the research to find out how options and motivations of actors are influenced by their culture and structure. Structural factors influencing the primary actors are seen as activities of other actors. For example, the farmers in Tat are not allowed to go logging according to the national forest protection policies. These national policies would not hold any power if they were not implemented on the local level. The local authorities in Tat implement the policies and implementation is therefore seen as their activity. The options and motivations of these secondary actors are in turn influenced by the government's cultural and structural factors. In this way, the actors' field can be created by causally tying decisions of actors to activities of other actors. The interconnections between actors in the actors' field do not depend on whether actors know each other or communicate directly. They depend on the

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from Tran Duc Vien (1996), shows that the current population of Tat is two and a half times greater than the maximum carrying capacity connected to this farming system.

degree to which one actor influences either the range of options for action of another actor, or the type or content of the other actor's motivations for these options. That way, it is possible to step from actor to actor, starting out with the "primary actors", the farmers in this case, that are the ones directly standing on the society-nature interface. Going up the causal stream, other actors may then be identified, such as traders, banks, policy agencies, NGOs, national politicians etc., sometimes up to global actors such as the IMF. Thus, the AiC takes the changing material flows at the local level as its point of departure (its 'explanandum'), and then connect these to their primary actors and, *inter alia*, to national and global actors.

In the AiC applied here, the decision-making structure of each of the actors separately is analysed first at a very simple "rational choice" level. For the primary actors it involves what AiC calls a "deeper analysis", in which a second layer of depth is added that includes, for instance, economic endowments, social capital and cultural frames of interpretation. Not only what people do or consider as relevant is analysed, but also the potential options and motivations and the resources they have to choose these. The resources are called 'autonomy' in AiC terms, and derive from structural factors as access to land, roads, markets or population growth. The deeper analysis also explores cultural factors, which are influencing the decision making of the actors. The quantitative factors determining the actor's decision making, the so-called "objectified motivations" are included as much as possible encompassing cost-benefit analysis by the actors and calculations of "returns-to-land" and "returns-to-labour". The well-known types of policy instruments such as economic incentives, regulation, self-help promotion or cultural communication may influence these, in turn, forming appropriate opportunities for more sustainable development that encounters the initial identified environmental problem.

1.2-2 Site selection

In the explorative phase of the research, we selected three research sites that together reflect a transition gradient of the agricultural production system from a village more focused on subsistence towards a village more integrated into the market economy. Differences in resource dependency were the main variable to select the villages, because this is directly connected to the MFA research. During the research, however, we soon decided to conduct the research in only one village, due to time pressure. The Vietnamese counterpart CRES already had much data available on Tat hamlet in Hoa Binh province, in the Northern Mountain Region of Vietnam. Together with the MFA research, good insights into the features of a village economy that undergoes rapid change can be obtained.

1.2-3 Primary actors

There is a clear gender based division of labour activities in Tat. Logging, for example, is always done by men, while women are responsible for swidden farming. Nonetheless, the household is the main organisational unit in Tat. The household is responsible for all decisions regarding the organisation of labour, management and use of resources, and the accumulation and allocation of capital. Therefore, the main actor in the problematic activities

analysed in this research report is the household.[47] Table 1 provides information on the distribution of paddy and swidden fields per household in Tat (taken from Stalpers *et al.* (see part I).

	No swidden fields		Some swidden fields		**Total**
No paddy fields	12	11%	5	5%	**17**
Some paddy fields	29	26%	65	59%	**94**
Total	**41**		**70**		**111**

Source: Household survey including all 111 households comprising Tat (Stalpers *et al.,* see part I)

Table 1: **Agricultural Land Use in Tat hamlet**.

The distribution and availability of paddy and swidden fields seem the most important variables for the main sources of income and forest dependency of the people. Rice is the staple food in Tat. Most households do not grow sufficient rice to feed their family. Most families have a rice shortage for at least one month per year. All income generated is therefore primarily spent on rice or food in general. Swidden farming is an income source available to most households, because it requires only small investments. Besides, swidden and paddy rice farming are traditionally the two pillars of the subsistence based economy of the Tay (Cuc and Rambo, 2001). In addition, swidden farming causes soil degradation.

We have classified four groups of households on basis of the different land uses:[48]

1. Households with some paddy and some swidden
2. Households with some paddy and no swidden
3. Households with no paddy and some swidden
4. Households without paddy or swidden

Stalpers *et al.* (see part I) gives an analysis per household type, by linking socio-economic data to the MFA flows. For this, the households are categorised on whether or not the household owns paddy fields and swidden fields. As is shown in Table 1, most of the villagers have both paddy and swidden fields and is taken as the reference for the other household categories (*ibid.*).

The household category with only swidden fields are decisively poorer than the reference category: they have no motorcycles, televisions, radio's or videocassette recorders (Stalpers *et al.,* see part I). This category of households has 1.3 times as much swidden area per household and 2.4 times per person as the reference category (*ibid.*).

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[47] Because men appear to have a different logic than women, the question arises whether the household is right unit for analysis of the decision making process for swidden farming. However, we decided to take the household as unit, because the men decide on the opening of swidden fields, while the women decide on the work on the swidden.

[48] The classification more or less coincides with the classification the villagers made themselves regarding socio-economic stratification during a research of CRES (Le Thi Thu Thanh: research notes). They divided the village in three social groups on basis of amount of paddy, amount of cattle and type of house.

The household category that uses only paddy fields belongs to the richer families of the village. They are more wealthy than the other categories, with the most motor cycles and videocassette recorders (Stalpers *et al.,* see part I). Their paddy areas are on average only 10 percent larger than the paddy area of the reference category (*ibid.*).

The households with fewer paddies are the "newly weds" and newcomers, who did not participate in the redistribution of paddy fields about 10 years ago. The available paddy fields were distributed among the families who at that moment lived in Tat. Families who established households later did obtain only small paddy field or even none.

The category no Paddy and no Swidden, 12 households (11 percent) in total, contains a mixture of rich and poor families. The rich households from this category have members with alternative jobs like high government cadre, trader or shop owner. Others with no paddy and no swidden are extremely poor.

1.2-3 Methods and research process

Several methods are used for the AiC:

- Initial survey (overlap and together with MFA regarding socio-economic data)
- Semi-structured interviews
- Unstructured interviews
- Option ranking
- Historical diagramming
- Literature study

For the semi-structured interviews, respondents from the MFA sample were selected. In this way, we envisioned complete data sets on a few households. During analysis of the returns to land and labour however, difficulties came up connecting the data on the land use activities. The AiC researchers gathered precise data on time use and prices of the products, often, however, leaving out the amount of product and the accompanying agricultural area. Then, we hoped to find these matching data on kilos and areas in the MFA data base. Sometimes the data sets matched, but sometimes not. We had to leave out many respondents for calculating the returns to labour, because we did not have complete data. Finally, we came up with a few respondents for some land use activities of which we had complete data sets. References are made to the sources of the data inputs.

In this report, terms and remarks that specifically refer to the AiC toolkit are often put in brackets throughout the main text. This is done only for the technical purpose of showing the connection between field realities and the toolkit.

2 The research region and Tat Hamlet

Over the years, a wide array of secondary data has been gathered and published by CRES and the East-West Centre describing environmental, social, economic, political, cultural, geographical features and trends of the Northern Mountain Region in Vietnam and Tat hamlet in particular. Here, general description of the region and the village follows. Several sources are used, namely secondary sources (Le Trong Cuc and Rambo, 1999: 1-13;

Rambo and Tran Duc Vien, 1999: 14- 29; Le Trong Cuc and Rambo, 2001), observations, informal interviews, and secondary data from the government.

2.1 Vietnam's Northern mountain region

The Vietnamese Government has assigned high priority to the development of the Northern mountain region, the area stretching from Vietnam's border with China in the north, to the southern boundary of Nghe An Province in the central region (Le Trong Cuc and Rambo, 2001). This is due to its lagging economic situation, the high concentration of ethnic minorities and its valuable mineral and energy resources. A number of major government development programs are focused on the uplands. In addition, foreign Official Development Assistance has been invested in the northern mountain region. Many foreign NGOs are also active in the northern mountain region, especially in the Da River Watershed. Despite these efforts, development of the region is still proceeding at a relatively slow pace (Le Trong Cuc and Rambo, 1999:2).

The northern mountain region is characterised by rugged and often almost inaccessible terrain, poorly developed transportation and communication infrastructures, low education levels, high rates of population growth and mainly subsistence economies that suffer from frequent shortfalls in production of food crops.

Economy

Average per capita GDP levels are far below the national average and the percentage of people living in absolute poverty is relatively high. Even in the most favoured mountain communities, like our research village Tat hamlet, the economic activity is low. In 1996, the cash incomes were far below the national average of US$ 300. An agricultural labourer earned 3-5.000 Vietnamese Dong per day, which is less than US$ 0.50 (Le Trong Cuc and Rambo, 1999:4). During our research, the average day wage in Tat was about 30.000 Vietnamese Dong per day, which is equal to US$ 2. All highland people purchase goods produced in the lowlands such as salt, iron tools, matches, kerosene and torchlight batteries. The total volume of traded products is small, because the northern mountain region inhabitants have little purchasing power and the cost of commodities transported into the mountains are very high. Besides, negative terms of trade result from the raw products exported and the finished products imported.[49]

In the northern mountain region, the grain production is not sufficient to meet the minimal consumption needs of its population. In 1994, the gross per capita output of food in paddy was 239 kilos, compared to the 350 kilos that is considered adequate to meet nutritional requirements. Consequently, the northern mountain region relied on substantial imports from other parts of the country (Le Trong Cuc and Rambo, 1999:4). Our research shows the continuation of this problem. Respondents indicate that in Tat hamlet the majority of the households lack rice at least one month a year.

The main obstacle to expansion of the market economy in the mountains is the absence of institutions, physical infrastructure, and resources needed to

[49] This is also mentioned by Stalpers et al., see part I, explaining why the volume of products exported is much (i.e. 2.3 times) higher than the volume of products imported in Tat hamlet.

support commercial activities. In 1996, only 37 % of the villages had a market (Le Trong Cuc and Rambo, 1999:4). The research site Tat hamlet is the relatively rich economic centre of the village it belongs to, but has no market either. Joint efforts to start a market a few years ago by CRES from the Hanoi University, the Agricultural University and village authorities failed, due to financial mismanagement and insufficient capital and products available in the village. Le Trong Cuc and Rambo (1999:4) describe a vicious cycle which can still be seen in Tat today: efforts to increase production fail because of lack of markets, and at the same time development of markets is inhibited by the shortage of saleable produce. The government had redistributed the land to individual households, issuing private titles and stewardship arrangements (see chapter 6).

Population

The Northern mountain region is characterised by a great diversity of ethnic groups; 31 of Vietnam's 54 officially recognised ethnic groups live in the Northern mountain region. The Kinh, originating from the lowlands, constitute the largest group with 2,5 million people in 1996. The Tay people (1 million in 1996) have the second largest population (Le Trong Cuc and Rambo, 1999:6). Mainly people of the Tay ethnic minority inhabit Tat hamlet. There are only a few Kinh and Muong families in the hamlet. Although residential segregation is more or less the norm at hamlet level, intermixing of different ethnic groups is a common characteristic of ethnic minority spatial distribution in the northern mountain region (Le Trong Cuc and Rambo, 1999:6). The vast majority of the villages have three or more ethnic groups in residence (*ibid.*). Tan Minh village, to which the "Tay hamlet" Tat belongs, also encompasses a "Dao hamlet", and many Muong and Kinh families.

A massive influx of Kinh migrants (the ethnic Vietnamese majority), combined with high rates of population growth among the indigenous minorities, resulted in a tripling of the population density between 1960 and 1989 in the region (Le Trong Cuc and Rambo, 1999:4). In our research site, the population growth is 3.6% over last year (Stalpers *et al.,* see part I). This is due to both natural population growth and immigration of families to Tat hamlet. Population densities calculated in terms of nutritional or physiological density are as high in the mountains as in the deltas of Vietnam, while its environment degrades more easily.

Environment

The environment of the northern mountain region has already been severely degraded due to widespread deforestation and consequently serious soil erosion and loss of biodiversity (Le Trong Cuc and Rambo, 1999:3). Changes in land cover occur, deforestation and land degradation are rapidly expanding.

Mountain agro-ecosystems in general are characterised by a low carrying capacity. This certainly applies for traditional systems of swidden farming, which are only sustainable at densities under 40 persons per square kilometre (Le Trong Cuc and Rambo 1999:4). The farmers in Tat still practice swidden farming. The current population density is 64,6 persons/square kilometre.[50]

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[50] Total surface area of Tat is 743 hectare (Rambo and Tran Duc Vien 1999: 16). The current population of Tat is 480 persons (Stalpers *et al.,* see part I). This implies a population density of 64,6 persons per square kilometre.

Therefore, the fallow periods of the swiddens have decreased below the forest regeneration minimum, resulting in severe soil erosion.

Since 1992, CRES and East-West Centre have studied the changes in economy, population (demographics and culture), and environment in Tat hamlet. When CRES started to study Tat, the lifestyle of the villagers was almost completely based on subsistence production. The Tay in Tat produced almost all of the things they needed in daily life themselves and had extremely little involvement in the larger market system. Only four years later the hamlet has become deeply involved in the market economy. The people devote much of their labour and time to the production of saleable goods and have developed a much greater dependence on manufactured consumer goods in their daily existence.

Along with the economic adjustments, changes in dress, language, and leisure activities can easily be observed, as surface signs from changes happening at deeper cultural levels like growing literacy rates, increased communication between ethnic groups and increased exposure to mass media. During our research in Tat hamlet, we saw the increased contact between Kinh and Tay reflected by the Kinh dress of the boys, the popularity of karaoke bars and the fluency in the national Kinh language among the youth. This has a slightly negative effect on the ability of the youth to speak their native Tay language according to several respondents.

This present report will provide an insight into the current features of this village economy undergoing rapid change.

2.2 Description of research site Tat hamlet

This section will give a general description of the main research site partly taken from and additional to the features described by Stalpers *et al.* (see part I) regarding demographics and income. Other sources that are used are literature, (Rambo and Tran Duc Vien, 1999: 14- 29), observations, informal interviews, and secondary data from the government.

Physical characteristics

Tat hamlet is one of six hamlets that make up Tan Minh village, which in turn is one of the 21 villages in Da Bac district, in Hoa Binh Province (see Figure 1). Tan Minh is located in the mountain and valley realm of the Northern mountain region. Tat hamlet is located along the all-weather road from Hanoi via Hoa Binh into the Northern mountain region at 300 metre elevation. Daily, a bus goes to the lowlands, transporting marketable goods and passengers. Tat hamlet lies in the watershed of the Da River. The Da River Reservoir provides the Hoa Binh Dam, Vietnam's largest hydropower project. Flooding of the reservoir in the 1980s forced about 10.000 household, mostly of the Muong ethnic minority, to relocate. Several of these households resettled in Tan Minh, of which a few came to live in Tat.

The total surface area of Tat hamlet is 743 hectare, most of which is hill slopes and mountains. Flat land is scarce. Only a few hectares in the valley floor are flat enough for the construction of wet rice fields. Paddy soils are of a fine texture and very dark in colour (Le Trong Cuc and Rambo, 2001).

In the 1960s, primary forest still covered much of the territory. At present, only tiny remnant patches survive on extremely steep and inaccessible slopes

and peaks. Hilltops are covered with secondary vegetation. Most slopes are covered with swiddens or plots that are recently left fallow covered with grasses, herbs and scattered patches of bamboo and small trees. Slopes and hillocks in non-protected areas surrounding the hamlet have mostly been cleared for planting cassava swiddens or palm tree gardens (Rambo and Tran Duc Vien, 1999: 16). Soils on the hill slopes are generally highly acidic and poor in nutrients and the soil colour varies from light grey-brown to yellow-brown to red-orange. The upland soils have fairly high clay content (Le Trong Cuc and Rambo, 2001).

The mean temperature in Tat is 23 degrees Celsius, with the average high of 29 degrees Celsius and average low of 15 degrees Celsius. The annual rainfall is 1910 mm per year of which the summer rainfall (May-Oct) accounts for 92 percent of annual total rainfall (Le Trong Cuc and Rambo, 2001).

Land use

The Tay practice so-called composite swidden, a combination of swidden and paddy farming.[51] The farmers grow paddy and swidden rice for own consumption only, and often have to buy extra rice to meet their subsistence needs.

About ten years ago, the paddy fields were redistributed among the households based on the size of the family at the time. The land has not been redistributed again since, and newcomers cannot claim any paddy fields. There is no suitable (flat enough and enough access to water) land left to make more paddy fields in the valley where the village is situated. However, since the introduction of new rice varieties, freely distributed by the government, the yields of the paddy fields have increased considerably.[52] The agricultural focus has shifted from the swidden fields to the paddy fields, although most people owning paddy fields also practice swidden farming.

At present swiddens are mostly planted with cash crops instead of swidden rice, to provide the household with extra cash. Small patches of the swidden fields are used to grow vegetables for own consumption and are planted with crops for feed. However, respondents tell that the yields of the swiddens have decreased due to the deteriorating quality of the soils. Both the cropping time and the fallow periods of the swidden fields have decreased, whereas the areas where people are allowed to make swiddens have been limited for forest conservation goals at the same time.

In the areas where the swidden fields are located individual land use rights have been granted in the 1990s, when most of the forestland was allocated to individual households under the Land Law. The government granted long-term (20 to 50 years) land use rights on parcels of barren hill slope land to individual households by issuing so called "red books". In these areas most of the swidden fields are found, and also some forest gardens. Besides, the government allocated 100 hectares of protected forestlands on hilltops to

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[51]The defining characteristic of composite swiddening is that households simultaneously manage both permanent wet rice fields in the valley, shifting swidden fields on the hill slopes, and exploit wild resources of the forest (Rambo, 1998).

[52] The new varieties need fertiliser, which is not freely distributed. Farmers can buy the fertilisers at the district on condition that they register.

households that would be paid for protection. Although it is prohibited, swidden fields are found in this area as well. Section 6.2 will go into more details about the implementation of the different land use policies.

It seems that the distribution and availability of paddy fields and other agricultural land influence the people's forest dependency. Until recently people used to hunt regularly, inter alia on wild pigs, deer, and the occasional tiger. According to the people, most forest animals have disappeared due to intensive hunting and loss of forest area. Bamboo and bamboo shoots are two important commercial non-timber forest products (NTFP). Small-scale logging also seems to be commonly practised. The main logging site is not located in Tat, but in the forest of Dieu Luong, another hamlet of Tan Minh. Although people say that the big trees of the primary forest are gone now due to swidden expansion, collecting and selling of timber and non-timber forest products are still very important income sources for the farmers in Tat. The marketing of these commercial products occurs via middlemen from the lowlands.

Home gardens provide another main source of vegetables that are also bought and collected in the forest. Fish used to be caught in the river, but the stream has become too shallow recently (probably due to soil erosion), and fish is found in the fishponds nowadays. Livestock is kept and bred as draught animals and for marketing.

Administrative organisation

Tat hamlet is organised according to the administrative model found everywhere in rural Vietnam (Rambo and Tran Duc Vien, 1999: 20). As a sub-unit of Tan Minh village, it is under the authority of the Village People's Council, People's Committee, and Party Organisation. These organisations are responsible for local implementation of national policies. A hamlet leader and vice leader are responsible overseeing the day to day administration of the hamlet and reporting to the Village People's Committee. All these local authorities reside in one of the hamlets that constitute Tan Minh. The Forestry Office and Land Office are responsible for the land allocation policies.

Tat is economically the most developed hamlet of Tan Minh village and the administrative and economic centre. The inhabitants of Tat hamlet have relatively good access to public services compared to inhabitants of the other hamlets, because the village headquarters is located in Tat (Rambo and Tran Duc Vien 1999: 21). In addition to the People's Committee offices, there is a tax office, a post office, a health clinic, a pharmacy and the bus station. Given the central economic, political and social position and the fact that the people of Tat hamlet are regularly exposed to researchers for instance, it seems like the inhabitants adapt innovations more easily. Several leaders and farmers mention this as a positive characteristic.

Social Organisation

The household is the main unit of Tay society. In former years, recurrent festivals bound families together on the village social level, but these traditions are less followed at present. The household is responsible for the organisation of labour, the use of resources and accumulation of capital (Rambo and Tran Duc Vien, 1999: 20). Most households encompass the nuclear family, in some cases a widowed parent lives with the youngest married child. The tradition for a newly married couple to live with the bride's

parents for a few months or years is still in practice. In this period, the new couple accumulates resources to establish their own household, and the groom fulfils his obligations to his father in law.

The formation of new household places pressure on the natural resources of Tat, to supply building materials and to provide land for new fields (Rambo and Tran Duc Vien, 1999: 20). The Tay used to build houses on stilts traditionally, constructed of large timbers from the forest and thatched with palm leaves grown in palm tree gardens. At present, most new houses are built on the ground in Kinh style.[53] Due to deforestation, there are no more large trees for pillars to support the traditional Tay-style house.

