Figuring rural development : concepts and cases of land use, sustainability and integrative indicators
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Leiden University Press

Cover design: Maedium, Utrecht
Lay out: The DocWorkers

ISBN 978 90 8728 078 9
e-ISBN 978 90 4851 267 6
NUR 922

Figuring Rural Development

Concepts and cases of land use, sustainability and integrative indicators

PROEFSCHRIFT

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van de Rector Magnificus prof. mr. P.F. van der Heijden,
volgens besluit van het College voor Promoties
te verdedigen op 4 maart 2010
klokke 13.45 uur

door

Marieke Hobbes
geboren te Zoeterwoude in 1976

Promotiecommissie

Promotor:	Prof. dr. G. R. de Snoo
Co-promotor:	Dr. E. van der Voet
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To the memory of my father

Preface

The journey that ended in this dissertation started in April 2001 when I received a research position at the Institute of Environmental Sciences (CML) in Leiden, for the project 'South-East Asia in Transition' (SEAtrans). This was one of the first projects where two departments within CML, Environment & Development and Industrial Ecology, closely worked together. SEAtrans was an initiative of the Institute of Social Ecology (IFF), in Vienna, with partners from Italy, Spain, the Netherlands, Laos, Thailand, Vietnam and the Philippines, and funded by the EU. The general objective of the project was to explore the sustainability of the modernization of South-East Asian societies, by studying the flows of materials and energy on the national and the village levels. In the selected villages, the focus was on flows of biomass products (corn, rice, logs, etc.) and the explanation of why farmers chose for these livelihood activities. CML led the local work in Vietnam and in the Philippines, collaborating with researchers from the Center for Natural Resources and Environmental Studies, Hanoi (CRES) and Isabela State University, the Philippines. Aside from traveling for project meetings, I spent about 5 months in the Philippines and about 2 months in Vietnam for organizing and implementing the village-level field research.

In 2004, we were invited to join the project titled 'Technology of water for irrigation and potable use' (TIPOT), funded by the Asia Pro Eco Programme of the EU. The project concerned the development of a low-cost technology for subterranean treatment of groundwater to combat the arsenic pollution of drinking water in the Bengal region. CML's main task was to formulate guidelines for the embedding of the technology in the local communities in West Bengal and society as a whole (the 'delivery system'). It was initiated by Queen's University Belfast, with partners from Germany, Spain, the Netherlands and India. Thanks to this project I had a job and a full-time Indian assistant-researcher who also gathered an ocean of data on social, economic, agricultural and nutritional issues of the TIPOT case study village, specifically for my PhD. When this project ended, the database was by far from complete, and the depth of the idea of what I actually wanted to do with this database was not fathomed yet. I received one extra year (two years half-time) from CML to devote entirely on my PhD. Parallel to the ongoing data gathering process I developed the indicators described in Chapter 5 and 6. The results of the SEAtrans project can be found in Chapters 2, 3, and 4.

In scientific terms, the process underlying the thesis can be described as a rise of methods over substance.

Chapter 2 started out as a first attempt to connect the methodological framework of Material Flow Accounting (MFA) to agricultural transition theory and 'Action-in-Context' (AiC) as a research tool. It was to be a real interdisciplinary methodological and substantive undertaking, with MFA representing the natural science side of the story, AiC representing the social part and the combination of those showing a surplus value. The first anonymous reviews were dreadful, criticizing especially the "unworkable" and "ponderous" methodology. As a result, I changed the paper into a relatively traditional social-ethnographic case study with an almost fully substantive focus, only based, almost implicitly, on the MFA and AiC methodological foundations.

Chapter 3 reports on the second try to apply the same frameworks (AiC and MFA), but now "emerged" as the explicit topic of a methodological paper, illustrated with a case study of an indigenous people village in the uplands of Vietnam. This attempt was greatly helped by that it could be presented as a member of the "socially extended" MFA family, by which also publication in the Journal of Industrial Ecology came within reach. The substantive story is well represented, but the actual focus is on the methodological elements. The chapter is especially interesting for the MFA world. Socially extended MFA should find its value at levels where MFA has already proven its utility, which is for broad questions at large, e.g. national, scales. Socially extended or not, MFA does not link up broadly, i.e. theoretically, with issues of local-level rural development. With that, it does not form a deep key to figuring rural development. How should I continue? Here is where the next quest came into being, which was the construction of a new form of MFA that does contain links to theory on important rural issues in the developing world.

Chapter 4 is the result. It develops my own 'rural MFA'. Material flows are conceptually linked to phenomena in rural societies, such as to the transition from extensive to intensive and industrial agriculture through indicators of material productivity and material intensity, to globalization through two indicators of market incorporation, and to food security by way of five synthetic indicators expressing present and future food security. The system is certainly quite "ponderous", as my previous anonymous reviewer would have put it. It results in indicators, however, that are not to be found with the same clarity using any other method. The rural MFA framework is applied on three case study villages in Vietnam, Thailand and the Philippines. The indicators give a quantitative comparison between villages in terms of the indicators, displaying their quite different characteristics on a truly comparative scale.

On this newly acquired footing and confidence, Chapter 5 is an example of the environmental methodologist reaching out into the heart of rural development, i.e. development and poverty. It develops 'freely disposable time' (FDT) as a logically coherent indicator of wealth and poverty. FDT is the time that actors have left after satisfaction of their households' basic needs, and with that captures much of what has been called 'freedoms' by Sen and the capacity that people have to invest in the future, e.g. through schooling or investments in sustainable agriculture.

Chapter 6 was primarily meant as the concluding chapter of the volume. It could not be stopped developing, however, and now discusses land use themes, methodology for theory building and an elaboration of the FDT concept of Chapter 5 into an indicator of community development. Chapter 7 now presents the actual conclusions of the dissertation.

Acknowledgements

This journey would not have been possible without many people from CML, the SEAtrans and TIPOT projects. In the SEAtrans project, I worked together with René Kleijn. Thanks for being the exemplary colleague. I would like to thank the Vietnamese researchers Phan Thi Anh Dao, Le Thi Thu Thanh, and Trinh Khanh Chi for their hard work and dedication in the SEAtrans project part of the data I used for this thesis. The director of CRES, Le Trong Cuc, helped in logistical support. The Dutch team consisted of the students Serge Stalpers, Patrick Heezen and Jiska Kooijman. You were a great team with a strong drive through the sometimes grueling circumstances. The Vietnamese case study was a story on its own and a big learning process for me, but we finally succeeded in building a coherent team and get some good data out. I am grateful to all the respondents in Tat hamlet for their hospitality and the valuable time they gave to co-operate with the research. In the Philippines, I would like to thank the CVPED staff members at that time, especially the coordinators Andy Masipiqueña and Jan van der Ploeg for their scientific and logistic assistance, and the office workers Madel and Eso for their practical help. I appreciate the SEAtrans fieldworkers Orlando Balderama, Liesbeth Denis and Sietske Veenman and their field assistants Sammy, Leonardo and Jane for all their work. I had the honor to have Arnold Macadangdang as my private research assistant, interpreter, guide and companion in the field. I am most grateful to our to all our respondents in Dy Abra, Masipi East, and Puerta, who gave us so much of their time to learn about their way of living, carefully looked after us and made us feel at home. Especially Dar and Rose in Masipi East made a home for me every time I returned to the field. I would like to thank Marina Fischer-Kowalski, Heinz Schandl and Clemens Grünbühel (IFF) who initiated and organized the SEAtrans project that laid the foundation of this dissertation. Besides that, Clemens shared his data with me on the Nalang case study that became a central village for my rural MFA. I acknowledge Bhaskar Sengupta who contacted me to ask if CML would be interested in participating in the TIPOT project on a low-cost in-situ arsenic removal technology. In Angel Carbonell we found a great colleague to participate in the project just by picking the right person from the internet. Sukanya Sarkhel was chosen to be my Indian partner in the project and work for me. Your hard work, dedication and persistence has been essential to finish the work. You made me feel very welcome and at home when visiting your place. While working for all these projects, I spent most of the time at the office of the former Department of Environment and Development of the Institute of Environmental Sciences (CML), Leiden University. With the financial help from the institute I could finish this dissertation. I would like to thank all my colleagues and ex-colleagues at CML for their support, and specifically Reimar Schefold for stepping in at a crucial moment and Marco Huigen for nudging me into full-fledged database work. My family and friends have always encouraged me, with special thanks to my mother for her confidence in me. During the process of delivering this thesis, I delivered three wonderful children. With them and a dissertation as basic need, there was hardly freely disposable time left, but enough destinations. Dimple helped us out during the last year. Wouter was my supervisor in the SEAtrans project. Together we enrolled in the TIPOT project and a happy marriage

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1

Introduction

This chapter introduces sustainable rural development as a confluence of sustainable development and rural development.

1.1 Aim of the study and structure of the chapter

The drive behind the present study is to strengthen the scientific basis of sustainable development in rural areas of developing countries, and to do so as effectively as possible within the limited budget of a PhD study. The aim of this study is ***to contribute significantly to the growth of sustainable rural development as a systematic field of enquiry.***

Sustainable rural development is a hybrid concept. Focused on the rural areas in the developing countries, it is an attempt to merge sustainability goals, i.e. the safeguarding of natural capital in a broad sense, with development goals, i.e. economic progress in a broad sense. Likewise, the science underpinning sustainable rural development may be viewed as a confluence of two scientific fields, one with its starting point in the sustainability concept and one with its starting point in the rural development concept. Figure 1.1 is the graphic representation.

To be effective as a confluence discipline, sustainable rural development should combine the strengths and fill the missing elements of the two parents. The present chapter is therefore largely devoted to an overview of these two parents that helps identify these strengths and missing elements, differentiating between substantive aspects and methodological aspects, as Figure 1.1 shows. Sections 1.2 and 1.3 focus on sustainable development. Sections 1.4 and 1.5 focus on rural development, as also noted in the Figure.

Based on these overviews, Section 1.6 takes stock of what out of the parent fields should be combined to make the blend of 'sustainable rural

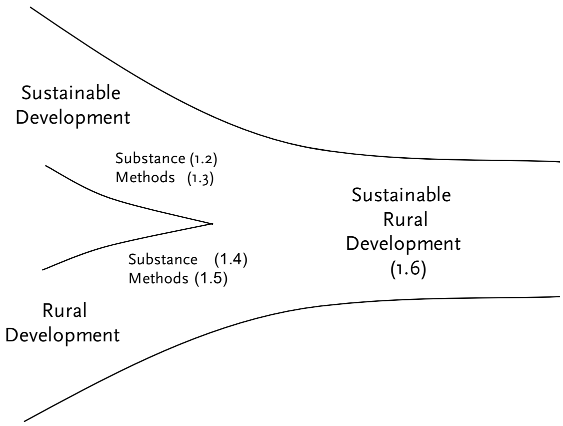

Figure 1.1 'Sustainable rural development' (substance and methods) as a confluence of substance and methods from 'Sustainable development' and 'Rural development'. The numbers refer to sections in Chapter 1.

development' as effective as possible. Section 1.6 also takes a position in a broad methodological sense, contending that sustainable rural development should be structured as a *discipline* (a "systematic field of enquiry") rather than a mere agglomeration of applied studies. In this section, the aim of the study acquires its strategic content.

Section 1.7 then translates strategy into action. Based on Section 1.6 and the desire to serve the new discipline as effectively as possible – implying a focus on significant gaps and major opportunities – the section formulates the main questions of the present study. Rounding off the chapter, Section 1.8 supplies an overview of the study as a whole.

1.2 Substantive aspects of sustainable development

Defining sustainable development

Sustainable development has been defined in many ways, but the most adhered to is from the report of the World Commission on Environment and Development (Brundtland) 'Our Common Future' (1987): *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. Why was this definition a turning point in development thinking? Development has long had a single focus of growth. The sustainable development concept lays bare that growth needs limits. The limits proposed by Brundtland are that growth in the present should not undermine society's adaptation or growth potential in the future. This definition of sustainable development does not add new aspirations to the development ideal. Rather, it adds a relatively simple minimum standard ("without compromising ...."). We will find this conceptual structure back in many places of this study, e.g. at the very end, where the development indicator contains three minimum standards (on risk, external effects and quality of life).

In the years after 1987, the sustainable development concept has been 'upgraded' to an umbrella concept capturing not only the protection of the future generations against the greed of the present (intergenerational equity), but also the protection of the poor against the rich – in fact the protection of all vulnerable groups in society. On a more theoretical level, the sustainable development concept can now be seen as a Rawlsian ethics (e.g. Zylicz, 2007), set to strike a balance between *equity* (protection of the weak such as future generation and the basic needs of the poor) that serves as a minimum standard for the pursuit of *efficiency* ('development', the good of the system as a whole). If equity is assured, no great harm can be done by defining "development" simply as economic growth, prosperity or profit. The result is the well-known formulation of sustainable development as "PPP" (People-Planet-Profit) or as a balanced growth serving economic rationality, social justice and ecological equilibrium at the same time (Lehtonen, 2004).

Sustainable development builds on a wide range of natural science, social science, technological and humanities disciplines, plus branches of study that have specialized specifically on environmental issues since the 1970s in various ways. The latter comprise environmental science, political ecology, industrial ecology, conservation biology, sustainable agriculture, ecological anthropology and so on. 'Sustainability science' may be used as a broad umbrella term, first because it expresses the linkage with sustainable development quite well, and second because it denotes a recent attempt to build a broad but systematic 'meta-discipline' (see for instance Komiyama and Takeuchi, 2006; the Sustainability Science Program at Harvard and the new Centre for Sustainability Science and Society at Groningen University).

Themes in sustainable development research

The UN Division for Sustainable Development lists 43 areas as coming within the scope of sustainable development, which are categorized by broader subject and briefly described underneath. The categorization is primarily by system type (global, nature-dominated, mixed and human-dominated).

- **Earth system**

Although basically all themes in sustainable development have their own global level component (global biodiversity hotspots, global food market, global pollution flows etc.), the Earth System policies and sciences focus fully on getting a grip on the world system as a whole. The global climate and all it entails (climate models, sea level rise, mitigation and adaptation options, international agreements, energy and emission predictions etc.) is the main focus of Earth system work.

- **Biodiversity and natural resources**

Nature is usually regarded as carrying its own ('intrinsic') value and is as such part of the equity component of sustainable development. Biodiversity conservation is strongly linked with the sustainable use of natural resources (forests, soils, wetlands, capture fisheries etc.) for societies, connected as they are through issues such as viable minimum populations, ecosystem services and institutional arrangements, e.g. 'co-management' of nature by the state and communities together.

- **Land, water, food**

Systems of land and water use (agriculture, animal husbandry, groundwater management, peri-urban landscape management etc.) are focal points of human-environment interactions. Due to its equity drive, sustainable development policies here tend to focus on areas and issues of scarcity, unsustainability, resource conflict and basic needs, especially food. On the science level, sustainability science adds a stronger 'planet' element to the primarily human-oriented sciences of agriculture, geography, rural development and food security studies.

- **Pollution, sanitation, waste**

Pollution abatement is a classic theme in environmental science and technology, connected to waste management, sanitation issues, health and urban system issues in general. 'Sustainable cities', 'cradle-to-cradle' product design and likewise innovation-oriented actions and theories are the latest leaf on this tree, which is of great relevance not only for the industrialized world but also for the rapidly industrializing and urbanizing developing countries.

- **Human drivers and human impacts**

Change in any human-environment system, from the global climate to village-level land use change, has human impacts as well as human causes. These causes are often studied as parts of the themes mentioned above. They may also be studied and addressed separately, however. The latter makes sense especially if drivers and impacts are broad and interconnected. Poverty, often being a cause as well as an effect of environmental degradation, is one example. Other typical elements here are demography, changing consumption patterns when nations develop and urbanize, public visions of nature and the "greening" of business and culture.

- **Conceptual enquiry**

What is the good of economic growth at all? How can future generations, i.e. entities that do not exist, have rights? The 'ecological footprint' is a strong metaphor but how can it be made operational in a balanced manner? What is a 'green GNP'? Conceptual issues such as these are not only core business of sustainability science but also play a basic role in the public foundation and the political negotiation of sustainability policies.

In almost each particular case of sustainable development policy or sustainability science, the themes of sustainable development appear to be interconnected. To mention one example, policies and studies which focus on the future of the African drylands start out with interconnections between land, water, food, biodiversity and natural resources but then also encounter the effects of climate change, shifting world markets and large cities as drivers of land use change. Another example is the policy issue of biofuels development that starts out from the global (energy and climate) theme but then also encounters issues of biodiversity, food, green consumers and so on. As a result, there is a strong drive to build sustainability science as an interdisciplinary *meta*-discipline, able to overarch and integrate contributions from many others.

The present study, focusing as it does on rural areas, finds its main footing in the sustainability science themes of land, food and natural resources. The human drivers theme is also presented, e.g. in the explanation of land use and the 'social extension' of material flows in Chapters 2 and 3. Conceptual enquiry in this study focuses mainly on methodological issues in later chapters, e.g. on induction versus deduction.

1.3 Methodological aspects of sustainable development

Because of the need to integrate themes and disciplines, sustainability science has a strong methodological thrust. The focus here is on two major elements: frameworks and indicators.

Frameworks

Its interdisciplinary and overarching nature makes sustainability science a highly 'frameworked' discipline. In the present study, a 'framework' is any relatively broad prescription for how to structure research, e.g. specifying key concepts, causal relations and research steps.[1] Some major examples will now be discussed.

The Drivers - Pressures - State - Impacts - Responses (DPSIR) framework, developed by Rapport and Friend (1979) and further sophisticated for instance by the OECD (1991) and the UN (2001), may be called the mother of all environmental frameworks. It displays that *Driving* forces (i.e. human activities and factors that result in environmental change) exert *Pressures* (e.g. unsustainable resource exploitation, emissions to the environment) that lead to changes in the *State* of the environment. This then leads to *Impacts* that may induce societal *Responses*. Responses of society (spontaneous or through environmental policy) to real or predicted environmental change are the feedback mechanism from impacts back to driving forces. DPSIR thus shows the environmental effect chain and the human-environmental interface.
Many frameworks in environmental science elaborate specific parts of the DPSIR structure. One example is Environmental Impact Assessment (EIA) that focuses on the causal chain between proposed activities (a project or policy) on various components of the environment (e.g. air, biota) and onward to the impacts on society (e.g. in terms of public health or landscape quality). In order to support political decision-making, various policy or project scenarios are usually scored on a number of criteria in a multi-criteria analysis (MCA) structure (Edwards-Jones et al., 2000).

In the Industrial Ecology branch of sustainability science, the frameworks of Life Cycle Analysis (LCA) and Material Flow Analysis (MFA) are used to analyze and assess the environmental effects of changes in the flows of materials in society. LCA assesses the potential environ-

1 See for instance the Oxford Advanced Dictionary: a framework is "part of a structure that give shape or support" or the freedictionary.com: a framework is a "skeletal support" or a "fundamental structure". Compared to frameworks, 'methods' then are the more concrete research prescriptions, e.g. how to make a sample or how to interview, and 'tools' are all means to apply the methods, e.g. a weighing scale or a software package. The terms of 'system' and 'model' are applied more loosely, a system being any collection of elements with some degree of coherence, and a model being any representation of a system. Both systems and models may be either substantive or methodological. A framework may also be called a methodological system, for instance.

mental impacts of a product or service all along its production, use and waste phases ('from the cradle to the grave'; e.g. Guinée, 2002; Bouman et al., 2000). Based on theory of social-industrial metabolism (Ayres and Simonis, 1994), MFA is a form of material input-output analysis of social-environmental systems, e.g. countries. LCA and MFA can be seen as methodological elaborations of the Pressures and some length of the State and Impact elements of DPSIR (Kleijn et al., 2008: 267; Tsetse, 2008), focusing as they do on material flows and stocks in societies and their emissions to the environment. MFA and can be used, for instance, to signal environmental issues, trace back their origins of flows in society and estimate future flows and stocks. Material flow accounting is one application of MFA, developed in order to counterbalance the national economic accounts providing indicators for problem-relevant subjects such as environmental pressure (Eurostat, 2001).

The Problem-in-Context (PiC) framework developed by De Groot (1992) is an expansion of the DPSIR scheme in three directions. First, it takes full account of the normative character of environmental science and adds a 'norms chain' parallel to the effect chain. Second, the impact variables such as human health, biodiversity or economic growth are acknowledged as depending on ethical (self-)reflection, called 'normative contextualization'. Finally, it supplies a full sub-framework to develop the 'Drivers' element of DPSIR. This Action-in-Context (AiC) framework is designed for the explanation of human activities. One characteristic of the framework is 'progressive contextualization' (Vayda, 1983), meaning that the application starts out from the activity (or deliberate non-activity) to be explained and then works its way 'outward' into an ever-widening context of actors, societal structure, cultural factors and so on. One element in AiC broadly overarches what micro-economics (e.g. Simon, 1979), social psychology (e.g. Fishbein and Ajzen, 1975) and other causally oriented actor-based disciplines offer to study decision making (e.g. Long and Long, 1992). A second element, the 'actors field' is a unique in AiC, however. It depicts the interlocking of 'actors behind actors' causing the action in question. PiC has recently been expanded to OPiC (Tsetse, 2008) that adds more attention to creative search for options for solutions outside those directly generated by the problem analysis and problem explanation.

In the present study, Chapters 2 and 3 will apply and interconnect the MFA and AiC frameworks. Chapters 4 and 5 will develop frameworks of their own.

Indicators

In Dubin's (1978) book in theory building, all quantifiers (all 'metrics') that make concepts operational are called indicators. This terminology is theoretically justified but in practice different terms apply. Quantifiers that seemingly express the concept in question directly are simply called variables, and quantifiers that still lie fairly close to the concept are called 'proxies' or suchlike. The term 'indicator' is then reserved for cases in which a certain tension is felt between a big concept ('development', 'sustainability', 'poverty', 'health', ...) and the simple number that supposedly expresses that big concept.[2] Indicators play a key role in sustainable development policy making. Making things measurable is also essential for scientific development. Scientific progress requires that theories may be tested, and testing requires valid quantifications.

Indicators may be classified on two levels of methodological sophistication. First, there are the *aggregate* or *composite* indicators that merely add up, with or without weighing, the scores on a number of components that are all supposed to 'contribute' to the concept (e.g. sustainability) but without significant grounding that these are indeed the valid components or that adding up is their most defendable relationship. An example from the field of nature conservation is the indicator of 'conservation value' of areas, which simply adds the scores of size, optimum population, diversity and several others (Edwards-Jones et al., 2000: 105).[3] Another example is ESI, the Environmental Sustainability Index (Hák, 2007) that adds up scores on air quality, reduction of population growth, private sector responsiveness and so on. Although it is interesting to see the Netherlands positioned way below Albania on this indicator, Hák concedes that "as is often the case with composite indices, ESI is difficult to interpret". Nevertheless, the vast majority of the array of sustainability indicators inventoried in Hák et al. (2007: 369-381) is of the composite kind.

On a higher level of methodological sophistication lie what I call *synthetic* indicators. Synthetic indicators are structured along the lines of an underlying descriptive or causal model or framework (*cf.* Dubin, 1978: 164; OECD, 2008). The framework of Material Flow Accounting, for instance, generates synthetic indicators such as total material flows

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2 This definition excludes what are often called 'ecological indicators', which are biological occurrences (e.g. the abundance of a species group) that serve as indicator of some feature of an ecosystem as a whole, such as water quality, air pollution or total biodiversity (e.g. Newman and Schreiber, 1984).

3 See also Smith and Theberge (1987) for more examples and a discussion.

per capita or per dollar of GNP of economies (Eurostat, 2001). The Life Cycle Assessment framework calculates 'total toxic potential' indicators of products based on a coherent model of the total toxic impact of pollutants (Guinée, 2002). The ecological footprint (Rees, 1992) forms another example of a synthetic environmental indicator. It converts all consumption of a social entity (household, town) into the area of land needed for the sustainable production of this consumption plus the area of land needed to sequester the greenhouse gasses produced.

Synthetic indicators are open to criticism as are the composite ones. Concerning the toxic potential of a group of substances, for instance, it may be questioned whether the toxic impact arises out of the addition of the effects of all emissions ($tox_a + tox_b + tox_c + ...$), or out of the one most dangerous emission ($MAX[tox_a, tox_b, tox_c, ...]$). Another example concerns the global warming element in the ecological footprint (e.g. Fiala, 2008). In stead of calculated the surface needed to sequester the CO_2 emissions, it could have been chosen to calculate the surface area of solar cells that would have been needed to avoid this emission at all, resulting in a very different footprint for the same activities (De Groot, 1992). Or, to mention an example from economics, GNP is usually seen as representing a nation's wealth. If a large percentage of GNP is in fact spent on repairing environmental damage, however, would that really be wealth? All such discussions on the quality of synthetic indicators are intrinsically superior to the discussions on composite indicators, however, because they do not propose alternative intuitive choices on how to add components but propose alternative theory and models, which are open to scientific scrutiny.

In the present study, Chapters 4 and 5 develop framework-based, synthetic indicators for sustainable rural development.

1.4 Substantive aspects of rural development

Rural development is a multidisciplinary field of enquiry informed by the need for poverty alleviation in the rural areas of developing countries. Rural development includes contributions from geography, agriculture, economics, political science and social anthropology. Ellis and Biggs (2001) provide an overview of ideas that have pervaded the discipline of (Anglo-Saxon) rural development studies from the 1950s to the present. These ideas comprise rapidly evolving mixtures of normative objectives ("poverty eradication", "free markets"), ideas on causes and solutions of rural problems ("lazy peasants", "state-lead credit", "rural safety nets"), research lines ("gender and development", "farming systems research") and methods ("participatory rural appraisal", "stakeholder analysis"), running up to the present-day livelihoods approach. The present section also provides a thematic overview but with a different purpose. In view of the aim of this study as a whole, we need to identify substantive core themes rather than Ellis and Biggs' (2001) mixture of substance, methods and values. Furthermore we need to move away from the fleeting fashions of the scientific trade and focus on themes that are sufficiently perennial to serve as loci for the systematic accumulation of theory and policy wisdom (e.g. with the help of synthetic indicators).

The focus of this section is therefore on general themes in rural development research rather than on themes with only a local[4] or partial[5] character. I will discuss the concepts of development, poverty, food, globalization, household strategies and farming styles, land use dynamics and common properties and participation.

- **Development**

The concept of development is widely used as to make the world a better place, especially for the poor (see the yearly Human Development Reports of the UNDP and the World Bank's World Development Reports[6]). In his reflections on the concept, Chambers (2005) contends that a personal dimension is needed. The objective of development is well-being of all, including social, psychological, spiritual and material aspects (Chambers, 2005: 193). Several of these aspects were already included in the Basic Needs approach (Streeten, 1979) that will be discussed further in

4 Local themes are often salient or even hot issues, but on a relatively restricted, less-than-global scale. One example is that in the densely populated areas of Asia, rapidly expanding cities gobble up prime agricultural land (Döös, 1992). Another local theme of rural development concerns the relationship between agriculture and nature conservation, which comes to the fore specifically in and around protected areas; see for instance numerous articles in journals such as *Environmental Conservation*. 'Co-management' of natural resources jointly by government and local communities or user groups is an important issue in this field (Borgerhoff Mulder and Coppolillo, 2005). Thirdly, issues of identity 'versus' development are a main theme in all areas where indigenous and mainstream cultures meet (Persoon et al., 2004). Other local themes of rural development concern, for instance, post-war recovery and natural disasters.

5 Partial themes often have the form of 'the role of X in rural development'. One example concerns the role of land tenure, with the work of Platteau (2000) as a well-known overview. Another important factor theme is the role of gender in rural development, with Shiva (2006) as one of the prolific authors. Other themes concern the role of (fictional) narratives in nature conservation (De Groot and Zwaal, 2007), the role of HIV/AIDS in (under)development and the role of politics of natural resource management (Bryant and Bailey, 1997; Vayda and Walters, 1999).

6 See for Human Development Reports URL http://hdr.undp.org/en/reports; for World Development Reports URL http://go.worldbank.org/LOTTGBE910

Chapter 5. Development theory has a macro-economic basis (Todaro, 1994), focusing as it does on growth of nation-wide GNP. The rural development discipline has not added anything substantial here on its own, rural level. One interesting (qualitative) element is worthy to note, however, namely the "development narratives" concept introduced by Roe (1991) and made popular by Leach and Mearns (1996). Development narratives are the stories that development organizations tell to justify their existence and funding. One example are the Malthusian narratives about population growth that leads to land degradation and poverty, persistently told about rural areas where in fact no such mechanism is visible at all (e.g. Carswell, 2004).