Gender

Gender is one of the main differentiating factors in the internal social organisation of Tat hamlet (Rambo and Tran Duc Vien 1999: 20). Only men speak in public meetings. Men likewise occupy all leading positions in government bodies. Gender is also the basis of division of labour within the household. During our research, we saw many examples. Men do the land preparations in the paddy and clear and burn the swidden fields. Women transplant paddy seedlings and sow the swidden fields. Weeding is also a typical women task. Women primarily do harvesting of the paddies while men carry the rice bundles back to the houses. Women harvest the swidden and carry the products down from the hills to their houses. This is extremely heavy work, a basket filled with products weights up to 35 kilos, which nearly equals the body weight of the women (Stalpers *et al.,* see part I). Collecting of NTFP, like broom grass and bamboo shoots is mainly done by women, while logging is only done by men. Young boys tend buffaloes and cows, girls care for smaller livestock. Women and girls do all domestic tasks.

During our interviews many women complained about their heavy workload and their lazy husbands. From our observations, we indeed got the impression that women work longer days and have substantially less leisure time. Both men and women have many agricultural tasks. However, men are responsible for the short term, extremely physical demanding tasks such as clearing swidden and ploughing the paddies. Women, on the contrary, are responsible for many time consuming, continuous, repetitive tasks as weeding, food collecting and preparation, cleaning etc. Besides, both men and women perceive the maintenance of the swidden field, which only women do, as very physically demanding. Men have leisure time at lunch or around diner for example, while women prepare food, cook, and do the dishes. Moreover, most men attend many social gatherings, meetings, and parties while women stay at home to look after the children. During our four months of research we have witnessed and attended many parties and social festivities with only male participants. Wedding parties and parties hold to thank exchange labourers are an exception, but women do not drink alcohol and go home early whereas most men stumble home drunk at midnight.

Cultural characteristics

Most of the inhabitants of Tat belong to the Tay ethnic minority. The Tay are the largest minority population in Vietnam. However, the Tay of Tat hamlet are culturally and linguistically quite distinct from the main body of Tay. The

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[53] See also Table 12 in Stalpers et al., see part I.

Tay of Tat belong to a smaller, geographically isolated Tay population, that live only in Hoa Binh province, primarily in Da Bac district (Rambo and Tran Duc Vien, 1999: 17). Cultural characteristics of the Tay are changing under the influence of the dominating Kinh culture. Some examples of this influence are easy recognisable in the dress code and the language of children.

Almost all men and children in Tat fluently speak the national Kinh language. Women have more difficulties with the national language. Women hardly come outside the village, and between neighbours and the family, Tay is the common language. In addition, only men speak in public or with officials using the national language. In the primary and secondary school, the pupils are taught in Kinh. The children are fluent in Kinh from an early age. Parents told us that they encourage their children to learn Kinh, because of the importance to communicate with government officials and traders. However, some parents regret the side effect of fluency in Kinh, namely the decreasing ability to understand Tay or related languages.

Another, slowly changing, cultural characteristic is clothing. Women still wear traditional clothes. The women are dressed in black tubular skirts with a woven waistband in a bright colour green, pink or red. On top of that, they wear form fitting long sleeved blouses in pink, green, blue or white cotton. On their heads, the women wear headscarves in, again, very bright colours like pink, red, green, blue or purple. Men and children dress like contemporary Kinh, consisting of trousers and shirts. Respondents said that more and more adolescent girls continue to wear Kinh style clothes instead of the traditional women clothing.

3 Swidden farming as problematic activity

This chapter describes the decision making processes of the farmers in Tat in relation to the identified problematic activity of swidden farming. First, the general motivational factors identified during the research will be described. Then, a general picture of swidden farming follows. Next, the main types of swidden crops, i.e. swidden rice, canna, cassava, ginger and vegetables, are explored. In the next chapter, the other implementable and potential options are described and analysed. Following the causal lines of the AiC framework, the structural and cultural factors influencing the behaviour of the actor will be explored subsequently. Terms and remarks that specifically refer to the AiC toolkit are often put in brackets throughout the main text.

3.1 Motivational factors

Options, in the AiC scheme, are a list of possible actions considered by the actor as being connected with an objective of the actor (De Groot and Hobbes, 2001:10). Actors choose between the options on basis of several motivational factors. Motivations consist of a dimension and quantification. The dimension is qualitative and tells us what is important about an option. The quantification of the dimension tells where the actor places the option along the dimensional axis. On basis of interviews with the respondents, we distinguished several motivational factors, which are connected to all options.

Decision-making processes related to land use will in first instance be identified on the economic (motivational) dimension of returns-to-land or returns-to-labour. Economic returns are in general, and as appeared during

the research, the most decisive motivational factor for actors to choose for an option. The distinction between returns to land and labour is valuable to understand the production decisions of (subsistence) farmers. Do farmers choose between options in terms of the highest returns of rice, no matter how much time it takes, or the highest returns, in terms of money or calories per hour? Next to the quantitative motivations of *returns-to-land* or *returns-to-labour*, quantitative motivations of *'investments', initial or maintenance* and *no risk* (of loosing investments) were the major considerations the respondents pointed out.

A qualitative motivation that the farmers consider is *no hardship*, which means no high physical demands, risks or other inconveniences.

The motivational factor "*Connection*" is divided into material and time.[54] The respondents often stressed the importance of efficient use of time and materials. People combine different activities in order to "*make extra money in spare time*" or "*not to waste any materials*". Respondents, for instance, decided to raise chickens because it just takes some minutes after breakfast and before dinner. The same motivations are connected to raising ducks. Furthermore, the season when ducks are raised is chosen with the motivational factor "*material connection*". After the rice harvest, the paddies are studded with loose rice grains. Many respondents consider it a waste if the remaining seeds are left to rot on the fields. So, people buy ducks and send them into the paddies to feed themselves. Cultivation of cassava is another example of material connection. Although the productivity of cassava is low due to soil degradation, cassava is widely grown. People refer to *material connection*, because cassava can be eaten, fed to pigs, and the remains can be dried and sold.

People also said they preferred some activities to other activities because of the fun of working together with other women for instance.

The motivational factor *"food quality"* encompasses the taste, smell, and size of the food item and the use of chemical pesticides. Many respondents fear the excessive use of chemical pesticides on products bought in the shop. Food variety is valued by the respondents saying that the diet of the farmers can be dull.

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[54] The connection motivational factor is strictly speaking not a motivational factor because of two reasons. (1) It implies double counting because the returns-to-labour motivational factor already includes the time connection factor. If actors consider the time factor as very important, we could put more or less weight on the hardship factor. (2) The material connection results in situations where people only consider options in combination with a specific other option. Thus, one option is ultimately linked to the other that serves as precondition. For this reason we could for instance ignore the separate option "ducks", and instead focus on the combined option of "paddy and ducks" as ducks on their own are never considered as option on its own. Despite these considerations, we decided to use the time and material connection factors for analysis in this report. In this way, the importance the respondents give to the connection factor is shown most explicitly.

3.2 Swidden farming

3.2-1 General description of swidden farming

Motivations for swidden farming

The Tay of Tat hamlet have traditionally practised so called composite swidden farming, a mixture of swidden and paddy field farming. Self-sufficiency in rice production is a goal of all farmers. Since many swidden fields are not fertile enough for rice production anymore, people plant cash crops like canna, ginger and cassava on their swidden fields to provide income to buy rice. People plant vegetables to provide extra food sources as well, while cassava is also consumed and used as feed for pigs.

Sixty-four percent of the households in Tat cultivate swidden fields (Stalpers *et al.,* see part I). In February or March, the fields in the regenerated forests are cleared to be burned in March or April. People said that clearing the field is the hardest work because they have to cut down many trees manually. Then, the men make or repair fences and ditches to protect the swidden field from (wild) animals. Men usually also help or take the responsibility for clearing and burning the swiddens. Women have the responsibility over the complete production cycle in the swidden; swidden farming is mostly women work. The planting, weeding, and harvesting is done by women. The men only help with the swidden rice harvest. All other products are carried down by women, in headband baskets weighting up to 35 kilos, which almost equals their bodyweight.

The high physical demand of swidden farming forms one of the reasons why women do not like swidden farming. Climbing steep hills and carrying heavy baskets with products down entail risk of accidents and catching diseases (m*otivational factor: no hardship).* Women consider weeding as very hard work and much harder than weeding the paddy field for instance. They said that weeding the swidden is so difficult because there are many tree roots left and grass is bigger and tougher than in the paddy.

Another important reason for the dislike is the low efficiency of the swiddens. The poor quality of soils results in low labour productivity; the women work long days for yields that are not enough to fulfil subsistence needs (*motivational factor: returns-to-labour).*

Thirdly, the swidden fields are far away from the village. People usually go there for the whole day, which makes it difficult to combine working on the swidden with other work and taking care of children, who come home for lunch during school days (*motivational factor: time connection).* During the whole production process, women go to the swidden to check the field. Women spent most of the time on the swidden, sometimes together with one or more of their children or with other women in exchange labour. However, the long distance from house to field makes it difficult to check on the swidden regularly. Broken fences or first indications of pests often go unnoticed, and the risk increases that freely grazing buffaloes and cows in the forest, or mice will ruin the fields *(motivational factor: risk).*

The last demotivational factor for swidden farming is the drop in the amount of women doing swidden work. Nowadays, fewer women are doing swidden work so (1) there are less helping hands (there is less exchange labour for swidden than there is for paddy), and (2) less women to have fun with (Exchange labour is a kind of collective social capital, a micro-structural

factor. This case shows that the institution of exchange labour still exists for the paddy fields. However, for the swidden fields the institution is not well working anymore since fewer women practice swidden farming nowadays. The focus of agriculture has shifted to the paddy fields and working on the swidden fields has become more fragmented. The lack of fun making on the swidden fields between women is also related to this as a micro-structural factor. At individual level, this leads to a negative interpretation of the objectified motivations for swidden farming. The lack of exchange labour obviously has a negative effect the autonomy component).[55]

Structural factors

There seem to be four major forces driving the motivational factors, namely population growth, government policies and limited access to the market and credit facilities.

Population growth is one of the causes of land shortage. In response to land shortage, the fallow periods of the swiddens have been shortened. This, in turn, has led to deterioration of forest and soils and consequently to low labour productivity. The government tries to save the remaining forest and re-green the uplands by implementing a forest protection policy. Consequently, even less suitable swidden land is available. To relieve (some) pressure of the forest, the government has also started an agricultural program to increase the paddy yields. New varieties, techniques and chemical fertilisers have been introduced and farmers are very eager to intensify the paddy production. Farmers in Tat say that the paddy yields have increased indeed. A shift in focus from forest activities (swidden farming and collecting vegetables) to paddy farming and more commercially oriented activities (having a shop and breeding livestock) is visible.

However, swidden farming is not completely abandoned in favour of paddy farming. One major limitation is the shortage of paddy fields. Another important constraint is that the access to product markets is strongly mediated through the monopoly of middlemen. In addition, access to the capital market is quite weak. Because of these limitations, which will be described in detail later, the people in Tat still largely depend on the forest, in terms of practising swidden, collecting non-timber forest products or logging for cash income.

3.2-2 Swidden rice

Rice is the staple food in Tat, as in the whole of Vietnam. The Tat inhabitants eat rice three times a day, and a meal without rice is considered incomplete. The people of Tat hamlet prefer swidden rice, both the sticky and normal varieties, to paddy rice. The taste and smell of swidden rice is said to be better than of paddy rice (These two factors can be regarded as cultural influences. Food is not only measured in nutritional value. Rice is interpreted as a necessity, being the staple food crop in Vietnam, and the quality of rice that is consumed is highly valued).

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[55] Social resources: (equivalent to) individual social capital: the sources you can access by virtue of membership of social networks (thus including the things you can get or borrow from friends, etc).

Swidden rice fields are traditionally made on the fertile soils of newly cleared old forest. Therefore, this type of farming contributes considerably to the deforestation of the last patches of old secondary forest. Since the ban on clearing old forest for swidden cultivation, rice swiddens have been developed on the last most fertile available swiddens on the regenerated forest lands. Despite the ban, rice swiddens are still made in old secondary forest as well. A well-informed respondent estimated that 30 percent of the households in Tat do not obey the regulation on swidden farming. Table 2 displays the timing of main activities for swidden rice cultivation.

February/March	Clearing regenerated forest
March/April	Burning
April	Sowing rice seeds (and vegetables)
May	Weeding 1
June/July	Weeding 2
September	Rice harvest

Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 2: **Main activities for swidden rice cultivation**.

Swidden rice farming is in decline. All our respondents predicted the strong decline or total extinction of this type of farming. The farmers base their prediction on several observations. The first is that the distances from house to fields in the old forest are becoming too large *(motivational factor: no hardship, time connection)*. The fields are difficult to reach and consequently difficult to protect against damage by cattle or pests *(motivational factor: no risk)*. Furthermore, soil fertility in all swidden fields is declining rapidly. The productivity of rice swidden is thus very low, especially in comparison with paddy fields *(motivational factor: returns to labour*). Table 3 shows the calculations of the returns to labour of swidden rice cultivation of three households.

Thus, although swidden rice is preferred over paddy rice for its high quality, the farmers have stopped or reduced swidden rice production to a minimum. On the contrary, cultivation of cash crops on the swiddens is rising. The three main swidden crops are cassava, canna, and ginger.

Hh	Costs rat poins on (VND)[3]	Cost converted to kg rice (kg/crop)[3,4]	Seeds (kg/crop)[3,5]	Gross production (kg/crop)[3,5]	Net production (kg/crop)	Labour (hours /crop)[6]	Returns to labour (kg/day)[7]	Returns to labour (VND/ day)[7]
1 (1) [2]	12,000	4.4	15	50	31	150	1.6	4406
1 (2) [2]	12,000	4.4	15	300	281	344	6.5	17619
2	1,000	0.4	15	240	225	378	4.8	12834
3	0	0	12	240	228	586	3.1	8404

[1] Data on sizes of the swiddens are missing. Respondents had difficulty estimating the size of the swidden areas, and some people tried to calculate the size on basis of the amount of seeds they planted. This implies that it would not be meaningful to calculate the returns to land, even if we would have adequate data, because it directs towards a complete returns to labour calculus for swidden farming.

[2] Household 1 is included twice: the respondent said that the last crop was not good (30 cum), while a good harvest yields about 200 cum. The resulting difference in time use is calculated on basis of extra harvest time the 250 kilos would take.

[3] Inputs and production taken from data base MFA

[4] Since people never sell swidden rice, we take a shadow price of 2,700 VND per kilo, the price paid for paddy.

[5] Converted from cum to kg: 1 cum is about 1.5 kilos.

[6] Sources: household interviews by Le Thi Thu Thanh and Kooijman (2001).

[7] Assumed is that eight working hours constitute one working day.

Table 3: **Returns to labour of one swidden rice crop of 3 households**. [1]

3.2-3 Canna

Canna is a relatively new cash crop that people have cultivated since four years. Previously, canna was grown in small amounts for feed only. Since the completion of the road to Tat, and the government project for canna noodles, people have grown canna on larger scale. Traders *(tertiary actor)* come to Tat after the canna harvest. They load the canna collected by middlemen (*secondary actor*) in Tat. The trader then sells it to one of the government owned noodle factories (*quaternary actor*).

In February, old swiddens are cleaned and canna is planted. People say that growing canna is harder work than any other swidden product, because it needs three times weeding (May, July and August), but especially because the harvest (November or December) is difficult and time consuming work (digging and pulling out the canna root), and because the transport of the products down from the fields is physically demanding and dangerous (*motivational factor: returns to labour and hardship*). Nevertheless, the women swidden farmers prefer canna to other cash crops such as ginger and cassava. The market prices are relatively high, 3,000 to 3,500 VND per 10 kilo at the time of the research, and the investment costs are low compared to ginger (*motivational factor: returns to labour*). However, changes in canna cultivation can be observed. A recent drop in prices, combined with the decreasing soil quality and consequently decrease in yields, has made several women decide not to grow canna during the time of the research. If prices would go up again, they would like to continue the canna production.

However, all respondents predicted the decline of canna cropping because the soils will further deteriorate, by which the canna will be of low quality. Consequently, the prices will drop too low for canna being a profitable crop. These days, the returns to labour for canna are low, as is shown in Table 4 with an average of about 7,000 VND per day.

House-hold	Planting canna (kg)	Gross production (kg)	Net production (kg)	Net production (VND)[3]	Labour input (hours)	Returns to labour (VND/day)[4]
1	50	400	350	87,500	129	7,054
2[2]	450	2,000	1,550	387,500	664	6,069
2[2]	450	3,000	2,550	637,500	792	8,371
3	100	1,100	1,000	250,000	293	8,874
4	250	500	250	62,500	123	5,285

[1] Data on sizes of the swiddens are missing. Respondents had difficulty estimating the size of the swidden areas, and some people tried to calculate the size on basis of the amount of seeds they planted. This implies that it would not be meaningful to calculate the returns to land, even if we would have adequate data, because it directs towards a complete returns to labour calculus for swidden farming.

[2] Household 2 is included twice: the respondent said that the last crop was not good (2000 kilos), and that she normally harvests about 3 tons. The resulting difference in time use is converted linearly on basis of extra harvest time that the 2,500 kilos will take. The argumentation is that time use on clearing, sowing, and weeding will remain the same, while harvesting and transportation of canna is hard work highly depending on the yield (average of the respondents is 10 kg per hour, with a minimum of 5 and a maximum of 16 hours per kilo).

[3] Selling price is 3,000 to 3,500 VND per 10 kilo. Here we take 325 VND/kilo.

[4] Assumed is that eight working hours constitute one working day.

Sources: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 4: **Returns to labour of one swidden canna crop of four households**.[1]

3.2-4 Cassava

Cassava is used as snack, feed and in last place as cash crop. Cassava forms the biggest swidden crop (in kilos) in Tat (Stalpers *et al.,* see part I). In the past cassava was grown to complete subsistence needs, being eaten as staple with rice, and as feed for livestock. As paddy yields are rising, the proportion of cassava in meals is decreasing (*motivational factor: prestige*). Cassava is primarily eaten as snack nowadays. With the rise of livestock breeding, especially pigs and ducks, the importance of cassava as feed has grown. Cassava is not preferred as cash crop because of the very low returns to labour, as is shown in Table 5. The average of the returns to labour of these 4 households is about 6,000 VND per day.

The prices for dried cassava are little higher (*motivational factor: returns to labour*). Cassava surplus, i.e. the remaining after eating and feeding, is therefore usually dried and sold.

House-hold	Yield (baskets)	Yield (kg) [2]	Time use (hours)	Net production per day (kg)[3]	Net production per day (VND) [3,4]
1	20	600	104	46	9,231
2	9	270	128	17	3,375
3	20	600	129	37	7,442
4	8	240	94	20	4,085

[1] Data on sizes of the swiddens are missing. Respondents had difficulty estimating the size of the swidden areas, and some people tried to calculate the size on basis of the amount of stems they planted. This implies that it would not be meaningful to calculate the returns to land, even if we would have adequate data, because it directs towards a complete returns to labour calculus for swidden farming.

[2] One basket cassava root is 30 kilos (Stalpers, 2003)

[3] Assumed is that eight working hours constitute one working day.

[4] If cassava is sold, it brings between 1,800-2,200 VND per 10 kilogram. Here, we take a shadow price of 200 VND/kilo.

Sources: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 5: **Returns to labour of one swidden cassava crop of 4 households**. Assumed is that all cassava is sold.[1]

Most respondents mention the multiple purposes of cassava as an advantage of the crop *(motivational factor material connection).*

To produce cassava, cassava stem cuttings of the previous harvest are planted, by which the investment costs are zero. Another advantage is the ability of cassava to grow in relatively poor soils. After rice and canna have consecutively grown on the same plot, cassava can still grow in the depleted soils. However, the roots are of lower quality than when grown on richer soils. Thus, some households clear regenerated forest to make a cassava field. The cleaning or clearing is done in January or February and the cassava is harvested in October or November. Comparing swidden cassava to other swidden products, women say that cassava is the easiest to cultivate. Not much grass grows on cassava swiddens by which it does not need weeding often, sometimes just once. Besides, the cassava plants are not dense by which it is easy to weed. Crop failure is rare and cassava does not need much care to grow. The harvest is easy. However, the transportation of the harvest

back home is difficult and damage by cattle on the field happens quite often (*motivational factor: no risk*). Therefore, some people make a fence to protect the swidden. For cassava, the respondents predict a further decline in production due to soil degradation, as is the case for swidden rice and canna.

3.2-5 Ginger

Ginger is a relatively new cash crop cultivated since four years, like canna. Ginger used to be grown for own consumption only. According to the farmers, Japanese traders came to Tat when the dirt road was finished and ordered ginger. Unfortunately, we were not able to trace these traders. Traders in Ha Dong, the large market and suburb of Hanoi, order ginger. Middlemen put relatively small quantities, up to 3 bags of 50 kilos, on the bus. After the harvest, the trader comes to Tat to collect larger amounts.

Ginger is often mixed with corn or canna. Ginger is planted in January or February for which people clear a new field or, in case when ginger is mixed with another crop, just clear grasses. People usually weed one or two times. The women harvest ginger somewhere between July and September, depending on the time of planting and whether the market prices are considered high enough. Table 6 shows the returns to labour of one ginger swidden crop.