- **Poverty and food security**

Poverty is in many ways the negative of development. If development is understood as a multidimensional process (improvement of 'total' human well-being), poverty is defined as a lack thereof. If development is seen primarily as an economic process, so is poverty seen as primarily a lack of economic means. Two key notions in rural development studies with respect to poverty are the poverty trap and its opposite, the out-of-poverty phenomenon. People are said to be caught in the poverty trap if they have to spend all their energies on sheer survival, without anything left to invest in a better future. Out-of-poverty strategies are seen as the active investments of poor households for improving their lot, e.g. through education or land improvement. Seen this way, there is a crucial difference between poverty as merely having little to spend and poverty as having lost the capacity to invest (*cf.* Sen, 1999). Food security is a basic need and therewith strongly linked to poverty. It holds a special place in rural development studies because it is often the most salient aspect of rural poverty (e.g. in famines). On the positive side, food surpluses are usually a cornerstone of rural progress.

- **Globalization, localization, commoditization**

Globalization can be divided in cultural and economic globalization, to which political globalization is sometimes added (Boli-Bennett, 1980; 87). Cultural globalization denotes the emergence of a global field of culture (values, images) where Western culture has a strong influence on nations, communities and individuals worldwide (Arnett, 2002). 'Localization' is often mentioned as a response to this influence, referring to communities or people that counterbalance the globalization tendencies by re-asserting their own cultural identities (Appadurai, 1990). Economic globalization denotes the creation of a world market into which more and more communities and people are taken up, both for buying and supplying goods and services. For farming communities, the allied terms of 'incorporation' or 'commoditization' can be used to denote their degree of involvement in external markets on both the input and output side of the farming system (Galjart, 1986; Manno, 1999). Incorporation at the input side (e.g. for seeds and fertilizer) is often viewed as bringing about a deeper dependency than incorporation on the output side, i.e. selling on the world market without relying on external inputs (Zuiderwijk, 1998; Bolhuis and Van der Ploeg,1985).

- **Household strategies and farming styles**

A prime focus in rural development studies concerns farming household choices. In his classic study on the Russian smallholders, Chayanov (1966) studied the household cycle and subsistence production. In this tradition, Scott (1976) describes the fear of food shortages, explaining the 'safety first' strategy of peasants who will always first provide in their subsistence security and only then take a look at external markets and maximize economically. Contrarily, Popkin (1979) argues that peasants tend to act much more rationally (profit maximizing) overall. The Scott/Popkin peasant strategies are related to Van der Ploeg's (1991) concept of farming styles, which are based on different *calculi*. An example are the "I" and "E" calculi, in which farmers highly value the health of their farm or the size of their bank account, respectively. This gives rise to different farm development pathways, which may co-exist in the same region.

- **Land use dynamics**

Land use dynamics are the higher-level patterning, often called 'emergent properties', of the choices, often called 'strategies', of many rural households together. Theories on land use change therefore have a basis in household decisions, on to which they add their own large scale and long-term perspectives. Some theories emphasize a region's internal dynamics, of which the Malthusian spiral of increasing population, increasing resource exploitation intensity, resource degradation and increasing poverty is the most well known. Homer-Dixon's (1999) theory of conflict is a modern, 'neo-Malthusian' version. Strong opposition against this notion has been voiced by Boserup (1965) and more radically by neo-Boserupians such as Tiffen et al. (1994) who point at the many cases where farmers and whole regions have successfully gone through a transition to sustainable intensive agriculture under circumstances of rising population density. Other theories put the external influences on land use at center stage, especially markets, to which neo-Thünian perspective (Walker and Solecki, 2004; De Groot, 2006) adds the geographic perspective of growing cities and moving frontiers, e.g. of extensive and intensive agriculture. In the same vein, Rahman et al. (2008) discuss the transition-inhibiting effect of institutional disconnection between farmers and urban markets. In most empirical studies of land use change, internal and external factors are shown to interact. Burger and Zaal (2009), for instance, study the investments of farmers in the quality of their land and their institutions, and all factors are shown to converge in these investments. In the same vein but on a scale of inter-regional comparison in Africa, Hyden et al. (1993) present good soils, good external markets, attachment to the land and flexible institutions as key factors in agricultural intensification, which rings the same bells as the conclusions of Diamond (2005) on the fates on rural-based civilizations as a whole.

- **Common property, social capital, institutions**

In reaction to the all-pervading 'tragedy of the commons' narratives (e.g. Hardin, 1968) and free market and central state ideologies, many scholars have written about the ability of people to organize themselves for collective action and work together towards a common goal. Ostrom's (1990) 'Governing the Commons' is the classic example, focusing on environmental management, and the World Bank's attention to village-level social capital as a key to rural development is the most salient policy result. Social capital points at institutions for collective action. In the same vein, Agrawal (1999) has argued to replace the vague and romanticizing notion of 'community' by a focus on local institutions.

- **Exclusion and voice**

Exclusion and voice are key concepts in a critical subcurrent that flows through much of rural development. The general pattern is: if we have something that is actually or potentially good (e.g. development, social capital or gender policies), who is then in fact excluded from that good? Whose voice is never heard, and through what mechanisms of power? One example is Cleaver (2005), in a paper called 'The inequality of social capital and the reproduction of chronic poverty', which focuses on how the poorest are excluded, passively and actively, from investing in and taking advantage of building village-level institutions.

1.5 Methodological aspects of rural development

Methodological issues do not play a prevalent role in rural development studies. Consequently, the methodological content of the discipline is less impressive than its substantive achievements. We take only a brief look, therefore.

- **Indicators**

How to measure development, poverty, food security? These questions are essential for rational policy making. As a result, a wide array of indicators exists for each core concept of rural development. Well-known poverty indicators are those that relate incomes or expenditures to standards of basic needs, such as the 'one dollar per day' poverty indicator, the food energy intake method and the cost-of-basic-needs (CBN) method (Ravallion, 1994; Wodon, 1997). These indicators measure poverty at the micro (household) level, and each of these indicators may be lifted to the macro level in many ways in order to express poverty distributions over society. For food security, Hoddinott (1999) counted about 450 indicators proposed and in use by policy and other organizations, focusing on food supply, food access or food intake. On top of that, indicators of 'community food security' (Kantor, 2001) focus on social, economic and institutional factors that underlie a community's food situation.

- **Participatory methods**

Rural development studies draw most of their methods from the general social-scientific pool. Something that the discipline may really call its own, however, are participatory methods, usually grouped under the heading of Participatory Rural Appraisal (PRA; Chambers, 1994). PRA is a family of methods that enable local people and researchers alike to conduct a joint fact finding and appraisal, usually focused on the design or evaluation of a (self-)development project or policy. One example of the PRA repertoire is participatory environmental mapping, in which researchers and local people draw up an informal map of the location (on paper or in the sand), enlivened by the stories of what happens where, why it is so, what it used to be in the past, and so on. On the whole, PRA is an adequate approach to arrive at valid local description. It is less effective for more formal (comparative, explanatory, quantitative) scientific work (Bauer, 2003).

- **Sustainable Livelihoods (SL) framework**

Rural livelihoods in developing countries tend to be very complex. Farming activities intermingle with off-farm work; subsistence production intermingles with market-oriented crops; temporal variation (e.g. between seasons) and spatial variation (e.g. between villages) are often intense. In order to capture these complexities, the Sustainable Livelihoods (SL) approach has evolved from the late 1980s onwards (Sen, 1981; Chambers and Conway, 1992; Scoones, 1998; Carney, 1998 and Ellis, 2000). Central in the SL framework stand the household 'capitals' (capabilities, capacities), composed of natural, physical, human, financial and social capital. Ownership of assets but especially access to non-owned assets such as to the natural environment are seen as the key to poverty elimination and empowerment (e.g. Bebbington, 1999; Leach et al., 1999). Mediated by the context, assets and access result in 'livelihood strategies'. These include the full portfolio of farming and non-farming activities that people undertake to make a living. All SL framework variants end with 'livelihood outcomes', assessed in terms of normative goals and (unquantified) indicators such as described by Ellis (2000: 42) for environmental sustainability and livelihood security, including income level, income stability, seasonality and risk. The SL framework is a causal framework in the sense that the various elements are all depicted as influencing each other. How these linkages actually run is left vague, however. Due to this looseness, the framework is effective in supplying researchers with a common language for qualitative insight, but much less so for quantifying and comparative work.

1.6 A strategy for Sustainable rural development

SARD ('Sustainable Agriculture and Rural Development') is a global initiative that emerged from the Dialogue on Land and Agriculture of the UN Commission on Sustainable Development in the year 2000 (UN, 2000). SARD addresses issues of sustainable agriculture, water, energy, health and biodiversity in a holistic manner. The science of sustainable rural development is the underpinning of initiatives such as these.

Sustainable rural development as a "systematic field of enquiry" as the aim of this study puts it – what should it be, and how to get there? These are the two questions addressed in this section. I distinguish between substantive and methodological issues.

In the foregoing sections, we have come to know sustainability science as a discipline not lacking in substance with respect to rural areas in the developing world. Its knowledge on land, natural resources, human drivers etc. lacks a strong link, however, with the key issues that drive both the people and the policies in these areas, namely, poverty and development. The themes of rural development studies hold a much stronger position here, and a discipline of sustainable rural development, if it wishes to combine the strengths and resolve the weaknesses of the parent disciplines, should give prevalence to the rural development themes. It should add sustainability knowledge to the development themes rather than the other way around.

A reverse picture emerges in the methodological area. The aim of the present volume is to help develop sustainable rural development not as a mere collection of separate studies but as an interconnected, *systematic* field of enquiry. As may be clear from the overview of Ellis and Biggs (2001) (Section 1.4), rural development does not represent the biggest bulb in the lightshow of systematic disciplines. The concepts are there but largely, the 'metrics' are missing. Sustainability science puts much more energy in the development of systematic frameworks, methods and indicators – compare Sections 1.3 and 1.5. In other words, blending rural development and sustainability science into a real discipline will comprise bringing the power of 'framework thinking' into rural development.

Below, the situation will be explored in some more detail.

What should it be? Substantive issues

As said, an effective substantive confluence of rural development and sustainable development amounts to a large extent to 'bringing sustainability to rural development'. Such a merger does not have dramatic proportions. Both disciplines share a strongly normative culture, focusing on poverty alleviation and sustainability, respectively. Moreover, sustainability is already present to some extent, however implicitly, in rural development – recommendations from rural development specialists normally do not include the clearing of more rainforest or the introduction of highly erosive crops. And reversely, the rise of integrated conservation-and-development projects (ICDP's; Pimbert and Pretty, 1997; Scholte, 2003) proves that even the traditionally misanthropic conservation branch of sustainability science has actively incorporated the poverty alleviation objective.

The relative ease of the merger may also be expressed in terms of the People-Profit-Planet triplet of sustainability science.

- For rural development, 'People' (i.e. social justice) translates into the equity principle of protection of basic needs fulfillment, which is the same, in practice, as poverty alleviation.
- 'Profit' (i.e. efficiency) means very different things for different actors. For a business, it translates into literal profit. For rural development, it translates into system-level economic growth, achievable through effective linkages of land use systems to urban markets, using opportunities for local value addition, effective investment of remittances and other such means.
- 'Planet' for rural development translates into biodiversity conservation, land use sustainability and the avoidance of negative external effects of local actions (e.g. for downstream communities).

Obviously then, the PPP of sustainable development already includes the basic tenets of rural development. A merger of the two disciplines therefore is only a gradual affair, bringing more 'people' to sustainability science but especially bringing more 'planet' to rural development. This may also be visualized through the following causal chain:

Land ⟷ land use ⟷ material flows ⟷ economic flows ⟷ economic development

In this picture, the challenge of sustainable rural development is to create a stronger integration between land (including biodiversity) and development, through the intermediary concepts that include land use and material flows.

More detail on the directions for sustainable rural development can be found through the major substantive themes of the two mother disciplines (Sections 1.2. and 1.4). Sustainable rural development will have to connect the sustainability issue with the development concept, with poverty and food, with globalization and household strategies, with land use, common properties and exclusion. The theme of human drivers is important as well because of the desire for policy impact that sustainable rural development inherits from both its parents. Knowing the causal origins ('root causes') of sustainability and development problems is conditional for policies that address causes of problems rather than symptoms. Explanatory theory is essential for policy-relevant science.

What should it be? Methodological issues

Method, not substance, marks the difference between science and daily life thinking. Method, therefore, is the essence of the capacity of sustainable rural development to rise above the level of a mere collection of studies. This principle has already led to the insight that in sustainable rural development, the frameworks and methods of sustainability science should have a place of prevalence.

A second methodological issue arising from this principle is the need for a primacy of deductive approaches, i.e. approaches that follow the classic empirical cycle for theory building. Section 6.2 will discuss the superiority of deductive methods on the level of separate studies. The same image presents itself on the level of a discipline as a whole. Disciplines need theories to act as long-term focal points for progress, and testing these theories is the essence of that progress (Overmars et al., 2007). This does of course not preclude that inductive studies have a role to play too, but it does make clear that theories need to be made testable. And that, in turn, implies that their key concepts need to be supplied with the best possible 'metrics', i.e. synthetic indicators (see Section 1.3).

How to get there?

How to contribute to this aim most effectively? Three elements appear to stand out:

1. a substantive focus on the long-term, general themes of rural development
2. a methodological focus on frameworks and framework-based indicators, and
3. a methodological focus on deductive approaches, especially to develop explanatory theory.

These foci are carried over to the next section, where the questions of the present study are elaborated.

1.7 Questions of the dissertation

This section develops the foci of the preceding section into to a number of overall research questions. For ease of reference, the questions are numbered consecutively.

Foci 1, 2 and especially 3

Land use is a key theme for both development and sustainability, and explaining land use is key to design effective policies. Explaining land use combined with a description of the land use system gives insight in development pathways and policy options for sustainability. A common sense hypothesis is that people use the land because it forms a source of income. One then would expect rational choice theory to stand central in the explanations of land use, relating the options of land users to the cost and benefits of these options. In actual practice, however, land use studies rather appear to relate land use to a host of other variables such as age, amount of children, length of residence and so on. What is the matter here? It appears that, even though land use theories have a rational choice basis, neither these theories nor rational choice theory directly are in fact used in land use studies in general. Instead of a deductive approach of testing and using explanatory theories, land use studies approach the explanation of land use in an inductive manner.
Two questions arise:

(1) Can land use be explained in direct relation with rational choice theory and land use theories based on rational choice?
(2) Can plausible development pathways and effective policy options be designed by using explanatory theory and methods?

Foci 1, 3 and especially 2 (frameworks)

Material flow accounting (MFA) is a framework developed in the Industrial Ecology branch of sustainability science. MFA appears to be quite a good candidate for use in sustainable rural development because it studies the material exchanges between an economy and its natural environment. This includes biomass flows that are the intermediaries between land use and economic flows. Though primarily designed for use on national or regional scales, MFA has also been applied on the local village level. At first sight, the outcomes of these studies do not appear to be directly connected to any substantive theme of rural development, however. Moreover in these and other MFA applications, explanations of the described flows are non-existent or only rudimentary.
Three questions arise:

(3) Can MFA be extended so that it may include explanations of relevant material flows?
(4) Does MFA as applied on the local level indeed fail to link up directly with any of the substantive themes of rural development?
(5) If so, can MFA be redeveloped into a framework that does link with key themes of rural development and may generate synthetic indicators for concepts of these themes?

Foci 1 and 2 (indicators)

In order to respond to shifting markets, climate change, natural resource depletion, population growth or any other opportunity or threat, rural dwellers need to have the capacity to invest in the future, e.g. in the sustainability of their farm. Very poor people often do not have this capacity, which is one reason why poverty plays a key role in sustainable rural development, interconnecting the themes of development, food security and sustainability of land use. Poverty is a world-wide phenomenon but difficult to measure. To have good poverty indicators is therefore an issue of great relevance. Existing poverty indicators only cover monetary aspects of poverty (e.g. GDP per capita or cost of basic needs). Poor people are often also very short in *time*, however, or may have time resources left even if having no cash. A capacity indicator that integrates time and cash, i.e. a measure of poverty and capacity to invest that could be truly adequate, is not available anywhere, however. In other words, the most pivotal indicator for sustainable rural development is missing. Such an indicator should primarily be formulated and tested at the household level. Since sustainability and development often require collective action too (e.g. investment in village-level irrigation or forestry), it should be worthwhile if the indicator could also be made valid at that level.

Questions emerging from this are:

(6) Is it possible to develop a universal (and synthetic) poverty/wealth indicator that integrates cash and time, and therewith more truly represents household capacities to invest in the future?

(7) Can this indicator actually be applied through a framework that is robust enough to handle complex real-world situations around the world?

(8) Might this indicator be expanded to include the community level and indicate capacity for sustainable community development?

1.8 Overview of the dissertation

The blending of rural development studies and sustainability science in the present thesis follows a pattern of a certain prevalence of development studies on the substantive side, and a certain prevalence of sustainability science on the methodological side. Abstractly put, all chapters in their own way bring the rigor of natural science methodology to the richness of social science concepts.

Chapter 2 of the dissertation describes three villages in the Philippines' forest fringe (see Figure 1.2), focusing on the question of what factors determine land use change. To answer this question, a combination of two methodological frameworks (MFA and AiC) was applied to identify land use transition of villages and put that in their social context. The function of the chapter in this thesis is twofold. First, it is a substantive introduction on concepts of rural development. It describes the meaning of 'rural' by setting the scene of remote farming villages in the Philippines. The meaning of 'development' is introduced by looking at the microeconomics of land use and possible sustainable and unsustainable future land use pathways. Land use change is central in this chapter, and is brought in connection with (rational choice based) theories of land use change that focus on population dynamics (e.g. Malthus *versus* Boserup) and market dynamics ('neo-Thünian' theory). To explain land use, household level decision-making models hold a central place, applying rational choice theory in a multi-criteria form. External markets and traders of corn, timber, etc. represent the theme of economic incorporation. The second function of this chapter in the present study is that it is an example of using frameworks such as AiC and MFA in an almost hidden way to tell a story on sustainable and unsustainable land use change pathways. The result is a substantive story without explicit reporting of the framework methods. The chapter addresses research questions 1 and 2 of the preceding section.

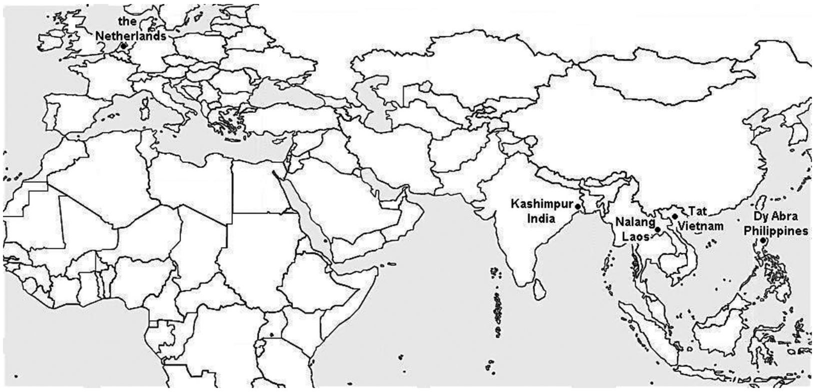

Figure 1.2 Map indicating the locations of the case studies in the study.

Chapter 3 is different from the preceding chapter in that it focuses on one village in Vietnam rather than three in the Philippines, but especially because the MFA and AiC frameworks have now become explicit objects for improvement and reflection, focusing on their combination to form 'Socially Extended MFA'. As in the preceding chapter, land-use patterns are explained using theories on land use dynamics and a household-level broad rational choice model in multi-criteria form. The conclusions of the chapter are both substantive and methodological, addressing research questions 1, 2, 3 and 4. The chapter also offers an example of a village caught in a poverty trap and with that relates to Chapters 5 and 6, where the poverty trap becomes part of a broad capacity indicator.

Chapter 4 focuses on research questions 4 and 5. It continues with many of the data presented in the previous two chapters but starts out from the question of what may be the key concepts of rural development that MFA can be made to connect with. On that basis, the MFA idea is reconstructed to form a new, 'rural MFA' framework that provides material flow categories out of which some 20 indicators are generated, divided in five groups on material productivity, material intensity, material incorporation and food security. The material intensity and productivity indicators refer to agricultural transition. The food security indicators are very different from the existing ones because they are developed from material flow analysis. Through these indicators, rural livelihoods and communities can be positioned in terms of general problems and processes of land use change, globalization and risk. The rMFA framework is applied on three case study villages: Tat in Vietnam, Nalang in Laos and Dy Abra in the Philippines. The indicators give a quantitative comparison between villages in terms of the indicators, displaying their quite different characteristics on a truly comparative scale.

Chapter 5 focuses on research questions 6 and 7. It introduces a framework that generates a synthetic indicator expressing multi-dimensional development capacity and poverty, based on a unique confluence of cash and time budget thinking. The indicator is called 'freely disposable time' (FDT). FDT is how many hours per day the productive members of a household have left after satisfying all the basic needs (sleep, care, food, housing etc.) that they have to supply for themselves and their dependents. The key of the system is the time/cash equivalent, where cash and time are translated into each other through the household's income per hour. A household's FDT may be put to any use such as leisure or doing extra work for extra consumables or better-than-basic housing, or to invest in the future (education, soil conservation etc.). Therefore, FDT is a key condition for any out-of-poverty strategy and reflects the investment capacity for farmers and any other actor to respond to changing circumstances. In terms of the Sustainable Livelihoods approach, FDT can lay claim to being the livelihood outcome indicator *tout court*. Theories on land use dynamics served as a motivation for the development of FDT. The robustness of the framework underlying FDT is tested on complex and variegated farming households in a peri-urban village in India and on a few households in the Netherlands.

Chapter 6 provides a number of discussions that draw on the material from all chapters. It starts out on farm and village typology, then discusses the status of land use theories and subsequently the need for adequate terminology in rural development. The next section moves deeper into a discussion on the importance of deductive research approaches for progress in the rural development discipline. The chapter is rounded off by an example of expanding the FDT indicator to form an indicator called community development. This connects to the social capital theme in rural development and addresses research question 8. This indicator may be a fertile subject for future participatory research in rural development.

Chapter 7 provides the conclusions on all the chapters.

References

Agrawal, A. (1999). Enchantment and disenchantment: The role of community in natural resource conservation. *World Development,* 27 (4), pp. 629-649.

Appadurai, A. (1990). Disjuncture and difference in the global cultural economy. *Public culture*, 2 (2), pp.1-24.

Arnett, J. J. (2002). The psychology of globalization. *American Psychologist*, 57 (10), pp.774-783.

Ayres, R. U. and Simonis, U. E. (1994) (Editors). *Industrial metabolism: Restructuring for sustainable development*. Tokyo; New York: United Nations University Press.

Bauer, H. (2003). *Lion conservation in West and Central Africa: Integrating social and natural science for wildlife conflict resolution around Waza National Park, Cameroon*. PhD Thesis, Leiden University.

Bebbington, A.J. (1999). Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty. *World Development,* 27 (12), pp. 2021-2044.

Bolhuis, E. E. and Van der Ploeg, J. D. (1985). *Boerenarbeid en stijlen van landbouwbeoefening*. Leiden: Leiden Development Studies.

Boli-Bennett, J. (1980). Global integration and the universal increase of state dominance, 1910-1970. In: Bergesen, A. (Editor). *Studies of the modern world system*. New York: Academic Press.

Borgerhoff Mulder, M. and Coppolillo, P. (2005). *Conservation: Linking ecology, economics and culture*. Princeton; Woodstock: Princeton University Press.

Boserup, E. (1965). *The conditions of agricultural growth: The economics of agrarian change under population pressure*. London: Earthscan, reprinted in 1993.

Bouman, M., Heijungs, R., Van der Voet, E., Van den Bergh, J. C. J. M. and Huppes, G. (2000). Material flows and economic models: An analytical comparison of SFA, LCA and partial equilibrium models. *Ecological Economics,* 32, pp. 195-216.

Bryant, R. L. and Bailey, S. (1997). *Third world political ecology: An introduction*. London; New York: Routledge.

Burger, K. and Zaal, F. (Editors) (2009). *Sustainable land management in the tropics: Explaining the miracle*. Ashgate Publishers.

Carney, D. (1998). *Sustainable rural livelihoods: What contribution can we make?* London: Department for international development.

Carswell, G. (2004). Continuities in environmental narratives: The case of Kabale, Uganda, 1930-2000. In: Jones, S. and Carswell, G. (Editors). *Environment, development and rural livelihoods*. London: Earthscan, pp.32-56

Chambers, R. (1994). The origins and practice of participatory rural appraisal. *World*

Development, 22, pp. 953-969.

Chambers, R. and Conway, R. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. Institute of Development Studies discussion paper 296. Brighton: IDS.

Chambers, R. (2005). *Ideas for development*. London: Earthscan.

Chayanov, A. V. (1966). *The theory of peasant economy*. The American Economic Association. [originally published in 1926]

Cleaver, F. (2005). The inequality of social capital and the reproduction of chronic poverty. *World Development*, 33 (6), pp. 893-906.

De Groot, W. T. (1992). *Environmental science theory: Concepts, methods in a one-world, problem-oriented paradigm*. Amsterdam: Elsevier.

De Groot, W. T. (2006). From friend to enemy and onwards: An evolutionary perspective on the people-nature relationship. In: Van den Born, R. J. G., Lenders, R. H. J., De Groot, W. T. (Editors). *Visions of nature*. Berlin: Lit Verlag, pp. 19-40.

De Groot, W. T. and Zwaal, N. (2007). Storytelling as a medium for balanced dialogue on conservation in Cameroon. *Environmental Conservation*, 34 (1), pp 45-54.

Diamond, J. M. (2005). *Collapse: How societies choose to fail or succeed*. New York: Viking Press.

Döös, B. R. (1992). Population growth and loss of arable land. *Global Environmental Change,* 12, pp. 303-311.

Dubin, R. (1978) *Theory building*. (revised edition). New York: Free Press.

Ellis, F. (2000). *Rural livelihoods and diversity in developing countries*. Oxford: Oxford University Press.

Ellis, F and Biggs, S. (2001). Evolving themes in rural development 1950s - 2000s. *Development policy review,* 19 (4), pp. 437-448.

Edwards-Jones, G., Davies, B. and Hussain, S. (2000). *Ecological economics: An introduction*. Oxford: Blackwell Science Ltd.

Eurostat (2001). *Economy-wide material flow accounts and derived indicators: A methodological guide*. Luxembourg: Statistical Office of the European Union.

Fiala, N. (2008). Measuring sustainability: Why the ecological footprint is bad economics and bad environmental science. *Ecological Economics,* 67 (4), pp. 519-525.

Fishbein, M. and Ajzen, F. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Galjart, B. F. (1986). *Omwille van de ontwikkelingssociologie*. Muiderberg: Countinho.

Guinée, J. B. (Editor) (2002). *Handbook on life cycle assessment: Operational guide to the ISO standards*. Dordrecht: Kluwer Academic Publishers.

Hák, T. (2007). The Yale and Columbia Universities Environmental sustainability index 2005. In: Hák, T, Moldan, B. and Dahl, A. L. (Editors). *Sustainability indicators. A scientific assessment*. Washington: Scientific Committee on Problems of the Environment, pp. 361-367.

Hák, T, Moldan, B. and Dahl, A. L. (Editors) (2007). *Sustainability indicators. A scientific assessment*. Washington: Scientific Committee on Problems of the Environment.

Hardin, G. (1968). The tragedy of the commons. *Science*, 162, pp. 1243-1248.

Hiroshi Komiyama, H. and Takeuchi, K. (2006). Sustainability science: building a new discipline. *Sustainability Science,* 1, pp. 1–6.

Hoddinott, J. (1999). *Choosing outcome indicators of household food security*. Washington: International Food Policy Research Institute.

Homer-Dixon, T. F. (1999) *Environment, scarcity, and violence*. Princeton: Princeton University Press.

Honderich, T. (1995). *The Oxford companion to philosophy.* New York: Oxford University Press.