During the first years the prices of ginger were very high (between 50-70,000 VND per 10 kilos). The prices of the seedlings were high as well, but good profits could be made. Many households started to grow ginger. (*motivational factor: returns to labour*). Gradually, in pace with soil exhaustion, the quality of the produced ginger decreased. The prices dropped as well. These days, regular prices are between 13,000-15,000 per 10 kg, depending on the quality. A few households have now given up ginger production because of expected non-profitability. Other households still grow ginger, speculating on the storage capacity of ginger. Harvest can be postponed for one year, in expectation of rising prices (*motivational factor: no risk*). Nevertheless, comparable to the other swidden products, respondents predict a fall in ginger production, because the soil quality will become too low.

House hold	Gross production (kg)[2]	Net production (kg) [2]	Net production (VND)[3]	Labour input (hours)	Returns to labour (VND/day)[4]
1	60	40	56,000	52	8615
2	245	140	200,000	299	5351
3[1]	60	50	70,000	110	5091
4[1]	120	80	112,000	109	8220

[1] Household number 3 and 4 stressed that this was a bad crop, destroyed by insects.

[2] The ginger seeds are saved from the previous harvest (causing the difference between gross and net production).

[3] Selling price is 13000-15000 per 10 kg. Here we take 1400 per kilo.

[4] Assumed is that eight working hours constitute one working day.

Sources: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 6: **Returns to labour of one swidden ginger crop of three households**.

3.2-5 Vegetables

Most women mix cash crops with small amounts of vegetables on the swidden. These vegetables (like cabbage and green papaya) are for own consumption.
Some women from the large paddies actor category said to prefer vegetables from the shop to self-grown vegetables. The possibility to choose from a broader scope of varieties outweighs the extra costs (in terms of money) of buying in the shop *(motivational factor: food variety).* An explanation could well be the time saved, as respondents often say that it is much easier to buy vegetables in the shop *(motivational factor: returns-to-labour).* Other respondents with large paddies prefer self-grown vegetables to shop vegetables for health reasons. They are bored with eating the same vegetables every day, but their fear of harmful chemicals on shop vegetables prevents them from buying the vegetables *(motivational factor: food quality*). Most respondents with small or no paddy fields do not buy many vegetables because they cannot afford it. However, the risk of poisonous chemicals on vegetables from the shop or market was a common fear as well.

The risk of cattle destroying the swidden vegetables is as high as for all swidden crops. If a household practises swidden farming, they usually grow some vegetables in their swidden as well. It takes a little extra time and after the long walk to the swidden, it is efficient to do as much as possible in the field (*motivational factor: time connection*). Besides, the leaves of the vegetables are used for feed.

3.2-6 Discussion

In the past, the agricultural focus of the Tay had always been on swidden farming. In recent years, this focus has shifted to paddy farming. However, the tradition of swidden farming being an accustomed part of the Tay's farming system, makes it to many women natural to practice swidden farming. Although swidden farming has always been an important form of land use in Tat hamlet, swidden cash crops are a relatively new phenomenon. Cultivation of swidden rice is in decline because the agricultural focus shifted to paddy production and the soils of the swidden fields do not have sufficient fertility anymore for good yields. The increase in cash crop production (canna, ginger, and cassava) has started since the construction of the road four years ago. People often use the money to buy rice.

The contemporary decision-making processes of the farmers for the different swidden crops appear to mainly depend on profitability, without any capital investments. These factors, although the land production is in decline, still outweigh the hardship and the negative time connection of swidden farming for many people. Table 7 shows the motivational factors that people valued on the different swidden products.

	Rt land	Rt labour (VND per day)	Inves-tment		No Risk	No Hard-ship	Connection		Fun	Food	
			Initial	Mainte-nance			Ma-terial	Time		Qua-lity	Variety
Rice	?	10,000	+	+	-	-	-	-	0	++	++
Canna	?	7,000	+	+	-	--	-	-	0	n.a.	n.a.
Cassava	?	6,000	+	+	+	-	+	-	0	0	+
Ginger	?	7,000	-	+	0	-	-	-	0	0	0

Explanation of qualifications: na = not applicable, 0 = neutral, + = positively corresponding with the motivational factor, - = negatively corresponding with the motivational factor.
Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 7: **Motivational factors for swidden crops** (all combined with vegetables).

Swidden rice is the first crop on the swidden grown for subsistence purposes. When rice cannot grow (anymore), people usually plant canna as a cash crop. Cassava can still grow when other crops cannot grow anymore on the depleted soils. Cassava is popular for its multipurpose use: feed for the pigs, snack and the remainder is sold. The prospects of swidden farming are not good. There is a reduction of amount and quality of yields, caused by deteriorating quality of the soils (reduction of fallow periods). This is, in turn, is caused by land shortage (forest conservation zonation and population growth). Besides, there is a high risk due to unstable market prices. Finally, the competition between swidden and the increasing amount of livestock is growing, because the latter often destroy swidden crops.

Chapter 6 will discuss the structural factors of population growth, government policies and market in more detail. First, other implementable and potential options that already form important livelihood activities for many people will be explored in the next chapter. People say that they would prefer to generate more income from other sources in order to reduce or stop doing swidden.

4 Other implementable options

Swidden farming is identified as main problematic activity because it leads to soil degradation and deforestation in Tat hamlet. To gain insights in the interplay between all livelihood activities, this chapter will explore and analyse the other main livelihood activities. The first section describes paddy rice farming that forms a major food source and preferred income source, which scope is restrained by several factors however. Next, more details are given on the incomes gained by collecting of non-timber forest products that the MFA research identified as "unsustainable flows" as well. Keeping cattle, pigs, and poultry, form relatively new income sources that may compete with swidden farming. Logging, leading to deforestation, still provides an important income source for many households, although there is not much quality forest left. Being a middleman and work in services form more wage oriented income sources. The potentials and constraints of the activities will be described, and the various motivational factors identified. In this way, the preferences for the activities can be compared among each other and with swidden farming. The next chapter will deal with potential options; activities identified and already carried out by some people that people could do

instead of swidden farming if they would have the resources and motivations. Terms and remarks that specifically refer to the AiC toolkit are often put in brackets throughout the text.

4.1 Paddy

The traditional focus of the Tay people was on swidden rice farming. During the last few years, this focus has shifted to paddy rice farming. This holds for households that have a paddy field (85 percent of the households), but for many of these the limited access to capital is a restriction to intensify paddy production with use of chemical fertilisers, high yielding varieties, etc (autonomy factor: lack of capital). People say that due to land shortage the cultivation of paddy is for most people not enough to meet their rice needs (physical autonomy factor: lack of suitable land). For people who do not have a paddy field, intensifying paddy production is not even an implementable option. People said that if they would had sufficient paddy to complete their subsistence needs, that they would like to reduce or stop swidden farming. All the motivational factors mentioned for the swidden fields apply to the paddy fields as well.

Although everyone prefers swidden to paddy rice because of the taste and smell (*motivational factor: food quality*), most of the rice is produced on paddy fields. However, lack of capital prevents most farmers to shift to optimum intensive farming. People say that intensive paddy farming requires high yielding rice varieties, chemical fertilisers (next to the manure they use) and pesticides, and that many farmers lack money to buy enough fertilisers or pesticides, while some have no money for chemicals at all *(motivational factor capital for initial and maintenance investment)*. We have spoken to 3 households who had lost 40 to 50 percent of their crop due to mice or insects *(motivational factor: no risk)*. Farmers who spray in advance, indicate crop damages of 10-20 percent. These farmers say that preventive spraying works if done regularly. To spray the crop when it is already infected will reduce the damage only if it is done in the very early stage of the infection, according to the respondents. Spraying two or three days later, the time that is usually needed to arrange the money by collecting and selling NTFP, is not considered very effective.

All farmers would like to have large paddy fields, at least to ensure a stable rice supply. The cultural preference for rice, the drastic decrease in swidden rice yields, and government programs promoting paddy farming, contribute to the overall popularity of paddy rice. Paddy farming is also preferred as source of income. Several farmers said that if rice production would greatly exceed the food requirements of the family, they would like to sell paddy rice. They would like to spend the revenues on investments (fertilisers and equipment) to increase the paddy production (*autonomy factor: lack of capital to make investments, which is related to the potential option to intensify paddy production. If people would have the capital to make investments but not choose to spend the money on intensifying the paddy production, then the "intensify paddy production" would be an implementable option).* We have not met any farmer in Tat who actually sold rice. One household, consisting of five persons, had a surplus production of 100 kilos last year. All of it was saved for the next year in case the paddy yields would be less. Many respondents said that they would reduce or stop doing swidden as soon as the paddy yields would be sufficient to feed the family throughout the year. If

the necessity to earn money to buy rice has faded, swidden would be the first income source to be abandoned.

Paddy farming is regarded as easy because it is physically less demanding work than swidden farming while the labour productivity is much higher. Paddies, in general, are closer to the farmer's house than the swiddens *(motivational factor: no hardship and returns to labour)*. The short distance enables the farmer to go back home at noon for lunch and a siesta. This is highly appreciated by the farmers (*motivational factor: no hardship).* Work in the paddy is also easier to combine with other activities such as a having a shop or making wine, or taking care of children especially when they return home from school for lunch (*motivational factor: time connection)*. Paddy has a good material connection with livestock. Livestock is used as draught power and the manure is used on the paddy, while ducks eat the left over husks of rice plants. Table 8 gives an overview of how the identified motivational factors score on paddy production, by putting a relative weight on the motivations.

	Rtland (kg/ha)[1]	Rtlabour (VND/day)[1]	Investment		No Risk	No Hard-ship	Connection		Fun	Food	
			Initial	Maintenance[2]			Material	Time		Quality	Variety
Paddy	2,800	28,000	--		0	+	+	+	+	+	+

Explanation of qualifications: na = not applicable, 0 = neutral, + = positively corresponding with the motivational factor, - = negatively corresponding with the motivational factor.

[1] Table 10 displays the calculations of the returns to land and labour of one crop. Here, the averages are shown and rounded off.

[2] Maintenance costs are included in the returns to land and labour.

Sources: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 8: **Motivational factors for paddy cultivation**.

Table 9 shows the seasons wherein the main activities of the main paddy crop take place. Ploughing and harrowing is done twice and people consider it as hard working done by only men that organise exchange labour. In the meantime, the nursery is sowed to be transplanted after 15 days. Bunds are made by men and women together as well as fertilising the fields (chemical fertilisers and manure). Men spray pesticide, and apply rat poison, while women look after the activities of transplanting, weeding and harvesting. Women said that transplanting and weeding are not so much hard work, but that these activities easily cause pain in the back. For these activities the women arrange exchange labour which they appreciate for the fun making among the women.

Regular checking of the field during the whole production process is done by both the owners of the fields. The man looks after transportation and usually arranges exchange labour for this task. The main crop yields slightly more than the second crop on average. The average yields are between 2500 to 5000 kg per hectare with an average of about 3500 kg per hectare per crop (source: calculated from MFA data base).

Returns to land and labour of paddy production

Table 10 gives an overview of all the costs and benefits of the main rice crop of eight households who already had a rice field in use (thus the extra investment costs in developing a new rice field (and consequently less need for fertilisers) are not included).

Harrowing 1	April or May
Harrowing 2	May (some households)
Make bund	May
Harrowing 3	May or June (some households, when new paddy)
Fertilising (manure)	May or June
Transplanting	May or June
Fertilising (N and /or K)	some households
Pesticide 1	June or July (all households)
Pesticide 2	July (some households)
Weeding 1	June or July (all households)
Weeding 2	July (all households)
Protect from mice	August (all households)
Harvest	August
Transport	August
Checking	whole production process
Drying & Packing	

Sources: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 9: **Season of main activities during main paddy crop**.

Table 10 shows that the average of total input costs is on average about 1,300,000 VND per hectare, which is huge amount considering that the people in Tat have to find this in activities like making swidden or collecting and selling NTFP (paying for the inputs through NTFP work (@ about 20,000 VND per day) requires 65 days of that work).

The average net production is about 2,800 kg/ha per cropping. Probably farmers pay good attention to the gross production, which would be about 3,200 kg/ha per crop, because all the rice is consumed and the money invested in the rice field is not paid with the returns of the rice field but with other sources of income. Although it is obvious that farmers strive to maximise their production with a returns to land calculus, especially since the production does not fulfil the subsistence rice needs at the moment, farmers expressed their wish to sell rice in the future as important income source. At this moment, the average returns to labour is about 28,000 VND per day.

HH	Area field (m^2)[1]	Yield (kg/ha)[2]	Labour (hrs/ha)[3]	Total input costs (VND/ha)[4]	Costs converted to kg rice/ha[5]	Returns to land (kg/ha)	Returns to labour (kg/day)	Returns to labour (VND/day)[5,6]
1	720	2,778	3,785	1,895,833	702	2,076	4	11,846
2	1,600	3,125	1,450	706,250	262	2,863	16	42,655
3	1,100	3,409	1,814	1,072,727	397	3,012	13	35,870
4	1,000	3,800	1,968	1,321,000	489	3,311	13	36,347
5	2,000	4,000	1,858	1,095,000	406	3,594	15	41,798
6	1,200	3,750	2,696	1,090,000	404	3,346	10	26,812
7	700	2,500	2,798	1,585,714	587	1,913	5	14,766
8	790	2,532	4,148	1,329,114	492	2,039	4	10,619

[1] Source: MFA household questionnaire

[2] Average of both the first and second crop are taken.

[3] Labour includes all the hours of labour spent on the main activities as shown in Table 9 and are converted linearly to hectares. Part of the labour is exchange labour (it can be regarded as family labour, because it is exchanged).

[4] Total input costs are converted linearly to applications per hectare, including: insecticide, rat poison, chemical fertiliser, seeds and transport costs of buying these good (seeds and chemical fertilisers are bought from the bus driver or in a shop in Tat, or from the hamlet leader or in market in Tuly (petrol costs for a return trip by motor bike are 10000 VND).

[5] Shadow price for rice is taken (it is now only used for subsistence purposes). When people buy rice for wine making, they pay 2,700 VND per kilo (source: Trinh Khanh Chi). The same amount shows up when comparing the statements that "one chick costs 10,000 VND", and that a respondent "exchanged 5 cum (~1.5 kilos) rice for two chicks".

[6] Assumed is that eight working hours constitute one working day.

Sources: Household interviews by Le Thi Thu Thanh and Kooijman, combined with results MFA household questionnaire (Stalpers, 2003)

Table 10: **An overview of the returns to land and returns to labour** of one hectare of paddy rice per cropping of eight households in Tat hamlet in 2001. All households have two croppings a year.

According to most respondents, the paddy yields have doubled in the last 5 to 10 years. In the future all respondents predict a rise at the same rate. The respondents expressed their trust in the scientific developments in new rice varieties and appropriate chemical fertilisers. They hope that the government will provide them with new and improved high yielding varieties and chemicals, whenever scientists have come up with something new. In addition, the farmers said that the government should organise training courses teaching the proper techniques that go along with new varieties. In the desired future all respondents hoped for yields at least trice as much than at present. We have no data on sustainability issues of this intensification process, which is of course crucial for future yields.

4.2 Collect and sell non-timber forest products

Collecting and selling of non-timber forest products (NTFP) form an important source of daily income in Tat. The most popular products are bamboo shoot, bamboo, palm leaves, broom grass and plant roots. The MFA research shows that 69 percent of the households collected bamboo (7 percent for own use, 14 percent for selling and 48 percent for both own use and selling) and that 86 percent of the households collected other NTFP (Stalpers et al., see part I). Collecting has become popular since the completion of the road to Tat, when better transportation encouraged traders to order products.

Palm leaves and broom grass are sufficiently available in the territory of Tat hamlet (see also Stalpers *et al.,* see part I). Because there are not enough resources left within the territory of the hamlet half of the bamboo shoots are (illegally) collected in the territory of the neighbouring hamlet. This suggests overexploitation of the Domestic Environment (Stalpers *et al.,* see part I).

Actors from all categories collect NTFP. The work is regarded as very tough (*motivational factor: hardship*), but the high profits make the effort worthwhile (*motivational factor: returns to labour*). Respondents said that the minimum daily income made by collecting is 20.000 VND (1,3 US$) per person. The money is primarily used to complete subsistence needs, or to buy chemical inputs for the paddy field. Collecting is regarded as tougher than swidden farming.

Collecting is mostly done by women; men only help with collecting bamboo and firewood. Women of all actor categories collect and sell NTFP. Most of the households of the small paddy category lack rice a couple of months a year. The money these households earn with collecting is mostly used to buy rice or other basic subsistence goods. The households from the large paddy category use the money for subsistence needs as well, but are able to buy "extra" subsistence goods like fertiliser, or special food like noodles and glutamate.

Collecting and selling NTFP became popular about 3 to 4 years ago, when the road from Hanoi to Tat was completed. Better means of transportation encouraged traders from the lowlands to order products in Tat. Trading has become more frequent with the daily bus services between Tat and Hanoi. Before the completion of the road, no bamboo traders visited Tat. Bamboo shoots were mainly eaten. Some people sold small quantities of bamboo and dried bamboo shoots on markets in neighbouring province Vinh Phu, for which they had to walk, carrying the products, a few days through the forest. Nowadays, the bus or trucks from traders transport the bamboo.

People said that NTFP grew in abundance in the past. At present, the signs of overexploitation are increasing. High quality bamboo shoots are no longer growing in the forest area of Tat. The collectors go to the forest of neighbouring hamlet Inh. The bamboo shoots area of Ihn is relatively close to Tat, and far from the centre of Inh. Therefore the risk of being caught by inhabitants or the forest keeper of Inh, while illegally collecting bamboo shoots, is low (*motivational factor: no risk*). If a collector is caught, the bamboo shoots are confiscated and a fine charged by the forest department. One woman told us that the fine is likely to be remitted if one stresses one's poverty and the necessity of the money for one's family.

Bamboo shoots and bamboo are considered the most difficult products to collect. The collectors have to walk long distances through the hills in order to

find products of enough quality *(motivational factor: hardship).* Traders do not buy low quality products, or give very low prices. Products of good quality become harder to find, so the risk of lower sales is increasing (*motivational factor: risk)*. Dragging and carrying the products is very hard work *(motivational factor hardship).* Bamboo poles are not carried but pulled trough the forest. This also requires a lot of strength. Collecting is done by men and women, but usually not together.

Table 11 shows the returns to labour of collecting bamboo shoots of six households. The months of May, June and July form the main season for bamboo shoots. The time use of one trip includes walking to the collecting place, collecting and transport back home, boiling before selling and the delivery to the middle man, which takes on average between 7 to 8 hours. The returns to labour of these 6 households show an average of about 26,000 VND per day. These outcomes are slightly better than what the people said that they gain on average, namely between 15,000 and 20,000 VND per day. Table 11 shows a minimum of about 20,000 VND and a maximum of 36,000 VND returns per day. The difference might partly be the result of the fact that collecting by children is also taken up in the time use data per family per year. People said that average yields are one basket of bamboo shoots per trip that weights between 17 and 35 kilos, and depends on the age and gender of the collector and the collecting season. At the time of the research, the price was 20,000 VND per 10 kilos, in the beginning of the collecting season. At that time the bamboo shoots are very young, still under the ground and thus difficult to find. Therefore, a woman can collect about 5 to 10 kg in one day, making between 10-20,000 VND per day. In the peak season, the prices decreased to about 10,000 VND per 10 kilos. After this season, the prices change a little.

Broom grass is the most favoured product to collect for marketing. The collecting season starts in December, is peaking in January and February, and some people still collect in March. The returns to labour are high, as is shown in Table 12 wherein the returns to labour of five households are displayed. The average income earned with collecting broom grass by these five households is about 28,000 VND per day, with a minimum of about 22,000 VND and a maximum of about 34,000 VND. Besides, broom grass is easy to find on nearby hills, and thus easier to carry than bamboo shoots (*motivational factors: no hardship*). Other advantages mentioned of broom grass over bamboo products are that it is not as heavy and that the season is relatively long.

Household	Yield (kg/year)	Labour (hours/year)	Yield (kg/day)[1]	Returns to labour (VND/day)[2]
1	160	57	22	22,456
2	723	258	22	22,419
3	220	68	26	26,036
4	600	134	36	35,955
5	1,370	383	29	28,586
6	1,297	521	20	19,935

[1] Assumed is that one working day has 8 working hours.

[2] If sold @ 1,000 VND/kg, the price paid during the high season (in low season the prices are 2,000 VND/kg, thus, the actual returns to labour will be slightly higher).

Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 11: **Returns to labour of collecting bamboo shoots** of six households during one year.

People do complain about the fact that it is easy to be scratched by the thick sharp grasses and leaves.

Household	Time (hrs/year)	Production (kg/year)	Returns to labour (VND/day)[1,2]
1	66	200	21,818
2	282	860	21,957
3	99	450	32,727
4	263	1,260	34,494
5	347	1,442	29,920

1 Assumed is that one working day has 8 working hours

2 Prices are between 8,000 and 10,000 VND/ kilo. Here, we take the average of 900 VND/kilo

Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 12: **Returns to labour of collecting broom grass** of five households during one year.

4.3 Discussion

Table 13 gives an overview of all motivational factors scored on the collection of bamboo shoots, bamboo and broom grass.