Hyden, G., Kates, R. W. and Turner, B. L. (1993). Beyond intensification. In: B. L. Turner, Hyden, G. and Kates, R. W. (Editors). *Population growth and agricultural change in Africa.* (pp. 410-439). Gainesville: University of Florida Press.

Kantor, L. S. (2001). Community food security programs improve food access. *Food Review,* 24 (1), pp. 20-26.

Kleijn, R., Van der Voet, E. and Udo de Haes, H. (2008). The need for combining IEA and IE tools: The potential effects of a global ban on PVC on climate change. *Ecological economics*, 65, pp. 266-281.

Leach, M., and Mearns, R. (1996). *The lie of the land: Challenging received wisdom on the African environment*. Oxford; Portsmouth, NH: James Currey/Heinemann.

Leach, M. Mearns, R. and Scoones, I. (1999) Environmental entitlements: Dynamics and institutions in community-based natural resource management. *World Development*, 27(2), pp. 225-247.

Lehtonen, M. (2004). The environmental social interface of sustainable development: capabilities, social capital, institutions. *Ecological Economics*, 49, pp. 199–214.

Long, N. and Long, A. (1992) (Editors). *Battlefields of knowledge: The interlocking of theory and practice in social research and development*. London: Routledge.

Manno, J. P. (1999). Privileged goods: Commoditization and its impact on environment and society. London; New York: CRC Press.

OECD (1991). *Environmental indicators, a preliminary set*, Paris: OECD.

OECD (2008). *Handbook on constructing composite indicators.* Paris: OECD.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Overmars K. P., de Groot W. T. and Huigen, M. G. A. (2007) Comparing inductive and deductive modeling of land use decisions: Principles, a model and an illustration from the Philippines. *Human Ecology,* 35, pp. 439-452.

Persoon, G. A., Minter, T., Slee, B. and Van der Hammen, C. (2004). *The position of indigenous peoples in the management of tropical forests.* Wageningen: Tropenbos Series 23.

Pimbert, M. P. and Pretty, J. N. (1997). Parks, people and professionals: Putting 'participation' into protected area management. In: Ghimire, K. B. and Pimbert, M. P. (Editors) *Social change and conservation*. London: Earthscan, pp. 297-330.

Platteau, J. Ph. (2000). *Institutions, social norms, and economic development*. Amsterdam: Harwood Academic Publishers.

Popkin, S. L. (1979). *The rational peasant: The political economy of rural society in Vietnam.* Berkley: University of California Press.

Rahman, S. A., De Groot, W. T. and Snelder, D. J. (2008). Exploring the agroforestry adoption gap: Financial and socioeconomics of litchi-based agroforestry by smallholders in Rajshahi (Bangladesh). In: Snelder, D. J. and Lasco, R. D. (Editors), *Smallholder tree growing for rural development and environmental services.* Dordrecht: Springer, pp. 227-243.

Rapport, D. and Friend, A. (1979). *Towards a comprehensive framework for environmental statistics: A stress–response approach.* Ottawa: Statistics Canada Catalogue 11-510, Minister of Supply and Services Canada.

Ravallion, M. (1994). Measuring social welfare with and without poverty lines. *The American Economic Review, 84*(2), 359-364.

Rees, W. E. (1992). Ecological footprints and appropriated carrying capacity: What urban economics leaves out. *Environment and Urbanization,* 4 (2), pp. 121-130.

Roe, E. (1991). "Development narratives" or making the best of development blueprints, *World Development,* 19 (4), pp. 287–300.

Scholte, P. (2003). Immigration: A potential time bomb under the integration of conservation and development. *Ambio*, 32 (1), pp.58-64.

Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis. Institute of Development Studies working paper 72*. Brighton: IDS.

Scott, J. C. (1976). *The moral economy of the peasant: Rebellion and subsistence in Southeast Asia*. New Haven: Yale University Press.

Sen, A. K. (1981). *Poverty and famines: An essay on entitlements and deprivation*. Oxford: Clarendon.

Sen, A. K. (1999). *Development as freedom*. New York: Knopf Press.

Shiva, V. (2006). *Earth democracy: Justice, sustainability and peace*. Cambridge, MA: South End Press.

Simon, H. A. 1979. Rational decision making in business organizations. [Nobel Memorial Lecture, presented 8 December 1978]. *American Economic Review,* 69, pp. 493-513.

Streeten, P. P. (1979). Basic needs: Premises and promises. *Journal of Policy Modeling,* 1, pp. 136-146.

Tiffen, M., Mortimore, M. and Gichuki, F. (1994) *More people, less erosion: Environmental recovery in Kenya*. Chichester: J. Wiley and Sons.

Todaro, M. P. (1994). *Economic development*. 5th Edition. Singapore: Longman Singapore Publishers Ltd.

Tsetse, D. (2008). Opportunity and Problem in Context (OPiC). *A framework for environmental management in developing countries.* PhD Thesis, Leiden University.

UN (2001) United Nations. *Indicators of sustainable development: framework and methodologies.* Background paper no. 3. New York: Commission on Sustainable Development, Division for Sustainable Development, Department of Economic and Social Affairs.

UN Commission on Sustainable Development (2000). Report on the eighth session (30 April 1999 and 24 April-5 May 2000), Economic and social council. New York: United Nations.

Van der Ploeg, J. D. (1991). *Landbouw als mensenwerk: Arbeid en technologie in de agrarische ontwikkeling*. Muiderberg: Coutinho.

Vayda, A. P. 1983. Progressive contextualization: Methods for research in human ecology. *Human Ecology,* 11 (3), pp. 265-281.

Vayda, A. P. and Walters, B. B. (1999). Against political ecology. *Human Ecology,* 27 (1), pp. 167-179.

Walker, R. and Solecki, W. (2004). Theorizing land-cover and land-use change: The case of the Florida ever glades and its degradation. *Annals of the Association of American Geographers,* 94 (2), pp. 311-328.

Wodon, Q. (1997). Food energy intake and cost of basic needs: Measuring poverty in Bangladesh. *Journal of Development Studies*, 34(2), 66-101.

Zuiderwijk, A. B. (1998). *Farming gently, farming fast: Migration, incorporation and agricultural change in the Mandara mountains of Northern Cameroon*, PhD Thesis, Leiden University.

Zylicz, T. (2007). Sustainability indicators: An economist's view. In: T. Hák, B. Moldan and A. L. Dahl (eds.), *Sustainability Indicators*. Washington: Island Press, pp. 99-105.

End of the road: the trading point of Puerta

2

Slopes, Markets and Patrons: Explaining Land Use along a Lowland-Upland Gradient in the Philippines

Abstract
Transitional lowland/upland areas display strong land use differences on a small scale. Focussing on the area between the Cagayan River lowlands and the global biodiversity hotspot of the Sierra Madre forest in the Philippines, the present chapter describes and causally unravels these land use differences and dynamics. Markets, slopes and population density play a central role in the resulting explanatory scheme that represents an adapted version of a classic land use theory. Mixed with auxiliary insight into the roles of roads and patronage, this scheme supports not only the development of scenarios of local futures and policies, but also the understanding of lowland/upland histories and patterns elsewhere in the Philippines.

Published as: Hobbes, M. and de Groot, W.T. (2004) Slopes, markets and patrons: Explaining land use along a lowland-upland gradient in the Philippines. *Pilipinas,* 43, pp.71-91 [published in 2006].

2.1 Introduction

Theories of land use change often focus on either population density or markets as the dominant factors driving agricultural change. The well-known idea of Malthus, for instance was that as population density increases, land per capita goes down, over-exploited soils degrade, and out-migration is finally the only option left to escape from ever deepening poverty. The seminal work of Boserup (1965) has greatly nuanced this picture and the study of Tiffen et al. (1994) on Machakos district in Kenya has even shown evidence of a reverse relationship; greatly facilitated by the lower transaction cost that came with the steep rise of population density, farmers massively invested in landesque capital such as terraces, and realized higher incomes per capita than in the low-density situation. Interesting for the Philippines too, Conelly (1992) describes a case where farmers in Palawan, facing an influx of new migrants, successfully intensified their land use system, investing in irrigated rice and fruit trees (partly using income gained from previous illegal logging and stimulated by the DENR[7] that, somewhat unexpectedly, took forest protection seriously).

Market-based theories of land use change, on the other hand, put the emphasis on the external influence of market forces, sometimes emphasizing that these markets emanate from the major metropolitan centres, thus giving rise to zones of different land use types hinging around distance-to-market as the central variable, as first defined by Von Thünen (1826). Growth of urban-based markets then results in an expansion of these land use zones as discussed, with a Philippine example on the history of Cagayan Valley, by De Groot (2003). This dynamic version of classic Thünian land use theory has the capacity to undermine the population-based visions on land use change. The miracle of Machakos might as well be explained to a large extent by the proximity of Machakos to Nairobi and the world (coffee) market, by urban remittances and by urban pensioners returning to the countryside (Murton, 1999) rather than population densities. And was the intensification on Palawan not caused primarily by the new road that connected the village to the Puerta Princesa market? (De Groot and Kamminga, 1995).

Classic Thünian distance-to-market patterns, e.g. because of distance to Manila, are certainly discernable in the Philippines, if a relatively large scale is chosen for the analysis. This holds for De Groot on the Cagayan region but also in the analysis of Romero (2005), for instance, who compares villages with travel times of 2, 4, 9 and 13 hours from Manila.

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In the present chapter, however, we are interested primarily in differences on a much smaller scale. Typically in the Philippines, large differences of land use can often be found at quite a small distance, especially between lowlands and uplands. Would population density or distance-to-market explanations suffice to understand these differences, or do other factors play a decisive role? That is the leading question for the present chapter.

The chapter focuses on a comparative description of land use, and especially the explanation of that land use, in four villages with areas adjacent to each other but on varying positions on the lowland-to-upland gradient. Based on these local descriptions and explanations, we will develop a more general explanatory scheme and look at future prospects and options to address a sustainability problem identified along the way.

2.2 Methods

This chapter is the result of a study that took place in the framework of project "Southeast Asia in transition", funded by the European Union. Two methodological frameworks were applied, one for describing the physical basis of socioeconomic systems (Material Flow Analysis; MFA) and one for explaining key components of that physical basis (Action-in-Context; AiC). MFA is a form of material input-output analysis widely used for the characterisation of the physical aspects of social systems on scales varying from households to whole nations; see Eurostat (2001) for the national level and Grünbühel *et al.*, 2003 for a local level application. In the present chapter, we will focus only on material flows associated with land use, such as those of crops and timber, put in kg per capita per year. AiC is an actor-based framework, inspired by Vayda (1983) and described in De Groot (1992), integrating aspects of the capacities and motivation of actors, embedded in the culture and structures of society and connected to other actors exerting power over capacities and motivations. In the present chapter, only the latter element is explicit, under the term of 'actors field'.

Researchers from Leiden University (the Netherlands) and Isabela State University (the Philippines) gathered the data between July 2001 and June 2002 with the support of the Cagayan Valley Program on Environment and Development (www.cvped.org), a joint undertaking of the two universities. Data on material flows, basic socio-economics and livelihood activities were gathered by semi-structured interviews covering all households in one of the selected upland villages (Dy Abra) and a sample in three other, adjacent research sites. For the other data, interviews followed techniques from Participatory Rural Appraisal such as option ranking, historical diagramming and participatory mapping (Chambers, 1994), topical interviews with key respondents, informal interviews for sensitive issues and focus group discussions.

With 1,828 inhabitants covering a total area of some 9,000 hectares, the population density of the four villages together is 20 people per square km, as compared to the 180 persons per square km in Isabela province as a whole (excluding the protected area in the Sierra Madre). The variable of population density does require some methodological attention here, however. Population density plays a double role in models of land use change. First on the level of the households, high population density tends to go together with land scarcity and hence with motivation to intensify land use. Second on a larger scale, high population densities tend to reduce transaction cost (e.g. for the diffusion of innovations), attract connections with urban markets and urban ideas (Turner *et al.,* 1993). On the small scale of our investigation, the land scarcity factor certainly plays a role but the other effect of population density does not come into view. Furthermore on our small scale, land scarcity is not validly estimated by simply dividing the official village territory by the number of inhabitants, since land inside the borders may well be inaccessible (e.g. due to unequal division of land) or unsuitable (e.g. forests and rocks) and farmers may well have access to land outside these borders. For these reasons, we have taken land scarcity as the proxy of population density, assessed by two indicators: people's own views (e.g. complaints) and the existence of an internal land market with renting, mortgaging and so on.

2.3 The villages and land use types

The villages were chosen in Isabela province, close to each other and selected on the basis of their position between the edge of the Cagayan valley lowlands and the forest of the Sierra Madre (see Figure 2.1). Van den Top (2003) gives a general account of the history of this region. The villages are Masipi East, Dy Abra and Puerta, to which we added some recent clusters of houses near the forest, here called the 'pioneer village'. Their territories mainly comprise some (irrigated) paddy land, white and (mostly) yellow corn, grasslands, banana plantations, swidden fields and secondary forest. Some details of geography and people of the villages are given underneath. After that, we give some general information on the major land use types in the region. Greater detail on the land use of the villages is provided in the next section.

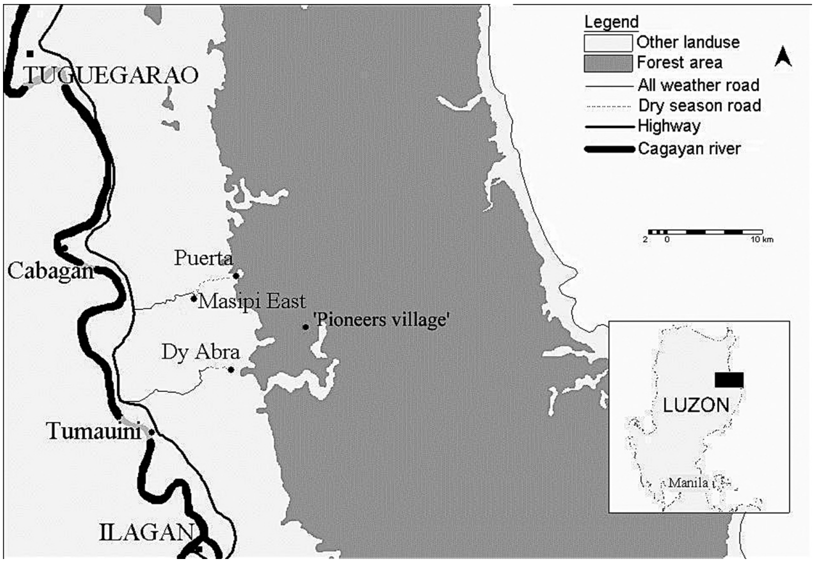

Figure 2.1 Map of research area in the Philippines. The locations of Masipi East, Dy Abra and Puerta are accurate. The location of the 'pioneers village' is a guesstimate.

(1) Masipi East, with a total population was 980 people grouped in 187 households at the time of the research, lies in the transition zone between lowland and upland, connected to the central (Maharlika) highway of the Cagayan Valley by 8 km of paved road with regular traffic. It is a community of Ilocano settlers who arrived with 5 families in the 1940s. From 1979 until 1988, more people arrived to work for the WESCA logging company and many of them stayed afterwards as a farmer. The village was declared an 'agrarian reform community' in 1984, due to which much attention was paid to agricultural development, such as irrigated rice and hybrid corn cultivation, by government and NGOs. During the time of the research it was the only village with electricity. Contrary to the other research villages, agriculture was not the only source of livelihood; traders, furniture makers, drivers etc. were also found in Masipi East.

Masipi East has about 90 hectares of fertile and titled flat land, irrigated by a scheme constructed by the National Irrigation Authority. Land scarcity was felt by most of the inhabitants and many of them feared that more land conflicts would occur in the future, especially since mortgaging of land had become fashionable which is open to conflicts. A cooperative had been set up in Masipi East to obtain a logging license under the Community Forestry Program (CFP) in exchange for reforestation. No reforestation took place, logging continued illegally and people lost their faith in the co-operative.

(2) Dy Abra, with 549 people in 94 households at the time of the research, is situated on moderately sloping land that also includes 39 ha of flat area that is planted with rice (partly irrigated by hand and partly with a small gravity system). The village lies at 17 km from the central highway to which it is connected with an unpaved road. Once a day a truck goes to the highway, which takes one bumpy hour, and more in the wet season. The founders of Dy Abra belong to the Tinguian ethnic group from the Cordilleras. They migrated to the area in the 1960s, settling first in a location called Banig, where they opened the forests to practice their traditional slash and burn farming. Many inhabitants worked for the large-scale logging operations between 1972 and 1982. The village was resettled in 1989 to its present location in order to move it away from influence of the New People's Army (NPA). The connectedness to the forest was still present; many households of Dy Abra were involved in small-scale logging activities and still some 30% of the households practiced some swidden farming in the far away areas (up to 4 hours on foot). At the time of the resettlement, the government gave out Certificates of Stewardship Contract (CSCs) issued under the Integrated Social Forestry (ISF) programme in order to provide a reasonable land tenure security (officially a 25 years usufruct right) on the sloping (hence public) land. The rich obtained more land than the poorer people, but interfamily ties are still strong, indicated, *inter alia*, by the intensive use of exchange labour. As people said, "*we are still one community*". Land scarcity was felt less than in Masipi East and a real land market had not developed yet. Some families had moved back to the forest, however, due to lack of enough land in the village proper and this indicates that the lower strata of village society did experience land accessibility problems.

(3) Puerta's name means 'gate' (to the forest). The first of the 209 inhabitants (in 45 households and of mixed Ybanag, Tinguian and Ilocano origin) settled around 1960, with other families arriving to work for the logging companies between 1979 and 1988. Although only 4 km from Masipi East (hence 12 km from the highway), the village was difficult to reach. No normal motorised vehicles reached the place and people brought all the products down to Masipi East on foot or carabao (*Bubalus bubalis carabanesis*), crossing many creeks and rivers, taking about 1.5 hours. The small trucks of banana traders came to the farthest place they could reach from Masipi-East, supplying food and drinks in exchange for banana. Also timber was transferred here. The village has a total of 12 hectares of irrigated, flat and titled land under rice. The rest

is moderately and steeply sloped, and largely under CSC tenure. These areas were all occupied by the time of the research with permanent agriculture. About 90% of the households had a banana plantation on their former swidden fields while only some of the inhabitants still practiced swidden farming. Some land scarcity was felt, because no nearby land was left for making swidden.

(4) The pioneer village was not an administrative entity, but consisted of newly built houses situated very close to the protected forest, roughly between Puerta and Dy Abra. Flat land is absent and all of the area is steeply sloping, covered with grass, shrubs and patches of secondary forest where people made swidden fields. The 90 people living here, partly in regular households and partly in households of recently arrived men aged between 18 and 25 years, were immigrants of the Ifugao ethnic group from the Cordilleras mountains in the West. The first settlers arrived around 1990, but most of them only a few years before the research took place. Land scarcity was not felt at all yet; people marked the borders of about 3 to 5 hectares per farmer with trees (enough for 4 to 5 years since a farmer can clear almost one hectare per year). Access to the highway leads through Masipi East, to which it is about 2.5 hours on foot. People used the same trading point as the inhabitants of Puerta.

A few words are in order here to introduce the major land use types of the region.

(a) Rice was grown in two major variants: upland rice and lowland rice. Upland rice was sown on freshly cleared land (swiddens) and can be productive at these sites for one or two years. Lowland rice can be rainfed or irrigated. Rainfed fields may be bunded in order to retain more water. Irrigation may be small-scale (pumped or manual), or a medium-scale scheme that taps a local creek and is often shared between several households, or a large-scale scheme which may be planned by the state or may be a community-based *zanjera*. Valley bottoms are the logically preferred place for irrigated fields, but when the need arises and water sources allow, terraces may be constructed progressively more uphill until complexes such as the famous landscape of Banaue arise. Rice does not require substantial capital inputs. Lowland rice can easily be marketed but as long as households have no surplus, all rice is consumed by the family.

(b) Corn was mainly grown on rainfed ploughed fields *(bangkag)*. Two types were present in the region. White corn is a traditional food crop and is grown by poorer families for own consumption. Yellow corn is grown from hybrid seeds and largely used as livestock feed for the urban meat markets. It requires larges doses of fertilizer to be productive and jointly with the seeds and pesticides, this implies a significant capital input for each cropping cycle. Yellow corn decays rapidly after harvesting and must therefore be sold immediately after harvest.

(c) Banana can grow anywhere provided the roots are not too wet, hence avoiding flat land and heavy soils. Usually, farmers first try the species 'lakatan' (*Musa accuminata)* that has high returns but needs good soil. Less preferred but still well-doing species are 'latundan' *(Musa paradisiaca)* and 'saba' *(Musa balbisiana*).

(d) Logging is illegal in the region but the thriving furniture industry along the highway testifies that the Sierra Madre forest is still entered by small-scale logging operations. Usually, the wood is ordered by a trader and a logging trip is then organised by a middleman, usually also the owner of the chainsaw. Profits for the organiser amounted to some 3000 pesos per trip, at the time of the research. The team is made up of a chainsaw operator and two helpers, who received some 400 and 100 pesos per day, respectively, excluding the food, gin an cigarettes provided by the organiser. Trips usually took three to five days, leaving some 2.4 cubic metres of squared and sliced logs to be hauled to the village. A hauler was then sent to transport the logs to the village, using the river or carabao, receiving some 300 pesos per man-plus-carabao day. All people going into the forest are farmers, using the slack time especially in the dry season to earn some extra cash. After the timber was hauled in, the trader came to the village to pick it up. The trader maintained good connections with the police, the army and the DENR, assuring that the timber would not be confiscated and the necessary bribes would not run too high.

One thing may be clear already from this overview, namely, that markets were essential for three of the four major land use types in the research area. The next section will give more information on where the land use types were located.

2.4 The major material flows of the villages

The data of the previous section are summarized in the first four rows of Table 2.1. Following the MFA methodology, land use will be described in this section by way of material flows, in kg per capita per year, of the various land use products. They are gathered in the middle of Table 2.1.

Table 2.1 Major material flows and other characteristics of the four villages

	Masipi East	*Dy Abra*	*Puerta*	*Pioneer village*
Population (no. of people)	980	549	209	90
Distance to highway (in minutes of travel time)	15	60 (more in wet season)	100 (on foot to Masipi East)	160 (on foot to Masipi East)
Land scarcity (proxy of pop. density)	Significant	Some	Some	None
Slopes	Flat plus some moderate	Moderate plus some flat	Steep, moderate plus some flat	Steep only
Main material flows (kg/cap./year)				
Lowland rice (irrig. and rain fed)	890	263	260	0
Upland rice on swiddens	0	20	70	300
Yellow corn on bangkag	900	1506	460	0
Yellow corn on swiddens	0	70	40	0
Banana	0	almost 0	1000	250
Fuel and construction wood	230	330	Appr. 400	Appr. 400
Commercial timber	50	1572	0	0
Manure (carabao and cattle)	318	762	485	Almost 0
Fertilizer	167	150	35	0
Gross income (PHP/cap./year)				
From corn, rice, banana	13,000	12,000	8,000	3,000
From commercial timber	150	8,000	600	0

See section 2.3 for the first four rows. PHP = Philippine Pesos (1 US$ = 45 PHP = 0.7 euro). Of the flow and income figures, the first two digits are significant. The flow figures of Masipi East, Puerta and the pioneer village are less precise than those of Dy Abra. The rice figures give the weight of milled rice. Weight of the wood is calculated with a moisture content of 35 percent. Weight of manure is calculated with a moisture content of 15 percent. Source: For the flow data: Hobbes and Kleijn (2007).

Overall, the figures show the predominance of irrigated rice, yellow corn, banana and logging. Looking at the figures village by village, the Table shows the first place of Masipi East in rice production, reflecting the presence of the irrigated rice scheme there. The other lands of the village were planted with yellow corn, leading to an almost equal flow per capita. Dy Abra may be called a yellow corn village, not only compared to other crops in the village, but also if the villages are compared in terms of corn production. Puerta, on the other hand, had much more focus on bananas. The figures of the pioneer village reflect its focus on swidden agriculture. Its banana production was not very high but on a steep rise because new plantations were bound to become productive.

The two flows of wood almost fully concern extraction from forest areas, because there were no significant plantations in the villages. The figures for fuel wood and timber for domestic construction are relatively low in Masipi East because relatively many people there cook on gas. Commercial timber was (illegally) extracted by farmers in Masipi East and especially Dy Abra, in the form of 400 to 500 logging trips as described in the preceding section per year.[8] In Dy Abra, men from more than two-third of the households were involved in logging as chainsaw owner or operator, helper or hauler.

Non-timber forest products (NTFP) consisted mainly of cogon (*Imperata cylindrica*) grass and bamboo used for the maintenance of housing or sometimes collected for tobacco curing in the lowlands. When in the forest for logging, bamboo cutting or burning the swidden, people also spent some time on hunting and gathering. The total flows were negligible in kilogram terms, however, with 11 kg per capita per year in Dy Abra and probably less in the other villages.

The total manure production by the village livestock, expressed in kg per human inhabitant per year, is taken up here only for later discussion. The relatively high figures of Dy Abra and Puerta, caused by high numbers of carabao especially, may be associated with the strong demand for draught power for the ploughed corn fields and for the hauling of logs. In Masipi East, ploughing is mainly done by tractor.

Overall, it may be noted that of the first three villages, the total production per capita of the three major crops (rice, corn and banana) was almost equal or close to 1.8 tons per capita per year, with Masipi East equally divided over rice and corn, Dy Abra mainly in corn and Puerta mainly in bananas. In terms of the resulting gross income, differences show up. Given the prices of an average of 8 pesos/kg for rice, 6.50 pesos/kg for corn and 2 pesos/kg for banana, and shadow-pricing subsistence production, gross agricultural incomes per capita were as shown in Table 2.1, with Masipi East and Dy Abra in the lead and the pioneer village at only 3,000 pesos per capita per year.

The low incomes during the pioneer stage are an expected thing; people were in fact investing in land expansion and planting bananas. Moreover, the swidden soils do not require fertiliser; if the cost of fertiliser

[8] Although 20% of the households in Puerta were involved in hauling and 6 % of the men were chainsaw operator, the logging trips they participated in were organised in Masipi East. In Table 2.1, the flows are allocated to the main actors (i.e. Masipi East) but the income has been partitioned over the two villages.

(about 8 pesos/kg) is subtracted from the gross income in the other villages, the difference becomes somewhat less pronounced. Incomes from commercial logging, on the other hand, were a substantial addition to incomes especially in Dy Abra. With an average timber price of 5,000 pesos per cubic metre at the trading sites, the gross income per capita from logging in Dy Abra amounted to 8,000 pesos per year.

In terms of our search for factors that drive land use in the lowland/upland gradient, we may now go one step further than the first conclusion that markets are essential. Looking at the distance to the highway, which is a good proxy for distance to urban markets, this factor does not seem to exert a major differentiating force between the villages. Yellow corn and banana, the two most commercial crops and not easy to transport at all because they are heavy and prone to rot, are not grown closest to the highway. Distance to market only appears to exert some influence within the pioneer village, where people planted banana preferably at places with best access to the trading point.

Also, population density does not seem to be a good candidate for explaining the land use differences between the villages. Table 2.1 shows that the major crops of yellow corn and banana, with peaks in Dy Abra and Puerta, respectively, are distributed quite different than the population density gradient from Masipi East to the pioneer village.

Rather, slopes appear to be pivotal. The village with the most flat land is most devoted to rice; the village with most moderate slopes is most devoted to yellow corn and the villages with the most steep slopes harbour the most bananas. And indeed if one looks at a smaller scale within the villages, one sees this pattern in full; all lowland rice on available flat land, almost all corn on moderate slopes and all banana on the steep slopes.

Several questions remain, however. Banana grows perfectly well on moderate slopes too, for instance, and why is it not found there? And markets and slopes, both being somehow 'key', obviously must interact; how do they? As Elster (1989) has pointed out, true explanatory insight requires that not only causal factors are identified, but also the causal mechanisms, the processes that link the factors to each other and to the *explanandum*. Gathering this insight is the aim of the next two sections.