	Rt land	Rt labour (VND/ day)	No Risk	No Hard ship	Connection		Fun	Food		Investment	
					Ma-terial	Time		Quality	Va-riety	Initial	Mainte-nance
Bamboo shoots	Na	26,000	0	--	0	-	+	+	0	0	0
Bamboo	Na	+	0	--	0	-	+	na	Na	0	0
Broom grass	Na	28,000	+	-	0	0	+	na	Na	0	0

Explanation of qualifications: na = not applicable, 0 = neutral, + = positively corresponding with the motivational factor, - = negatively corresponding with the motivational factor.

[1] Tables 11 and 12 display the calculations of the returns to labour. Here, the averages are shown and rounded off.

Table 13: **Motivational factors for collection of Non-Timber Forest Products**.

NTFP versus swidden

Respondents of all categories experience collecting of NTFP as tougher than swidden farming, with the exception of one female respondent. She said that swidden is harder work, because swidden activities are tied to the agricultural calendar. Activities as sowing have to be done at the right moments and cannot be postponed until she feels less tired. She thinks that collecting is easier to fit in a personal schedule and therefore less hard work.

Several respondents indicated that collecting is more fun than swidden farming because collecting is usually done with a small group of women.

Respondents from the small paddy categories qualified the hardship of collecting as heavier than the large paddy respondents. The explanation might be that the former are more dependent on collecting and that they have to do it more often and that they therefore feel it as a heavier burden.

All respondents predicted a decline of NTFP in the near future due to overexploitation. They expressed their hope that the forest protecting policies will have an effect on NTFP as well as on trees and forest quality in general. If the forest is regenerated and the NTFP re-grown, the respondents would like to continue collecting and selling because they need the money. The collectors know it will harm the forest, but there are no other income sources available (*no discussions have taken place about sustainable ways of gathering of NTFPs)*. Collecting of broom grass however, can continue because it grows plentiful and has relatively high returns to labour. The collectors said that they would like to stop collecting bamboo (shoots) and prefer help to intensify the paddies and to promote livestock breeding as alternative and steady sources of income.

4.3 Raise and sell cattle

Cattle can be perceived as an alternative income source to swidden farming (and collecting NTFP). Cattle provide more money and require less work in comparison to swidden farming (motivational factor returns to labour, and no hardship). Cattle also form a threat to swidden farming; free grazing cattle often ruin swidden crops. Raising cattle, however, has not suppressed swidden farming yet. The main reason is that cattle require high initial investments. Therefore, this option is not open to all farmers. Some poorer households lack the capital. For them cattle form a potential option (economic autonomy restriction). To overcome this limiting factor the government provides credit for livestock. Besides, swidden products can provide a steady income, while a cow can only be sold once for a large sum of money. Cattle are only sold when the farmer is faced with (un) expected high expenditures.

During the collectivisation period, more than 10 years ago, cows and buffaloes were kept on small scale. Households shared cattle and used them only as draught force. At present, many households have their own cows and buffaloes. Next to draught animals for ploughing and pulling logs, cattle nowadays also form an important income source.

The government stimulates livestock breeding. Farmers can obtain a special government loan from the poverty reduction fund. According to several key informants, four assumptions constitute this policy:

- Livestock produces manure that can be used to fertilise the paddies to increase the paddy rice yields
- Livestock is an alternative income source to logging, and will thus relieve some of the pressure on the forest
- Meat intake will increase, so the diet of the farmers will improve
- This helps in Vietnam aim to become a meat exporting country

These assumptions are disputable. The idea of manure fertilising is only applicable if the pasture is near by the paddy fields, as manure is too heavy to carry to distant paddies. Besides, livestock and logging are intertwined indeed because (1) cattle is used for logging and (2) money earned from logging is often invested in livestock in case a household was not able to obtain a government loan.

However, livestock has become a popular income source. Raising livestock is less hard work than logging, collecting NTFP or doing swidden. Swidden is less profitable as well. The relatively low risks contribute to the popularity of livestock, and cattle in particular. Livestock breeding is legal, and cattle have a low vulnerability to diseases compared to pigs or poultry. There are good medicines available, and the medicines for cattle are free of charge, because the district participates in a vaccination program for cattle as part of the poverty reduction program 327 for the poorest areas in Vietnam. Therefore, farmers prefer to invest the livestock loan in cows rather than in pigs or poultry. Cows also eat grass, where pigs have to be fed with special feed. Farmers can buy feed for pigs, which is expensive, or, they can collect or grow the feed themselves, which takes much time. Cows are preferred to buffaloes, because their reproduction pace is faster. The low risk of diseases and the fast reproduction pace secure the investment in cows, as farmers feel they will be able to pay back the loan and profit from the investment (*motivational factor: risk of losing investment)*.

Farmers strive to raise a small herd that will provide calves once a year. Cattle are sold when facing (unexpected) high expenditures, such as hospitalisation, a funeral, building a new house, or purchasing a motorbike or other assets like TV or VCR. Cattle thus functions as a safety net as well. The price of a cow depends on the weight and gender, with an average of 1 to 1,5 million Vietnamese Dong.

The main risk of free grazing cattle occurs when the animals break into a field usually destroying most of the harvest, with even worse consequences if the cattle and the field do not have the same owner. There are many stories about furious owners of the ruined fields, who beat up the trespassing animals. These beats may result in sever injuries, or even death or loss of unborn calves. People say that the trespassing problem has become worse.

Animal	Head September 2001	Amount died (during last year)	Amount sold (during last one year)	Amount bought (during last year)
Buffalo	107	8	4	-
Cows	138	8	23	8
Pigs	214	123	54	88
Chicken	1634	774	-	8
Duck	69	245	69	23

Source: taken from Tables 21 and 24 in Stalpers et al (Part 1 of this report).

Table 14: **Total numbers of cows, buffaloes, pigs, chickens and ducks in September 2001** and the amount of deaths, buying and selling of livestock over one year. The data is based on a household questionnaire of 29 households.

The grazing grounds are limited due to land shortage. The forest protection policy which allocated plots of protected forest to individual households has made the problem more complicated, according to the farmers. The conflict between cattle and crops forced some households with larger herds to take turns in looking after the cattle during the day, and lock the cattle up at night to prevent crop damage by their animals. This new activity takes up to four hours a day, and is often done by children. Before, people only checked on the cattle walking around freely in the forest somewhere about 4 times a month.

The rough environment, especially the steep slopes form a risk for cattle. Despite of the difficulties, the respondents would like to see the government loans for livestock continued in the future. As one respondent said: "Everyone still likes to receive the loans because we cannot move to other jobs such as being a trader".

4.4 Raise and sell pigs

Farmers often raise white pigs in combination with small-scale swidden farming. Cassava and to a lesser extend taro is grown on swidden fields to feed the pigs. However, as income source white pig breeding can be seen as an alternative or even competitor to swidden farming. Pigs provide more money (motivational factor: returns to labour), take less time (motivational factor time connection), the work is less hard (motivational factor: no hardship), and feed which is now grown on the swidden (cassava and taro) could be grown in home gardens as well. Despite these advantages not all farmers raise white pigs. The investment costs of white pig breeding are too high for poorer households. White pig breeding is a potential option for those families, with lack of capital as autonomy restriction. Some farmers who do have the capital still refrain from investing in pigs. The high susceptibility to lethal diseases of white pigs makes the risk of investing high, which demotivates the farmers (motivational factor: no risk).

White pigs versus Muong pigs

In the past, the farmers in Tat mainly raised the native species called Muong pigs for special occasions such as weddings and funerals. There were no organised commercial buyers at that time. Some years ago, white pigs were introduced as part of the governmental agricultural extension programs. White pigs cost less than Muong pigs, but white pigs only need 4-6 months to gain a weight of 40 to 70 kilos (starting weight is 3-5 kilos), while for Muong pigs it takes about one year to gain the same weight. The resulting higher

returns to labour appear to outweigh the many disadvantages of white pigs. Table 15 and 16 show the returns to labour of two farmers raising Muong pigs and two farmers raising white pigs. The two example farmers raising Muong pigs focus on the reproduction of the pigs, showing a returns to labour of 15,000 VND per day. The pigs of the two example farmers raising white pigs do not reproduce, but are kept for the meat. They are sold in 5 and 6 months respectively with an average returns to labour of about 21,00 VND per day.

Many farmers raise white pigs instead of Muong pigs despite the high risk of diseases, the hardship and time spent on collecting (often combined with collecting firewood), preparing the feed and cleaning the cages, and the higher initial and maintenance costs. Table 17 shows all the motivational factors comparing raising white pigs versus Muong pigs. People said that Muong pigs hardly need care and eat almost everything and can be easily looked after in spare time, producing delicious meat (*motivational factors: hardship, material connection, time connection, food quality*).

Ir	Investment reproducing Muong pig	Reproduction (amount of piglets in 2 litters per year)	Gross production	Buying feed and medicines (VND/year)	Take care (collecting feed, cooking, feeding)	Returns to labour (VND/hour)	Returns to labour (VND/day)
1	(@200,000): 50,000 VND per year	14 piglets	(sold @ 100,000 VND/pig when 6-7 kilo). Total: 1,400,000	15,000	About 2 hours per day. Total: 720 hours/year	1,335,000 VND / 720 hours = 1,850	15,000
2	(@200,000): 50,000 VND per year	17 piglets	(sold @200,000 VND/pig @ 60 kilo: thus during 1 year sell 0.5). Total: 1,700,000	38,000	About 2 1/2 hours per day. Total: 900 hours/year	3,312,000 VND / 890 hours = 1,910	15,000

Table 15: **Example for one year Muong pig breeding of two respondents**. Assumed is that the reproducing pig will reproduce for 4 years.

HH	White pig	Repro-duction	Gross production (VND)	Costs (food, medicine)	Net production (VND)	Time use (hours)	Returns to labour: (VND/hr)	Returns to labour (VND/day)
1	2 pigs: 90,000	0	(5 months later: together 90 kilos, sold for) 810,000	52,000	668,000	288 (for 5 months)	2,319	18,600
2	2 pigs: 250,000	0	(6 months later: together 160 kilos, sold for) 1,520,000	0	1,270,000	420 (for 6 months)	3,000	24,000

Table 16: **Example for half year White pig breeding of two respondents.**

White pigs, on the other hand, need special feed, require a tight time schedule for care taking and the meat has more fat (*motivational factors: hardship, material connection, time connection, food quality*). The investment costs of the construction of a concrete cage and the expensive white piglets are too high for poorer households (*motivational factor: initial investment costs*). White pig breeding is a potential option for those families, with lack of capital as *autonomy restriction*. Some farmers do have the capital for the initial investments. However, they said that they refrain from pig breeding because they are afraid that they will not have enough money to buy medicines (*motivational factor: maintenance costs and risk*). Vaccinations and curative medicines are indispensable, because a high susceptibility to lethal diseases is an unfortunate characteristic of white pigs (*motivational factor: risk*). As was shown in Table 14, 123 pigs died from September 2001 to September 2002.[56]

	Rt land	Rt labour (VND/day)[1]	No risk	Hard-ship	Connection		Fun	Food		Investment	
					Ma-terial	Time		Qua-lity	Va-riety	Initial	Mainte-nance
Muong pigs	Na	15,000	+	+	+	+	0	++	+	+	+
White pigs	Na	21,000	--	-	0	-	0	+	+	--	--

[1] Tables 15 and 16 display the calculations of the returns to labour. Here, the averages are shown and rounded off.

Table 17: **Comparing motivational factors for raising white versus Muong pigs**.

[56] Table 14 does not specify between white and Muong pigs is made, but following the stories of the respondents, the greater part of the death rate will consist of white pigs.

The district agricultural department distributes medicines, but these are not free of charge as they are for cows and buffaloes. Even with capital available for medication, some poorer farmers would still not dare to take the risk. All respondents expressed the wish that the government would set up a vaccination program with effective medication, free of charge or at least less expensive than medication costs now. Respondents predicted that if such a program would be available, all farmers in Tat would raise white pigs.[57]

White pigs versus cattle

People appreciate white pigs for the high returns to labour. The returns of cattle are higher, but takes a longer time span. A big advantage of pigs is the two litters a year, forming a steady income. Sows give birth to 4 to 5 piglets twice a year while a cow delivers year on average one calf a year. People sell pigs more easily than cows, spending the money on clothes and assets. Not all pigs are sold, most are kept as insurance. Cattle only serve as a safety net.

Comparison	White pigs	Cattle
Production	2 litters a year (@ 4-5 piglets)	1 litter a year (@ 1 calf)
Risk	High	Low
Connection material	High (eat waste of wine and rice and feed is grown on swidden)	Na
Connection time	Low (difficult to combine)	High (easy to combine)
Initial investment	Medium – high	High
Maintenance	High	Low

Table 18: **Motivational factors for raising white pigs versus cattle**.

White pigs versus swidden

Farmers often breed white pigs in combination with small-scale swidden farming. Feed crops, like cassava and taro are grown in the swidden to feed the pigs. White pigs stay in a cage near the house. The pigs cannot forage their own, but need feeding three times a day. Unless there is no labour shortage, it is difficult to combine pig breeding with large-scale swidden farming, because the latter requires whole days in the fields. Collecting feed (such as taro leaves, cassava, bran, banana stem, and wild vegetables) for the pigs is considered as the hardest work of breeding pigs.

[57] The fast growth of white pigs in a cage has encouraged some farmers to experiment with Muong pigs in a cage. Muong pigs still do not seem to grow as fast as white pigs, but there were no final results yet.

White pigs provide more money, take less time and the work is less hard in comparison to swidden farming (*motivational factors*). However, the investment costs of white pig breeding and the risk of diseases are much higher. Swidden crops on the other hand are liable to damage by grazing cattle.

Comparison	White pigs	Swidden
Return to labour	21,000 VND/day[1]	7,000 VND/day[2]
No Risk	High	Medium
No Hardship	Medium	High
Connection time	Medium	Low
Initial investment	High	Low
Maintenance	High	Low

[1] Average is taken from Table 16.

[2] Average is taken from Table 5.

Table 19: **Comparing motivational factors for raising white pigs versus cultivating swidden**.

4.5 Raise and sell poultry

Poultry form a minor income source. Chickens and ducks are not raised the whole year round.

Chickens are highly susceptible to diseases (*motivational factor: risk*). Table 14 showed that 774 chickens died from September 2000 to September 2001, leaving 1630 chickens in September 2001. The respondents said that pests usually attack the village in the season after Tet, around March and April. The high risk of diseases makes the farmers reluctant to invest in chickens. One exception forms a recently established chicken farm, which will be described in the next chapter dealing with potential options. Chickens are held for eggs and meat. Chickens are easy to keep and only take a few minutes a day (*motivational factor no hardship, time connection*). The chickens eat rice, which makes the maintenance costs higher than for cattle for instance (*motivational factor: maintenance investment costs*).
The farmers prefer to have some chickens available to be served when important guests unexpectedly show up. Poorer farmers raise chickens to sell. A chick costs about 10,000 VND, while a full-grown chicken can be sold for 25-50,000 VND, dependent on the weight. People mainly use the money for food, school equipment, and clothes.

Ducks form a seasonal sideline activity as well. After the rice harvest, the paddies are studded with loose rice grains. Many respondents consider it a waste if the seeds are left to rot on the fields. Thus, farmers buy ducks and send them into the paddies to feed themselves with the left grains. The farmers keep the ducks for 2 to 4 months, bought in September to November and sold in January before the new agricultural season starts again, when they weigh 1.5 to 2 kilos (@ 15-20,000 VND per kilo). Duck eggs are preferred to chicken eggs, because the taste is stronger. With no maintenance costs low risks of diseases and hardly any time spent on care (varying between 15 to 45 minutes per day), ducks are perceived as a good sideline activity. However, Table 14 shows that 245 ducks died from September 2000 to September 2001 (leaving 69 ducks in September 2001),

implying a high risk. Table 20 shows an indication of the profitability of raising ducks based on three examples.

Respondent	Investment	Profit (VND)	Total time spent on care taking (hrs)	Profit (VND/hour)
1	30 chick @ 105,000 VND	800,000	84	9,000
2	13 chick @ 65,000 VND	330,000	18	18,000
3	10 chick @ 50,000 VND	250,000	18	14,000

Source: Household interviews by Le Thi Thu Thanh and Kooijman.

Table 20: **Three examples indicating the profitability of raising ducks**. Ducks are raised for 2 to 4 months. Assumed is that all ducks will survive and be sold. For calculating prices and profits, averages are taken of the weight (1.75 kg per duck) and of the prices (and the numbers are rounded off).

Discussion

Ducks and chickens are kept seasonally and for eggs, meat and income. Farmers prefer breeding ducks to chickens, for which several reasons are given that are summarised in Table 21. Ducks have a higher returns to labour than chickens, which is mainly due to the lack of maintenance costs and a higher productivity. Besides, ducks have a lower risk of diseases than chickens, although the number of Table 14 show the contrary. Moreover, the meat and eggs of ducks are perceived as more delicious. However, without having a paddy field, people do not consider keeping ducks. The material connection to the paddy fields makes keeping ducks a conditional option, whereas chickens are also kept as income source by people without a paddy field.

	Rt land	Rt labour	No risk	Hard ship	Con-nection		Fun	Food		Investment	
					Ma-terial	Time		Qua-lity	Var iety	Init ial	Mainte-nance
Chick ens	Na	+	-	+	+	+	0	+	+	0	-
Ducks	Na	++	+?[1]	+	++	+	0	++	+	0	++

[1] This is in contradiction with Table 14.

Table 21: **Motivational factors for raising chickens versus ducks**.

4.6 Fishpond

Having a fishpond is a sideline activity used for subsistence. The government launched a program for fishponds in Tat as part of the poverty reduction program. About 10 families were selected in Tat hamlet. These households received a loan to build a fishpond. It was anticipated that the sales of the fish should be enough to pay back the loan in two years and to complete subsistence needs. When debts would be paid, farmers could sell the fish in Tat. Unfortunately, some problems arose according to various respondents. The fishponds were not well constructed (e.g. not connected to a running

water system, or flooded during heavy rain), in some cases the reproduction of the fish failed and fished died because of unknown diseases (*motivational factor risk*). Besides, the fish is difficult to sell in Tat, because the villagers have no money to buy the fish.

Respondents without fishpond mentioned the lack of suitable flat land as restriction *(environmental-physical restriction)*. The fishpond should also be close to the house to prevent theft of the fishes (*motivational factor: risk).* Richer informants who built fishponds with their own capital were more positive. They stressed the easiness of the work and the time and material connection. They feed chit (March and April), cassava leaves (April to July/August) and if there are no cassava leaves, they feed them banana leaves from the garden. They liked fish as contribution to their diet, but hardly sold any fish.

	Rt land	Rt labour	No Risk	No Hard ship	Connection		Fun	Food		Investment	
					Ma-terial	Time		Qua-lity	Variety	Initial	Maintenance
Fish pond	na	+	-	+	+	+	0	+	+	--	-

Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 22: **Motivational factors for having a fishpond**.

4.7 Vegetables from forest and home garden

Collecting forest vegetables

In the past, 10 to 20 years ago, vegetable seeds were not available for the Tat inhabitants. Therefore, forest vegetables were the main source of vegetables. At present, two female traders deliver seeds on request during their regular visit to Tat. Thus, forest vegetables are collected on small scale for subsistence only nowadays. The vegetables collected in the forest are least preferred of all vegetable sources. The two main motivational factors are the low *food quality* and the hard work (*hardship*). Collecting vegetables in the forest is harder work than growing vegetables in a home garden and or in a swidden. The latter is not an activity on its own, but a side line activity when cash crops are cultivated on the swidden. We spoke with one extremely poor household without paddy or swidden, who lived on forest vegetables. Other poor households only eat forest vegetables when they have no other option.

Vegetables in home garden

Having a home garden is a sideline activity for subsistence only. Not many households have a home garden. Respondents say that there has been no change in home garden vegetable production during the last 10 years and that it has always been small scale. Suitable area for home gardens is limited, because most land has a steep slope, which makes it impossible to fertilise well (*restriction: lack of suitable land*). In addition, sowing and weeding the home garden costs time. The respondents said to have no time available for vegetable home gardens, because they are busy doing other things (*this indicates towards a low returns to labour of home garden vegetables compared to other activities)*.

If a household has a garden, it mostly grows vegetables like spinach and kohlrabi. These vegetables are chosen for their suitability to the soil (*motivational factor: no risk of crop loss)*. Secondly, the seeds for these vegetables are cheap and easy to obtain from trader who regularly visits Tat (*motivational factor: low investment costs, no hardship*). Some women dislike self-grown vegetables because of the small variety (*motivational factor: low food variety*). The shop offers a broader scope of vegetables to choose from. Contrary to these women, other women indicated to prefer self-grown vegetables to vegetables from the shop. The latter fear that the vegetables from the shops might be contaminated with poisonous chemicals (*motivational factor for self-grown vegetables: food quality*).

	Rt land	Rt labour	No Risk	No Hardship	Connection		Fun	Food		Investment	
					Material	Time		Quality	Variety	Initial	Maintenance
Forest vegetables	na	-	0	--	0	-	-	--	0	na	Na
Home garden vegetables	?	-	+	+	0	+	0	+	0	0	0

Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 23: **Motivational factors for forest vegetables versus home garden**.

Fruit trees in home gardens

Fruit trees in home gardens are relatively new phenomenon. A few years ago seeds for home- grown fruit trees were not available at the market or district. A project of the agricultural university introduced fruit trees Tat. Pumpkins and apricots are grown on small scale and with various results. Fruit trees are a preferred income and food source, but several restrictions make this option a potential option for most actors. Section 5.4 deals with fruit trees as a potential option.

4.8 Middleman

Being a middleman is a typical sideline activity. The money generated is limited and the activity is only done complementary to, for example, keeping a shop (motivational factor: time connection). Requirements for being a middleman are a suitable geographic position of the house, writing and calculating skills, and trustworthiness. Being a middleman has the advantages of no risk, no hardship, no investments, and earning a little extra money in spare time (motivational: factor returns to labour).

The term middlemen is used for secondary actors in the actor field that can be constructed for swidden products. These persons live in Tat, and are part of the microstructure of the actors. A middleman works for a trader from outside Tat. These outside merchants ask villagers that live near to the road to become middlemen. The job of middlemen is to weight and store the swidden (or NTFP) products harvested by households in Tat. The trader gives the middlemen an amount of money in advance, enough to buy the quantity of products the trader needs. The middlemen pay the farmers with this cash advance. The trader sets prices for the products in advance. In return, the

middlemen receive a small fee per weighted and stored kilo. The fee for broom grass is about 1000 VND per kilo, for instance.

Only household members of houses along the road can become middlemen. The trader prefers the houses that are situated at cross-sections of forest trails to swidden, or NTFP areas, and the main road. Storage of the products on the yards of these houses is easy for the farmers and for the traders. It saves the farmers an extra walk with their heavy load to bring the products to the middlemen. Moreover, the trader assures himself of a steady supply of products, which, in addition, are easily picked up with a truck.

Having a shop goes very well with being a middleman. Traders expect that shopkeepers can calculate and write, the main requirements for the registration of collected kilos and prices. However, not all middlemen are shopkeepers. Some farmers (mostly women) are middlemen in their spare time. They became middlemen for the little extra money they can earn in their spare time (*motivational factors: returns to labour and time connection*). The work is not heavy (*motivational factor: no hardship*). Middlemen bear no risks (*motivational factor: no risk):* they do not have to pay the farmers with their own money. Besides, they do not have to make investments (*motivational factor: investment*). The middlemen also stressed that they like to meet a lot of people every day (*motivational factor: fun*). Some people said that they would not like to be a middleman. The reasons given is that being a middleman is a seasonal occupation (harvest or NTFP seasons) and that middlemen have to stay at home a few hours every afternoon waiting for farmers to hand over their products.

	Rt land	Rt labour	No Risk	No Hard ship	Connection		Fun	Food		Investment	
					Ma-terial	Time		Qua-lity	Variety	Initial	Mainte-nance
Middlemen	na	+	++	+	0	+	+	na	na	0	0

Source: Household interviews by Le Thi Thu Thanh and Kooijman (2001).

Table 24: **Motivational factors for being a middleman**.

4.9 Logging

An estimated 78 percent of the households participate in logging, almost all of this is for selling (Thesis Duong). According to Duong, at least 750 cubic metres of logs per year are extracted per year through Tat households. Some local people say that with such rate of extraction, the resource will be finished in three years. Large high value trees are getting scarce, logging is becoming more difficult. The last remaining big old trees are in far away and difficult to reach patches of the forest.

For some households logging is a sideline activity while others participate in logging teams on a regular basis. The income generated with one logging trip

is in most cases enough to feed the family for a month or longer. Therefore, logging is neither a sideline activity nor a full-time occupation but somewhere in-between. The risks of logging are high, so are the physical demands and the investments. However the returns to labour are very high and wipe out all demotivational factors. Logging is an important income source for the farmers in Tat. It provides the most cash money of all cash income sources. The money is used to complete subsistence needs if a family lacks a few months rice for instance, to buy assets and is perceived as safety net. Logging happens in small teams consisting of 4-5 men, with 1 or 2 buffaloes carrying 1 or 2 logs. A respondent told us about his logging activities. The man goes logging 5 to 10 times a year. Each logging trip takes about 10 days during which the man collects about two cubic metres of wood. The selling price is 500-600.000 Vietnamese Dong (= 36 US$), to be shared among the participants.[58]

The allocation of protected forest to individual households in 1998 as part of Program 327 also made logging more difficult (see also Rambo and Tran Duc Vien, 1999: 152). Individual households were made responsible for the protection of 'their' forest plot against logging and clearing for swidden. In the past, the forest was common property and all inhabitants of Tat were allowed to cut trees. Nowadays, agreements have to be made between loggers and owners of forest plots. Sometimes people cut trees without permission of the forest plot owner. If caught logging in other people's forest, the logger risks a fight with the owner who usually hands them over to the forest keeper. However, the loggers often can persuade the owners with a party on expense for the damage to the forest. If the forest keeper catches the loggers, he confiscates the logs and buffaloes of the loggers. On top of that, the forest keeper charges a fine, usually twice the value of the log (*motivational factor: risk*). In addition to the high risks, participating in logging trips is dangerous and physically demanding work (*motivational factor: hardship*). However, the extremely high returns to labour outweigh all objections and make logging a popular income source. The motivational factors are summarised in Table 25.

	Rt land	**Rt labour**	**No Risk**	**No Hard ship**	**Con-nection**		**Fun**	**Food**		**Investment**	
					Ma-terial	**Time**		**Qua-lity**	**Vari ety**	**Init ial**	**Mainte-nance**
Logging	na	25,000[1]	--	--	0	--	+	na	na	na	na

[1] One trip takes about 10 days, 4 men participate, benefiting 1,000,000 VND, resulting in a returns to labour of about 25,000 VND per person per day.

Table 25: **Motivational factors for logging**.

[58] Other research in Tat (Thesis Duong) quotes higher figures of up to 1,7 million VND per cubic metre and a gross benefit of a logging trip of over 1 million VND. This money is shared between the "wood boss" who organised and financed the trip, and his helpers (wage, food, buffalo hire, etc.) leaving a net profit of around 100,000 VND per trip for the organiser.

4.10 Services

Services in Tat form a sideline activity. Motorbike taxi is the most important one. Many households in Tat bought a motorbike in the last few years (9 of the 29 respondents of the MFA household questionnaire). Motorbikes are used for transport of people and goods. Sons of the households take orders as motorbike taxi. They drive persons or goods to nearby villages or markets. However, there is not much demand for their services, because most other people cannot afford to order a motorbike taxi.

4.11 Discussion

This chapter described the most important livelihood activities in Tat next to swidden farming. Table 26 gives an overview of the activities that are dependent on natural resources and their motivational factors.

The farmers in Tat always search for any kind of income sources. The ones without any investments, steady and available almost throughout the year are practising swidden farming and collecting of NTFP. The natural resources for these activities are in decline, however. People prefer other sources of income, because these activities are considered as very hard working with a decline in production. Cattle and pigs are most favoured alternative income sources, while poultry are kept seasonally. The activities require high investments and entail high risks due to fatal diseases, but the returns can be very high when lucky. Logging still forms an important addition to the income, although high quality forests are far away and the activity entails high risks of being caught. Paddy farming is what people prefer the most. Now it only serves as food source, often not enough to feed the family, but people would also prefer it as income source. The next chapter will deal with some potential options; activities identified and already carried out by some people, that could form other income sources if people would have the resources and motivation to do so.

	Rt and (kg/ ha)	Rt labour (VND/ day)	No Risk	No Hardship	Connection		Fun	Food		Investment	
					Material	Time		Quality	Variety	Initial	Maintenance
Paddy	2,800	28,000	0	+	+	+	+	++	+	--	Included in rt
Bamboo shoots	na	26,000	0	--	0	-	+	+	0	na	na
Bamboo	na	+	0	--	0	-	+	na	na	na	na
Broom grass	na	28,000	+	-	0	0	+	na	na	na	na
Cattle	na	+									
Pigs	na	21,000	--	0	0	+	0	+	+	--	Included in rtl
Chickens	na	+	--	+	+	+	0	+	+	0	-
Ducks	na	14,000	--	+	++	+	0	++	+	0	Included in rtl
Fish pond	na	+	-	+	+	+	0	+	+	--	-
Logging	na	25,000	--	--	0	--	+	na	na	na	na

Explanation of qualifications: na = not applicable, 0 = neutral, + = positively corresponding with the motivational factor, - = negatively corresponding with the motivational factor.

[1] Tables 10, 11, 12, 16, 20, 25 display the calculations of the returns to labour. Here, the averages are shown and rounded off.

Table 26: **Motivational factors for natural resource based activities**.

5 Potential options

The previous section described the general implementable options, or in other AiC terms, all the options the actor in fact can choose between, given his/her resources. Some of the described options were not implementable for people who lacked the resources. This section will describe the general potential options. These are all the actions the actor could do, if he had the resources (it thus includes the implementable options). Autonomy (resources and restrictions) is what makes the difference between potential and implementable options. It is the degree to which the actor actually can do what he/she could do.

The potential options discussed in this chapter have already been (halfway) implemented by some people and some of them might be viable alternative livelihood activities that are sustainable. As appeared in the previous chapter, paddy production is the most preferred food and income source, and the two general ways to increase the production are to develop more paddy fields and/or to intensify the production. The first two sections describe both subsequently. The next section describes how bamboo and timber trees could be produced as a cash crop in forest gardens. Production of fruit trees in home gardens is explored in the next section. Possibilities for swidden farming are described in the next two sections, i.e. making fields in the old forest and the feasibility of using fertiliser on swidden fields. Further, there is one household experimenting with industrial chicken farming. Having a shop forms for some households already an important income source. This is often combined with production of wine that is drunk in large quantities by the male inhabitants of Tat. Finally, the manufacture of half or finished products might form viable alternative livelihood options ameliorating the terms of trade.

5.1 Expansion of paddy fields

Swidden farming and collecting non-timber forest products (NTFP) will be less necessary if the paddy rice yields will be sufficient to feed the family all year round. Creating new paddy fields requires large investments of time, physical strength and money (restrictions: physical autonomy: bodily health, available time and economical autonomy). No household can miss the time necessary for creating a new field. This time must be spent on earning a daily income to survive. Secondly, respondents said that looking after far away new field is only efficient when it can be combined with a garden, fishpond, or other small activities. Families lack the money to afford these other activities.

One way to increase the paddy production is to develop new paddies. All the flat areas are already converted into paddy fields. Respondents say that there are still some patches of flat area in the hills further from the village with sufficient water in the neighbourhood that can be converted into a paddy field. People perceive creating a new paddy field as very physically demanding, saying that the area should be flattened out, a new bund should

be constructed, and the field should be ploughed two times instead of once in normal paddy (*motivational factor: hardship*). However, people say that the new fields need less weeding than the normal paddy because there are about 50 percent fewer grasses. An another advantage person pointed out is that new paddy needs about 40 percent less fertiliser application than existing paddy, because the soils of the new paddies are more fertile. Respondents said that it will take 6-7 years for the soils to be depleted to the same extent as the existing paddies *(motivational factors: no hardship, maintenance costs)*.

The productivity of existing and new paddy is similar when applying appropriate amount of fertiliser. People say that high yields depend on the time and care invested in the paddy. The paddy has to be checked regularly for pests and weeds. New paddy fields are usually further away from the village, so it takes quite some time to get there. Nevertheless, as a respondent said it: "*If a households makes the effort of creating a new paddy field, it will also invest as much time as needed in the paddy*". For efficiency purposes, farmers strive to combine new paddies with a fishpond, chickens, or garden in the surroundings of the field. Therefore, the farmer can check both at same time. Another efficient combination that people pointed out is to keep cattle in the area surrounding the new paddy field, because it is easy to collect the manure and use it in the new field. People said that the new fields are usually too far away to bring manure up there and that they prefer free manure to expensive chemical fertiliser. Thus, eventually a whole new sub-farm will be developed with rice, cattle, home garden, etc. managed by the son for instance.

5.2 Intensify paddy production

Another way to increase the rice production is by intensifying paddy farming. Intensive paddy farming requires time and money. Capital is needed to purchase the latest high yield varieties and fertilisers. The new varieties require new growing techniques. Learning and applying these new techniques costs time in all phases of the production cycle. Many households in Tat do not have the capital or the time to make these investments (economic and physical autonomy restriction). Therefore, intensifying paddy farming is only a potential option for many households.

Except from creating new paddies, the production in existing paddies can be intensified in order to augment the rice production. The poorer households, in general the households with small or no paddies, have difficulties with intensive paddy farming. These respondents said that they lack the money to buy fertiliser, by which the yields are not high enough to fulfil subsistence needs. They buy rice during some months of the year. Most of the money for buying rice is earned by collecting non-timber forest products or the sales of swidden crops. The time spent on earning money is not spent in the paddy, which lowers the paddy yields. In addition, the money earned is used up on buying rice and not on intensifying the rice production. Poor families usually lack the capital to spray preventive pesticide on their paddy fields. They often have no savings either to buy pesticides when the first signs of pests are visible in their fields. Only at that time, the poor families start finding extra sources of money to buy pesticides. The days spent on working and arranging for pesticides can be fatal to the crop. We have spoken with several households who said that they lost 40 to 50 percent of their crop to mice and

insects *(motivational factor: risk)*. Farmers who sprayed in advance mentioned crop damages of 10 to 20 percent. All farmers would like to have large paddy fields. The cultural preference for rice with every meal, the drastic decrease in swidden rice yields, and government programs supporting paddy farming, contribute to the popularity of paddy rice.

5.3 Bamboo and timber trees in forest garden

Respondents from all actor categories said that they would like to plant high quality bamboo (*Luong*) or timber trees on their exhausted swidden fields, mentioning a twofold advantage. Trees and bamboo will combat the soil erosion, and it will serve as a cash income. Nevertheless, most households lack the investment money (*economic restriction*).

Some respondents also expressed the fear of theft if they would grow *Luong* on far away swidden fields. *Luong* is highly appreciated for its multi-functionality. There are many ways of earning money from *Luong*. The bamboo is strong and straight, and the bamboo shoots are of a good quality and both can be sold for good prices. If the quality of the bamboo would not be good enough for sale, it can be used within the household.

If a household makes a swidden in their allocated protection forest, they are obliged to plant trees after usage to speed up the regeneration. Melia (*Xoan*) is preferred (see chapter 6). The tree grows easily, does not need care, the leaves can be used as fertiliser, and the timber can be harvested and sold after 3 to 5 years. The seedlings can be found in the forest. People also grow palm and tea in their forest garden.

5.4 Fruit trees in home garden

Fruit trees are for most farmers a potential option because they experience several autonomy restrictions: the lack capital to invest in small trees, the lack knowledge about cropping techniques and the lack of suitable land.

People say that they prefer fruit trees as a food and income source. The returns to labour of fruit trees can be very high, and most farmers would like to try growing some species. A few households grow fruits like persimmon, grape, litchi, and apricot. These households got seeds and seedlings from the District as part of the agricultural extension plans. The production so far is limited however. There have been crop failures and other obstacles. People mentioned several demotivational and restricting factors for having a home garden.

Firstly, both vegetables and fruit trees need flat land to grown on. The farmers in Tat lack suitable flat land *(environment restriction: limited land).* Flat land is necessary for fertilising. Without fertilising the farmers fear the crops will not grow well. Flat land is also a required to prevent the fallen fruits from rolling down. The second major restriction is the lack of investment money for seedlings (*economic restriction: lack of capital).* Thirdly, the farmers say that they lack knowledge of growing techniques for fruit trees *(cognitive restriction: lack of knowledge).* This restriction increases the risk of crop failure, and the high investment costs are perceived to too risky because of this (*motivational factor: risk, high initial investment costs*). Another risk for fruit trees is theft. Especially on land further away from the house, the farmers fear that the fruits will be stolen. The fifth major restriction is the

absence of an internal market. There is hardly a demand for fruit from the villagers. The inhabitants of Tat have no money to buy fruit. The nearest market were fruits can be sold is in Cao Son a few kilometres down the road to Hanoi. Selling fruits at that market is only profitable if a large amount of fruits is sold. Respondents explained that the time they spend on transport and selling at the market will be too long too if only small quantities are sold. Then, the sales minus the costs (including transportation) do not weigh up to the money that could be earned with another income generating activity (*motivational factor: returns to labour).* Thus, because fruit is not grown in large quantities, selling at the Cao Son market is no option yet.

5.5 Swidden in old forest

National forest protecting policies divided the forest area of Tat in four different land use zones:

(1) protected forest areas with regenerating secondary forest where no cultivation is allowed, (2) tall grass forest areas which are earmarked for swidden farming,

(3) bamboo forest areas where collecting for subsistence is allowed, and

(4) grazing areas for livestock.

The soils in the tall grass swidden areas are degraded and the yields are low. The soils in the old forest are much better, but the farmers are not allowed to clear protected forest for swidden fields *(formal autonomy restriction)*. However, clearing of old forest does happen. One respondent estimated that 30 percent of the households in Tat clear swiddens in the old forest. Rambo and Tran Duc Vien (1999:152) also found out that many households are engaged in illegal clearing activities. Although people know that clearing contributes to the deterioration of the forest, several respondents explained that food shortage leaves some households no choice. Therefore, these households take the risk of a fine, although the risk of being caught is low if the swidden is not visible from the road. Besides, the respondents said that they could often alleviate the fine by showing that they are poor.

5.6 Intensify swidden production with fertilisers

People mentioned some good experiences with fertilising swidden fields situated on relatively flat areas. However, less than 20 percent of the total land area of Tat has a slope of less than 25 percent. This includes the paddy field (Rambo and Tran Duc Vien, 1999:16). Thus, relatively flat swiddens are rare and the steep sloping fields are not suitable for fertilising, because the fertiliser will wash out with the rain and groundwater (*environmental restriction*). Besides, people said that the distance of the field is an important factor. The bags with chemical fertiliser or baskets with manure are too heavy to carry far into the hills (*physical restriction*). Money for buying fertilisers forms another constraint (*economic restriction*). Many farmers in Tat lack the capital to buy fertiliser.

5.7 Industrial chicken farming

Industrial chicken farming is a new development in Tat. It is a potential option because most farmers lack the capital for the necessary investments and the required knowledge for taking care of such a farm. There are also some demotivational factors attached to a chicken farm, such as the high disease risks and difficult time connection.

There is one woman in Tat with a chicken farm. In our view, it is exceptional for an inhabitant of Tat to start a new business not done by anyone else. Variations in crops or animal species do occur, and if the results are good, neighbours adapt the variation. However, especially a woman does not often start a completely different activity. This woman showed tremendous daring (*psychological resource*) considering the fact that farmers in Tat do not seem to have strong moral resources. The woman told that she learned about chicken farms from friends in a nearby town, where her daughter was hospitalised. These friends gave her the name of a trader in Ha Dong, the big market near Hanoi, who sold the chickens and advised her on food and medicines. A chicken farm has many risks (*motivational factor: risk*). Chickens are vulnerable to diseases and no effective medicines are available. The woman said to fear that her chickens would die of diseases. However, she believed that she would find out ways to prevent illnesses and to learn good caring techniques as time goes by (*cognitive resource*). She would also take seasonal precautions. She started her farm at the time that the chicken would be fat for Tet, Vietnamese New Year. She hoped to sell them all then. The season after Tet is always characterised by high risks of diseases in Tat. Thus, she was planning to start the cycle again after this season. The chicken farm had high initial investments and high maintenance costs (*motivational factor: investment and maintenance costs*). The woman sold her cow in order to earn the initial investment money. Not many farmers would be willing to take this step, because cows are a highly valued safety net. Others simply lack the money or means to make money to invest *(economical restriction: lack of money)*. The woman said that she earned the money for the maintenance costs (food and medicines) by collecting and selling NTFP.

The woman could not yet estimate the returns of the chicken farm, because she started only 2 months ago and did not complete a full production cycle yet. However, she thought that if the chickens would stay alive they would be more profitable than collecting NTFP. She argued as follows: if she could cover the costs of the chicken farm with the money earned by collecting, than the chickens would grow fat – and increase in value – and could be sold for a good price. The money she earned with selling NTFP in this way will finally provide more money than selling NTFP only. She said that she preferred the chicken farm to her cow, because you can sell a cow only once and a few chickens when in need for some money, still having many chickens left. She said that another advantage of the chicken farm is the relatively easy work. Care taking costs two to three hours a day *(motivational factor: no hardship)*. However, there has to be somebody at home all day to prevent fights between the chickens (*motivational factor: time connection*).

The woman said that the chicken farm had not decreased her dependency on the forest (yet). She collected and sold NTFP to earn money for the daily expenditures. Possibly, her forest dependency will decrease with the completion of a production cycle, when she can invest part of her profit in the new chickens and feed.

It is questionable whether industrial chicken farming will be a viable option for the future. Tat does not seem to have a comparative advantage towards the lowlands. Table 14 even shows that keeping chickens contains a high risk, since 32 percent died during the period of September 2000 to September 2001.

5.8 Shopkeeper

In order to start a shop, one should meet several requirements. Geographical location (environmental resource) is important. High initial investments are necessary and maintenance cost are high as well (capital resources). In addition, a shopkeeper needs good relationships with suppliers and customers (social resource).

Tat has many small shops. Keeping a shop was for many respondents a preferred source of income, because the work is not hard (*motivational factor: no hardship*) and the contacts with customers and traders make it a pleasant job *(motivational factor: fun*). However, having a shop is only a potential option for most farmers.