2.5 First explanation: options and motivations of the primary actors

In Action-in-Context, primary actors are defined as the first social entities that are identified as having a decision-making influence on the action in question. In our case, these are simply the village households deciding on the main land use options. For a proper explanation, insight is needed in all of the household's main livelihood options, because for their decision-making, actors compare the merits of all these options. In this section, we distinguish between two main actor groups, the pioneer households focussing on swiddens and the households focussing on permanent agriculture, because they differ considerably in motivational terms. We grouped the main motivational factors that were identified during the interviews for choosing between the different land use activities as follows:

- Returns to labour: the net returns in pesos per working hour.
- Returns to land: net returns (in pesos) per hectare for the land use activity.
- No risk (of losing investments due to government intervention, typhoons or other hazards).
- Prestige: the cultural benefit a farmer receives from a particular activity.
- Food quality: the cultural value of having this crop in the meal.
- Adventure: the appeal of the activity as a breakaway from daily life.
- Independence: the pride one takes in being one's own boss.

Most values are expressed on an ordinal scale.

The pioneer farmers

The pioneer village is part of a persistent flow of Ifugaos migrating from the Cordilleras to the Sierra Madre (Van den Top, 2003). The main drive for the pioneers was to be independent and to start a new life. They like to be in the forest and know quite well how to deal with sloping swiddens since these are also present (above the rice terraces) in the traditional Ifugao land use system Conklin, 1980; Gonzalez, 2002). Table 2.2 gives an overview of the specific motivations. We have added yellow corn grown on swiddens to the Table, not because the pioneer farmers grew it but for analytical reasons. Contrary to yellow corn on ploughed land, it grows on swiddens without fertilizer (but, like upland rice, for a few years only).

Swidden farming is looked down upon in Philippines society but as the neutral values on 'prestige' in Table 2.2 indicate, the villagers them-

Table 2.2 Activities and motivational factors of farmers with swiddens

	Returns to labor (PHP/day)	*Returns to land (PHP/ha/year)*	*No Risk*	*Prestige*	*Food quality*	*Adventure*	*Independence*
Swidden yellow corn	30	2000	+	0	n.a.	0	+
Swidden rice	30	3600	+	0	++	0	++
Banana	80	9600	-	0	+	0	+

The numbers are taken from the calculations of Hobbes and Kleijn (2007) and rounded off. PHP = Philippine Pesos (1 US$ = 45 PHP = 0.7 euro). The returns of the lower quality of banana are displayed. The swidden rice is used for home consumption; the returns to land and labor are calculated using the market price of normal rice of 8 PHP per kilo. Explanation of quantifications: ? = unknown; n.a. = not applicable; 0 = neutral; + = positively corresponding with the motivational factor; ++ = strongly positively corresponding with the motivational factor; - = negatively corresponding with the motivational factor.

selves did not find this an issue of importance. Rather, they highly valued their independence, as reflected by the positive value in the Table. People were content not having to deal with the rules and regulations of the government, the social control of neighbours and the whims of traders.

The pioneers occupied public land. This land was locally regarded as fallows owned by inhabitants of Puerta and Dy Abra. The pioneers did not fear eviction, however, neither by the villagers nor by the government. Government in general ignored swiddens, even though prohibited by law. As people said, forest animals raiding the crops were more dangerous than government officials. The risk factor in Table 2.2 therefore only relates to agricultural risk.

Comparing the crops in the Table, banana turns out to be the best economic option by far. In fact, it was the only one that could be grown with a rate or return higher than the daily wage of agricultural labour in the villages at the time of the research (60 pesos per day in Puerta and Dy Abra and up to 100 in Masipi East), and planting yellow corn is no alternative. It takes about three years after planting before the trees give significant numbers of fruits, however, and in the meantime, farmers have to survive. Most swiddeners therefore did plant upland rice, together with the banana shoots, after opening the swiddens. (If more rice calories were expected to be needed and soils appeared to allow, they sometimes waited with the bananas for one year.) The banana plantations were developed especially on places with best access to the trading point, because bananas are heavy and get easily damaged during the difficult way down. Banana plantations have relatively high returns that are quite steady, but they are susceptible to typhoons, wild animals and diseases as is reflected by the negative value on the risk factor in Table 2.2.

Upland rice can be grown for only one or two years on the same field before it is outshaded by grasses or, in our case, banana. Theoretically, it would be quite profitable for the swidden farmers to sell their upland rice varieties and buy lowland rice with the revenues, since upland rice goes for a price of 22 pesos per kilo and lowland rice costs only 8 pesos per kg. There is no steady demand, however, and the pioneer farmers also said that they so preferred the taste of their upland varieties that they were prepared to sell only incidentally for special reasons. In that sense, the swidden farmers were rich. They felt no need to go running for cash if subsistence food need was satisfied and the bananas would soon bear fruit and bring cash anyway.

The figures of Table 2.2 show that the pioneer farmers, although making swiddens, were no swidden farmers in the sense that they had any intention to go into a rotational system of rice and fallows. Their swiddens were the cutting edge of the expansion of banana plantations into the forest, planted with rice to cover food needs until the bananas matured.

Farmers focussing on permanent agricultural fields

Table 2.3 gives an overview of all the motivational factors for the major material flows of farmers with permanent agricultural fields in Puerta, Dy Abra and Masipi East.

In Puerta, 14 households had titles (covering between 0.25 and 2 hectare) for the 12 ha area that was suitable for irrigated rice. These households were members of the irrigation association of Masipi East. Rice was grown for own consumption.

Two thirds of the households of Puerta cultivated yellow corn. Some of it was on remaining flat land that was unsuitable for rice, and most of it was on the moderate and somewhat steep slopes. However, yellow corn was not very popular. People complained about the risks inherent in this crop, for instance that all fertilizer can be washed away in cases of early rains on the steeper slopes. Table 2.3 shows the low returns to land of only 3,000 pesos per hectare per year, and these depict in fact the average of relatively lucky cropping cycles without wash-out or other mishaps. In such cases, farmers run at a big loss because of the capital inputs needed for this crop. One example is a farmer saying: "*Last year we had to sell our carabao to pay back the debt to the trader because the corn harvest was lost*".

Table 2.3 Motivations for the major material flows in the three non-swidden villages

	Returns to labor	*Returns to land (PHP/ha/year)*	*No risk*	*Prestige*	*Food quality*	*Adventure*	*Independence*
Irrigated rice in Masipi East	+++	20,000	++	++	++	–	+
Irrigated rice in Dy Abra	+++	40,000	++	++	++	–	+
Irrigated rice in Puerta	++	13,000	++	++	++	–	+
Yellow corn in Masipi East	++	16,000	–	+	n.a.	–	–
Yellow corn in Dy Abra	++	20,000	–	+	n.a.	–	–
Yellow corn in Puerta	+	3,000	–	+	n.a.	–	–
Banana in Puerta	++	9,600	-	-	++	-	+
Logging	+++	n.a.	-	+	n.a.	++	++

The numbers are taken from the calculations of Hobbes and Kleijn (2007) and rounded off. PHP = Philippine Pesos (1 US$ = 45 PHP = 0.7 euro). The returns of the lower quality of banana are displayed. The irrigated rice is used for home consumption; the returns are calculated using the market price of 8 PHP per kilo. The returns to land are net results, i.e. with capital inputs subtracted. Explanation of quantifications: ? = unknown; n.a. = not applicable; 0 = neutral; + = positively corresponding with the motivational factor; ++ = strongly positively corresponding with the motivational factor; +++ = extremely positively corresponding with the motivational factor - = negatively corresponding with the motivational factor; – = strongly negatively corresponding with the motivational factor.

Most people in Puerta had a banana plantation that yielded more on average than yellow corn and formed a steadier source of income although, as said, there are also risks involved. People then only loose their labour investments, however, hence the better value on the risk criterion in Table 2.3. As for the logging trips that people from Puerta often participated in, Table 2.3 shows the high returns to labour and the appreciation that participants have of the male fun and adventure with lots of food, drinks, smokes, and forest camping during these trips. Risks are not perceived as very high in spite of the illegal character.

In Dy Abra, most households cultivated a rice field (rainfed, watered manually or watered by gravity). It was grown of the flat valley floor lands and solely used for own consumption. Rice cultivation was highly valued for the economic returns, the steadiness of the income, the high prestige and food quality, as reflected in Table 2.3.

Most households cultivated yellow corn on the rolling ploughed fields *(bangkag)*. Net returns are much higher, on average, than in Puerta due to better soil quality and more favourable average slope. The cost of wage labour was low in comparison to Masipi East and relatively much family and exchange labour was used on the cornfields. Some people cultivated white corn for own consumption as well. In spite of the obvious success of yellow corn for the individual actors (Table 2.3) and in the village as a whole (Table 2.1), opinions on this crop were often negative, with farmers especially referring to ever-larger quantities of fertilizer needed to maintain yields, saying, for instance: *"Our corn soils have become addicted to vitamins and chemicals"*.

In Masipi East, both irrigated rice and yellow corn gave lower net return in than in Dy Abra. This was not caused by lower yields but by a higher price of hired labour. Moreover, farmers in Masipi East apply more inputs in the yellow corn cultivation without getting much higher yields. The superiority of rice over corn remains, however. As in Dy Abra, the soils under yellow corn appeared to become exhausted. Farmers said, for instance: *"The corn soils are getting old. I have to apply more and ever stronger fertiliser each year"*.

Overall explanation of the land use pattern, primary actors level

This subsection will analyse the motivational factors as displayed in Table 2.2 and Table 2.3 pertaining to the major land use types, focusing on the primary actors.

Overall, we see a pattern emerging that resembles the explanation of land use in Tat hamlet, Vietnam, as described by Hobbes et al. (2007; Chapter 3), where "the key to the explanation of the land use...., appeared to be the limited availability of favoured options". In our case study area, irrigated rice was the superior crop on almost all accounts in the three main villages. The net returns of this crop sharply drop when land is not flat however, and corn then takes over. Therefore, people fill the flat areas with irrigated rice as much as possible, and if there are energies left (e.g. because households have only little flat land, or possibly none because this land is all occupied already), yellow corn is planted on the sloping land. The same mechanism then repeats itself with corn and banana, because the profitability of corn declines sharply when slopes are too steep. Banana, that does well enough on moderate but also on steeper slopes, then takes over, again planted to the extent that households still have energies left after satisfying first their rice and then their corn options, if they have any.

Logging is a special case due to its adventurous character and good returns to labour. Limitations of availability of this option also play a determining role, however. First, the local demand from the furniture shops in the valley is limited. Secondly, logging can only be done in the dry season when transport is not too slippery and dangerous. And third, chainsaw ownership and social networks determine who can join.

Upland rice or corn on steeply sloping swiddens had a low return to labour – so low, in fact, that swiddens, contrary to what is usually assumed when *kaingin* (slash-and-burn) farming is discussed, did not function as part of a swidden/fallow system, but only as the cutting edge of the expansion of banana plantations on the steep slopes. The forest trees had to go, and working on that and waiting for the banana trees to mature, some crops like upland rice or yellow corn were planted that assured subsistence for one or two years. This is analogous to the role that swiddens used to have in the lowlands as the cutting edge of paddy land expansion (Fegan, 1982: 97).

This then is the economic mechanism how markets, slopes and population density appear to interact in lowland/upland transitions zones of the Sierra Madre. Markets of crops, logs and labour set the maximum profitability of the major land use types. These maxima have a sequence, in our case with irrigated rice first, then yellow corn and then banana. Slopes then subtract from these maxima, because they imply lower yields, more labour or more risk. On that basis, the landscape fills up with people first going for the best crop at its site of maximum profitability (in our case, irrigated rice on the valley floors), up to a slope level that a next crop becomes more profitable. In our case: yellow corn, already at relatively weak slopes. Then the next crop follows (in our case banana), each time with swidden crops for temporary survival at the frontier if forest is encountered there. Figure 2.2 visualises this.

In a perfectly concave landscape, *i.e.* a landscape with increasing slopes at increasing distance from the valley bottom as tends to be roughly true in the Sierra Madre lowland/upland gradient, a perfect zonation from the valley bottom outwards is the theoretical result, with empirical reality determined by the details of the terrain. In all this, population density plays a major role in the background because it largely determines up to what slopes the landscape will in fact be filled. Due to village-level land scarcity, the village poor may be pushed upward to the frontier, and due to regional-level land scarcity elsewhere, new migrants may move the frontier further out and up.

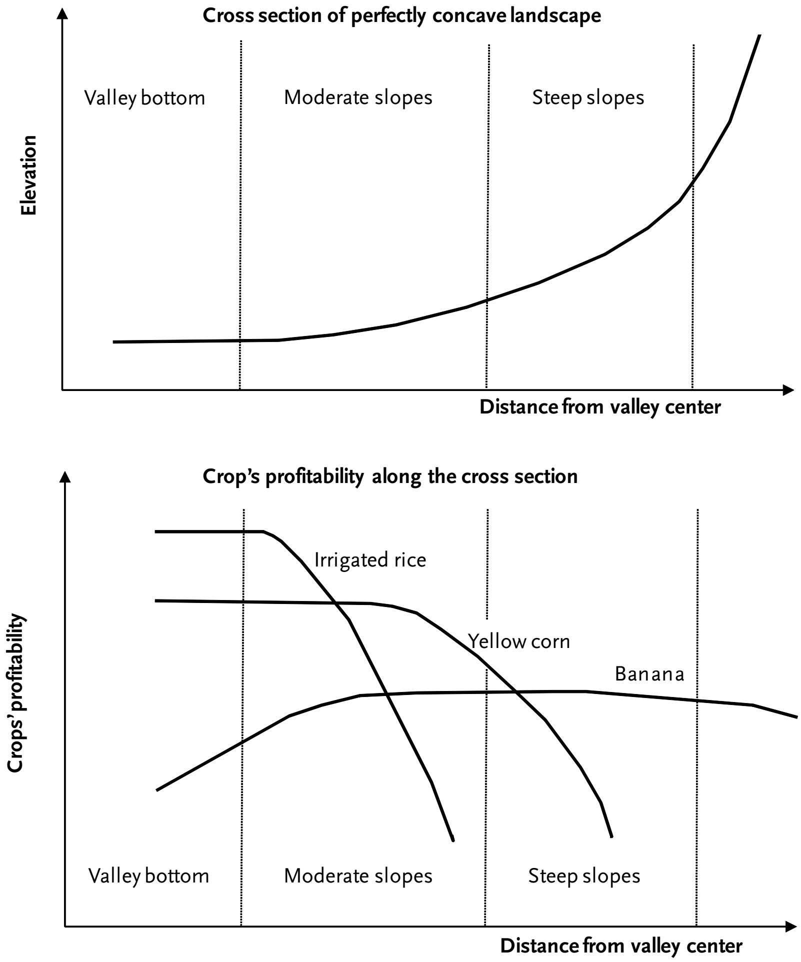

Figure 2.2 Slope-dependent profitability of the three major crops. In a perfectly concave landscape (top figure), where elevation and slopes increase monotonously with distance from valley bottom, the curves result in a zonation of rice, corn and banana going from the valley bottom outward (lower figure). Note that the abscissa does not denote distance to market but the distance from the valley center.

Figure 2.2 looks remarkably Thünian, only with slopes in stead of distance to market (major roads, cities) on the X axis. It is Von Thünen in the mountains, so to speak. Contrary to large-scale flat landscapes such as Brazil (Cleuren, 2001) or North Germany – the native land of Thünian theory – vertical slopes dominate over horizontal distance in the lowland/upland gradient. Distance to roads does play an auxiliary role, however, as we have seen. The end points of rural roads determine to which distance banana plantations and logging are profitable (see next section), and this, in turn, is an all-pervading factor for the Sierra Madre forest at present due to the lack of any non-economic regulation.

Looking out to other regions with this explanatory scheme in hand, it may be obvious that, depending on factors such as scale, migration histories, culture, markets, soils, slopes and many others, each region will have its own particular story and deviations from the scheme. The famous rice terraces of the Cordilleras show, for instance, how far irrigated rice terraces can go up in different times and circumstances than those of the present chapter (e.g. higher population density, no yellow corn market). It is as Brox (1990) has asserted about the utility of 'grand theory': explanatory schemes should be seen as analytical tools rather than as claims to truth. That way, we believe, that the scheme can serve as a template for better understanding many other upland/lowland histories in time and patterns in space.

In a later section, we will use our data and explanatory scheme to look at the future of the case study region, in which we will take continuing population growth as the key characteristic of that future. In order to do so properly, however, we must first somewhat deepen our foundation and explore a number of phenomena that causally underlie the primary actors, factors and mechanism identified up till now.

2.6 Second-layer explanation: secondary actors and structural elements

As said, the Action-in-Context framework defines secondary actors as those who exert power over the options and/or motivations of the primary actors. Other actors, in turn, have an influence over these secondary actors' options and/or motivations. These are then simply called tertiary actors, and so on. Here, we will explore some relations in these actors fields connected with structural processes, with a special view to relevance for future scenarios.

Irrigated rice

Due to its central place in the Asian economies, farmers growing irrigated rice are connected to a large and tightly woven actors field comprising landlords and traders, urban consumers, central government deciding on price policies, IRRI (International Rice Research Institute) developing new breeds and so on. In our field study area, irrigated rice was not really a cash crop and thus not very interesting for traders. Rice growing was connected to government agencies as secondary actors however, that strongly supported rice especially by supplying irrigation projects, tenure security on irrigated land, agricultural extension and so on.

Due to high production cost and protection of farmers against the world market, Filipino consumers pay two or three times as much for rice as do Thai and Vietnamese (USDA, 2001). Under pressure of WTO, the government is ostensibly liberalising rice imports and if this would really be effective, prices will plummet. Theoretically then, our subsistence rice growers could devote their irrigated land to some cash crop and buy rice on the market, but since millions of other farmers are bound to do the same, this is unlikely to be successful. The most likely assumption for irrigated rice in the study region therefore appears to be that rice will stay on the present irrigated land, possibly with some further intensification due to population growth but without any real push upwards terracing of sloping land.

Bananas and 'pulled in-migration'

Central in the actors field of banana growing are the relatively small-time traders that connect the farmers to local and regional consumer markets. Government agencies that should regulate land use on the public lands are absent. For the future, it can be assumed that it will remain profitable to convert steeply sloping land to banana plantations. We may note here, however, that plantations tend to stay close to the trading points due to the weight and vulnerability of banana during transport. With that, local government deciding on expanding and improving the local road network is an important secondary actor with respect to the expansion of banana on the forested slopes. As we saw, bananas are key to the influx of pioneer migrants. As also Van den Top (2003) found during his field research six years before us, these *kaingeneros* were not destitute people pushed out of their home region, but well-organized groups with entrepreneurial spirit, pulled to the Sierra Madre by the profits and the lack of any government willing to stop them, in spite of decades of discussion on swiddening and forest loss.

Logging

Contrary to the regulation of migration, government at least has some track record in the Sierra Madre with respect to logging (Van den Top, 2003). At the time and place of the field work, however, government in logging meant only that some bribes were paid, some threats were made and some logs hidden sometimes, so that the actors field was composed only of the private actors described in Section 3. Seen this way, the future of the great Sierra Madre forest depends solely on the Thünian market forces; the farther from the pick-up point where the truck will reach, the more the carabao hauling will cost, and some economic break-even distance will one day be reached (provided the road is not extended). At present, however, illegal logging already reaches deep inside the Sierra Madre Nature Park and the break-even distance still seems to be beyond the horizon. This is especially because rivers running out of the nature park act as logging transport highways greatly reducing the distance that actual hauling needs to take place. The long-term trend for the Sierra Madre forest also contains some positive elements, however. The national GO and NGO commitments to forest protection begin to receive authentic responses also on the regional and even local levels (Van der Ploeg, 2003), and logging flows along the rivers are easy to control once political will would present itself.

Yellow corn

Corn traders were the most important secondary actors in the economy of the research villages. Virtually all yellow corn (except on the swiddens) was grown with loans for inputs (fertilizer, seeds, pesticides, hired labour; up to 10,000 pesos per hectare) extended by various traders in Tumauini, either directly or through ‘guarantors’ in Masipi East, on the basis of crop collateral. The latter meant the trader did not want cash back but requested that the whole harvest be sold to him, so that he was assured he could fulfil his contract with the stockfeed mills. The trader deducted the loan plus possible outstanding debt plus interest (usually 40 percent per cropping) before paying the farmer out (if anything happened to be left). If the crop had failed due to typhoon, fertilizer wash-out, decay or other reasons, the crop collateral still stood, implying that farmers entered into debt bondage with the trader that, due to the crop collateral, is also a crop bondage. The guarantors and traders mutually assured that farmers did not easily escape to an other trader. The result is, as one farmer said: *“If you have many debts you are forced to plant yellow corn on large scale”*.

No wonder that farmers often complained about the traders. In all villages, many farmers repeated: *“We are the victims of corn”*. At the same time, only very few of them actively tried to escape from the system if they could (*i.e.* if they did not have too many debts already).[9] The reason

9 One example is a farmer in Puerta, the same one quoted already on the loss of the carabao, who said: *“Now, we only cultivate a small field of yellow corn with inputs bought without a loan. We are afraid to borrow money again. On the other fields we plant rainfed rice and white corn. And we focus on our bananas”*.

was that the traders were the farmers' only access to credit, and farmers with good track records could even get consumptive credit and instant help in acute needs. Thus around corn in the uplands, a system of patronage had developed comparable to that around rice in the lowlands and around tobacco in the past (Van den Top, 2003).

Within the traders group, those owning transport and a warehouse sold the corn directly to the stockfeed mills in Manila and Bulacan, and small traders sold to the larger ones. A trader who financed his farmers could buy for around 6.80 pesos per kg and sell for around 8.20 pesos to the mills. With a turnover of about a million kg/year and after paying the bank, labourers, trucks, warehouse rent, taxes and other cost, a profit is left of some 500,000 pesos per year. The trade is not without risk, however, and especially vulnerable to massive crop failures due to, for instance, typhoons.

Looking at the future of yellow corn in the region, two structural aspects are of importance. One is the market, which can be assumed to be quite steady because the demand is driven by the urban preferences for animal proteins, and these are only expected to rise, along with urban population as such. A much more problematic phenomenon is that the yellow corn farming appears to be unsustainable, as the farmers indicate. This may well point at a well-known phenomenon connected to ploughing and fertilizer. Ploughing exposes the organic matter in the soil to air and sunlight. The ensuing mineralization and nutrient release is of short-term benefit to the plants but if the post-harvest rotting of roots and crop residues does not sufficiently replenish the organic matter, the soil needs more and more external supply of nutrients (fertilizer), until its structure has deteriorated such that even heavy doses do not work any more and yields begin to drop rapidly in spite of the fertilizer. Given the pivotal place of yellow corn in the local economy, massive poverty will be the result. The patronage system would exacerbate this problem. In the early stages of declining yields in spite of high inputs (hence loans), all farmers would become bonded in debt, without the freedom to switch back to subsistence crops or other alternatives. Research into the soils under yellow corn is urgently needed. For the time being, it would be irresponsible to ignore the unsustainability risk.

2.7 Future scenarios and policy options

The insights built up in the preceding sections allow look into future scenarios and explore possibly effective policies for this area.

As has been found, slopes determine much of the land use in this lowland/upland region, and slopes do not change. There is an inherent stability in the land use pattern, therefore, with population growth as a slow but steady driving force. Without an unsustainability drama in the yellow corn and without (unexpected) market crashes, population growth may slowly move the irrigated rice somewhat up the slopes where water and soils allow. On the other end of the slopes spectrum, population growth will exert a significant pressure on the 'banana frontier', that will tend to move ever closer to and then into the Sierra Madre forest, destroying this last large-scale stronghold of endemic Philippine biodiversity. Since banana plantations display a dependency on distance to market, roads must follow the bananas for this scenario to come true. If roads are not extended, the banana expansion will tend to peter out due to decreasing profitability at growing distance from the market – provided, of course, that migrants are profit-oriented as the current banana pioneers are. If migrants would be not, that is to say if they would be pushed out of their home areas by sheer poverty and be happy enough with bare subsistence, this mechanism would not work, and deeper action than benevolent inactivity would be needed from the government.

We have seen as well that illegal logging is another threat to the forest, which is likely to continue (independent of population growth) as long as forest policies are not implemented. Up to the present day all over the Sierra Madre, the cumulative effect of countless small-scale logging trips is disastrous. Market demand for planted fast-growing exotics such as *gmelina* may help change the timber supply picture in the near future. *Gmelina* appears to do satisfactory on the market provided it is old enough when cut and well dried, and plantations may be internationally certified. Government commitment is necessary too, however, in order to prevent that plantations will only make their quantum leap after the natural forest is gone. During our interviews, respondents often expressed that they wanted the behaviour of themselves, their neighbours and their government to become more future-oriented, more work-oriented and more rules-based. *"People are lazy and they don't organise. They only organise for the immediate gains of illegal logging"*. And: *"The government should implement the law, otherwise you cannot blame the illegal loggers. The authorities do not implement it and even take the money"*.

Unsustainability of the yellow corn would pull the economic carpet from under the whole upland system. Hobbes and De Groot (2003) sketch three land use scenarios for the area based on the dynamics of corn, keeping constant the other factors. The first scenario has a Malthusian character, the second is characteristically Boserupian and the third represents a more opportunistic wriggling out of debt's embrace.

Option 1: Going Down. One scenario is based on the assumption that most farmers will remain within the corn system as it works at present, forced by debt and crop bondage to continue planting yellow corn on a large scale. In that case, it is quite unlikely that farmers will have the means to invest in measures that might avert the ongoing process of soil degradation. Initially, fertiliser use may continue to rise in order to compensate the soil degradation. With that, however, profits will go down, until profits hit the zero mark and the whole system crashes, ending on a soil quality level where corn is simply not profitable anymore. The loss of the high-value crop will cause out-migration as well as greatly increase the pressure on the forest of farmers seeking to find some last livelihood option there. Farmers might be lucky if some crop such as banana would grow on the degraded soils, but a more likely possibility is that the degraded lands will revert back to grassland or bushland, which appears to be the almost universal fate of overexploited soils.[10]

Option 2: Sustainable Yellow Corn. A second scenario is that farmers would continue to maximise their area of yellow corn for economic reasons, but manage their farming practices in such a way that they remain free of debt and the soil free of degradation. One step towards this is to devote all vulnerable slopes to banana, *gmelina* or some other permanent cover.[11] On the remaining less sloping land, soil management should focus especially on maintenance of organic matter content, being the key of intrinsic soil fertility. Well-known *in situ* options in this respect are, for instance, green manure, mulching, trees on field boundaries, intercropping and short fallows. Farm-level options are to mix some grassland and cattle into the farming system to provide manure, or to make compost from leaves and residues including those from the permanently covered steep slopes. Finally, supra-farm options may involve the concentration of (composted) products from forest patches or even rice husks from the lowlands on the corn land. Basic circum-

10 A recent discussion concerns cassava grown, as corn ultimately, for large-scale companies. Cassava used as a follow-up of corn, exploiting the cassava's capacity to eke out a soil's last nutrients, may be regarded as just another end point of the 'going down' scenario.

11 This is probably more profitable than trying to prevent soil erosion by combining relatively complicated soil conservation techniques with an annual crop such as corn. In spite of the development of a model farm exemplifying such techniques in Puerta, they remain un-adopted. As one respondent said: *"[If you apply anti-erosion measures,] your neighbours laugh at you, and have higher yields with less labour input"*.

stances for more organic farming do not appear to be unfavourable. In Dy Abra, for instance, there is enough space left for more livestock grazing, and the present 762 kg per capita per year of (dry) manure is already sufficient for 3 tons of dry manure per hectare of corn field per year, which is a substantial contribution to fertility upkeep (De Haan *et al.*, 1997)

Option 3: Sustainable Livelihood Diversification. The third scenario is that farmers may drop the emphasis on yellow corn altogether and diversify livelihoods, with help of components such as white corn, vegetables, banana, *gmelina*, upland rice, cattle, forest patch management and so on. Some farmers in Puerta were in fact designing such strategies already. Other farmers especially in Dy Abra are shifting attention from yellow corn on the ploughed fields back to their old swiddens where they can farm without fertilizer. Close to the highway, fruit trees and vegetables might be feasible, analogous to Conelly's (1992) case, and *gmelina* might be of help farther from the road. If the high price of upland rice would appear to hold if a true market would be developed, it could become part of the picture as well.