The biggest obstacle is the high investment costs (*economical restriction: lack of capital*). The second constraining factor is the limited internal market in Tat. The farmers lack capital and spend a little money, so profits are not high enough to have a shop as a primary occupation (*motivational factor: returns to labour*). The income of a shop can be between 60,000 and 30,000 VND per month.

For profitability reasons and to please the customers**,** the shop needs attendance all day long (*motivational factor: time connection*). Because of the negative time connection motivational factor, having a shop is combined with other home bound activities. Winemaking is such an activity and highly preferred. Wine is a popular product. Per month, all shops in total sell an average of 300 litres of rice wine. Raising pigs is another good combination, which combines very well with making wine as well. The combination of these three activities is preferred, but lack of capital for the necessary investments is a major restriction for most people.

Another (*environmental*) restriction for some people in Tat is the geographic location. The shop must be located close to the road and there should not be other shops in the direct neighbourhood.

Social resources *(individual social capital)* are very important too. A shopkeeper needs social skills to build good relationships with customers. Shopkeepers say that it is important to have an outgoing character and to be able to make conversations easily. Shopkeepers must also be able to make strict agreements with customers and exercise enough pressure so that the customers pay their debts, since most people in Tat buy on credit. This often causes problems to shopkeepers, by which they have no regular daily income. The administration of debts takes time and there is a risk some persons will never pay their bills.

Social resources are also required for the relationships with traders and suppliers. Being part of good trading networks offers the shopkeeper benefits as discounts and credit. Shopkeepers and traders try to build relationships of trust. Relationships are gradually formed if business between suppliers and

buyers works well. If a relation is established a shopkeeper can get discount or wholesale benefits.

5.9 Wine production

Producing rice wine for commercial purposes is a potential option to most farmers. The investments costs form a barrier even though the costs are not high when compared to livestock for example (*economic restriction: lack of capital*). Another constraining factor is time (*physical restriction: lack of time*). Processing of rice wine needs constant observation and the fire needs to be tended continuously. Producing rice wine therefore is a typical housebound activity, which is available only to the households, who can afford to keep one member at home all day, instead of going to the swidden or collecting NTFP.

The gross returns of ten litres wine are:[59]

Costs: 10 kg rice bought @ 2,700 VND per kilo: total 27,000 VND

Benefits: 10 litres of rice wine sold @ 6000 VND per litre: total 60,000 VND

Returns: 60,000 VND – 27,000 VND = 33,000VND

There are about 10 wine producers in Tat. Most producers produce wine for retail purposes. Their average production is 30 litres a day. Two wine producers have built a small-scale factory. Their average production is 70 litres a day, almost fully sold wholesale to wine traders of nearby hamlets.
Only adult men drink wine. Tat hamlet has 480 inhabitants (Stalpers *et al.,* see part I). The number of adult men is estimated at 200. The male road constructors, who stay in Tat as long as the construction of the road is not completed yet, are notorious for their alcohol intake. All together, the total number of wine consumers is estimated at 250. The average day production in Tat is 300 litres. Wine is not stored. This implies an average wine intake of more than 1 litre per man per day.

Many female respondents complained about their husbands drinking habits. Often heard complains were that husbands spend the household money on alcohol, laziness –husbands prefer drinking with friends to helping their wives– increased feeling of insecurity during evenings and nights and abuse.

5.10 Manufacture of half or finished products

Dried bamboo shoots

Dried bamboo shoots provide more money than fresh bamboo shoots (added value is 2000 VND per 10 kilos). However, at present, not many households sell dried bamboo shoots. The main *demotivation factor* is *time connection*. Drying bamboo shoots takes 2-3 days of sun. All this time, somebody has to keep an eye on the shoots. If it starts raining, the shoots have to be covered. Besides, the shoots have to be protected against cattle that will eat it. The returns to labour of the shoots is not enough for someone to stay at home for three days in a row without doing other work. Most households need to work

[59] This does not include the labour, not the investments, not the collection of the fire wood necessary for producing wine.

during these days to earn the money for daily needs. Nonetheless, drying bamboo shoots could well be combined with other housebound work. Some households already do it. These households built a platform or the shoots are dried on top of their houses by which the bamboo shoots are out of reach for cattle. Household members take turns in guarding the shoots on rainy days. When the children come home after school, they combine doing their homework with watching over the shoots.

Broom grass and brooms

Broom grass is collected in large amounts. The collectors earn between 8,000 and 10,000 VND per 10 kilos. Traders transport the grass to the nearest city, Hoa Binh, where the brooms are manufactured. The prices of brooms are considerably higher than for broom grass. The price for one broom is 5,000 VND. Of 2 kilos broom grass, 3 brooms can be made. The production of brooms made of broom grass, which is abundantly growing in Tat, seems profitable.

We have asked our respondents why nobody in Tat makes brooms. The respondents indicated that they do not know the techniques *(cognitive restriction).* However, when they came to think of it, the respondents said that the techniques could not be so difficult.
The second restriction people referred to is the non-existing relationships with broom traders, and therefore no means of transportation (*social restriction; no network*). Nobody in Tat owns a truck to transport the brooms to market, and renting a truck is expensive (*economical restriction: lack of capital*).

The last demotivational factor goes for men only, and addresses the nature of the work. Making brooms is perceived by the respondents as typical women work, although it could also be suitable for children.

Soybeans and tofu

One respondent told us about her plans for a tofu machine. She would like to sell the tofu at the nearby markets of Tu Ly and Cao Son. She said that the market prices for tofu are high, by which she expected to make profit (*motivational factor: returns-to-labour*). In addition, she would like to improve the variety of the diet of her family, and use the tofu as substitute for the more expensive meat *(motivational factors: food variety, material connection*).
She learned the techniques from a woman who sold her self-made tofu at the market. She said that all she would need is a tofu-machine and soybeans. She said that in the nearby village Cao Son, farmers already grow soybean in the swidden. There, soybean is used as feed, but she would like to make tofu out of it. There are two restrictions to her plan. Firstly, she lacks money to buy soybean during the soybean harvest season in Cao Son. No NTFP is in season at that time so she has nothing to sell, and consequently no money. Therefore, she prefers to grow soybean herself. Unfortunately, she has no swidden so she cannot try.

The second restriction is the lack of capital to purchase the tofu machine. She experimented with making tofu from (bought) soybean some years ago. She tried two different tofu machines, cheap, manual ones. However, the results were disappointing and the processing took too much time: about 2 to 3 days for a small quantity of tofu. This time she cannot miss, because she has to earn her daily living money. She now wanted to invest in an electric tofu-

machine, which costs about 1 million Vietnamese Dong. With this machine, you can make tofu much faster, within a day, with a good quality. She hoped to receive a loan from the poverty reduction fund to fulfil her wish. She planned to grow soybeans in the garden next to her house.

Another idea is to start a collective soybean field with a small group (5 or 6) of women. However, she has some doubts about this idea. According to the respondent, many collective projects have gone wrong in the past because some members of the group did not contribute their share of labour but did benefit from the joined labour of the other project members. Several other female respondents mentioned this problem too. It is therefore very important, so they say, to form a group with motivated women on voluntary basis, who are willing to live up to the agreements.

5.11 Discussion

People say that they prefer income sources by which they could reduce or stop doing swidden and collecting of NTFP. Swidden farming and collecting and selling NTFP are two income sources, which require low initial investments and maintenance costs. Therefore, these options are open to everybody, who is in good physical condition, being rich or poor. This chapter has explored some potential options that might form a substitute of these two activities.

There are not many activities that neither require high initial investments and maintenance costs. Increasing paddy production by developing more fields (for which no capital but only labour is required) is hardly an option because of lack of suitable land. The only other activity is production of brooms could be an income generating activity not requiring high investment costs. Knowledge and marketing channels are not available yet however.

Most activities require initial investments and maintenance costs. Intensifying paddy production with use of high yielding varieties and chemical fertilisers is ongoing, but many people lack the capital for optimal production. Planting of high quality bamboo and timber trees in forest gardens could form a good income source, with positive effects for regeneration of the soils as well, but the good species are not yet readily available in Tat. Production of fruit trees as cash income restricted by suitable land for home gardens and lack of marketing possibilities. With the available labour, capital and knowledge some people choose for a certain combination of activities. Important with combining activities are time and material efficiency. The farmers try to avoid any waste of time or material as much as possible. A favoured combination is enough paddies for subsistence, a shop, middleman, winemaking and raising white pigs. These are all housebound activities so time can be used efficiently. Wine can be sold in the shop, and wine grounds are good feed (better than cassava) for the pigs. The husks of the rice can also be fed to the pigs. Being a shopkeeper and middleman is handy combination because the suppliers to the shop are often NTFP traders as well.

Lack of labour, capital and knowledge remain the most important constraints for people to choose freely between the activities to make a better living. In the next chapter, the structural and cultural factors behind these restrictions and possible opportunities will be explored.

6 Structural and cultural environment of swidden farmers

Lack of labour, capital and knowledge that restrict farmers to choose livelihood activities, derive mainly from structural factors. Population pressure, government policies, limited access to markets and credit facilities are the main driving forces behind the land use system in Tat. The section problem awareness and visions goes deeper into the interpretations of the people in Tat, passing over the general motivational factors of cost efficiency, hardship, fun, etc. Thus, this chapter deals with, as put in Action-in Context terminology, the structural and cultural environment of the actor that influences the autonomy factors, the availability of the options and motivations of the actors.

6.1 Population pressure

Population pressure is rising due to immigration, natural growth, the establishment of more separate households, and the limitation of available land due to forest protection and land allocation policies.

Year	No people	Growth/year	Households	Growth/year	Average household size
1993	389		69		5.6
1996	402	1.1%	75	2.8%	5.4
1998 (August)	432	3.7%	91	10.2%	4.7
2001 (September)	480	3.6%	110	6.5%	4.4

Sources: Data of 1993-1998: Family Planning Clinic as reported in Cuc and Rambo (1999), 2001: initial household survey for SEAtrans (Stalpers, 2003).

Table 27: **Population and household trends.** The percentages growth are average growths per year over the stated years.

Table 27 shows the population growth of the households. The current population growth rate of 3.6% per year is in part due to natural population growth and in part due to migration of families to Tat hamlet. The average household size is decreasing, showing the impact of the family planning policy of Vietnam. The number of households increased more than the population. This reflects a reduction of the household sizes. Construction of the Hoa Binh Dam has caused some people to relocate from inundated areas to Tat hamlet.
Several respondents ascertained the effectiveness of the family planning program. In their opinion, most households have only one or two children nowadays. This view matched with our observations and visits to families.
Increased literacy and education rates among all Tat inhabitants might have contributed to this process as well. Tran Duc Vien (1999: 162) stated that the education level in Tat was relatively high compared to other upland villages. We observed that all children attend primary and secondary school, by which it is not likely to assume that the education level has dropped.

6.2 Forest protection and land allocation policies

Many different policies and programs are implemented in Tat. Allocation of forest plots to individual households and redistribution of paddy fields, for example, have been mentioned several times in the preceding chapters. Here, a concise description of the related policies follows.

Since 1990, the Vietnamese government is concentrating on upland development. Two programs currently targeting the uplands are the "327 Program", alternatively called the "Re-greening the bare hills program" and the more ambitious "Five Million Hectare Reforestation Program." Several important nation-wide laws have had a special impact on the mountainous areas in general, like the Land Law, which guarantees land tenure and transfer rights to individual households and the long-term (20 to 50 years) allocation of forest land to households. In this section, these policies are compared with the local situation in Tat hamlet.

The 1993 Land Law

The 1993 Land Law provides long-term allocation of land usage rights to individuals, households, and organisations. This law provides the possibility of transfer, exchange, mortgage, and inheritance of such rights. The law authorises households to receive 20 years tenure rights for land cultivated with annual crops and 50 years tenure rights for land planted with long-term crops. The Land Law has three main aims: (1) to encourage stability and security of land tenure, (2) to establish a legitimate market in land usage rights, and (3) to increase state control of land use. The drafters of the law aimed to increase investment in land, improve agricultural yields, and promote more appropriate land use. In the uplands, the land allocation process is often combined with 'Program 327' to meet the following goals: (1) increase the area of cash crops, (2) reduce the land area dedicated to staple food crops, and (3) increase reforestation (Dennis, 2000).

However, the preconditions on which the Land Law and Program 327 are based do not entirely correspond with the local situations in the uplands. In the first place, land tenure has often not been that insecure or unstable in reality, with much upland land being privately owned *de facto*. In Tat hamlet, the Land Law caused rather than solved tenure insecurity due to imperfect implementation as will be explained in the next section. Secondly, the capacity to implement laws is often limited in remote upland areas.

Program 327

In 1993, the Vietnamese government allocated 68 million US dollars to program 327, which was a large share of central government transfers to the provinces. About 40 percent of these funds were earmarked for interest-free loans to households (Dennis, 2000). The poverty reduction fund provided some of these loans for farmers in Tat. The remaining 60 percent were assigned to the government's investment in infrastructure, scientific and technical facilities, public services, reforestation, and initial support to settlers (*ibid*.). Under the program, the government planned to grant land use rights to parcels of barren land and to protect certain areas of the remaining forestland. Parcels of forestland, usual forest that had been under the control of state-owned forestry enterprises, were transferred to households. Every family member would receive about one hectare of forest to protect, for which the government would pay the households 50,000 VND (approximately 3 US$) per hectare per year (*ibid*.).

In 1998, the Forestry Office and the Land Office, both district offices, had allocated most of the forestlands of Tat hamlet to individual households (Rambo and Tran Duc, 1999: 150). In the early 1990s, the Forestry Office allocated approximately 100 hectares of protected forestlands on hilltops to households. The households are not allowed to cut timber or to clear

swiddens on these plots. The Forestry Office issued certificates, "green books", to these households, but had not given any payments for protection. Later, the Land Office allocated about 100 hectares of hill slope land to households under the 327 program and issued "red books" to recipient households. Rambo and Tran Duc (1999: 152) mention that these distributed plots are supposed to be kept under forest but are in fact frequently cleared for swiddens.[60] They give several possible explanation for this behaviour.

First, the land allocation has been imperfectly implemented in Tat hamlet. Problems occurred because the Land Department Cadre failed to make an actual map or ground survey from plots allocated under program 327. Households received red books showing the outline of their plot but not its actual location on the landscape. Furthermore, the assigned plots did not match with the land that households regarded as theirs *de facto*, because the family controlled the land for over two decades for instance. *De facto* rules are that the former owners may continue to cut palm leaves of the trees that they planted before the plot was allocated to an other household. Change of ownership implies that as soon as the palm trees are not productive anymore or and die there are no rights anymore for the former owner. Thus, increased tenure insecurity rather than security was a result of the forest allocation program.

The second reason for the incomplete implementation of the program is lack of financial resources. A survey performed by CRES in Tat hamlet revealed that only one third of the households claimed to have received cash money from the 327 program. However, this number is not very reliable, as the local people attribute all forms of government assistance for forest development, protection, and generation to the 327 program (Cuc and Rambo, 1999: 132). Furthermore, the amount of the payments is less than the promised 50,000 VND per hectare.

A third reason for the poor implementation of the program comes from Tat's geographical features. According the Land Law and program 327 all land sloping at a gradient of over 25 degrees is categorised as land designated for forestry purposes. Cultivation of annual crops is banned on such areas. Of the total area of Tat hamlet, less than 20 percent has a slope of less than 25 percent (Rambo and Tran Duc Vien, 1999: 16). There are only a few hectares on the valley floor flat enough for paddy rice. Strict obedience of the law would cause serious agricultural restrictions and consequently food security problems.

The last reason for the lack of desired results of the program forms more a cultural explanation. Some of the households in Tat perceive the forestland as common property. About 80 percent of households received plots of forestland. The households that did not receive plots consist of newcomers, newly formed couples or households that refused to accept plots on barren hills. These households still go to the forestland, which is perceived as common land to make their swiddens (Rambo and Tran Duc Vien, 1999:

[60] According to our respondents, they have in fact been allocated three types of land: (1) "mixed forest" or "mixed garden" where swiddens are allowed, (2) "regeneration forest" and (3) "protection forest". Swiddens or tree-cutting are not allowed in types 2 and 3. The mixed garden areas were mainly allocated on land that had already been swidden for a long time and had degenerated into grassy forest.

137). One of our respondents estimated that 30 percent of the households in Tat go to the formal protected forest to make swiddens.

The Five Million Hectare Reforestation Program

The Five Million Hectare Reforestation Program started in 1998, for the period 1998-2010, with the ultimate goal of bringing Vietnam's forest cover from current rates of about 28 percent back to the 43 percent existing at the time of national independence (Dennis, 2000). This program intends to mobilise many sectors of society, from the household level to the forestry departments, state forest enterprises, private enterprises, and social organisations. The draft objectives are as follows (taken from Dennis, 2000):

(1) Speed up reforestation activities.

(2) Establish areas for production of raw material for domestic consumption of fuel wood, forest product processing, and export of value-added forest products.

(3) Contribute to job creation and increased incomes and standard of living for people living in mountainous areas.

(4) Improve credit facilities.

In relation to the first objective, a reforestation farm is developed in Mit hamlet part of Tan Minh village. Current reforestation efforts in Tat are limited to the obligation for farmers to plant trees in their swiddens that they cleared on allocated forest protection plots. There may be an opportunity to combine the reforestation objective of the government with the wish of farmers in Tat to grow the bamboo species *Luong* in fallow swiddens. *Luong* bamboo has multiple benefits for the local farmers (see section 5.2), and could be very effective against soil erosion.

Luong bamboo also goes with the second objective, because the bamboo shoots can be dried and turned into "value- added forest export products". Another example of such a product and "forest product processing" could be brooms made of broom grass (see section 5.10). These options have not yet been implemented in Tat and were not thoroughly explored during our research. We have not heard about job creation in Tat, nor seen any other examples of this third objective.

Signs of improving credit facilities are clearer and respondents told us frequently about provided loans. Many farmers invested the loan in raising pigs, but investments do not pay off as expected due to lack of knowledge on disease prevention, and other caring techniques.

Different government policies regarding land use are translated in agricultural extension programs. These consist of projects aiming at stimulating paddy farming and livestock breeding. The district agricultural department organises training courses to teach the farmers about new rice varieties and the accompanying growing techniques. The new varieties and use of chemical fertilisers aim to increase the yields up to levels high enough to support subsistence needs.

The government also stimulates livestock. Farmers can get a loan from the poverty reduction fund to invest in livestock. One of the advantages of livestock is their production of manure, which can be used to fertilise the paddies. Secondly, livestock is a less forest depleting income source than

logging or bamboo collection. If livestock becomes a current income source, the pressure on the forest can be reduced.

6.3 Access to markets and credit facilities

There is hardly an internal market in Tat. Farmers are poor by which there is not much demand for goods and products. The poverty also restricts the ability to invest in the production of sellable goods.
Access to markets outside Tat away is difficult. Markets in the surroundings of Tat are Tu Ly, Cao Son, Hoa Binh and Ha Dong (sequence is according to distance from the village). Ha Dong is a suburb of Hanoi with a large market. Here traders with businesses all over Vietnam gather. Shopkeepers and middlemen, with knowledge of the trading business, indicate that lack of capital and social capabilities block people in Tat to become traders.

NTFP and logs are collected in large quantities, but there are no inhabitant of Tat who is a regular whole sale trader. Transport is an obstacle. Logs and bamboo are often traded to the lowlands for which the bus driver acts as middleman. According to the local people, this transportation is necessary for the bus to make any profit. Without logs and bamboo, the bus would only run in the Tet period. An other way is that the transport fees to be paid to the bus driver are paid by the regional trader.

Another obstacle is the monopoly of the traders. To become a successful trader, relationships with buyers are very important. The potential buyers from Tat are the traders in Ha Dong market. These buyers hold a monopoly and they profit from the lack of knowledge of the new sellers. New sellers do not know the accurate prices, and do not know any other buyer. This enables the traders in Ha Dong to set low prices for the products they want to buy. New sellers have to accept these prices. Only when a buyer and a seller have developed a relationship, they can make price agreements. Relationships are built by experience, which creates mutual trust for good transactions. Respondents told that relationships become better after several successful deals, usually in a time span of 1 to 2 years. If sellers and buyers have come to know each other, price agreements can be made. The seller then can get a higher price for his products. The Tat inhabitants have no financial reserves to bridge the gap between the first few business transactions with low profit until a relationship has grown and the transactions would become more profitable.

Small-scale trade, e.g. with a few bags of bamboo shoots, at nearby markets is not profitable according to 3 respondents who had individually tried to trade in NTFP. We spoke with a shopkeeper who seemed to have relatively good chances to become a small-scale trader. This respondent runs a successful shop, has savings, owns a motorbike and has the indispensable connections with a buyer. However, the respondent said to refrain from becoming a bamboo shoot trader. He had his own transportation (motorbike), but he could not afford to loose the time it would cost him (almost a day) to drive to the market, sell his product, and drive back. He had to spend this time to earn money in his shop and with wine making. According to him this is more profitable than trading. There was no one else to work in the shop and do the winemaking (his wife was working on the paddy, was collecting NTFP, was taking care of pigs and his children were still too young). He said that if the

household would have had sufficient labour to attend the shop during his absence, he would try to become a trader.