All three scenarios have their consequences for the Sierra Madre rainforest. Especially the 'going down' case is a great risk not only for the farmers but for the forest as well, setting the frontier in rapid, poverty-driven motion again. We hope to have shown with this chapter, however, that the explanatory analysis of land use in this lowland/upland gradient has not only generated theory for understanding many other of such areas in the Philippines and elsewhere, but also for a more stable future of nature and people alike.

Acknowledgement

We are grateful to our to all our respondents in Dy Abra, Masipi East, Puerta and the people living near their swiddens for their valuable time they gave to co-operate with the research and their hospitality. Much of the data presented here was gathered by Liesbeth Denis, Orlando Balderama and Sietske Veenman. We would like to thank Arnold ('Every step you take ....') Macadangdang for his translations, information and company. Finally, thanks are due to René Kleijn for his co-ordination, to Maarten van 't Zelfde and Cecille Mangabat for additional contributions, and to CVPED for being both a support system and a home.

References

Boserup, Ester. 1965. The Conditions of Agricultural Growth. London: Allen and Unwin.

Brox, Ottar. 1990. "The Common Property Theory: Epistemological Status and Analytical Utility." Human Organisation, 49: 227-235.

Chambers, Robert. 1994. "Participatory Rural Appraisal (PRA): Analysis of Experience." World Development, 22: 1253-1268.

Cleuren, Herwich M.R. 2001. Paving the Road for Forest Destruction: Key Actors And Driving Forces of Tropical Deforestation in Brazil, Ecuador and Cameroon. PhD dissertation, Leiden University.

Conelly, W. Thomas. 1992. "Agricultural Intensification in a Philippine Frontier Community: Impact on Labour Efficiency and Farm Diversity." Human Ecology, 20: 203-223.

Conklin, Harold C. 1980. Ethnographic Atlas of Ifugao: A Study of Environment, Culture and Society of Northern Luzon. Connecticut:Yale University Press.

De Groot, Wouter T. 2003. "Thünian Land Use Theory, Visions of Nature, and the Future of the Sierra Madre Forest," in Jan van der Ploeg, Andres B. Masipiqueña and Eileen C. Bernardo (eds.), The Sierra Madre Mountain Range: Global Relevance, Local Realities, pp. 381-408. Tuguegarao City: CVPED/Golden Press.

De Groot, Wouter T. and Evelien M. Kamminga. 1995. Forest, People. Government. A Policy-Oriented Analysis of the Social Dynamics of Tropical Deforestation. CML report 120, Leiden University.

De Groot, Wouter T. 1992. Environmental Science Theory. Concepts and Methods in a One-World, Problem-Oriented Paradigm. Amsterdam: Elsevier.

De Haan, Cees, Henning Steinfeld and Harvey Blackburn. 1997. Livestock and the environment: finding a balance. FAO. http://fao.org/WAICENT/FAOINFO/AGRICULT/aga/lspa/LXEHTML

Elster, Jon. 1989. Nuts and bolts for the social sciences. New York: Cambridge University Press.

Eurostat. 2001. Economy-wide Material Flow Accounts and Derived Indicators. A Methodological Guide. Luxembourg: Statistical Office of the European Union.

Fegan, Brian. 1982. 'The social history of a Central Luzon barrio" in Alfred W. McCoy and Ed. C. de Jesus (eds.), Philippine Social History, pp 91-127. Sydney: George Allan and Unwin.

Gonzalez, Rhodora M. 2002. "GIS-assisted Joint Learning: A Strategy in Adaptive Management of Natural Resources" in James Oglethorpe (ed.), Adaptive Management, pp 15-39. Sui Technical Series Vol. 3. IUCN, Gland, Switserland and Cambridge, UK.

Grünbühel, Clemens M., Helmut Haberl, Heinz Schandl and Verena Winiwarter. 2003. "Socioeconomic Metabolism and Colonization of Natural Processes in SangSaeng Village: Material and Energy Flows, Land Use, and Cultural Change in Northeast Thailand." Human Ecology, 31(1): 53-86.

Hobbes Marieke and Wouter T. de Groot. 2003. "Corn and Beyond: an Exploration of Sustainability, Indebtedness and Future Land Use of The Sierra Madre Forest Fringe, Philippines," in Jan van der Ploeg, Andres B. Masipiqueña and Eileen C. Bernardo (eds.), The

Sierra Madre Mountain Range: Global Relevance, Local Realities, pp. 161-174. Tuguegarao: CVPED/Golden Press.

Hobbes, Marieke and René Kleijn (eds.). 2007. Local Material Flow Analysis in Social Context at the Forest Fringe in the Sierra Made, The Philippines. Vienna. Working paper 98, Institute for Interdisciplinary Studies of Austrian Universities—IFF, Vienna

Hobbes, Marieke, Serge I. P. Stalpers, Jiska Kooijman, Thanh Le Thi Thu, Chi Trinh Khanh and Dao Phan Thi Anh. 2007. "Material Flows in Social Context: A Vietnamese case study combining the Material Flow Analysis and Action-in-Context frameworks." Industrial Ecology.11 (1):141-159

Murton, John. 1999. "Population growth and poverty in Machakos District, Kenya." Geographical Journal, 165 (1): 37-46 pp.

Romero, Marino R. 2005. Investing in the Land. Agricultural Transition towards Sustainable Land Use in the Philippines' Forest Fringe. PhD dissertation, Leiden University.

Turner II, Bill L., Goran Hyden and Robert W. Kates. 1993. Population growth and agricultural change in Africa. Gainesville: University Press of Florida.

Tiffen, Mary, Michael Mortimore and Francis Gichuki. 1994. More people less erosion: environmental recovery in Kenya. London: John Wiley.

USDA (2001) http://oryza.com/asia/philippines/index.shtml

Van den Top, Gerhard M. 2003. The Social Dynamics of Deforestation in the Philippines. Copenhagen: NIAS Press.

Van der Ploeg, Jan. 2003. "Of Ducks, Desire, and Discovery channel: Emerging Environmentalism in the Sierra Madre Mountain Range," in Jan van der Ploeg, Andres B. Masipiqueña and Eileen C. Bernardo (eds.), The Sierra Madre Mountain Range: Global Relevance, Local Realities, pp. 409-427. Tuguegarao: CVPED/Golden Press.

Vayda, Andrew P. 1983. "Progressive contextualization: methods for research in human ecology." Human Ecology, 11(3): 265-281.

Von Thünen, Johann, H. 1826, Der Isolierte Staat. Translated, adapted and re-printed as P. Hall. 1966. Von Thünen's Isolated State. Oxford: Pergamon.

Tat: road, rice fields, swiddens

3

Material Flows in a Social Context: a Vietnamese Case Study Combining the Material Flow Analysis and Action-in-Context Frameworks

Abstract

Material flow analysis (MFA) is one of the central achievements of industrial ecology. One direction in which one can move MFA beyond mere accounting is by putting the material flows in their social context. This "socially extended MFA" may be carried out at various levels of aggregation. In this chapter, specific material flows will be linked to concrete actors and mechanisms that cause these flows, using the Action-in-Context (AiC) framework that contains, inter alia, both proximate and indirect actors and factors. The case study site is of Tat hamlet in Vietnam, set in a landscape of paddy fields on valley floors surrounded by steep, previously forested slopes. Out of the aggregate MFA of Tat, the study focuses on material flows associated with basic needs and sustainability. The most important actors causing these material flows are farming households, politicians, traders, and agribusiness firms, of which local politicians turned out to be pivotal. The study shows the value of combining MFA with actor-based social analysis. MFA achieves the balanced quantification of the physical system, thus helping to pinpoint key processes. Actor-based analysis adds the causal understanding of what drives these key processes, leading to improved scenarios of the future and the effective identification of target groups and instruments for policy making.

Published as: Hobbes, M. Stalpers, S. I. P., Kooijman, J., Le, Thi Thu Thanh., Trinh, Khanh Chi., and Phan, Thi Anh Dao (2007). Materials flows in a social context: A Vietnamese case study combining the material flow analysis and action-in-context frameworks. *Journal of Industrial Ecology*, 11 (1), pp. 141-159.

3.1 Introduction

Material flow analysis (MFA) constitutes a major approach for studying linkages between environment and society. This chapter addresses one limitation of industrial ecology (IE) and MFA, mentioned by Hinterberger and colleagues (2003) and worded by Duchin and Hertwich (2003: 9) as follows: "[IE and MFA] have until now not embraced a systematic approach to studying the economic, social and psychological aspects of decision-making."

Aggregate material flows studied in MFA can be linked to general economic system characteristics such as those of computable general equilibrium models (Ibenholt 2002), applied general equilibrium models (Kandelaars 1999), or simply gross domestic product (GDP). Kytzia and Nathani (2004) refer to this approach as the integration of material flows into a larger economic framework. Conversely, economic and other social elements may be added to models in which MFA stands central, giving rise to a family of approaches that could be called "socially extended MFA", of which the strictly economic version, discussed by Kytzia and Nathani and called by them "economically extended MFA", is one subset.

The integration of material flows into larger economic frameworks may generate relevant system-level descriptions such as dematerialization (material flows divided by GDP; Eurostat 2001). It does not, however, give causal insights, because causal agency (i.e. the decision making of actors) is not represented at the general system level. Socially extended MFAs may fare better in this respect, because they allow coming closer to concrete actors. One example of extended MFA with relatively lumpy material flows and actors is found in work by Kytzia and colleagues (2004), where flows of "food products" run between aggregate actors such as "agriculture" and "retailing". This level of aggregation can be used for scenarios such as simulating the effect of vegetarian diets on land use. Causal explanation as to *why* such things would happen requires a more truly actor-based approach that facilitates more insight into actors' decision making over concrete material flows, for example, farmers choosing between land-use options, food industries considering their options, or consumers deliberating on purchasing environmentally friendly goods. This level is also referred to by Fischhoff and Small (2000) when they say that for progress in IE, there is a need to connect IE models with models of human behavior. For a related discussion of the need to link integrate social scientific methods into industrial ecology, see the article by Andrews (2000) on microfoundations for industrial ecology.

The social sciences provide a wide variety of behavioral models that may be used for socially extended MFA. They may be grouped as micro-economic models, broader models of rational choice, and models that also include "non-rational" elements, such as social norms. All of these actor-based models link up closely with the design of policies. Roughly, the more comprehensive the model being used to explain why actors behave the way they do, the more comprehensive the policy that can be designed. Moreover, as we will exemplify here, actor-based analysis does not need to be confined to the actors that directly generate the material flows. Chains of indirect actors may be identified, too, as well as the causal mechanisms through which the actors are connected to each other. With that, the social structures of power that generate the material flows come within reach. All actors identified in the causal chains are potential target groups for policy making.

Binder and colleagues (2004) give an example of an actor-based socially extended MFA of regional wood flows. In the present chapter, we introduce an alternative actor-based approach. In comparison to the work by Binder and colleagues, the present study is based on more explicit views of the decision-making processes of actors and chains of actors that generate the material flows. This chapter does not, however, aim at comparing different approaches, but rather, at adding another example in this line of methodological development, and thereby preparing the ground for evaluating or integrating different approaches in the future.

Against this background, the aim of the present chapter is to elucidate and to illustrate the value of an explicit actor-based connection between material flows and their social driving forces (actions, actors, and mechanisms). For the illustration of this socially extended MFA we use data from a village study in Vietnam, gathered in the framework of the EU-funded project Southeast Asia in Transition.

The structure of the chapter is as follows. (1) We first establish an aggregate MFA of our Vietnamese location and then select a number of interesting concrete flows out of the aggregate. (2) These flows are connected to the proximate actors, and it is explained why the actors generate these flows. (3) The final analytical step is to link the decisions of these actors to those of other actors exerting power over them, such as government agents. (4) On that basis we look at the future, identify policy options, and conclude on the value of connecting MFA with an actor-based social-scientific approach. For steps (2) and (3) we will use the Action-in-Context (AiC) framework of De Groot (1992), which we found appropriate (without systematic comparison, and hence without any claim of superiority) due to its explicit character, balance, and focus on multi-actor social causation.

3.2 Research area and fieldwork methods

Tat hamlet belongs to Tan Minh village, Hoa Binh Province, Vietnam. With a total territory of 740 hectares, it lies 140 km west of Hanoi. Most houses in the hamlet are found along the stretch of road that follows the river in the central valley, where 22 hectares of paddy fields have been developed. The valley lies at 300 meters elevation and is surrounded by mountains that reach up to 1,000 m, resulting in steep slopes, often of 45 to 60 degrees. On these slopes people practice swidden (shifting) cultivation,[12] covering an area of about 47 hectares. Tat is mainly inhabited by the Tay ethnic group. In 2001, the population consisted of 466 persons in 105 households.

Up until 1992, Tat relied almost completely on subsistence production. Especially since the improvement of the road in 1999, Tat has become deeply involved in the market economy, based on paddy (irrigated rice), swidden, livestock, and forest products. Vien (2003) and Rambo and Vien (2001) provide a detailed description of Tat's resource management system.

Researchers from Leiden University and Vietnam National University collected data in Tat from August to December 2001. A survey covering all households was conducted for basic socioeconomic and demographic data. A random sample of 29 households (i.e., a sampling factor of 3.83) then participated in a questionnaire to estimate their main material flows and stocks. Direct measurements and observations were carried out for buildings, waste flows, and food consumption. Household waste was measured for six different households during one week, for instance. To gain insight into the decision-making processes of the villagers, the team conducted semistructured interviews with a subset of the 29 households and used participatory methods such as option ranking and historical diagramming. Informal interviews were conducted with key respondents, including the hamlet leader and traders, also covering sensitive issues such as illegal logging. Detailed information on the

[12] Swidden or shifting cultivation is a form of agriculture also known as slash-and-burn agriculture. The system entails burning a patch of forest, cultivating there for some period until the soil decreases in quality and the land becomes overridden with weeds, and then leaving the plot to lie fallow for soil regeneration while it usually returns, to some degree, to forested land.

study can be found in Hobbes and Kleijn (2006). We do not go into issues here of the exact representativeness for the region or the exact statistical status of all data, because the function of the study is to illustrate a methodology rather than to contribute to empirical area studies.

3.3 The local MFA

The Aggregate MFA of Tat

An aggregate MFA (often called "bulk" or "economy-wide" MFA in, for instance, Daniels and Moore 2002) of Tat was established first. The advantage of this type of MFA is the international comparability of its indicators (Bringezu et al. 2003; Hobbes 2005, Chapter 4). The aggregate MFA follows the principles of Eurostat (2001), which distinguish between two system boundaries as shown in figure 3.1. The inner boundary draws the distinction between the society and its domestic environment. The outer boundary displays what belongs to the society under study and what to other economies. Material flows are defined as displa-

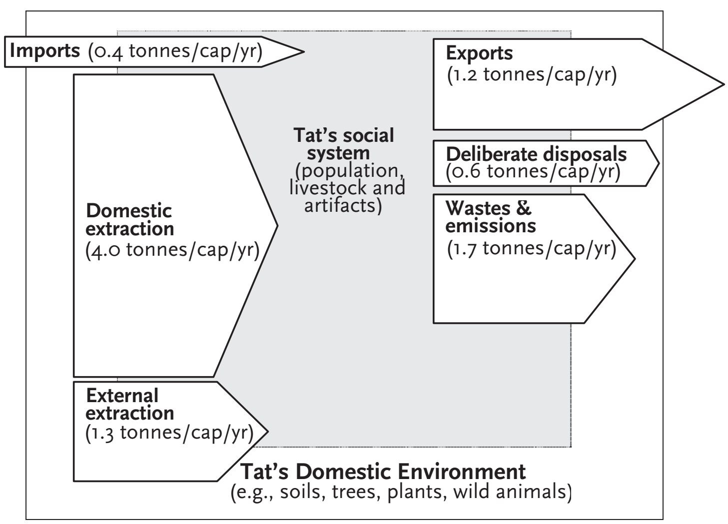

Figure 3.1 The aggregate MFA of Tat (excluding flows related to road paving). Flows are given in tonnes per capita per year, with moisture contents as actually present when the material is used (except for wood that is standardized at 35 percent moisture content and manure that is taken as dry weight). *Source*: Compilation of different data sources based on Stalpers (2003).

cements of materials directly caused by human labor or labor substitutes. Materials flowing into the social system are called inputs. If inputs flow from the domestic environment to the social system, they are called domestic extraction (DE); if inputs flow into the social system from foreign territories via an economic transaction, they are called imports. Because the inhabitants of Tat extracted a significant amount of products from the domestic environments of neighboring hamlets, a flow category called external extraction (EE) was introduced to make a distinction between these flows and the import of goods. Outputs from the social system flow either into a foreign territory (export) or to the domestic environment. In the latter case, the flow is called a deliberate disposal (DD) if the material is disposed with a further purpose (such as sowing seeds or applying fertilizer), and called wastes and emissions (WE) if disposed of without a further purpose. We have excluded the flows associated with the paving of the road that happened to take place during the fieldwork period, because these dominated the MFA without adding relevant insight. For instance, the directly measured net additions to stock (NAS) of the society were 320% over 2001 if the paving is included, compared to 1% if excluded. The NAS is not included in the figure, because it was only 0.034 tons per capita per year. The time frame of the MFA of Tat is from October 2000 to September 2001.

The direct material input (DMI) indicates the material dependency of the society. It is the sum of the imports, domestic extraction (DE), and external extraction (EE). The DMI of Tat was about 5.7 tons per capita per year, out of which 70% was DE and 23% was EE. The remaining 7% was imported from the markets in the lowlands.

Subtracting the export from DMI in order to get the direct material consumption (DMC), we see a drop to 4.5 tons per capita per year. Thus, about 80% of Tat's DMI was consumed within the society, whereas the remaining 20% was exported.

The physical trade balance (exports minus imports) was about 0.8 tons per capita per year; exports weighed 2.3 times more than imports. Typical for a rural economy, this is due to the fact that the exports consisted of raw materials and the imports consisted of final and processed goods (see figure 3.2).[13]

[13] Balancing the inputs and the outputs we notice that the totals do not match. This is mainly due to the different water content of the various materials (Hobbes, 2005).

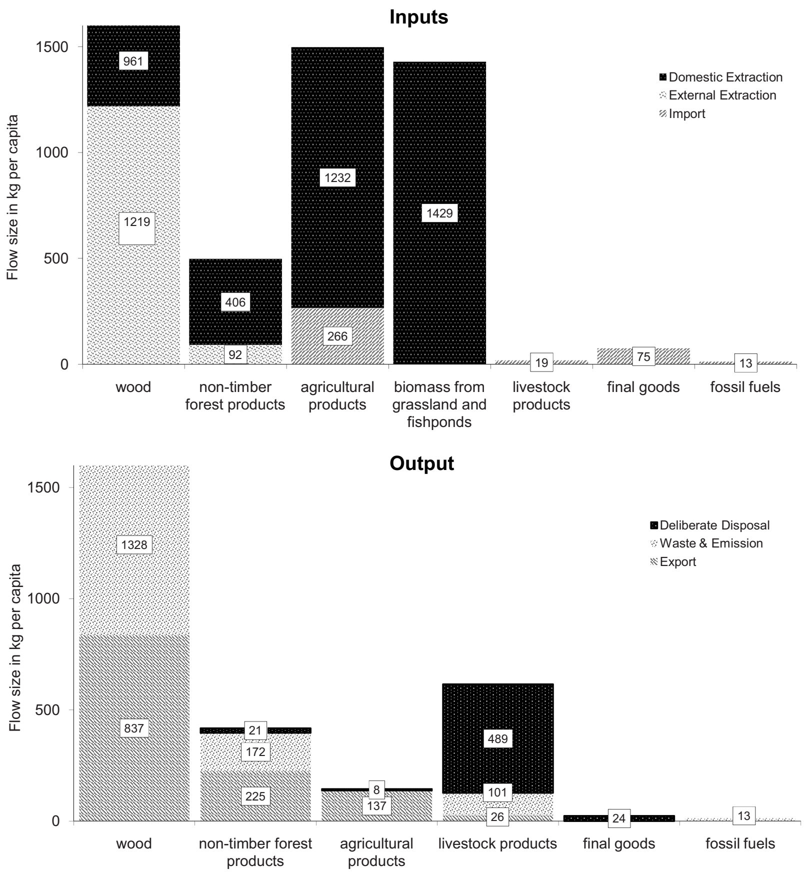

Figure 3.2 The input and output sides of the MFA of Tat hamlet (excluding flows related to road paving). Flows are given in kilograms per capita per year, with moisture content as actually present when the material is used (except for wood, which is standardized at 35% moisture content, and manure, which is taken as dry weight). Outputs exclude human excrement. The first two digits are significant. Note that the (wood) data being represented by the first bar on each graph actually far exceed the height of the graph, but the bar has been truncated on each graph to save space. Source: Compilation of different data sources based on Stalpers (2003).

Disaggregated Values of Material Flows

It is well known (e.g., Kleijn 2001) that aggregate MFAs do not link up unambiguously with environmental impacts, because all materials flows are accounted for on a mass basis regardless of their per-kilo environmental impact. Moreover, and of special relevance for the linkage between MFA and explanatory social science, the aggregate flows cannot be connected with the concrete decision making of actors. Therefore, figure 3.2 gives more disaggregated information on the input and output flows.

The figure shows that the inputs for Tat came mainly from the forest and soils with only a small contribution from final goods. Wood constituted the largest flow, adding up to 2 tons per capita per year. The domestically extracted portion was firewood, returning as waste and emission (WE) in the outputs. The other portion of the wood input was timber extracted from the territories of neighboring hamlets (EE). Of this amount, 30% ended up as WE in the conversion from round to square logs. About 98% of the remaining timber was exported.

Bamboo and bamboo shoots are included in the nontimber forest products (NTFP) category in figure 3.2. Of the approximately 200 kg of bamboo collected per capita per year, about 85% was used as fuel and 15% for construction. About 130 kg of fresh bamboo shoots per capita per year was collected, of which about 70% was marketed. The marketable variety was not available in Tat's own territory any more and was externally extracted. Other NTFP were mainly domestically extracted — sun-dried broom grass for marketing (about 34 kg per capita per year), sundried palm leaves for roofing (about 85 kg per capita per year), green manure (a combination of leaves, grass, and cattle manure; about 19 kg per capita per year), and plant roots for food and for medicines (about 3 kg per capita per year).

Agricultural products formed the second largest component of the DMI at about 1.5 tons per capita per year. About 18% of Tat's agricultural products were imported, such as livestock feed, seeds, and foodstuffs (e.g., rice, vegetables, and fruits). The remaining agricultural products were locally produced in the paddy fields (about 15%), swiddens (about 69%), and home gardens (about 14%). Rice, cassava, corn, potatoes, vegetables, and fruit were grown mostly for personal use, with most of the cassava, corn, and potatoes consumed by livestock, especially pigs. At the output side we see some deliberate disposal of seeds. The exports of agricultural products consisted of canna, ginger, and cassava roots, all originating from the swiddens and amounting to about 137 kg per capita per year.

Livestock consumed all of the biomass that originated from the grasslands and fishponds (grass and water vegetables). The biomass returns at the output side as the deliberate disposal of livestock products shown in figure 3.2, which was almost wholly manure of pigs, used to fertilize paddy fields, home gardens, and fish ponds at about 100, 5, and 380 kg per capita per year, respectively. About 26 kg per capita per year of livestock products, mainly meat, was exported.

Material Flows Selected for Explanation

As previously stated, material flows must be sufficiently disaggregated to be open to actor-based explanation. The whole of the aggregate MFA could be explained by focusing on all major flows one by one. Here, we will focus on only a few of them, selected for reasons of relevance to the population of Tat, analogously to Pfister's (2003) case study in Nicaragua, in which she focuses on the flows most strongly connected to sustainability and basic needs.

The (disaggregate) MFA shows that Tat imported rice. The MFA also shows that Tat produced about 63 tons of dry milled rice, which, when divided by the World Health Organization (WHO 1985) standard of calorific need for an average rural adult in the developing world of 2,500 kilocalories per day (equal to 252 kilograms of dry milled rice per year), can be shown as indeed not sufficient to feed the population. Although rural communities in Southeast Asia would prefer to be self-sufficient in rice, the rice deficiency of Tat would not be really problematic if the cash needed to buy the rice supplement could be earned by sustainable activities. This appears not to be the case, however. Of the four main export flows (figure 3.2), timber and NTFP were extracted in the territories of neighboring villages, their own territories already depleted. Of the exported agricultural products, the major flow came from the swiddens. Swidden cultivation may be sustainable at approximately 20 inhabitants per square kilometer (km2) in tropical forest areas (Dove 1985). This figure may be somewhat higher in Tat because people extracted some 15% of their agricultural products from nonswidden (paddy) land, but the actual population density was far beyond that, at almost 67 persons per km2, even if we take the full 7 km2 of the village territory as available for swiddening. Cuc and Rambo (2001) confirm this problematic situation, as did our own observations. People of Tat mentioned a strong decline of swidden productivity (between 20% and 50% in recent years) due to soil degradation.

Good locations for making swiddens were ever farther away from the village. Besides buying rice (and basic needs such as school fees), the cash earned in the exports was needed to buy the hybrid rice seeds and fertilizers (approximately 85 US$. per hectare per year) to keep up the domestic rice production. All in all, then, it appears that not only the rice supplement but also the domestic rice production, and with that Tat's most basic staple, was based on unsustainable extraction and swiddens. Against this background, it was decided to focus further study on the flows of timber, bamboo shoots, and swidden products.

3.4 Action-in-Context: the framework as applied here

Following principles laid down by Vayda (1983), the Action-in-Context (AiC) framework developed by De Groot (1992) offers a structure for explaining human activities. The application starts out from the activity (or deliberate inactivity) to be explained and then works its way outward into an ever-widening context of actors, factors, and mechanisms.

The first step in AiC is always as follows: Starting out from this or that activity, who are the actors? Actors are defined as social entities with decision-making influence over the activity in question, which in MFA is the generation of a material flow. These may be individual people, collective actors such as firms, organizations, or government agencies, or categories of these assumed to have sufficiently equal properties (Botsford 1992). After the identification of actors, the assumption is that people act the way they do because (a) they *can* do it and (b) they *want to* do it. These two conditions for human action go under many names in the social sciences, such as "capacity", "opportunities", and "desires" (e.g., Elster 1989; Bebbington 1999). In AiC, they are called "options" (i.e., the actor's alternative courses of action) and "motivations" or "motivational factors" (i.e., the considerations the actor uses to arrive at a decision between the options, such as financial cost and benefits, cultural value, or long-term value). Options and motivations, in turn, are causally embedded in culture and the structure of society. To elucidate this linkage, AiC supplies a conceptual scheme of broad rational choice with elements such as the actor's resources, knowledge, and interpretative frames. The decision making of actors in AiC may be specified as either maximizing or satisfying (Simon 1978) and either deliberative (Fishbein and Ajzen 1975) or based on social comparison (Jager et al. 2000). Moreover, AiC supplies a meta-model of decision making that includes also the moral domains of *homo communalis* (ethics of care; Gilligan 1982) and *homo honoris* (with honor and duty as the primary moral dimension; De Groot 1992). For the present study, however, it was found that a simple scheme with a multicriteria structure (see table 3.2 later in the chapter) yielded straightforward explanations, mainly because options clearly dominated each other.

Usually, other actors may be identified behind the primary actors that influence the action in question. This defines the AiC concept of the a*ctors field*, to which we pay some special attention here because of its relevance for the present chapter and because, to my knowledge, it is a unique feature of AiC. Actors fields depict *social causation* (Giddens 1979, 49), that is, the exertion of political, economic, or cultural power of one actor on another, intended or unintended, overt or covert (Gale 1998). Because, as said, actors make decisions based on their options and motivations, influence on the decision making of an actor is exerted by influencing that actor's options and/or motivations. Examples on the options side are to provide knowledge or credit so that more options come within the actor's reach, or to reduce the options range by way of prohibitions, pollution limits, and so forth. Examples of motivational influences are the establishment of levies or subsidies, changing land tenure systems so that future benefits of farmers' investments in the land become more secure, or changing the cultural image of options (e.g., smoking). Therefore, actors fields are constructed by identifying what actors, through what actions, influence options and/or motivations of other actors. From the primary actors outward, causal linkages are first explored in the direction of secondary actors that influence the options and/or motivations of the primary actors. From there, tertiary actors influencing the options and/or motivations of the secondary actors may be identified, and so on. In this way, the construction of actors fields identifies all of the actor groups that are potential target groups for policy making to influence the action in question. One example of a causal chain in the actors field is that a landlord (secondary actor) may prohibit farmers (primary actors) from growing a perennial crop because he fears that the government (tertiary actor) may change the land tenure system so that perennial crops give rise to ownership claims by the farmers. Behind this, the World Bank, threatening the government with withdrawal of agricultural loans, may be a quaternary actor. Thus, we see that the actors field concept is actor-based throughout, up to the world level, contrary to, for instance, the stepwise contextualization of Blaikie (1985), which moves from primary actors such as farmers up to the regional and world *systems*.

On a more theoretical note, the actors field concept should be clearly distinguished from the concept of social networks that forms the dominant idea on actor connections in social science. Social networks are composed of actors exchanging services or information between themselves, through ties of kinship, friendship, and so forth. Power is only a secondary issue. In actors fields, however, power constitutes the very links between actors. Actors in an actors field may often not share the same social networks, and may in fact not know each other at all. An actors field around poor farmers is typically composed of landlords, traders, governmental agencies, and so on, possibly running all the way up to the World Bank, as we saw. The social network of poor farmers, on the other hand, will tend to comprise only other poor farmers, with much weaker connection to social causation.

In terms of Giddens' truism that "institutions make actors" and "actors make institutions", the actors field concept focuses the researcher on the first of these linkages, whereas the concept of social network brings the researcher closer to how actors may "make institutions" through, for example, collective action. Thus, the concepts of social network, collective social capital, collective action, and institutions naturally overflow into each other, as may be seen, for instance, in the work of Janssen (2005), who, focusing on multiagent modeling, first discusses the architecture of the individual actors, then takes communication (i.e., social networks) as the key connection between actors, and then moves on to the evolution of cooperation (i.e., collective action). Focusing as we do here on social causation of the material flows, the actors field concept will be used for the social contextualization of these flows.

3.5 Applying Action-in-Context, I: the primary actors

To explain the selected flows, insight has to be gained in all the household's main livelihood options, because for their decision-making, actors compare the merits of all these options. Table 3.1 gives an overview

Table 3.1 Livelihood activities (sources of income), the percentages of households participating in these activities and the contribution of the activity to DMI in percentages

Source of income	*Percentage of households*	*Percentage of direct material input (DMI)[a] for which responsible*
Agricultural land	89	22
Paddy fields	85	3
Swidden fields	63	15
Home gardens	negligible	3
Logging	78	38
Collection of non-timber forest products	86	11
Livestock (pigs, cows, buffalo, fish)	83	minimum of 23
Services	34	negligible

Sources: For agricultural land, collection of non-timber forest products and services: Stalpers (2003). For logging: Duong (2001).

[a] The minimum of 23 percent of materials going to livestock consists of grass, and water vegetables. A total of 78 percent of the swidden products are fed to the one's own livestock. The 6 percent of DMI that is unaccounted for consists of imports of consumer goods.

of these options in Tat and shows that the great majority of households made a living by combining basically all activities. The third column in Table 3.1 shows the amount of materials that these activities brought about in terms of percentages of the direct material input (DMI).

Economic returns appeared the most decisive motivational factor for choosing between the possible livelihood activities, in our field study. Farmers distinguished between land and labor productivity (i.e., returns per hectare and returns per working hour); these are mentioned separately in Table 3.2. For rice, the farmers maximized their yields, caring less about the time expenditure. For the swidden products, mostly cash crops, a labor productivity strategy prevailed, balancing yield and labor expenditure without paying much attention to the yield per hectare. The respondents pointed at two other economic motivations, namely *no investments* and *no risk* (of losing investments). The farmers preferred options without high physical demands (*no hardship*) or risks. Women said that they preferred work that brings the *fun* of working together with other women. The motivational factor of *food quality* comprises the taste, smell, and size of the food item and the dislike of chemical pesticides on vegetables. *Food variety* was valued by the respondents saying that the diet of farmers can be dull. Because the people often stressed the importance of efficient use of time and materials in combining different activities, we identified the motivational factors *material and time connection* (efficient combinations in terms of product exchange and time-use, respectively).

Table 3.2 displays the basic quantification of the motivational factors of the livelihood options of the farmers. In what follows, the various options will be discussed in greater detail.

Very little new paddy land has been created in Tat since the 1970s (Cuc and Rambo 2001). There is no economically suitable land (i.e., flat enough with access to water) left for creating more paddy fields more than the 22 hectares in the central valley. As shown in Table 3.2, paddy farming was regarded as relatively comfortable work and easy to combine with other activities (because the fields are close to the houses). In spite of the prime focus on land productivity, paddy turned out to have a high labor productivity too, mainly due to high-yielding varieties and chemical fertilizers introduced by the government.

Swidden farming, as Table 3.2 shows, did not offer a favorable labor productivity compared to other land uses. Moreover, as is indicated by the negative value on the no hardship factor, the women (who did most swidden work) disliked swidden farming because it is extremely de-

Table 3.2 Main livelihood activities and motivational factors of the primary actor "farmer households"

Main livelihood activities	*Land productivity (kg/ha)*	*Labor productivity (VND/day)*[a]	*Labor productivity (kg rice equivalence/ day)* [b 2]	*No risk*	*No hardship*	*Connection*		*Fun*	*Food*		*Investment*	
						Material	*Time*		*Quality*	*Variety*	*No initial*	*No maintenance*
Swidden												
Rice	?	10,000	3.7	-	-	0	-	0	++	++	0	+
Canna	?	7,000	2.6	-	–	0	-	0	n.a.	n.a.	0	+
Cassava	?	6,000	2.2	+	-	+	-	0	0	+	+	+
Ginger	?	7,000	2.6	0	-	0	-	0	0	+	0	+
Paddy rice	3,200	28,000	10.4	+	+	+	+	+	++	0	–	–
(Non) timber forest products												
Bamboo shoots	n.a.	26,000	9.6	0	–	0	-	+	+	0	++	++
Broom grass	n.a.	28,000	10.4	+	-	0	-	+	n.a.	n.a.	++	++
Logging	n.a.	25,000	9.3	–	–	0	–	+	n.a.	n.a.	+	+
Animal husbandry												
Cattle	n.a.	+		+	+	+	+	0	n.a.	n.a.	–	+
Pigs (white)	n.a.	21,000	7.8	–	-	0	+	0	+	+	–	–
Pigs (Muong)	n.a.	15,000	5.6	0	+	+	+	0	++	+	-	-
Chickens	n.a.	+		–	+	+	+	0	+	+	0	-
Ducks	n.a.	14,000	5.2	–	+	+	+	0	++	+	0	+

Sources: field interviews and Staplers (2003). VND = Vietnamese Dong (1 US$ = 17,000 VND = 0.7 euro). Explanation of quantifications: ? = unknown; n.a. = not applicable; 0 = neutral; + = positively corresponding with the motivational factor; ++ = strongly positively corresponding with the motivational factor; - = negatively corresponding with the motivational factor; – = strongly negatively corresponding with the motivational factor.

[a] Displays rounded off averages for labor productivity. Assumed is that eight working hours constitute one working day. For the agricultural options the labor and other input costs include all the hours and monetary costs (including maintenance costs) spent on the main activities converted linearly to hectares.

[b] By expressing the labor productivity in kilogram rice equivalence per day (the staple crop), the figures of labor productivity in different currencies are (inter) nationally comparable. In Tat, the local market price is 2,700 VND per kilo rice.

manding and dangerous. The increasing distance to the new swidden fields made it difficult to check the swiddens regularly; going there had become a whole-day enterprise. This is reflected in the negative value put on the *time connection* factor in Table 3.2. Nevertheless, 64% of the households still cultivated a swidden, due to monetary needs, lack of other options during some periods of the year, the *material connection* of cassava (cassava roots and leaves used for livestock constitute about 76% of the material flows from swiddens), and the persistent swidden farming tradition (Cuc and Rambo 2001).

Timber and Non-Timber Forest Products (NTFP) were another source of monetary income. In the 1960s, primary forest still covered much of the territory and people used to hunt regularly on, for example, wild pigs, deer, and the occasional tiger. Only tiny remnants of primary forest survived on extremely steep slopes. Except for broom grass, collecting NTFP for other than one's own use was prohibited by law. The possibility of fines and confiscation is reflected in the *risk* factor in Table 3.2.

Table 3.2 shows that collecting NTFP and logging constituted income sources that required low initial investments and also that these activities were more interesting than swidden farming in terms of labor productivity. Somewhat surprisingly, the modest activity of collecting and selling broom grass appeared to be the best option on almost all accounts among the forest products. Additionally, broom grass is the best option in terms of sustainability. It is a seasonal product, however, and people needed money all year round. This is why people still went for logging and bamboo shoot extraction, in spite of their illegality and lower labor productivity. Implementation of forest protection policies was too weak to dissuade people from these options. In fact, timber and bamboo shoot extraction skyrocketed once the road connected Tat to the lowland markets.

As for animal husbandry, much feed was provided by cassava from the swiddens. Table 3.2 shows that animal husbandry could be an interesting alternative in Tat. Labor productivity does not include the high risk of diseases and the high investment costs of medicines. The positive *time connection* of animal husbandry strongly appealed to the farmers, however, as it mainly concerned housebound activities that may be easily integrated with other work.

The overall explanation of land use in Tat including the selected flows appears to be the limited availability of favored options. Table 3.2 indicates that paddy was clearly the superior option, followed by broom grass. These two options have limited availability however; paddy is restricted by space and broom grass is restricted by time, being highly seasonal. Therefore, after fully exploiting these options, people chose the two next-best options, which were bamboo shoots and logging. Logging, however, was dependent on incidental market connections, and bamboo shoots are seasonal. Thus, the remaining energy was spent on the swiddens, even though the labor productivity was very low and other factors did not offer great enjoyment either. Animal husbandry formed a year-round option, but was limited by high risk of disease. Consequently, the largest material flows are economically not the most attractive, as Table 3.1 demonstrates. Rice and broom grass, for instance, amounted to only 3 and 1% of DMI.

3.6 Applying Action-in-Context, II: actors fields

Now that we understand the land use practices of the primary actors that stand at the nature-environment interface causing the material flows, the actors fields of the selected flows can be construed.

Figure 3.3 depicts the actors field, with actors connected to each other through influence on options and motivations, both for bamboo shoot collection and for swidden cash crops. A major linkage exists between the farmers' (economic) motivations and the improvement of the road. The road brought on a forest exploitation boom by linking the households to the market without effective forest protection mechanisms in place.

Because the primary driving force of the two activities was commercial, the linkage between the households and the (regional) traders, mediated by the middlemen in Tat, forms the backbone of the actors field (indicated by the bold arrows). Figure 3.3 shows that these traders sold the products on the (inter)national market: the canna to the noodle factory, cassava to the cassava factories and the ginger to Japanese traders (not drawn in the figure). Here we see that two types of government actors were involved in the same trade. These were the local and regional authorities, which should be motivated to regulate illegal products trade, and the government-owned factories, which are financially interested in the reverse.

Other linkages in the actors field connect to risk as the second motivational factor of bamboo shoot collection and swidden farming. The (non-commercial) government actors mainly accommodated the illegal activities by not posing real risks of confiscation. It starts with the local

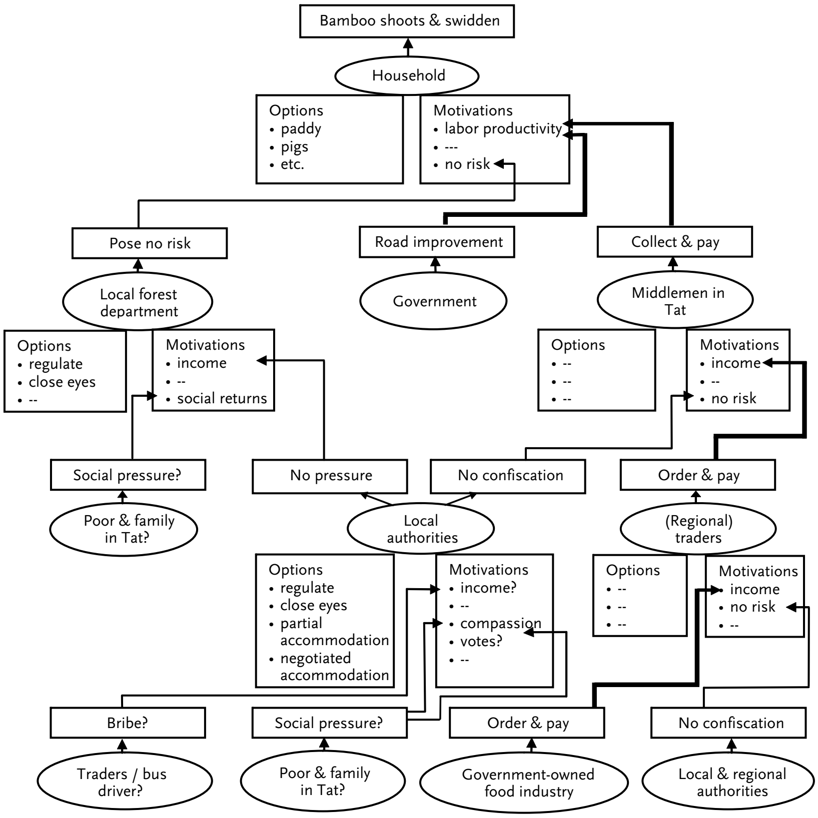

Figure 3.3 Summary of actors field for bamboo shoots collection and swidden farming. Below each actor category, the boxes indicate the options and motivations leading to the actor's actual action. Pose no risk, for instance, is the action by the Forest Department that influences the motivational factor risk of the households. The pose no risk action results from basically two options (regulate and close [one's] eyes) and motivational factors such as income and embeddedness in the community (social returns). No options and motivations (boxes) have been specified when the factors are obvious, unknown, or not interesting for this paper. Question marks refer to supposed actors and supposed lines of influence where no research has been done. The bold arrows refer to commercial influence, the others to all other sorts of influence.

forest department that mediated between the local people and the local authorities. The local forest officials felt unable to resist the social pressure from the local people and were, moreover, not forced by the local authorities to do so.

At the level of the local authorities, three new "power lines" were identified. Compassion with the local poor made the authorities close their eyes for the unfortunates breaking the law. As one official stated during the fieldwork: “The people rely on the forest to earn a living. If you catch them, they will be so miserable”. As indicated by the question mark, a supposed line of influence is that the authorities ignored the offenders because of social pressure from their fellow villagers, affecting the position of the local authorities in terms of votes and popularity. Finally, a question mark indicates a hypothetical bribe paid by the traders to the local authorities allowing the transport of illegal products. This bribe, if any, would be small, reflecting the relatively small value of this trade at the village level. This is likely to be different at the next level of the actors field, where larger (regional) flows were accommodated by higher (regional) authorities.

Overall, the actors field shows that although commercial actors generated the main driving force of the NTFP and swidden products, government actors played key roles too, first by connecting the hamlet with the commercial actors by the construction of the road and then by accommodating the illegal flows, for social reasons or for private benefit.

Figure 3.4 displays the actors field of logging. The protected forests had been allocated to individual households in 1998, and since that time, loggers had to make (financial) arrangements with the owners of forest plots to prevent a fight and to prevent being reported to the local forest department with a stiff fine as result. This is displayed in the actors field as the causal chain of the forest owners posing no risk to the loggers and the loggers offering the bribe/share to the owners. As the actors field further shows, the local forest department may also have been bribed to refrain from any action independent of the forest owners.

The actors field shows the traders mediating between the local people and the big traders. They acted as secondary actors buying the products from the people, and as quaternary actors bribing the forest officials. During the fieldwork, a respondent informed us about the latter procedure: “I have not often been caught during the three years that I have transported logs, and then I usually get off the hook by buying off the forest officials with small amounts of money, around 20,000 VND [1.3 USD] per person”. The next level in the marketing line, concerning the regional traders, involved bigger flows of wood and proportionally bigger amounts of money circulating between the non-commercial government actors and the traders. Most of the timber produced in Vietnam ends in the furniture industry for the (inter)national market (USDA 2003), so it is expected that the illegal wood flow from Tat ended there as well.

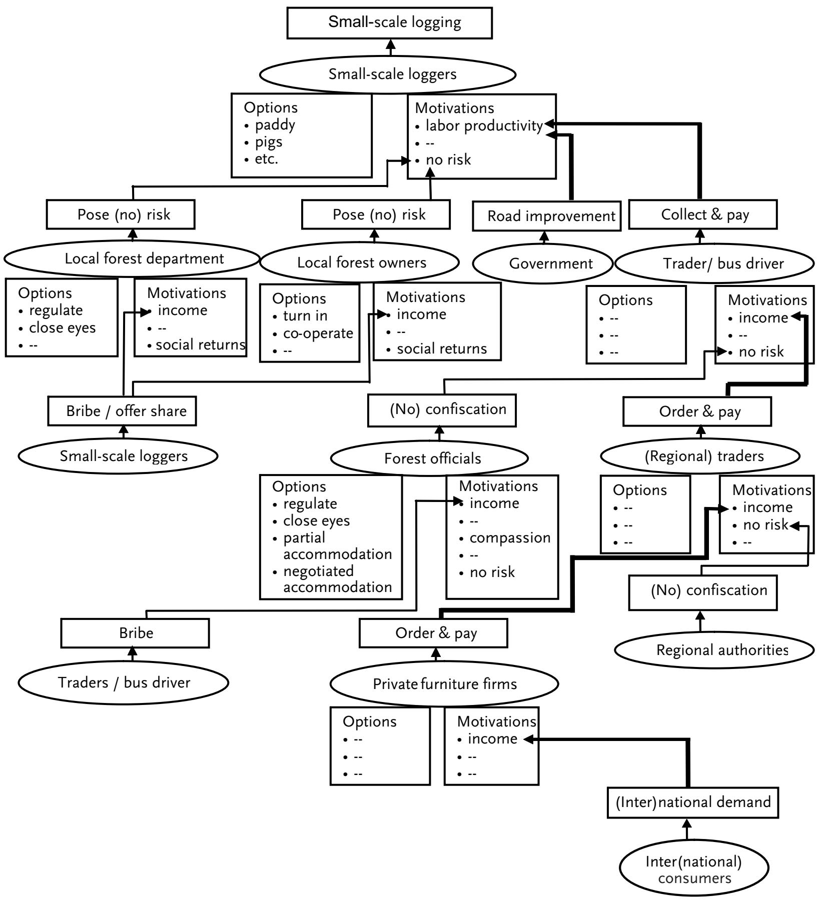

Figure 3.4 Summary actors field for small-scale logging.

Both being market-driven, the actors field for small-scale commercial logging was quite similar to the actors field of bamboo shoots collection and swidden farming, including the role of the road. The main difference was that logging was more illegal and that more money was involved.

3.7 Scenarios and policies

The understanding of the social causes of the selected material flows built up in the preceding sections enables us to look into future scenarios and explore possible effective policies.

The situation in Tat was characterized by intense land scarcity, with virtually all suitable land developed already into paddy fields, surrounded by steep slopes on which only a few activities are sustainable. During the research, the paddy production was too low to feed the population. Cash was needed for additional rice but also for inputs in the paddy production. Because of this urgent need, the lack of alternative options, and the lack of effective (self-)regulation, people did not stop depleting the swidden soils and exhausting the forest. The swidden and forest exploitation boom is soon to go bust and with that, the unsustainable material flows may vanish, as will people's current livelihoods. The key actors in the actors fields of these material flows were the actors in the product marketing lines and the public actors accommodating the market lines of illegal products.

To overcome this Malthusian scenario of land degradation, poverty, and disintegration, policies have to be developed that combine alternative livelihoods with straightforward implementation of the law at the local level and intervention in the illegal trade at higher levels. This section aims at providing the basic insights.

Problems of unsustainability can be solved by either increasing the productive capacity of the environment, or by reducing the unsustainable material flows. The latter, in general, amounts to either reducing the number of actors generating the flows, or reducing the flow per actor. For Tat this heuristic scheme, together with insights from the disaggregate MFA, additional sustainability indicators and some key elements out of the AiC such as the overall viability of rice, suggests that options to support future livelihoods are (1) paddy production development, (2) sustainable non-paddy agriculture (3) the development of value-added industry and (4) out-migration providing remittances.

Option 1: Paddy production development. Both local people and the government are highly interested in higher rice production. Price incentives will not make any difference here because the rice is only grown for their own consumption and motivations are focused on land productivity anyway, but yields could improve by 40% to 4 tons per hectare per year (Bong 2000).

Option 2: Sustainable non-paddy agriculture. A transition will have to take place towards sustainable non-paddy agriculture with a comparative advantage with regard to the lowlands. Stabling of all pigs and cattle will be necessary to reach the optimum output and to prevent crop damage. Anything more than what may be sustained by the village's own biomass surplus does not appear to be a viable option, because externally fed livestock can be produced much cheaper in the lowlands. If we would assume that out of the village's 700 hectare territory approximately 150 hectares is suitable for swiddening, and assuming that the swiddens are sustainable with 8 years of fallow after 2 years of cultivation, 30 hectares of swiddens would be available. If these would be fully planted with cassava for pigs (yielding an estimated 4 tons per hectare), and if the pigs' food intake is the same as during the study (187 kg cassava per pig per year) a total of about 600 pigs could be fed sustainably from the swiddens. Another viable option for sustainable non-paddy agriculture links up with the emergent practice of planting timber trees such as *Xoan* (*Melia azedarach*) and high yielding bamboo such as the *Luong* (*Dendrocalamus membranaceus*) on the swidden fallows. Assuming 100 hectares of forest gardens (former swiddens) planted with bamboo and timber, a production of at least 20 tons per ha biomass may be expected. Furthermore, production of vegetables and fruit trees that are specifically suited for the uplands might form a sustainable and viable activity.

Option 3: The development of value-added industry. The development of a value-added industry might form an important addition to income. One such activity is the manufacture of brooms, instead of selling the broom grass.

Option 4: Out-migration providing remittances. Out-migration is likely to start one day or another, due to the general land constraint and the growing population. Out-migration is not necessarily 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 and culture of their place of origin by way of remittances, for example.

The government is the crucial external actor for realizing these future scenarios for Tat. Besides supporting the intensification process of the paddy fields, the government could assist in the development of alternative crops and activities by, for example, supporting market connections, credit, knowledge and collective action. As said, such assistance should be combined with the strict implementation of the forest protection policies, including the interruption of illegal trading networks as our actors field analysis has shown. This implementation is not necessarily a one-way affair. Sustainability of the steep slopes is highly significant to government and local people alike.

We estimated a hypothetical MFA of Tat for a situation that satisfies two central criteria, namely sustainability and self-sufficiency in rice, the pillar in rural communities in Southeast Asia. With intensified paddy production (see option 1), a total of 88 tons of dry milled rice is produced, which would be enough to feed 350 people following the standard of WHO (1985) and allowing for some waste, unequal distribution, and so on.

Illegal logging, large-scale NTFP collection and swidden cash crops, being unsustainable, are assumed to come to a halt. On the swiddens, we follow the cassava option described under 2, *inter alia* because cassava does not require intensive labor. The pigs will be fed as well by rice waste and home garden crops. High yielding bamboo and timber trees will be planted on former swiddens; this forms a smaller but less risky second pillar of people's cash income. The other livelihood activities such as gathering of broom grass are assumed to remain equal. Table 3.3 shows the resulting aggregate MFA in comparison to the MFA of the empirical situation. Although no rice is imported anymore, the increase in wealth results in more imports of finished goods and fuel, so that imports are about equal in the two MFAs. The domestic extraction is higher in the new sustainable situation, which is mainly due to sustainable logging and bamboo gathering from the forest gardens. In other words, although the focus of the agricultural production has changed drastically, the amount of biomass extracted is about the same in the new situation. Export of livestock, wood and bamboo leads to higher exports in the sustainable village in comparison to the present one. The higher figure of the wastes and emissions is due to the amount of the manure from the pigs that is not used on the agricultural fields; this is in fact an anomaly in the sustainable scenario. Financially, the new situation would be good for the villagers, with an estimated income of approximately 1,000 USD and 400 USD per household per year from the

Table 3.3 The aggregate Materials Flow Analyses (MFAs) of Tat, the empirical versus the sustainable and self-sufficient situation

	Empirical figures of the MFA in Tat 2001 (tonnes/capita/year)	*Estimated MFA for Tat that is sustainable and self-sufficient in rice (tonnes/capita/year)*
Imports	0.4	0.4
Domestic extraction	4.0	7.0
External extraction	1.3	0
Exports	1.2	2.7
Deliberate disposals	0.6	0.4
Wastes and emissions	1.7	2.2

The material flows are given in tonnes per capita per year. The first column is taken from figure 3.1. The second column represents an estimated aggregate MFA in the situation in which Tat is sustainable and self-sufficient in rice production. These figures are calculated on the basis of the disaggregated flows of the empirical situation.

piggeries and from the production forest, respectively. Comparing the two MFAs in Table 3.3, the methodological conclusion appears to be that the key differences between the two situations (sustainability, self-sufficiency, population, incomes) do not show up clearly. Only the external extraction (EE) shows a marked difference connected to sustainability, but EE is something rather peculiar for Tat and no part of standard MFA. This finding mirrors the idea that aggregate MFA does not express much in terms of sustainability problems; it does not express much of sustainability solutions either.

3.8 Conclusion

Tat has served here as only a source of illustrative material for our primarily methodological objective. Nevertheless, some conclusions on the village appear to be within reach. First, the case study shows that indigenous forest dwellers, often credited with a great motivation to defend and a capacity to manage the forest they depend upon, may in other cases also revert to exploitation of their forest in a quite unsustainable manner, intruding even on territories of other villages, as soon as the village becomes connected to external markets (see also Colchester 1996). Government, in our case, did nothing factual to protect the local people against themselves and the commercial forces. Second, Tat shows up as an example of a "constrained ecosystem" (Agbo et al. 1993) with a high population density compared to its limited resources. Especially in isolated situations (islands, mountains) without special features that might attract foreign investments, out-migration is often the only option left after the possibilities of agricultural intensification have been exhausted (see for instance Zuiderwijk (1998) on the Mandara Mountains in Cameroon). Third, we have indicated that the external markets also offer opportunities for a more sustainable future through, for example, pig raising, forestry and possibly other options. This requires concerted action from the government and the community, however. The actors fields of AiC have shown that public agencies play pivotal roles; their tendency to succumb under the pressures of bribes and compassion should be changed into a longer-range vision of law enforcement for sustainability, coupled with support to the community to bring the sustainable options within reach.

Methodologically, what is the added value of socially extended MFA? Or, more specifically for the present chapter, what have the two frameworks – MFA and AiC – contributed to the analysis and policy design for Tat? First, standard aggregate MFA did not appear to contribute anything. Its use lies primarily in the fact that it is standard and aggregate, and thus well suited for comparison cross-scale (local, regional, national) and multi-system on the same scale (more villages in our case). The disaggregate MFA, on the other hand, has yielded a system description and with additional data, a physical problem description (the unsustainability of the swidden flows, the external extraction of timber, etc.). This physical problem description is obviously useful in itself but it does not bring us very far in the direction of explanations and, with that, of solutions. A characteristic recommendation for solutions based on this type of physical problem description is to say that population grows too fast and the forest is overexploited so that solutions lie in family planning and some kind of forest fencing. This, by and large, is how far MFA alone can go in this type of case study. Maybe more important than the physical problem description by itself, however, is the fact that the MFA indicates the points of departure where the explanatory-*cum*-solutions machinery of actor-based analysis can begin; it delivers the problematic actions that Action-in-Context can put into context.[14] Then, it is through the actor-based analysis that we may learn why people follow the unsustainable options, who is behind this, and what consequently might be done about it. On its own, AiC would not be able to deliver much due to lack of direction; it would not be informed as to what to explain. This relationship of MFA and AiC is only one instance of the general pattern of interdisciplinarity in environmental science; the natural sciences (and ethics) bring the problem descriptions and the social sciences then add the insights for explanation and solutions; see the Problem-in-Context framework in De Groot (1992) for environmental science in general and Lifset and Graedel (2003, 14) for the field of industrial ecology.