6.4 Problem awareness and visions

In human decision-making (and in the AiC framework), the pros and the cons of action alternatives are compared not only of concrete costs and benefits such as the money and time they cost, the calories they bring, and so on. They are also interpreted in the light of basic values, community-level impacts and "future values". In the latter sense, for instance, money earned from a logged tree may be seen very different from the "same amount" earned from the fruits of a fruit tree that still stands. In general terms, Tat is a place where many of these interpretations still point into a direction of community and sustainability. Community values, for instance, are expressed by one respondent as: "*It will be ok if all of us are of one heart and of one strength*". Concerning sustainability, one respondent said, for instance: "*In this situation [of logging, NTFP extraction, etc.], we cannot alleviate hunger and poverty. We should concentrate on agriculture. If we continue to depend on the forest, the forest will run out. If, however, we focus on improving the land, we will create a foundation for the future (…). If we allow the forest to regenerate [and manage it sustainably], it will be a golden resource…*".

On more basic levels, almost all inhabitants of Tat (between 93 to 98 percent) indicate several forest related problems as risks that directly affect their lives, such as shortage of timber to build houses, and scarcity of wilds animals and plants in the forests (Le Quang Trong and Rambo, 2001).[61]

The most important agricultural related problems indicated by (percentages of the) people of Tat are livestock diseases (98 percent), scarcity of land to make swidden (95 percent), rats destroying crops (95 percent), decline soil fertility (83 percent), increase number of weeds in swiddens (83 percent), increase number of weeds in paddies (68 percent) (Le Quang Trong and Rambo, 2001).

Striking is the fact that most of the parents (76 percent) want their children to work in the public sector (e.g. teacher, cadre, medical worker) and only a small minority of the parents (6 percent) want their children to be farmers and work the land (Le Quang Trong and Rambo, 2001).

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[61] Le Quang Trong and Rambo researched individual perceptions of personal life situations and environmental conditions, using a self-anchoring striving scale questionnaire for a sample of 40 respondents.

7 Summary on the local situation in Tat

Chapters 3, 4, 5 and 6 explored the local situation in Tat hamlet. This chapter will first summarise and discuss the most important livelihood activities and their interactions. Then, the most important structural factors that deny access to other livelihood options will be outlined. Finally, an overview of both sections are schematically drawn in an AiC deeper analysis scheme.

7.1 Livelihood activities

Paddy production is favoured by all farmers and is good on all accounts. In line with this, the government stimulates paddy production by providing subsidies and training; the introduction of high yielding varieties has increased the paddy production considerably. However, most households in Tat have a rice shortage during one or more months a year, for which four major constraints are identified. First, there is not enough suitable land for developing more paddy fields. Besides, there is unequal access to the existing paddy fields. Furthermore, many farmers do not have enough capital to optimally intensify the paddy production (e.g. pesticides, chemical fertilisers). Finally, farmers said that they lack knowledge of appropriate growing techniques that go along with the new varieties.

Swidden still forms an important livelihood activity for many farmers. The focus of rice production has shifted from swidden to paddy production, because of the increase in paddy productivity and the decrease of the productivity of the swiddens. An increase in cash crop (e.g. canna, ginger, and cassava) production on swiddens has taken place since construction of road. However, practising swidden farming is in decline. First of all, this is caused by the reduction of amount and quality of yields. This in turn is the result of the deterioration of the quality of the soils (reduction of fallow periods). Land shortage is the underlying reason for this process, resulting from forest conservation zonation and population growth. The second reason for decline in swidden production is the unstable market prices, inducing risk.

Collecting of NTFP, i.e. bamboo, bamboo shoots and broom grass, is for almost all households necessary to add to daily income. These activities also became popular since the completion of the road. However, bamboo is not collected sustainably, by which signs of overexploitation are visible and thus a fall of returns to labour. Besides, collecting is considered as very tough work.

People say that they prefer other income sources by which they could reduce or stop doing swidden and collecting of NTFP. Some farmers say that they would abandon swidden farming first because of (1) the low labour and land productivity, and (2) the need of the daily money earned with collecting. Other farmers prefer to stop collecting NTFP first because (1) the work is physically more demanding than swidden farming, and (2) swidden can be used to grow feed for livestock. However, swidden farming and collecting and selling NTFP are the two main income sources that require low initial investments and low maintenance costs. Therefore, these options are open to everyone who is in good physical condition. All people would like to stop and would thus prefer help to (1) intensify the paddies, and (2) to promote livestock breeding.

Livestock breeding requires high initial and maintenance costs. Therefore, this option is not available to the poorer families. The government provides loans to poor families to stimulate livestock breeding. However, not all farmers benefit, because only a selection of the poorest households receives this loan.

The availability of suitable land, labour, knowledge and capital are the main factors that constraint the household's access to other income sources than swidden farming or collecting NTFP or to intensify paddy production.

All household's labour is invested in income generating activities, that is if they have money for the investments necessary to start the activities. Family planning policies are resulting in smaller households. Besides, more children are attending school these days which results in less helping hands. This is one of the contributing factors to labour shortage in many households. Only extra labour input can intensify swidden production or augment the amount of money earned by collecting. Labour shortage, therefore, is an urgent problem to poorer households.

The cognitive restriction, lack of knowledge, is another limiting factor. If the farmers have not enough knowledge on suitable soils, techniques and medication the risk of investment is in many cases perceived as too high.

Lack of capital puts a heavy burden on the life of the Tat villagers and blocks the path to a less forest dependent farming system. Investments necessary for livestock and poultry are high. The initial investments for buffaloes are the highest, then for cows, then for Muong pigs, then for white pigs and then for chickens. The breeding costs are the highest for white pigs, followed by chicken, cows, and buffaloes. Pigs and chicken are characterised by a high disease risk. Most farmers have no financial buffer, by which it is a (life threatening) disaster if the livestock they invested in dies. This risk decreases the investment readiness even more. A weak internal market is another result of the general lack of money in Tat. Options like fruit trees in home gardens or having a shop require clients. Tat is the wealthiest hamlet of Tan Minh. Thus, there is no demand from other hamlets either. The regular markets in nearby villages are unreachable for the farmers from Tat, because the transportation costs would be too high.

People combine activities in the most efficient time and material connection with the available labour, capital and knowledge. The farmers try to avoid any waste of time or material as much as possible. When people have a paddy field, favoured combined housebound activities are having a shop, being a middleman, making wine, raising white pigs and keeping ducks after the rice harvest. Wine can be sold in the shop, and wine-making residues are good feed (better than cassava) for the pigs. The husks of the rice can also be fed to the pigs and to the ducks. Being a shopkeeper and middleman is a handy combination because the suppliers to the shop are often NTFP traders as well.

Other activities that (could) form an income source are high quality bamboo and timber trees in swidden fallows, but the investments are high. Endeavours with fishponds have failed to become an income source due to sickness and lack of knowledge. Developing home gardens with vegetables, feed for pigs and fruit trees is a side line activity, not producing income because of lack of suitable land and lack of an internal market while the transport costs to the nearest market are too high to be profitable. Manufacture of half or finished products could be an option, but it would only

be for women, people lack the knowledge, and there are no trading connections.

7.2 Structural factors

We identified five structural factors that underlie the main constraints (capital, knowledge, labour and suitable land) that deny access to the options other than swidden and NTFP. These are:

1. Population pressure and land shortage. The population in Tat is rising, but these days not at an alarming pace (3.6 % percent last year). The growth is due to immigration and natural population growth. The family planning policies seem to have their effect, with families having one or two children these days, leading to smaller households (the amount of households is increasing more than the population)[62]. Nevertheless, the population density in terms of persons per area arable land are high. All suitable land for paddies is already in use, and land shortage of the remaining areas that are used for swidden farming results in shortening of the fallow periods and, in turn, soil degradation.

2. Forest protection and land zonation policies. State owned land is re-allocated to individual households. 80 percent of the people now have stewardship rights to protect forestland in return for a yearly payment by the government. This privatisation of protected forest has not (yet) achieved the expected results due to several factors. (1) Although the farmers would like to plant *Luong* bamboo or timber trees on their swiddens People had not protected their forest land (i.e. reforestation of the swiddens), because there had not been any payment or less than agreed upon. (2) Increased tenure insecurity was caused by unclear allocation of the plots that often conflicted with the *de facto* customary law of ownership, leaving the "not-used" forest as an open access resource. (3) Strict obedience of the law would be disastrous for Tat, because more than 80 percent of the land in Tat is categorised as land designated for forestry purposes where no annual crops are allowed. This implies that all the swidden fields are officially illegal.

3. Poverty, by which there is no internal market. There is hardly an internal market in Tat for (local) products. Farmers are poor by which there is not much demand.

*4. External market: poor for general products, good for upland products***.** Access to markets outside Tat is difficult because of the difficult transportation possibilities and high costs. Middlemen from outside Tat arrange the transportation of the product, and the bus going to Tat only drives because of the logs and bamboo (shoots). For specific upland products, the external market is good, and there might be opportunities. High transportation costs, combined with land scarcity and general land characteristics in the uplands, makes it hardly feasible to market general products that can be grown in the lowlands more efficiently.

5. Poor credit facilities. Providing credit facilities is an important part of many governmentprograms. Some farmers can get a loan from the poverty reduction fund to invest in livestock for instance. However, the scope of the

[62] As we described in 7.1., the resulting labour shortage is a common problem for small households.

credit facilities are not sufficient. This will be explained in more detail in chapter 8.

Figure 1 gives an schematic overview or summary according to the AiC scheme of all the livelihood activities and options, their motivational factors and influencing structural factors.

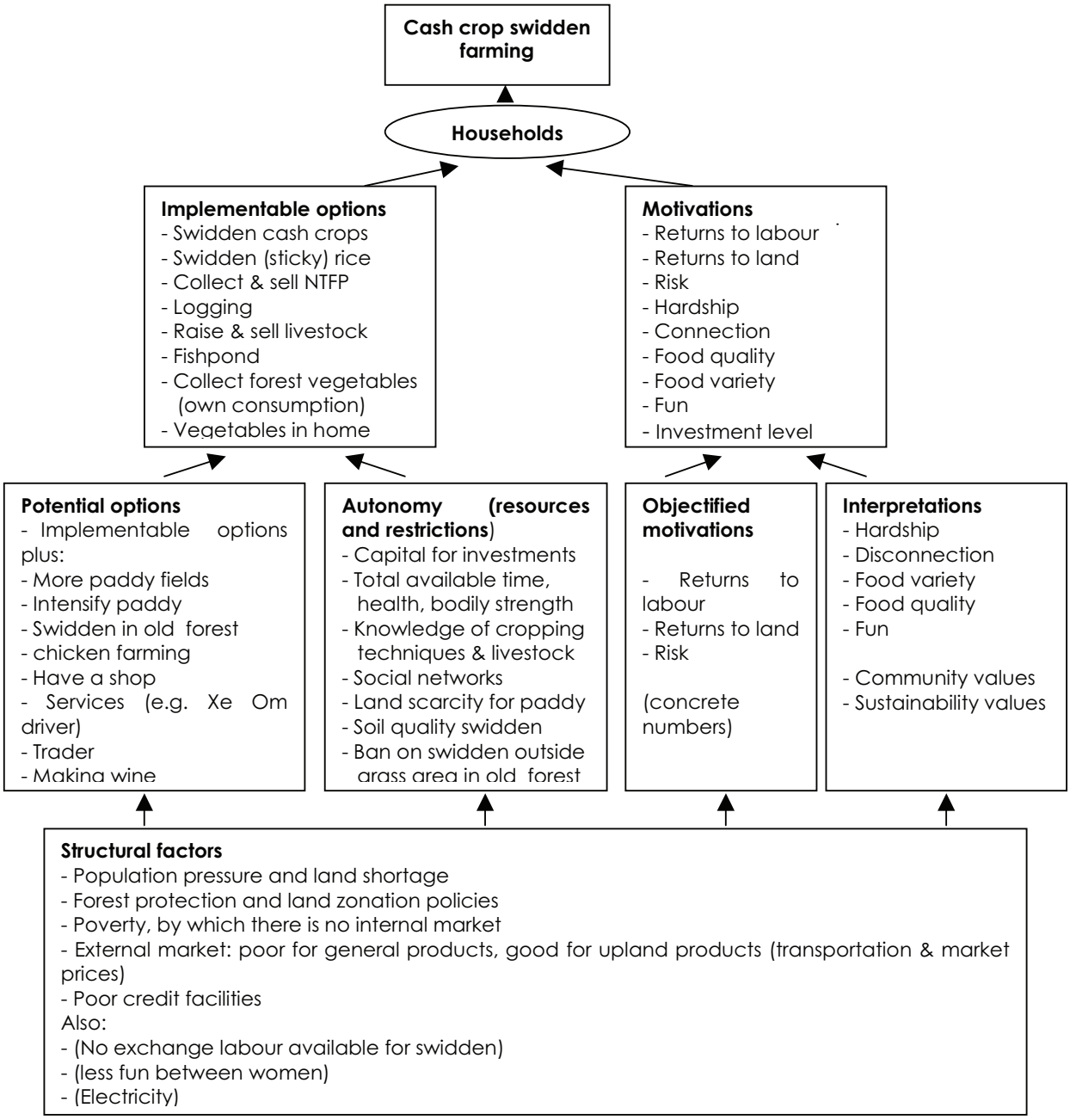

Figure 1: **AiC scheme for swidden farming.**

8 Actors fields

Structural factors influencing the options and motivations of primary actors, as described in previous chapters, can be seen as effects of actions of other actors, secondary actors in AiC terms. In order to study actor fields, the causal chains of social influence are explored in the direction of other actors. These actors influence the behaviour of the farmers, who directly stand at the nature-environment interface, directly causing the materials to flow and accompanying environmental problems. In this way, the construction of actors fields identifies all the actor groups that are potential target groups for policy-making. Based on the options and motivations of the different actors, concrete policies or measurements can be developed to achieve concrete solutions.

In this chapter, we will first analyse the actors field of the problematic activities of swidden cash crop farming and collecting of bamboo (shoots). Using this actors field, the actors field for logging is probed next. Finally, we will explore the not problematic flow, but potential option, of livestock breeding.

8.1 The actors field of swidden cash crops and bamboo

Figure 2 depicts the actors field for bamboo collection and swidden farming. Since the primary driving force of the two activities is commercial, the linkage between the Tat households and the (regional) traders, mediated by the middlemen, forms the backbone of the actors field. Following the products' marketing line that is driven by economic returns we see that the middlemen stand at the interface between the households and the (regional) traders transporting the products from the first to the latter. Continuing with the regional traders and the traders in Ha Dong buying the products from the middlemen, Figure 2 shows that these traders sell the products on the (inter) national market: the canna to the noodle factory, the bamboo to the paper factory and construction sites, cassava to the cassava factories and the ginger to the Japanese traders (the latter is not drawn in Figure 2). In this area of the actors field, we see that two government actors are involved in the same trade. These are (1) the local and regional authorities, who should be motivated to regulate swidden products and bamboo trade, and (2) the government-owned factories, that is of course quite interested in the reverse! Interesting linkages could be hypothesised on at this point, but no research is done.

The crossing between commercial and non-commercial government actors brings us to the second driving force of bamboo collection and swidden farming, i.e. risk. The non-commercial government actors mainly assist actors by not posing risks of confiscation, the driver of the product marketing line after the economic returns (which includes the risk on the market). It starts with the local forest department that mediates between the local people and the local authorities. The main underlying reason for the accommodation of illegal practises instead of enforcing forest protection appears to be the lack of pressure from the local authorities. A sideline explanation might be that the forester cannot resist the social pressure of the local people that he is supposed to hand over to the local authorities. Arriving at the level of the

local authorities along the actors field's power line, three new causal lines are identified. Compassion with the local poor makes the authorities to close their eyes for the unfortunates breaking the law. As one official said: "*The people are based on the forest to earn a living, so if you catch them, they will be so miserable*". As indicated by the question mark, a supposed line of reasoning is that the authorities ignore the offenders because of social pressure from their fellow villagers affecting the position of the local authorities, in terms of votes and popularity. (A partial or negotiated accommodation between the local people and the local authorities might be the resolution of the problem at this point). Finally, a double question mark indicates a hypothetical bribe paid by the traders to the local authorities for transporting illegal products. Pressuring the local forest department to apprehend the swiddeners and collectors would address an adverse logic.

From this point, we leave the course of (non-)actions of the government agencies directly aimed at the local people and arrive again at the area of the products' marketing line. The previously supposed profitable arrangements between the local authorities and the middlemen and/or traders will not lead to confiscation of the transported products. Another reason for the low risks that go along with transporting the illegal products might be that the loads going from the households to the traders are too small to be of (economic) interest. Maintaining this line of reasoning and continuing along the marketing line in the actors field suggests us to suppose that the authorities would be more attracted to the bigger traders transporting large amounts of illegal products. Although we have not done research in this area, we might surmise that the authorities that should regulate illegal trade do not or hardly confiscate products since there is still a market demand. At this point, it is likely that the actor field patterns repeat in such a way as among the local authorities, only at a higher level, thus driven by conflicting objectives of regulating the law, profits and political power. In all this, the causal chains show us that, although the problematic flows of swidden products and bamboo are steered by the market in the first place, the non-commercial government actors basically accommodate the household-to-market linkage in the actors field.

Unconnected to the risk factor, the major role that the non-commercial government actors have played is the construction of the road, indispensable for any commercial activity in the first place. The main line of reasoning explaining the bamboo and swidden flows, i.e. the products' marketing line that is driven by economic returns, impelled by non-commercial government actors by means of not posing risks, would fade away without the road. The construction of the road brought the village in a forest exploitation boom, by linking the households to the market without well working forest protection mechanisms at that time. As the actors field shows, the government actors that are supposed to regulate the forest protection appear not to do so because of the poverty of the local people, and the attraction of political power and profits that can be made along this marketing line. To overcome the pitfalls, proper win-win policies have to be developed and implemented at local level combined with regulation of illegal trade at higher levels. Otherwise, the current course will soon lead to a total collapse of the forest and its related land use activities.

8.2 The actors field of logging

The actors field for small-scale commercial logging is quite comparable to the actors field of Figure 2. Logging is also steered by the market in the first place and accommodated by the non-commercial government actors. The same actors play the key role in the actors field for logging as in NTFP. The main difference between the log flows and the flows of swidden products and bamboo, is that logging is more illegal and more money is involved, putting a heavier load on the power lines.

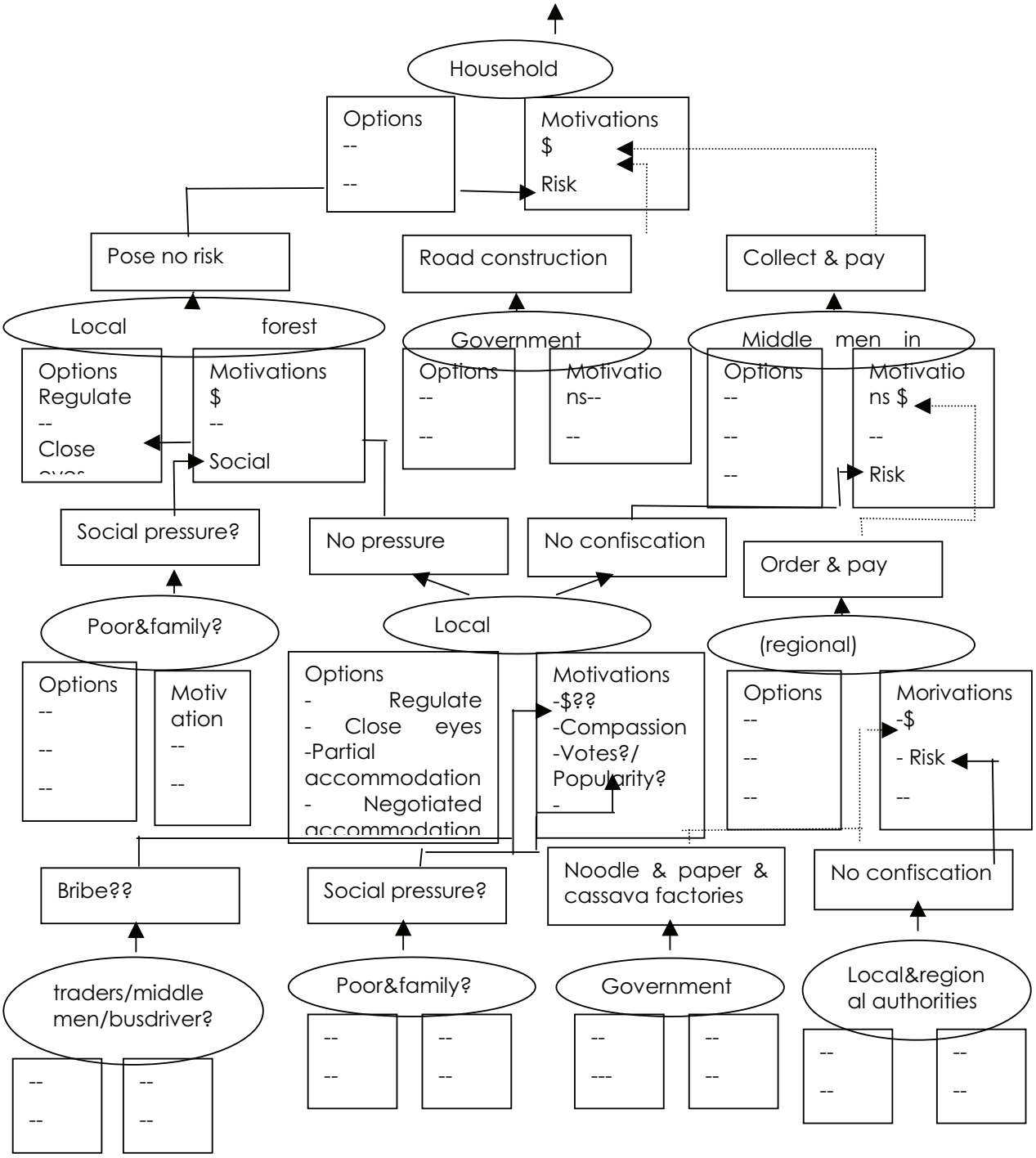

Figure 2: **Actors field for bamboo collection and swidden farming**.