Industrial ecology appears to have much to gain from socially extended MFA such as exemplified in this chapter. We have preferred an actor-based approach here rather than more aggregate approaches because of the direct causal linkages that this approach offers between material flows and society. We have used the Action-in-Context framework as an example mainly because of its explicit character, which makes it open to criticism and learning. Explicit frameworks such as AiC can also form a bridge towards computerized multi-agent modeling (e.g., Axtell et al. 2002; Janssen 2005). Due to the dominance of social networks as the prime way to conceptualize actor connections, virtually all multi-agent

[14] In field practice, this abstract sequentiality of physical and social analysis will and should be more cyclical, giving rise to more intricate patterns of interdisciplinarity. If, for instance, the physical analysis shows that agricultural intensification is necessary, social scientists may point out that intensification is more difficult for the poor than for the better-off, so that consequently the physical analysis may be separated for the poorer and richer farmers. Another example may be that flows could be disaggregated because they have different chains of explanation.

models contain social networks rather than actors fields but these causal linkages between primary, secondary and tertiary actors are quite open to modeling (Huigen 2004).

Material flow analysis, as a descriptive tool, is important for characterizing the system and for identifying which flows or trends are most relevant to explain. Actor-based explanatory approaches such as action-in-context can then supply this explanation, and serve to get a much better grip on future scenarios and relevant policies than MFA alone can do. In combination, the frameworks can be used for broad national-level explorations, but also for specific local analyses as we have shown. Local analyses may remain close to concrete environmental problems and may help so that the steep slopes of villages such as Tat can remain sources of crops and timber rather than mud flows.

References

Agbo, V., N. Sokpon, J. Hough, and P. West. 1993. Population-environment in a constrained ecosystem in Northern Benin. In *Population-environment dynamics: Ideas and observations*, edited by G. Ness, et al. Ann Arbor: University of Michigan Press.

Andrews, C. J. 2000. Building a micro foundation for industrial ecology. *Journal of Industrial Ecology* 4 (3): 35–52.

Axtell, R. L., C. J. Andrews, and M. J. Small. 2002. Agent-based modeling and industrial ecology. *Journal of Industrial Ecology* 5 (4): 10-13.

Bebbington, A. 1999. Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty. *World Development* 27 (12): 2021-2044.

Binder, C. R., C. Hofer, A. Wiek, and R. W. Scholz. 2004. Transition towards improved regional wood flows by integrating material flux analysis and agent analysis: The case of Appenzell Ausserrhoden, Switzerland. *Ecological Economics* 49: 1-17.

Blaikie, P. 1985. *The political economy of soil erosion in developing countries*. New York: Longman, John Wiley and Sons.

Bong, B. B. 2000. Bridging the rice yield gap in Vietnam. In *Bridging the rice yield gap in the Asia-Pacific region*, FAO/RAP Publication 16, edited by M. K. Papademetriou, et al. Bangkok: Food and Agricultural Organization Regional Office for Asia and the Pacific (FAO/RAP).

Botsford, L. W. 1992. Individual state structure in population models. In *Individual-based models and approaches in ecology,* edited by D. L. DeAngelis and L. J. Gross. New York: Routledge, Chapman and Hall.

Bringezu, S., H. Schütz, and S. Moll. 2003. Rationale for and interpretation of economy-wide materials flow analysis and derived Indicators. *Journal of Industrial Ecology* 7 (2): 43-64.

Colchester, M. 1996. Salvaging nature – indigenous peoples and protected areas. In *Social change and conservation*, edited by K. B. Krishna and M. P. Pimbert. London: Earthscan Publications.

Cuc, L. T. and A. T. Rambo, eds. 2001. *Bright peaks, dark valleys: A comparative analysis of environmental and social conditions and development trends in five communities in Vietnam's northern mountain region*. Hanoi: National Political Publishing House.

Daniels, P. L. and S. Moore. 2002. Approaches for quantifying the metabolism of physical economies. Part I: methodological overview. *Journal of Industrial Ecology* 5 (4): 69-93.

De Groot, W. T. 1992. *Environmental science theory. Concepts and methods in a one-world, problem-oriented paradigm*. Amsterdam: Elsevier.

Duchin, F. and E. Hertwich. 2003. Industrial ecology. *Internet encyclopedia of ecological economics.*<http://www.ecoeco.org/education_encyclopedia.php> >. Accessed December 2008

Dove, M. R. 1985. The agroecological mythology of the Javanese and the political economy of Indonesia. *Indonesia* 39 (April): 1-36.

Duong, N. T. 2001. Timber and fuel-wood: The state of exploitation and use in Tat hamlet, Tan Minh commune, Da Bac district, Hoa Binh province. MSc thesis. Hanoi: Vietnam National University.

Elster, J. 1989. *Nuts and bolts for the social sciences*. New York: Cambridge University Press.

Eurostat. 2001. *Economy-wide material flow accounts and derived indicators: A methodological guide*. Luxembourg: Eurostat.

Fischhoff B. and M. J. Small. 2000. Human behavior in industrial ecology modeling. *Journal of Industrial Ecology* 3 (2-3): 4-7.

Fishbein, M. and I. Ajzen. 1975. *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Gale, F. P. 1998. Theorizing power in ecological economics. *Ecological Economics* 27: 131-138.

Giddens, A. 1979. *Central problems in social theory: Action, structure and contradiction in social analysis*. London: Macmillan Press Ltd.

Gilligan, C. 1982. *In a different voice*. Cambridge, MA: Harvard University Press.

Hinterberger, F., S. Giljum and M. Hammer. 2003. Material flow accounting and analysis (MFA). A valuable tool for analysis of society-nature interrelationships. *Internet Encyclopedia of Ecological Economics*. <http://www.ecoeco.org/education_encyclopedia.php>. Accessed December 2008

Hobbes, M. 2005. Material flow accounting of rural communities: Principles and outcomes in South-East Asia. *International Journal of Global Environmental Issues* 5 (3-4): 194-224.

Hobbes, M. and R. Kleijn, eds. 2006. *Local material flow analysis in social context in Tat hamlet, northern mountain region*. Working paper 90, Institute for Interdisciplinary Studies of Austrian Universities—IFF, Vienna.

Huigen, M. G. A., 2004. First principles of the MameLuke multi-actor modelling framework for land use change, illustrated with a Philippine case study. *Journal of Environmental Management* 72 (1/2): 5-21.

Ibenholt, K., 2002. Materials flow analysis and economic modeling. In *Handbook of Industrial Ecology,* edited by R. U. Ayres and L. Ayres. Cheltenham, UK: Edward Elgar Publishers.

Jager, W., M. A. Janssen, H. J. M. de Vries, J. de Greef and C. A. J. Vlek, 2000. Behaviour in common dilemmas: *Homo economicus* and *homo psychologicus* in an ecological-economic model. *Ecological Economics* 35: 357-379.

Janssen, M. A. 2005. Agent-based modeling. In *Modeling in ecological economics*, edited by J. Proops and P. Safonov. Cheltenham, UK: Edward Elgar Publishers.

Kandelaars, P. 1999. *Economic models of material-product chains for environmental policy analysis*. Dordrecht: Kluwer Academic Publishers.

Kleijn, R. 2001. Adding it all up: The sense and non-sense of bulk-MFA. *Journal of Industrial Ecology* 4 (2): 7-8.

Kytzia, S., M. Faist and P. Baccini. 2004. Economically extended MFA: A material flow approach for a better understanding of the food production chain. *Journal of Cleaner Production* 12: 877-889.

Kytzia, S. and C. Nathani. 2004. Bridging the gap to economic analysis: economic tools for industrial ecology. *Progress in Industrial Ecology* 1 (1-2-3): 143-164.

Lifset, R. and T. E. Graedel. 2002. Industrial ecology. Goals and definitions. In *Handbook of Industrial Ecology,* edited by R.U. Ayres and L. Ayres. Cheltenham, UK: Edward Elgar Publishers.

Pfister, F. 2003. *Resource potentials and limitations of a Nicaraguan agricultural region*. Zurich: PhD Dissertation, Swiss Federal Institute of Aquatic Science and Technology - EAWAG.

Rambo, A. T. and T. D. Vien. 2001. Social organization and the management of natural resources: A case study of Tat hamlet, a Da Bac Tay ethnic minority settlement in Vietnam's northwestern mountains. *Southeast Asian Studies* 39 (3): 229-324.

Simon, H. A. 1979. Rational decision making in business organizations. [Nobel Memorial Lecture, presented 8 December 1978]. *American economic review,* 69: 493-513.

Stalpers, S. I. P. 2003. *Material flows in a small village in Vietnam's northern mountain region: A case study of Tat hamlet*. Report of the SEAtrans project. Leiden University: Centre for Environmental Sciences - CML.

USDA. 2003. *Vietnam solid wood products annual*. Global Agricultural Information Network (GAIN) Report No VM3026. Hanoi: GAIN.

Vayda, A. P. 1983. Progressive contextualization: Methods for research in human ecology. *Human Ecology* 11 (3): 265-281.

Vien, T. D. 2003. Culture, environment, and farming systems in Vietnam's northern mountain region. *Southeast Asian Studies* 41 (2): 180-205.

WHO (World Health Organization). 1985. *Energy and protein requirements: Report of a joint FAO/WHO/UNU Expert Consultation*. Technical Report Series 724, Geneva: WHO.

Zuiderwijk, A. B. 1998. *Farming gently, farming fast: Migration, incorporation and agricultural change in the Mandara mountains of Northern Cameroon*. Leiden University: PhD thesis.

Nalang

4

Material Flow Accounting of Rural Communities: Principles and Outcomes in South East Asia

Abstract

The chapter develops a system of local Material Flow Analysis that links material flows to issues of land use transition, globalisation and food security. This system (rMFA) is then applied to villages in Vietnam, the Philippines and Laos. The rMFA shows that these villages greatly differ in terms of these indicators, and with that, in terms of risks and future-oriented policies, issues that remain hidden in standard MFA indicators, as illustrated by an MFA application in India. The methodological conclusion is that rMFA offers a good tool for theory-connected insights and cross-country comparisons.

Published as: Hobbes, M. (2005). Material flow accounting of rural communities: Principles and outcomes in South East Asia', *International Journal of Global Environmental Issues*, 5 (3/4), pp.194–224.

4.1 Introduction

Under the pressures of population growth and globalization, agriculture in South-East Asia is undergoing many processes of change, such as, for example, increasing extraction of natural resources, intensified use of capital and labour inputs and the development of factory farming. These changes often go together with environmental imbalances that express themselves as pollution, soil degradation or resource depletion.

Material Flow Analysis (MFA) is a system approach that aims to elucidate human-environmental relations by focusing on the physical dimension of the economy. It studies the material basis of a social system (e.g. a society, a region or a village) by accounting for the import, extraction, transformation, waste, emission and export of materials. Due to its broad and systematic character, MFA may not be the most efficient tool to rapidly pinpoint specific problems in specific places. For the same reason, however, MFA may well be effectively used to describe basic processes in the human-environment metabolism and to compare economies (at any geographical scale) with each other via approaches such as the use of aggregated indicators. As discussed in the coming sections, such indicators are in fact in broad use already.

MFA has been widely used at the national level, and Eurostat (2001) has published a standardization for national-level MFAs. However, in this chapter, we are interested in material flows at the community level and such local-level MFAs are rare. Some local MFAs have now been conducted, largely following the Eurostat principles of the national accounts; e.g. Grünbühel et al. (2003), Singh and Grünbühel (2003), Amman et al. (2002), Hobbes et al. (2007; Chapter 3) and Hobbes (2004). Some of these publications combine MFA with energy flow analysis (EFA) and assess the 'human appropriation of net primary production' (HANPP) as an additional characteristic of human-nature relations. The local MFA studies characteristically aim to link the MFA data with problems, concepts and theories that are relevant for rural communities, such as transition in modes of production, market incorporation, modernization, dependency and cultural change. These linkages remain quite weak, however. MFA has never been designed with such purposes in mind.

Against this background, the primary aim of this chapter is to develop and illustrate a system of material flow categories and aggregated indicators that provide explicit and quantitative linkages to important aspects of globalization, agricultural transition and (actual and potential) food security. The designed classification and indicator system for rural MFA is referred to as rMFA.

The chapter is organized as follows. Section 4.2 lays down the principles underlying MFA flow categories and indicators in accordance with Eurostat. In section 4.3, the objectives for more local-level insight and theory-connected indicators for rMFA are discussed. Section 4.4 focuses on an operationalisation of these objectives, generating the indicators for material productivity, material intensity, material incorporation and food security, as well as categorization of flows that allow for the coherent and traceable calculations of these indicators. Next, section 4.5 describes the three research sites in Vietnam, the Philippines and Laos, as well as the research methods. Section 4.6 then gives the empirical results and the comparative insights. Finally, section 4.7 provides a discussion of the results in the broad context of societal change, environmental problems and MFA development. Data were gathered in the framework of the EU-funded project Southeast Asia in Transition (SEAtrans).[15]

4.2 Principles of MFA

This section provides a brief overview of general principles of material flow accounting, largely following the Eurostat guide (2001). MFA has been created to complement the standard national economic accounts, giving more insight into the physical dimension of the national economy (2000). The economy-wide MFA provides an overview, in tons or tons per capita, of annual material inputs and outputs of an economy. That way it becomes clear, for instance, how much material flow is associated with each dollar earned in a country.

In MFA, two system boundaries for material flows are defined. One (geographic) boundary determines what is part of the social system under study and what is part of other societies. The second boundary draws the distinction between the society and its so-called 'domestic environment' from which the society extracts materials and to which it disposes materials. Figure 4.1 gives an overview of the basic MFA model. Material flows are defined in MFA as displacements of materials di-

[15] Data for the Vietnam and Philippines case studies have been gathered by researchers from the Institute of Environmental Sciences, Leiden University (CML) together with researchers from the Center for Natural Resources and Environmental Studies, Hanoi University (CRES) and Isabela State University, Philippines (ISU). The Institute for Interdisciplinary Studies of Austrian Universities (IFF) worked together with National University of Laos (NUOL) for the Laotian case study.

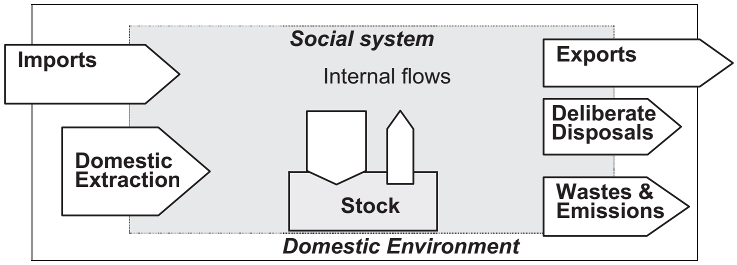

Figure 4.1 System components and flow categories in Material Flow Analysis. Adapted from Matthews et al. (2000). Following Eurostat, the social system is considered to comprise the human population, its domesticated animals (including aquaculture) and artifacts. The domestic environment then is the area where the population and their livestock dwell, and is considered to include agricultural plants.

rectly caused by human labour or labour substitutes. Displacements as a byproduct of intended extraction and not fit or intended for use ('hidden flows' in MFA terminology), such as mining overburden or soil erosion caused by agriculture, are usually omitted, as are non-anthropogenic, natural displacements.

Materials flowing into the social system are called 'inputs'. If inputs flow from the domestic environment to the social system, they are called 'domestic extraction' (DE); if inputs flow into the social system from foreign territories via an economic transaction, they are called 'import'. 'Outputs' from the social system flow either into a foreign territory (in which case the flow is categorized as an 'export') or to the domestic environment. The latter are divided into two categories, 'deliberate disposals' (DD) and 'wastes and emissions' (WE). If the material is disposed with a purpose, such as sowing seeds or applying fertilizer, the flow is called a DD. The waste and emission category is self-explanatory and includes all other flows. Internal flows are all those that do not cross the social system boundary.

The data of the various material flows can be aggregated to form new units, usually called indicators in MFA because they are constructed to express relevant system characteristics. Commonly used indicators are displayed in Table 4.1. Most of these borrow a few additional data from outside MFA proper, expressing flows in weights per capita or weights per dollar of GDP. One example is 'material intensity', which describes how many kg of material flows are associated with each dollar earned in the GDP. A decreasing material intensity indicates 'dematerializa-

Table 4.1 Definition and explanation of some MFA indicators

Direct Material Input (DMI) = Imports + DE	*Measures the material input of the economy*
Material Intensity = DMI/GDP	The degree to which the size of an economy (GDP) relates to material inputs. A reduction of DMI/GDP over time is called the 'dematerialization' of a society.
Direct Material Consumption (DMC) = DMI – Exports	Measures the material that remains in the social system or domestic environment, as wastes, emissions, deliberate disposal or addition to the material stock.
Physical Trade Balance (PTB) = Imports – Exports	If we assume that imports and exports tend to balance in financial terms, a society with a physical trade deficit indicates an exporter of relatively cheap, raw materials.
Net Addition to Stock (NAS) = closing stock – opening stock	This indicator measures the net physical growth of the economy.
Direct Processed Output (DPO) = DD + WE	Indicates the environmental impact of the society's outputs on its domestic environment.
Direct Material Output (DMO) = DD + WE + Exports	DMO is an indicator for the total environmental impact of a social system.

Source: Eurostat (2001)

tion' of an economy, which is then usually assumed to generate less environmental problems per dollar earned. It may now be revealed for instance that the economy of Brazil has grown in GDP terms but has not dematerialized, contrary to most developed countries (Amann et al., 2002). Well-designed aggregated indicators link the flow data to relevant issues and processes.

4.3 Objectives for indicators and flow categories for rural MFA

The previous section showed that the indicator of material intensity is linked to relevant issues at the national level. At the level of a rural village in a developing country, however, the material intensity indicator would be totally dominated by a purely incidental presence, of say, a hospital or a government unit (resulting in large cash flows without significant material flows). To take another example, the indicator of 'net addition to stock' (NAS) in such a village, would be fully dominated by the building of a concrete house in a certain year and would not be an indicator of any relevant ongoing process. Obviously, the design of aggregated indicators needs to be rethought for local MFA applications.

First, a rural MFA should retain the capacity to calculate important aggregated indicators of standard MFA, so that the local and the national

MFAs will remain clearly linked. Especially the indicators of 'direct material input' (DMI) and 'direct material consumption' (DMC) seem to be important in this respect because these are used to assess the transitions from hunter-gatherer to agricultural, and from agricultural to industrialized societies (Grünbühel et al., 2003; Singh and Grünbühel, 2003; Weisz et al., 2001).

Second, the local MFA should be connected to problems, processes and theory that stand central in rural societies. In this chapter, the focus is on (1) agricultural transition, (2) globalization and (3) food security.

Agricultural transition and intensity

Agricultural transition is defined as a change in the nature of the agricultural system. In line with MFA authors who distinguish between hunter-gatherer, agricultural and industrial societies Weisz *et al.* (2001), we distinguish between extensive, intensive and industrial agriculture, as we focus upon differences between communities that are primarily agricultural.[16] Transition, then, is the change from one system to the other. With that, we enter a much debated area within economic geography, based on the seminal work of Boserup (1965) and enriched of late by the case study of Machakos district in Kenya by Tiffen et al. (1994). This describes an example of massive change from an unsustainable extensive system to sustainable intensive agriculture with higher incomes per capita in spite of (or, as the argument goes, due to) a tripling in population density. There are several difficulties facing the seemingly obvious task of defining the boundaries between extensive, intensive and industrial systems by way of the material flows. Just like intensive systems, extensive systems may have a high production per capita, for instance, and be quite market-oriented. The same difficulty was encountered by Boserup, and her solution was to define the boundary between extensive and intensive systems simply by way of the number of croppings per year. For MFA studies, we suggest to follow the same course. That is, we may define qualitatively whether a system is extensive (with fallowing etc.), intensive (without fallows etc.) or industrial agriculture (e.g. factory farming or heated glasshouses), or of a mixed nature.

[16] This commonly used terminology is in fact confusing, suggesting as it does that intensification (higher inputs of labor and/or capital per hectare) is the same as a qualitative system change. Better words for the three types of agriculture could be: space-based agriculture, labor-based agriculture and capital-based agriculture – using space, labor and capital, respectively, as the major input to keep up profitability and sustainability of the enterprise.

This then leaves the MFA study free to empirically investigate if system type and transition are visible, quantitatively, in the material flows. We may then find, for instance, that intensive systems have a higher material input per produced ton. Alternatively, we may find that the intensification has been purely 'labour-led' (Clay et al., 1998), e.g. by way of intensified weeding, mulching and terracing, as found, for instance, with the Ifugao rice terraces in the Philippines, the Mafa in Cameroon (Zuiderwijk, 1998), and the Classic Maya (Johnston, 2003). Both ways of intensification may result in high agricultural production per hectare. In order to make such findings possible, the classification of material flow categories should of course include material inputs into agriculture and productivity of arable land. Indeed, the classification of Table 4.2 distinguishes between imported (i.e. monetary) and domestically extracted inputs to arable land. Section 4.4 will provide more details.

Globalization and incorporation

The next issue of theoretical importance is the relationship of MFA with the globalization concept. Globalization may be divided in two different processes: cultural and economic globalization (Giménez and Gendreau, 2001). Cultural globalization denotes the emergence of a global field of culture (values, storylines, images) where Western culture has a strong influence on nations, communities and individuals worldwide (Arnett, 2002). 'Localization' is often mentioned as a response to this influence, denoting that communities counterbalance the globalization tendencies by re-asserting their own cultural identities (Appadurai, 1990). Economic globalization denotes the creation of a strong world market into which more and more communities are taken up, both at the 'input side' of the consumer goods and services they use and at the 'output side' of the goods they supply. MFA cannot express cultural globalization but it can express economic globalization. The term of 'incorporation' will be used here to denote a community's degree of involvement in outside markets on both the input and output side of the community's economy (Galjart, 1986). Following Marx, rural sociologists such as Zuiderwijk (1998) emphasize the latter distinction because incorporation at the input side is viewed as entailing a deeper dependency and a deeper cultural impact than incorporation on the output side. Bolhuis and Van der Ploeg (1985) distinguish between three types of agriculture: 'subsistence agriculture' for farmers that are uninvolved in markets on both the input and the output side, 'incorporated agriculture' for farming with a high degree of incorporation on the input side and 'independent agriculture' for farming with a high degree of incorporation on the output side without relying on external inputs. Such farmers do exist indeed, such as the Kofyar of northern Nigeria described by Netting

(1993), or the Frisian cattle farmers in the Netherlands that were already fully market-oriented in the Middle Ages, or Hyden's (1980) 'uncaptured' African peasant who easily withdraws from the market system. On the other hand, farmers may also be forced into cash cropping or cash extraction because of sheer poverty, as the case of Tat in Vietnam (Section 4.6) will show.

It should be borne in mind that incorporation is not inherently connected to transition and intensification. Qualitative changes in agricultural practices may occur, for instance, due to population pressure rather than external markets and the other way around, an extractive (hunter-gatherer) society may be taken up in commercial orbits if their forest products find a world market, but continue to be an extractive society without system change. In MFA therefore, the input-side and output-side incorporation indicators should be kept separate from the intensity indicator(s). Section 4.4 provides more details on how the incorporation indicators are constructed.

Food security and dependency

Finally, MFA may be connected to the food security concept, a key issue for millions of people and communities in the developing countries. Food security is usually expressed using the single parameter of calories per person or per kilogram of body weight, and that simplification will be adopted here. Food security, then, is the degree to which one can grow, extract or buy the calories one needs. This definition keeps clear that hunger and mass starvation may occur also in times of relative food abundance, and that well-salaried people surrounded by well-working food markets are food secure also without growing anything (Sen, 1981).

To fully grasp the food security concept, therefore, incomes of people should be included. In this study however, we only focus on material flows. The actual food situation in a village may then be assessed, including the imports and exports on the food market. Of special interest, especially for developing countries, are four other non-economic calorific food security indicators concerning self-sufficiency and autarky. The first of those is the degree to which a community itself actually grows and extracts the calories it needs; this is the actual degree of food self-sufficiency (Pfister, 2003).[17] In this indicator, the food imported is excluded and the food exported is included. The latter could also be locally

[17] This is one of the indicators used by Pfister (2003), who assesses degree of self-sufficiency for staples of both human and livestock in flows per crop.

consumed, however. Excluding the exports, the second indicator is revealed: the potential degree of food self-sufficiency. Going deeper in the production process, the autarky indicators take the dependence on inputs from the market in the agricultural system into account. The first food autarky indicator is the degree to which a community could continue to produce the calories it needs without changing its present agricultural system and without depending on external markets; this could be called the degree of actual autarky. The second, most basic food autarky indicator expresses the degree to which a community would be able to feed itself when its own, domestic resources would be better utilized; this could be called potential autarky. Again, section 4.4 will provide more detail.

4.4 The rMFA flow categories and indicators

In order to calculate the indicators discussed in the preceding section, we need a well-structured system of categories of material flows. Table 4.2 presents the material flow categories used in the present study, with some examples added. This section first discusses the basic flow categories, then the sub-categorization of the flows at the input side and at the output side, and finally the indicators of productivity, intensity, incorporation and food security.

Basic flow categories

Table 4.2 follows the Eurostat MFA categories of import, domestic extraction (DE) and export. At this point, a terminological issue needs to be addressed. In Eurostat MFA, everything that 'comes from the land', be it forest products or intensively grown corn, is called 'extraction'. This category then includes the products from agriculture plus what is called 'extraction' in daily language and in terms such as 'extractive economies' (Ossewijer, 2001). In this natural usage, 'extraction' denotes everything that comes from the land without people investing in the maintenance of the resource (Weisz et al., 2001); examples are hunting, fishing from natural waters, natural grazing, logging or the extraction of non-timber forest products (NTFP). In order to avoid confusion, the Eurostat MFA category of domestic extraction will be marked here as DE and all other use of the terms agriculture and extraction will follow the natural nomenclature, denoting subcategories of DE.

In Table 4.2, the Eurostat categories of deliberate disposal (DD) and wastes & emissions (WE) are not taken up, because these are not related to the indicators of prime interest for local rMFA (see previous

Table 4.2 The material flow categories of rMFA, with some examples added

INPUT

IMPORTS

Import of consumer goods (IMPcons)

  for humans (IMPhum), e.g. food, beverage, consumptive fuel, sand for construction

  of and for animals (IMPliveaqua), e.g. livestock feed, salt, young livestock, fish feed, fish breed

Import of agricultural inputs (IMPag), e.g. seeds, fertilizer, fuel for agriculture, others

Import for extraction (IMPextr), e.g. fuel for extraction, other inputs for extraction

Import for infrastructure goods (IMPinfra), e.g. sand and gravel for infrastructure, others

Import for other sectors (IMPother)

DOMESTIC EXTRACTION (DE)

Agriculture (AgDE)

  for humans (AgDEhum), e.g. food crops, non-food crops

  for agriculture (AgDEag), e.g. green manure

  for animals (AgDEliveaqua), e.g. fodder for livestock or fish, grown as crop or as crop by-product

Extraction (ExtrDE)

  for humans (ExtrDEhum), e.g. timber, food, fuel wood, NTFP

  for agriculture (ExtrDEag), e.g. green manure

  by and for animals (ExtrDEliveaqua), e.g. grazing by cattle or cut-and-carry grass, gathered feed for fish

Aquaculture (AquaDE)

Minerals (DEmin), e.g. sand and gravel

OUTPUT

EXPORT

From livestock and aquaculture (LiveaquaEXP)

  for humans (LiveaquaEXPhum), e.g. eggs, meat, fish

  for agriculture (LiveaquaEXPag), e.g. animal manure

  for animals (LiveaquaEXPliveaqua), e.g. offal or fishmeal for livestock feed

From agriculture (AgEXP)

  for humans (AgEXPhum), food and non-food, e.g. by crop

  for agriculture (AgEXPag), e.g. green manure

  for animals (AgEXPliveaqua), e.g. exported fodder crop or feed corn

From extraction (ExtrEXP)

  for humans (ExtrEXPhum), e.g. timber, NTFP, gathered food, caught fish

  for agriculture (ExtrEXPag), e.g. bat dung fertilizer

  for animals (ExtrEXPliveaqua), e.g. exported hay

Minerals (MinEXP)

Mixed products (MixedEXP)

(Human consumption from livestock and aquaculture production, e.g. meat, eggs, fishpond fish)

PRE-CONSUMPTIVE AND PRE-EXPORT LOSSES FROM DE (LostDE)

From agriculture (LostAgDE)

  for humans (LostAgDEhum), e.g. rice husk

  for animals (LostAgDEliveaqua), e.g. cobs of yellow corn or feed as crop by-product

for agriculture (LostAgDEag), e.g. from green manure
From extraction (LostExtrDE)
for humans (LostExtrDEhum), e.g. from fruits or wild animals, and timber processing losses
for agriculture (LostExtrDEag), e.g. from bat dung fertilizer
for animals (LostExtrDEliveaqua), e.g. from cut-and-carry grass
From minerals (LostMinDE)
INPUTS INTO AGRICULTURE, ANIMAL HUSBANDRY AND EXTRACTION
Import of agricultural inputs (IMPag), e.g. seeds, fertilizer, fuel for agriculture, others
Import for extraction (IMPextr), e.g. fuel for extraction, other inputs for extraction
Import for animals (IMPforliveaqua), e.g. livestock feed, salt, fish feed
Agriculture for agriculture (AgDEag), e.g. green manure
Agriculture for animals (AgDEforliveaqua), e.g. fodder for livestock or fish grown as crop or as by-product
Extraction for agriculture (ExtrDEag), e.g. green manure
Extractivion for animals (ExtrDEforliveaqua), e.g. cut-and-carry grass, gathered feed for fish
Inputs from domestic live/aqua/hum to agric (LiveINPUTag), e.g. animal manure, night soil, compost from fishpond sediment
(Total animal manure)

section) and local pollution is no subject of this study. Instead, two other basic categories have been taken up, called 'pre-consumptive and pre-export losses from DE' and 'inputs into agriculture, animal husbandry and extraction' that enable the calculation of the food security and intensity indicators, respectively. The Eurostat MFA category of DD may be largely calculated from elements of the category 'inputs into agriculture, animal husbandry and extraction', e.g. by summing the fertilizers, seeds, fodder fed to livestock and green manure; extra are the inputs of fuel and machines. By way of the categories of import, DE and export, the standard indicators of direct material input (DMI), direct material consumption (DMC) and physical trade balance (PTB) may be calculated, e.g. for purposes of comparison with national MFAs (Grünbühel et al., 2003; Singh and Grünbühel, 2003; Weisz et al., 2001).