Only the foremost options (left boxes) and motivations (right boxes) are displayed. The symbol "$" indicates the overall cost-benefit analysis (e.g. returns-to-labour) of the actors. "Risk" refers to the risk of loosing investment. The arrows indicate lines of causal influence, determining the options and/or motivations of previous actors. The household (including the poor and family) is primary, as well as secondary and tertiary actor. The government is secondary as well as quaternary actor. The local authorities and the traders are both tertiary as well as quaternary actors.

The households and the small commercial actors, mediating between the local people and the traders in Ha Dong can act relatively undisturbed in the case of logging. However, the course of actions of the government agencies directly aimed at the loggers poses a higher risk of confiscation with higher fines (converted to bribes) than for the other illegal products. The other actor field patterns in this area form a reproduction of Figure 2. When we look at the mediating commercial actors, we grasp that in order to sustain the high risk, the (bribing) lines with the non-commercial government actors are more profound for logging than for the other illegal products.

A respondent informed us about this procedure: "I have not often been caught since the three years that I have transported logs, and then I usually get off the hook by buying off forestry officials with small amounts of money, around the 20,000 VND per person". Going down to the next level in the marketing line, arriving at the traders in Ha Dong, we are concerned with bigger flows of wood by which bigger amounts of money will probably circulate between the non-commercial government actors and the traders, for which hypothetical linkages could be made. The high bribing costs and the high risks of confiscation along the marketing line will be accounted for in the price the local loggers receive for their product, probably explaining the fact that the local people do not specifically make much money out of logging activities, as is described in section 4.9.

Looking at the actors field for logging, it is expected that the households will not refrain from logging until their remaining forest will be gone, unless appropriate package deals will be offered, e.g. stimulating industrial forestry and rigid local regulation, together with strict implementation of the law restraining the illegal trade course at higher levels.

8.3 Actors field of raising and selling livestock

Figure 3 draws a part of the actors field of breeding livestock. We see two main lines of influence determining whether farmers will invest in livestock or not, assuming that the market is secure.

A clear line depicts the way that the risk of diseases is overcome, which forms a main motivational factor for the poor households as is described in section 4.3. At this point, the veterinary doctors play a mediating role between the households and the government executing the vaccination program of the agricultural department. The government appears to have chosen to distribute medicines free of charge only for cows and buffaloes, not for white pigs, that are highly susceptible to lethal diseases.

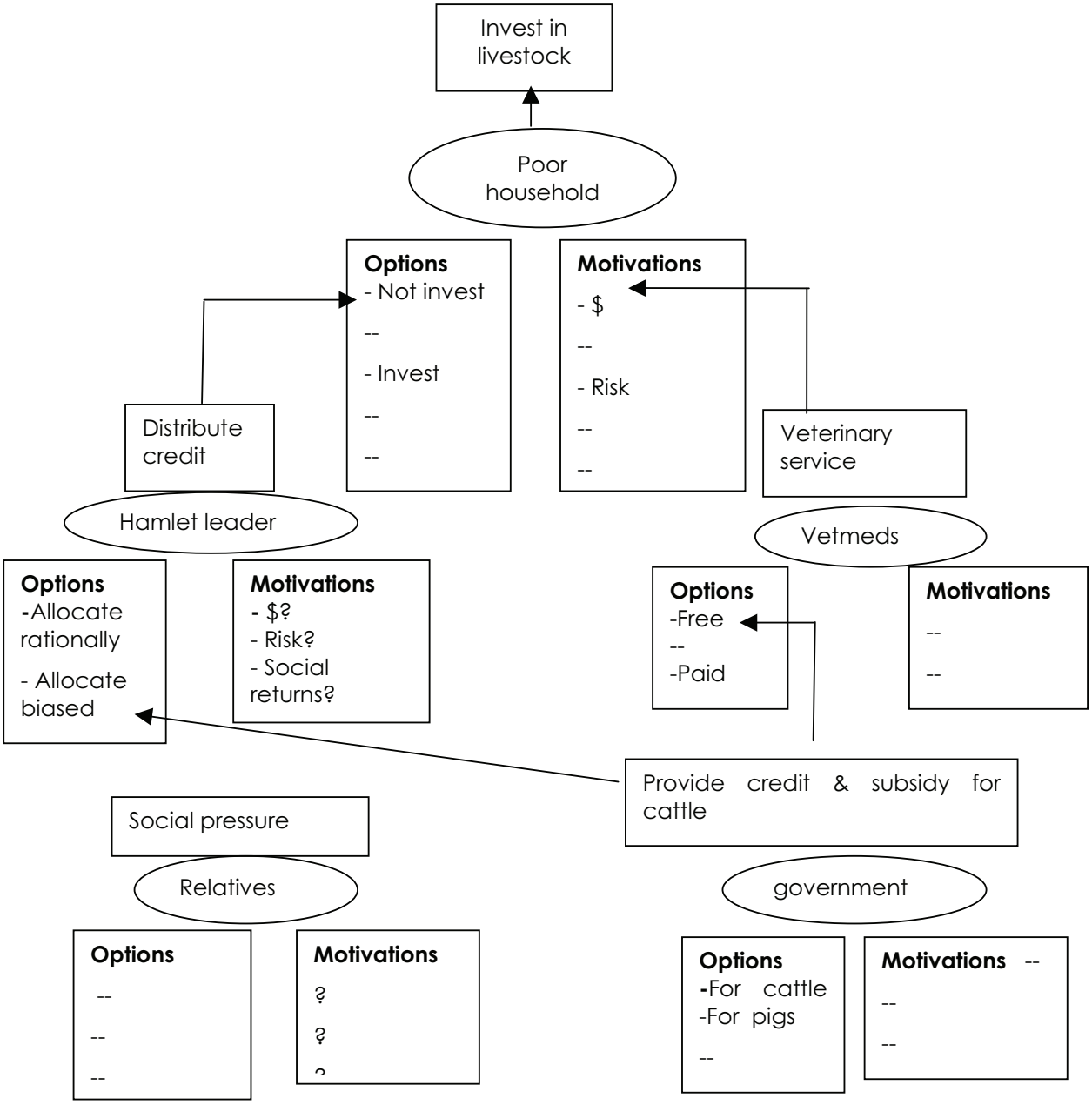

Figure 3: **Actors field for livestock**.

In this area of the actors field, we also observe that the government provides credit for livestock for the poor households. The linkage between the poor households and the government goes via the hamlet leader to whom the government hands out the money for the poor households. As is indicated by the question marks, we arrive at vague speculative pitfalls when this money comes into sight. The hamlet leader finally decides on who receives the money and he should be motivated to allocate the money rationally and justly. However, it is likely that he will be more motivated to allocate the

money in a biased manner steered by his friends and relatives. If he would not choose for biased allocation voluntarily, the underlying assertion of social pressure of his close friends and relatives would force the hamlet leader to choose more towards biased allocation than rational. This is underlined by the poor households who complained about the misuse of power by the hamlet leader accusing him of favouring his (already well to do) relatives and relations.

Reviewing the actors field of livestock breeding, we understand that the poor people still lack the credit to invest in livestock due to biased management of financial sources at the level of the local authorities. Furthermore, the government preference to support only livestock husbandry ignores the people's wish to also have access to the cheaper investments in pigs; it has remained unclear why the government would continue to do so. Obviously, much would be gained if both constraints could be lifted.

9 Discussion

This part of the report described and discussed the results of the Action-in-Context (AiC) research that was a component of the local level SEAtrans research in Vietnam. In part I, the MFA identified the main flows of bamboo, swidden products and logs that cause environmental problems of soil degradation and deforestation. The AiC research was conducted to explain the livelihood activities causing these problematic flows in Tat hamlet connected with their structural and cultural context.

In this chapter, we will first go deeper into the decision-making structure regarding the problematic land use activities of swidden farming, logging and collecting of NTFP. Furthermore we will analyse the potentials of other livelihood activities and the key factors and actors that control the options and motivational factors of the land use decisions. Next, future scenarios will be outlined.

Table 28 displays the basic motivational characteristics of all options connected to the problematic flows.

9.1 Decision-making of problematic land use activities

Rice production on paddy fields

The key change in the recent past has been the switch of focus from swidden rice to paddy rice production. Government programs have played a key role in the pull to the paddy fields. Soil degradation in the swidden fields is the key factor for the push to the paddy fields.

These days, paddy production is half-way intensified, with high-yielding varieties and chemical fertilisers, leading to the relatively high returns to land and labour of paddy rice that are displayed in Table 28. If stimulated by government and extension programs, paddy production may become more intensive, which is a wish of the farmers.

Expansion of the paddy fields is no option due to physical (slope) constraints, except on far away places from the village, leading to the development of sub-farms there. The people of Tat are caught in an intense land shortage caused by the growing population and the reduction of available land due to

forest protection policies. A logical future scenario for the rice production is that further intensification on the already existing paddy fields will occur, supported by government programs.

	Rt land (kg/ ha)	Rt labour (VND/ day)[1]	No Risk	No Hard ship	Connection		Fun	Food		Investment	
					Ma-terial	Time		Quality	Variety	No Initial	No Main-tenance
Swidden											
Rice	?	10,000	-	-	0	-	0	++	++	0	+
Canna	?	7,000	-	--	0	-	0	Na.	Na.	0	+
Cassava	?	6,000	+	-	+	-	0	0	+	+	+
Ginger	?	7,000	0	-	0	-	0	0	+	0	+
Paddy											
Rice	2,800	28,000	+	+	+	+	+	+	+	--	--
(Non) Timber Forest Products											
Bamboo shoots	Na	26,000	0	--	0	-	+	+	0	Na	Na
Bamboo	Na	+	0	--	0	-	+	Na	Na	Na	Na
Broom grass	Na	28,000	+	-	0	-	+	Na	Na	Na	Na
Logging	Na	25,000	--	--	0	--	+	Na	Na	Na	Na
Animal husbandry											
Cattle	Na	+	+	+	+	+	0	Na	Na	--	+
Pigs (white)	Na	21,000	--	-	0	+	0	+	+	--	--
Pigs (Muong)	Na	15,000	0	+	+	+	0	++	+	-	-
Chickens	Na	+	--	+	+	+	0	+	+	0	-
Ducks	Na	14,000	--	+	+	+	0	++	+	0	+
Fish pond	Na	+	-	+	+	+	0	+	+	-	+

Explanation of qualifications: Na = not applicable, 0 = neutral, + = positively corresponding with the motivational factor, - = negatively corresponding with the motivational factor, -- = strongly negatively corresponding with the motivational factor.

[1] The Tables 3, 4, 5, 6, 10, 11, 12, 16, 17, 20, 25 show the detailed calculations of the returns to labour. Here, the averages are shown and rounded off. The maintenance costs are included in these calculations.

Table 28: **All main livelihood activities and motivational factors**.

Swidden farming

In the recent past a trend in swidden farming can be identified from rice production to cash crops due to convolution of three main factors. First, although swidden rice shows a relatively high return to labour in the Table, swidden rice production is in decline due to the lack of fertile areas and soil degradation. Swidden rice needs the most fertile soils in comparison to other swidden crops, and the limited area of arable land restricts the rice production. At the same time, the need for producing rice on the swiddens lessened, because the focus of rice production switched to the paddy fields. Instead of growing rice on swiddens, the cultivation of cash crops on swiddens has become popular since the time that the road was constructed. The road connects the village to lowland cash crop markets that are expanding.

At this point in time however, we see when looking at the Table, that swidden agriculture is not a favourable option in terms of returns to labour any more in comparison to other land use activities. This is largely caused by the low productivity of the swiddens. For this reason some people have given up swidden farming. However, most people still continue swidden farming because there are not enough other income-generating activities that they can access, and because it is hard to change one's tradition so drastically, having always practised swidden farming. The trend, however, is that people will abandon swidden farming in the end, leaving the depleted soils.

Growing cassava will most likely form an exception on the trend of completely abandoning swidden agriculture. Cassava is hardly grown for the market because of the even lower returns to labour than the other swidden products, as we can see in the Table. However, the positive values the Table gives on the motivational factors of no risk, material connection, food variety and no initial investments point at, respectively, the low risk even when growing on the most depleted soils, at the value of its multipurpose use (e.g. feed for pigs, as snack, as cash) and at the fact that stem cuttings are used for planting the next crop instead of part of the yield of the previous harvest, as is the case with other swidden products. All these factors make that cassava is likely to continue to be planted, especially if people breed pigs. The described trend of a steady decline of the yields of all swidden products is caused by continuing soil degradation. This is the result of not leaving the swiddens enough fallow period to regenerate, which is in turn caused by land shortage caused, as said, by the rising population density and the forest protection policies, even though the latter are not well implemented. Without adequate forest protection, further expansion of swiddens into the forest is to be expected, when people search for new, more fertile swidden fields. This may well result in a scenario of ever expanding soil degradation and erosion. A preferred policy appears to be a package deal of (1) credit and programs for sustainable hillside crops with a good economic perspective (e.g. high quality bamboo and fruit or timber trees), and (2) strict forest protection.

(Non) Timber Forest Products

As we can see in Table 28, collecting NTFP and logging, similar to swidden farming, constitute income sources that require low initial investments whereas other income sources require high investments. The Table also depicts that collecting NTFP and logging are more interesting income sources than swidden farming in terms of returns to labour. Maybe somewhat surprisingly, the Table also shows that the modest activity of collecting and selling broom grass is the best option on almost all accounts among the (N)TFP options. Additionally, broom grass is the best option in terms of sustainability; people could continue to extract it to the end of days. The fact that in practice most households usually carry out many options such as swiddening, logging and collecting broom grass, bamboo and bamboo shoots is that these activities are seasonal; people seek to assure some income source throughout most of the year.

Even though, as we can see in Table 28, the returns per day for logging are not high and its illegality results in a strongly negative value on the risk factor in the Table, the returns add up when being in the forest for a 10 days logging trip, making it a good additional source of income throughout the year. Collecting bamboo and bamboo shoots for commercial purposes is also prohibited, but the rule that action should be taken "unless people are too

poor…" strongly applies here, resulting in a neutral risk value in the Table. Due to this, over-exploitation of trees and bamboo is apparent, and people have to cross the boundary of the territory of Tat to find bamboo and high quality trees for logging. In other words, both activities are unsustainable. Equal to swidden cash crops, the construction of the road, connecting Tat to the lowland markets, triggered the unsustainable NTFP boom. For NTFP, this combines with the non-implementation of the forest protection policies (zonation and prohibitions). Because of the market demand and without proper policy implementation, the current trend is likely to continue, depleting the last remaining forest resources even outside Tat's territory, and bringing the bamboo and lumber down to a very low level. Analogous to the recommendations for combating unsustainable swidden farming, a change in the current trend could be established by developing a package deal of (1) credit and programs for crops and products with a good economic perspective (e.g. high quality bamboo and timber trees on swiddens, endeavours with making brooms of broom grass), and (2) strict forest protection, including the interruption of the trading network of bamboo and lumber that was uncovered in the actors field in Chapter 8.

Animal husbandry

In line with the good returns shown in Table 28 for animal husbandry, we could assume that this activity could form an interesting alternative to swidden farming, unsustainable collecting of bamboo and logging. However, the displayed returns to labour in Table 28 do not take into account the high risks of diseases, that are especially high for pigs and poultry as the Table indicates. Because of these high risks, the investment costs for medicines are high as well. These are provided free for cattle but not for the other animals. Other maintenance costs involved is the feed necessary for pigs and chickens. An other demotivational factor shown in the Table is that the initial investments costs are high. As the actors field for livestock (Figure 3) showed, the government plays and will play an important role providing credit for initial and maintenance investments in the future. Cattle, pigs and poultry will probably continue to form an income in the future, to the extent allowed by the biomass surpluses of the village. Stabling of all pigs and cattle will be necessary to reach the optimum outputs and to prevent crops damage. Anything more than what may be sustained by the village's own biomass surplus, *i.e.* animal husbandry based on buying feed from external sources, does not appear to be a viable option because there is no comparative advantage with respect to doing the same thing in the lowlands, that are closer to the markets of feed supply and meat demand.

9.2. Future scenarios

In short, the current situation in Tat is characterised intense land shortage, with virtually all flat land being developed already into paddy fields, and surrounded by steep slopes on which only a few activities are sustainable. The production on the paddy fields is too low to sustain the whole population. The current forest exploitation boom is primarily caused by the construction of the road that was not combined with strong (self-)regulation. It is soon to go bust, and with it the unsustainable exploitation activities will vanish. For now, people do not stop the activities because of the unbalance between the urgent need for cash on the one side, and the lack of alternative options and (self)regulation on the other. Future land use scenarios that may be outlined

originate from three main developments that could take place: (1) paddy intensification, (2) diversification and (3) out-migration.

Paddy intensification

Further intensification of the paddy farming is likely to occur since the government is investing in the intensification process in anticipation of the wish of the people. Changes in rice prices will not make any difference here because the rice, due to the limitations of flat lands, is only grown for subsistence. Developing more rice terraces or going to remote places further away from the village to increase the rice production is probably possible only on a very small scale.

Diversification

Diversification of livelihood activities into a number of crops and other activities could form a positive future scenario. A transition will have to take place towards the development of crops and new activities with a good comparative advantage with regards to the lowlands, and also the development of a value-added industry might form an important income generating activity. For these two options, three conditions have to be met.

First of all, people have to find crops and activities with prices on the lowland market such that the investment pays off (there is no internal market). As we have seen, breeding cattle and pigs involves high investments and risks, while at the same time there will probably not be any comparative advantage with regards to the lowlands due to the environmental characteristics in the uplands. The same holds for chickens. However, the people also wish to plant timber trees and high value bamboo on the fallow swiddens. This would lead to a win-win situation in terms of environmental sustainability and good economic returns, probably having a comparative advantage with respect to the lowlands as well. Further, intensifying the production of vegetables and fruit trees that are specifically suited for the uplands might form a sustainable and viable activity as well. Whereas people mentioned that the slopes of the fields are too steep for fruit trees, we could think about other ways, such as preventing the fruits from falling down the steep slopes by catching them with a net, and developing small terraces for fertilising trees. The last activity that could be envisaged is the manufacture of brooms. At present, people sell large quantities of broom grass on the lowland markets, where they make brooms. People could develop a value-added industry and sell brooms (the authentic hill tribe brooms?) instead of broom grass.

The marketing of vegetables, fruits and brooms is a major constraint according to the people, which prevents them from changing their current livelihood focus. Thus, the second condition for transition and the development of a value-added industry is that a good connection to the lowland market has to be established. This connection entails finding buyers in the lowlands as well as finding arrangements for collective transportation, since individual-level transport is too expensive.

The last conditions for innovation are capital and knowledge. People in Tat said that next to the missing market, the lack of capital to make the investments is decisive for their behaviour. The development of a good working credit system by the government could be a solution, by which special attention should be paid to prevent misuse. People could generate credit themselves as well, even if it would originate from unsustainable

activities. The lack of knowledge does not appear to be very problematic even though people said that they miss the appropriate knowledge in some cases making investments more risky. Assistance in making brooms and managing fruit trees will surely bare fruits, because people already show innovative behaviour and are willing to test and endeavour if there is a good chance to make money.

Out-migration

Out-migration is likely to start one day or another, due to the general land constraint. If the intensification and diversification would be successful, out-migration would not necessarily be a doom scenario; Tat could become one of the world's many sustainable and culturally stable places from which young adults migrate to the cities in order to help themselves but also keeping up the economy (remittances) and culture of their place of origin. If the intensification and diversification would fail, however, Tat could become of the world's many other places where Malthusian processes of land degradation, poverty trap and cultural disintegration predominate.

In these future scenarios for Tat the government will play a key role. The government will probably continue to support the intensification process of the paddy fields. Further, the government could assist in the development of new crops and activities that have a comparative advantage with respect to the lowlands, in terms of help with establishing a good connection to the lowland market for fruits, vegetables and brooms for example, and stimulate collective action to reach this objective. Further, the government should provide knowledge and credit in cash or in kind, e.g. seedlings of timber or fruit trees. Assistance in diversification in livelihood activities could well be combined strictly implementing the forest protection policies. This implementation is not necessarily a one-way affair. Because the necessity of sustainability of the steep slopes is highly significant to all, government has every right, but also many possibilities to challenge the Tat community reinvent their culture in order to face the new problem of unsustainability and to assert their own capacities for economic collective action.

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