The flow sub-categories (input side)

The sub-categorization in Table 4.2 explicates boundary crossing and the internal flows by distinguishing between types of origin and destination. Within the basic category of import, a distinction is made between consumption goods and production (capital) goods and, within the latter category, between extraction, agriculture and other sectors, except for infrastructure that benefits all sectors.

Drawing a distinction between extraction (commercial or subsistence) and agriculture is needed to identify different modes of production.

The categories also enable the calculation of some of the material incorporation, intensity and food security indicators. Imports of capital goods for the secondary, tertiary and quaternary sectors have been lumped as 'other sectors' because of our rural focus. They may of course be disaggregated in other cases.

Within the sub-category of import of consumer goods, it is necessary to distinguish between 'for humans' and 'for animals' (livestock and aquaculture); this is a key for analyzing the food security situation.

On the final level of disaggregation, the table only gives examples such as 'food', 'feed', 'breed', or 'consumptive fuel'. These may be filled in differently for each separate study. Table 4.4, where all categories are quantified for the three villages, gives more examples.

Within the basic category of DE, the first distinction is between sources. Biomass has to be distinguished from minerals. 'Agriculture' refers to all the harvested agricultural products. 'Extraction' has already been defined. 'Aquaculture' refers not to the fish but to plants picked from fishponds; in the chosen system definition, the fish belongs to the social system like livestock. Within these source categories of DE, Table 4.2 makes a further distinction into destinations, such as 'for humans' and 'for livestock' for reasons already given. 'Agriculture' refers to internal recycling of agricultural products, e.g. in the form of mulching. The same subdivision by destinations is made within the category of 'extraction'; many products will be destined for humans but natural grazing is an important category too. 'For agriculture' here refers, for instance, to tree leaves brought to the fields for fertility enhancement (Van Beek and Banga, 1992).

The flow sub-categories (output side)

On the output side of Table 4.2, export is the first basic category, using comparable categories as on the input side: first sources and then destinations. Home consumption of domestic animal products (e.g. meat, eggs, milk and aquaculture production) is included between brackets here. It cannot be added up with the rest of the basic category because it is not an export, but there does not exist any conceptually possible place for it in Eurostat MFA, because humans and domesticated animals both belong to the social system and the consumption cannot be accounted for. The figure may be of interest to several potential indicators, however.

As said, the MFA category of wastes & emissions is not fully represented in the table. The same holds for the overall input-output balancing, even if a core concept for national level MFA. Instead, the category of 'pre-consumptive and pre-export losses from DE' (LostDE) is fully geared towards the calculation of the incorporation and food security indicators. The focus is only on DE flows destined for human use in the village or for export. In the DE subcategories, these flows are often expressed in terms that are not precise enough yet for a proper assessment of these indicators and to the degree that this is the case indeed, the 'LostDE' category aims to repair this. Take, for instance, the extraction of timber. Round logs may be transported to a village for slicing before selling and loose, say 50% of their weight in the process. If the indicator for output market would compare DE directly with the exports, the outcome would be that the degree of incorporation is 0.5 while in fact all logging is fully exported. The 'LostDE' category then first states the lost 50%, so that DE minus 'LostDE' may be compared with the export and the indicator ends with the proper 1.0 as degree of incorporation. The same goes for human consumption; if rice flows are expressed in tons of paddy, for instance, milling losses have to be subtracted first. Note that this holds irrespective of whether the 'losses' are in fact wasted or put to some good use (deliberate disposal).[18]

The category in Table 4.2 of 'Inputs into agriculture, animal husbandry and extraction' is geared towards the sound calculation of the agricultural intensity indicators. It starts with the categories of imports, agriculture and extraction for agriculture, animals and extraction, and adds inputs from domestic livestock, aquaculture or humans to agriculture.[19] The distinction between the sources and destinations of the material flows enables the assessment of the four intensity indicators mentioned below.

The total amount of animal manure compared to animal manure used on the agricultural fields is important to indicate potential types of land use and to calculate the potential autarky indicator. Because of the Eurostat MFA structure as used in this study, there is no conceptually correct position for the category total animal manure and it is therefore put between brackets.

18 The category of LostDE resembles the MFA category of hidden flows and the Eurostat MFA category of "unused domestic extraction" in particular. LostDE focuses on exported materials and foodstuffs only, however, and only on what is in fact exportable and edible in these categories.

19 This category matches largely with the standard MFA category of deliberate disposal but adding fuel and equipment.

Material productivity (MPROD) indicators

Table 4.3 provides the descriptive and formal notation of the indicators in terms of the categories used in Table 4.2. After mentioning some standard MFA indicators, the first rMFA indicators concern material productivity (MPROD), characterizing the output side of the agricultural system. Productivity may be expressed in tons per capita and in tons per hectare. This distinction is important because tons-per-capita and tons-per-hectare lie close to the concepts of 'returns-to-labour' and 'returns-to-land', respectively, that are central economic parameters of farming systems. In general, extensive systems (i.e. with low capital and labour inputs) under conditions of land abundance will tend to have high production per capita and low production per hectare, and intensive systems under conditions of land scarcity will tend to the reverse characteristics. This way, the productivity indicators are related to the material intensity indicators described below. However, a high production per hectare does not inevitably imply high material intensity, because much of the productivity may depend on land and climate quality and on the labour, rather than material inputs.

Six productivity indicators are designed on the basis of Table 4.2. The 'rice productivity' is put first, because rice in South East Asian villages is the cornerstone of the subsistence economy. Then, the 'total productivity of agriculture' includes rice but also other crops such as corn or tubers, and the 'total productivity of extraction' includes all extracted products. They are all expressed in kg per capita per year and in tons per hectare per year. In the last 'extraction' indicator in Table 4.3, 'extractive land' may often be taken as the village territory minus the arable land; in other cases, rocks and badlands may be excluded.

Material intensity (MINT) indicators

Agriculture and animal husbandry are called intensive if they apply high levels of inputs per hectare or per capita. The group of intensity indicators will be referred to as 'material intensity' because MFA focuses on material flows only, excluding the labour and capital components. Based on the category of 'Inputs into agriculture, animal husbandry and extraction' (Table 4.2), a number of indicators for the material input intensity can easily be calculated as displayed in Table 4.3. A distinction is made between intensity of agriculture focused on only imported inputs ('imported material intensity of agriculture') and on all inputs ('total'), both which may be expressed in kg per capita per year or in tons per hectare of arable land per year. The imported material intensity of agriculture is allied to the incorporation phenomenon, see below. Indi-

Table 4.3 The rMFA indicators used in the present study

Standard MFA indicators

- Direct Material Input (DMI) = Imports + DE [tons/cap/year]
- Direct Material Consumption (DMC) = DMI – Export [tons/cap/year]
- Physical Trade Balance (PTB) = Imports – Exports [tons/cap/year]

Material Productivity (MPROD)

- Rice Productivity in kg/cap (PRODofRice/cap) = production of rice [kg] per capita per year = AgDEhum rice [kg/cap] + 0.65* AgDEag rice seeds [kg/cap] + AgDElive rice [kg/cap]
- Rice Productivity in tons/ha (PRODofRice/ha) = production of rice [t] per hectare of rice field per year = (AgDEhum rice [t/ha] + 0.65*AgDEag rice seeds [t/ha] + AgDElive rice [t/ha]
- Total Productivity of Agriculture in kg/cap (TPRODofAg/cap) = total agricultural production [kg] per capita per year = AgDE [kg/cap]
- Total Productivity of Agriculture in tons/ha (TPRODofag/ha) = total agricultural production [t] per hectare arable land per year = AgDE [tons/ha]
- Total Productivity of Extraction in kg/cap (TPRODofextr/cap) = total extraction [kg] per capita per year = ExtrDE [kg/cap]
- Total Productivity of Extraction in tons/ha (TPRODofextr/ha) = total extraction [t] per hectare of extractive land = ExtrDE / total area minus arable land [t/ha]

Material Intensity (MINT)

- Imported Material Intensity of Agriculture in kg/cap (IMINTofAg/cap) = inputs [kg] from import to agriculture per capita per year = IMPag [kg/cap]
- Imported Material Intensity of Agriculture in tons/ha (IMINTofAg/ha) = IMPag [t/ha]
- Total Material Intensity of Agriculture in kg/cap (TMINTofAg/cap) = inputs [kg] into agriculture per capita per year = IMPag [kg/cap] + AgDEag [kg/cap] + LiveINPUTag [kg/cap]
- Total Material Intensity of Agriculture in tons/ha (TMINTofAg/ha) = inputs [t] into agriculture per ha arable land per year = IMPag [t/ha] + AgDEag [t/ha] + LiveINPUTag [t/ha]
- Total Material Intensity of Livestock keeping in kg/cap (TMINTofLive/cap) = total of all feed (imported and from DE) for domestic livestock, [kg] per cap per year = IMPforlive [kg/cap] + AgDEforlive [kg/cap] + ExtrDEforlive [kg/cap] - AgEXPlive [kg/cap] - ExtrEXPlive [kg/cap] - LostAgDElive [kg/cap] – LostExtrDElive [kg/cap]

Material Incorporation (MINC)

- Material Incorporation of Agriculture, input side (MINCinputsAg) = Import for agriculture / Total inputs to agriculture = IMPag / (IMPag + AgDEag + LiveINPUTag)
- Material Incorporation of Agriculture, output side (MINCoutputAg) = Agricultural Export / (Agriculture – Lost agriculture) = AgEXP / (AgDE – LostAgDE)

- Material Incorporation of Extraction, output side (MINCoutputExtr) = Export of extracted products / (Extraction – Lost extraction) = ExtrEXP / (ExtrDE – LostExtrDE)
- Total Material Incorporation, output side (TMINCoutput) = Export of agricultural and extractive products/ (Agriculture and Extraction – Losses from agriculture and extraction) = (AgEXP + ExtrEXP) / (AgDE + ExtrDE – LostAgDE – LostExtrDE)
- Material Incorporation of Consumption (MINCofcons) = Imported consumer goods for humans / (Imported consumer goods for humans + DE for humans – Exports of those goods – Lost DE of those goods) = IMPhum / (IMPhum + AgDEhum + ExtrDEhum - LostAgDEhum – LostExtrDEhum - AgEXPhum – ExtrEXPhum)[a]

Food security [b]

- Actual degree of food Consumption-Sufficiency (ACSfood) = (Imports of human food + DE of human food – Lost DE of human food – Export of human food) / Food need = (Imphumfood + AgDEhumfood + ExtrDEhumfood - LostAgDEhumfood - LostExtrDEhumfood - AgEXPhumfood - ExtrEXPhumfood) / Food need
- Actual degree of food Self-Sufficiency (ASSfood) = (DE of human food – Lost DE of human food – Export of human food) / Food need = (AgDEhumfood + ExtrDEhumfood - LostAgDEhumfood – LostExtrDEhumfood- AgEXPhumfood - ExtrEXPhumfood) / Food need
- Potential degree of food Self-Sufficiency (PSSbare) = (DE of edible human food – Lost DE of edible human food) / Food need = (AgDEhumbare + ExtrDEhumbare - LostAgDEhumbare – LostExtrDEhumbare) / Food need
- Actual Autarky (AAbare) = (DE of edible human food – Lost DE of edible human food – 4*fertilizer input) / Food need = (AgDEhumbare + ExtrDEhumbare – LostAgDEhumbare – LostExtrDEhumbare – 4*fertilizer input for DE bare) / Food need
- Potential Autarky (PAfood) = (DE of human food – Lost DE of human food – 4*fertilizer input + 1*excess animal manure) / Food need = (AgDEhumfood + ExtrDEhumfood - LostAgDEhumfood – LostExtrDEhumfood – 4*fertilizer input for DE humfood + excess animal manure) / Food need

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[a] Sand, gravel and cement are not included as consumption good.

[b] Consumption of livestock and livestock products is not included in the food security indicators

cators of the imported material intensity of extraction (IMIofExtr, etc.) may be defined analogously but will usually be less important. The intensity of livestock keeping is the livestock feed imported or extracted and fed to the livestock by humans (hence excluding natural grazing), in kg per capita per year.

One caveat may be mentioned here, that concerns the relative importance of organic and inorganic flows. Even if we take, as we should, the dry weight of animal manure (approximately 13 % of the wet-weight of feaces), would a ton of animal manure and a ton of fertilizer be of equal relevance? This being only another example in a well-known issue surrounding MFA in general (Kleijn, 2001), this matter will only be pursued when discussing the food security indicators. In Table 4.4, the two flows have simply been added.

Material incorporation (MINC) indicators

This group of indicators will be called 'material incorporation' because, as said, MFA does not include the economic aspect. On the input side, the degree of material incorporation of agriculture is defined as the ratio of imported inputs into agriculture to the total of material inputs, see Table 4.3. This is a dimensionless indicator, varying between 0 and 1. When MINCinputAg = 1, agriculture draws all its material inputs from external markets and is therefore fully incorporated on the input side. Input-side incorporation of extraction (logging, fishing etc.) may be calculated analogously, but will usually be less relevant because these inputs, by nature, will usually be small (except in fishing communities).

Next, Table 4.3 describes the degree of incorporation of agriculture on the output side (MINCoutputAg), defined as the ratio of exported production to the total production of agriculture, corrected for the processing losses. This dimensionless indicator will run up to 1 in cases of fully market-oriented production and be close to zero in subsistence agriculture. The degree of incorporation of extraction of products such as timber and NTFP (MINCoutputExt) is calculated analogously, as Table 4.3 describes. To calculate the total degree of incorporation on the output side, the total flows of agriculture and extraction should be taken. Again, see Table 4.3 for the formal expressions. Averaging the incorporation indicators of the input and the output sides does not make much sense, because a village with high external inputs and low external outputs is in a very different (and more problematic) situation from a village with the reverse characteristics.

Besides the incorporation of agriculture and extraction, the degree of incorporation in consumer markets may be of interest, e.g. for a connection with the process of economic globalization. Material incorporation of consumption (MINCofCons) is expressed as the imported divided by the total consumption. Table 4.3 shows the precise notation.

Food security indicators

As discussed in the previous section, five indicators may be constructed that express the calorific food security situation of a rural community. One basis for the calculations is the food need per capita, visible in all denominators in the expressions of Table 4.3. Following most statistical approaches (e.g. of the FAO), focus in this chapter is on calorific needs only, hence leaving out proteins, trace metals, vitamins and so on. Calorific need for an average rural adult in the developing world is 2500 kcal per day or, with uncooked dry white rice delivering about 363 kcal per 100 grams, 252 kg of that rice per year (WHO, 1985). In South East Asia, all other foodstuffs may be converted to the rice equivalence value. In this chapter, the conversion factor is 1/3 for banana, potato, cassava and corn, 1/10 for bamboo shoots and an assumed factor of 1 for imported foodstuffs.

The actual degree of food consumption-sufficiency (ACSfood) reflects the actual calorific situation in the village. With all components expressed in kg rice equivalence per capita, this is a dimensionless indicator that denotes theoretical full consumption-sufficiency if 1 or above. In practice, the outcome should be more than 1, in order to compensate for seasonal variations, unequal wealth distribution, unused food leftovers, and so on. Some compensation of these factors is achieved by using the food needs of adults rather than some average of adults and children.

The second food security indicator in Table 4.3, the actual degree of food self-sufficiency (ASSfood), expresses the degree to which a community actually feeds itself, hence, with imports left out. The indicator denotes full self-sufficiency if 1 or above. A discussion now becomes relevant as to what in fact constitutes 'human food', since usually, not all edible things are regarded as human food locally. Thus, a choice has to be made as to what is regarded as human food out of the usually long list of things produced in a village. In our Philippines village, for instance, people grow much yellow corn but they do so for the pig feed market; it is considered unfit for dignified human consumption (and very difficult to store anyway). A likewise role is played by cassava in the Vietnamese village. In this chapter, we take the community's own preferences as the default basis for the ASS calculation; if a choice for all edible stuff is taken, the indicator is called 'ASS in bare calories' (ASSbare).

The degree of food self-sufficiency as defined above reflects the actual food situation but may at the same time be regarded as only a surface characteristic, because the food exported by the community could also be consumed domestically. Thus, an indicator called 'potential degree of food self-sufficiently' describes the degree to which the community grows and extracts enough food to feed itself if necessary (e.g. if the terms of trade between import and export would deteriorate dramatically). In times when markets would fail, a community is likely to broaden its definition of what is edible; hence, the logical line is to take all edible food in the equation here. The quantitative and formal notations of the potential degree of food self-sufficiency (PSSbare) indicator are found in Table 4.3.

As a next step in the exploration of the food security and dependency of a community, we may calculate whether a community could also survive without external inputs in agriculture. Thus, the indicator of ‘actual food autarky’ is defined as the degree to which the community would be able to feed itself if input and output markets would fall away instantaneously (e.g. due to war or natural disaster). In this equation (see Table 4.3), focused as it is on bare essentials, all edible material should again be taken in stead of only the culturally preferred foodstuff. Part of the equation is an estimate of how many kg of grains may be produced per kg of external inputs (especially fertilizer). We have taken a factor of 4 here, based on the production function of rice in the research sites.[20]

The degree of actual food autarky does not reflect that on the longer run, communities may adapt to input and output market problems. One opportunity, accessible through rMFA, is to make the farming system more organic and use all the available animal manure in the village as input for agriculture. ‘Excess animal manure’ in Table 4.3 is all animal manure the community is not using yet (i.e. total animal manure minus the amount of animal manure used as agricultural inputs in Table 4.2). Then, assuming that 1 kg of (dry weight) animal manure can be converted into 1 kg of grains, the indicator of ‘potential food autarky’ describes the degree to which the community would be able to feed itself, on the longer run. This indicator expresses the basic independence of the community *vis à vis* the external (input and output) markets. If ‘potential food autarky’ exceeds 1, farmers may enter input and output markets voluntarily. To express this properly, the culturally preferred foodstuffs should be taken up in this equation, hence not the bare calories.

This way, we may characterize any rural community with a ‘food security profile’ of five indicators. Examples are in Section 4.6.

[20] For corn the factor should be 10, based on the production function of corn (Yield = 1016 + 10.53 * Fertilizer) in Dy Abra (with yield and fertilizer in kg/ha), see Hobbes and De Groot (2003).

4.5 Research sites and research methods

The villages chosen for comparison are Dy Abra in the Philippines, Tat in Vietnam and Nalang in Laos. The populations almost fully consist of smallholder farmers producing for subsistence and the market. First a short description of each research site is given, followed by an assessment of the modes of production and an overview of the research methods.

Dy Abra, covering an area of 2260 hectares, lies in the rolling landscape of Isabela Province between the Cagayan river and central highway in the west, and the mountainous Sierra Madre forest in the east. Moderately sloping and plane land in Dy Abra is primarily devoted to hybrid yellow corn (134 ha) grown for the burgeoning market for animal feed, and to rainfed and manually irrigated rice (total of 56 ha), grown for own use. In 2001, the village consisted of 549 people in 94 households. People still have a tradition of swidden ('slash and burn') cultivation and practiced (illegal) logging in the generally steeply sloping areas that are relatively far away from the village centre. Swidden fields were made by farmers that had no or limited access to permanent fields, covering an area of about 29 ha.

At 140 kilometres west of Hanoi and covering a total of 740 hectares, Tat hamlet is part of Tan Minh village, in the north of Hoa Binh Province, Vietnam. Most houses in the hamlet are found along the four-kilometre stretch of road that follows the river on the narrow valley floor, at 300 meter altitude, where most of the 22 hectares of paddy fields have been developed.[21] The valley is surrounded by mountains that reach 1000 meters within two kilometres of the road, resulting in steep slopes, often of 45 to 60 degrees. On these slopes people practiced swidden covering an area of about 47 hectares. In 2001, the population consisted of 466 persons, divided over 105 households. The village economy used to be completely based on subsistence production but since the arrival of the road in 1992 and its improvement in 1999, the hamlet has become deeply involved in market production. The people mainly make a living from a combination of irrigated rice and swidden farming, together with animal husbandry and the collection of forest products. Contrary to Dy Abra and Nalang, the village has a tax office, a post office, a health clinic, electricity (since 2001) and a bus that plies daily to the lowlands.

[21] The data on the sizes of paddies and swiddens and total area in Tat are based on remote sensing in 1998, taken from Cuc and Rambo (2001).

Nalang lies on the northern edge of the Vientiane Plain, where the flat and monotonous rice-growing area rises to forested hills around the town of Vang Viang and the Nam Ngum hydroelectric dam. While the valley bottom has been converted into paddies (139 hectare) including a system of irrigation, the higher levels are mainly covered with forest where pastures and swidden plots (totalling 23 hectares) are found. Nalang is characterized by a largely subsistence economy, based on traditional glutinous rice farming, with only one crop a year. For export, people are involved in some cucumber and banana agriculture, extraction of forest products and trade in cattle. The population in Nalang consisted of 702 people in 2001. The total area of Nalang is 1630 hectare.

As said, modes of production are to be assessed directly from people's activities. It then appears that the situation in all three villages is thoroughly mixed. In all three villages, people practice extraction (e.g. timber and NTFP), extensive (swidden) agriculture, single-cropping (rainfed) permanent agriculture and double-cropping, irrigated agriculture. In Nalang, the latter consists of dry-season cucumber on wet-season rice fields, and in the other two villages of double-cropped rice. At the same time, the mixtures may be scaled on a dimension of overall intensity. In Nalang, the great majority of the land is under single cropping of traditional rice varieties. People use stable manure on the fields and leave cattle to graze on the paddies. The cash crop cucumber is intensively cultivated. In Dy Abra, only imported fertilizers are used for both the hybrid corn and rice cultivation, of which most involve double cropping. In Tat, almost all rice fields are double-cropped and moreover, people apply fertilizer, and use much labour on green and animal manure management and keeping animals (pigs, ducks, fishponds) in an attempt at intensive, almost industrial animal husbandry – which in fact is failing due to high mortality rates.

Thus, modes of production cannot be characterized as simply 'extensive', 'intensive' or 'industrial'. Instead, Nalang is denoted as a mixture of low intensity, Dy Abra as a mixture of medium intensity and Tat as a mixture of high intensity. Tat appears to be a 'constrained ecosystem' (Agbo et al., 1993), where agricultural expansion would entail very high investment cost especially in terracing. In the next section, we will see if this characterization is reflected in the indicators of the rMFA.

The fieldwork in the three research sites took place between April 2001 and June 2002. The rMFA time frame was one year.[22] For data gather-

[22] During this period, the road in Tat was being paved. Because it is a one-time event dominating all the material flows in the village it was left out of the analysis.

ing focusing on basic socio-economics and the main material flows and stocks, a 100 percent sample of households was taken in Nalang and Dy Abra, while in Tat a random sample of 30 households was taken, based on an initial household survey covering all households. Methods used in Nalang were household questionnaires supplemented by structured and semi-structured interviews. The latter two were the main methods in the other two villages. Direct measurements were taken of buildings, fuel wood, wastes and food consumption. For additional quantitative and qualitative data on micro-economic and cultural matters, semi-structured household interviews, focus group discussions, topical interviews with key respondents, informal interviews for sensitive issues and participatory methods such as option ranking and historical diagramming were used in all research sites Chambers (1994). Primary reports on the villages are Hobbes and Kleijn (2006) on Tat, Hobbes and Kleijn (2007) on Dy Abra and Grünbühel (2004) on Nalang. Data from Nalang were furthermore interpreted for the present chapter by Grünbühel, which is gratefully acknowledged here.

How to account for the water content of biomass materials requires some attention here because it is as yet an unresolved issue in MFA. Eurostat (2001) recommends to account for the weight of products converted to a water content as typically reported in dominant statistical sources.[23] If, for instance, timber felled in the forest holds 45% water and the national timber statistics use a water content of 15%, one ton of felled timber should be taken up in the rMFA as 647 kg only. Analogous conversions would hold for bamboo shoots, fish, corn and so on. At the same time, however, the loads that people have to drag and carry are the real weights, not the 'statistical' ones. For a study that aims to reflect local realities rather than to link up with national statistics, therefore, an 'as is' approach could be used, as has been done, for instance, in the original Tat study (Hobbes et al., 2007; Chapter 3). The water content of most biomass materials is then variable, usually decreasing in the course of time between harvest and use. Data on the other villages did not allow this approach in the present study, however, and it was chosen to apply an 'as used' accounting instead, meaning that all weights have been converted to one water content, set as the content when the timber, fish, corn etc. is sold or consumed locally. For timber this water content is 35%.

23 Various products will always have different water contents in statistics of various countries. To overcome the problem of varying water contents and to arrive at universal comparison of weights, the solution would be to use purely dry weights for all products in all MFAs.

4.6 Results: the rMFA indicators in the three villages

Table 4.4 shows the rMFA flow data for the three villages, organized similar to Table 4.2. The sub-categories are chosen such that they still show enough details to make out the main characteristics in the three villages. Table 4.5 displays the outcomes of the indicators of which the formulas are given in Table 4.3. This section will show that a well-grounded insight in the rural systems is achieved by way of these indicators and the underlying material flow data.

Standard MFA indicators

Starting out with the standard MFA indicators in Table 4.5, the direct material input (DMI) shows that Nalang has less than half of the DMI level of Dy Abra and Tat. As may be traced in Table 4.4, the main items of DMI consist of DE (corn, natural grazing and timber in Dy Abra, timber, natural grazing and firewood in Tat and natural grazing and firewood in Nalang). It also shows that Nalang is much better off in rice and much less busy with other forms of agriculture or extraction. The amount of firewood used in Tat is more than twice the amount used in the other two villages; people need much firewood to keep themselves warm during wintertime due to Tat's mountainous landscape. Subtracting the export from DMI in order to get the direct material consumption (DMC), we see a steep drop in Dy Abra due to its huge exports of corn and timber, totaling almost 3 tons per capita per year (see Table 4.4). Tat exports only one-third of this amount, and Nalang only one-tenth. More than half of the difference in DMC between Tat and Dy Abra is caused by the amount of firewood consumption in Tat. More information on these indicators is given in section 4.7.

Material productivity (MPROD)

The material productivity (MPROD) indicators show a wide range of diversity among the villages. The productivity of the rice (PRODofRice) in kilograms per capita shows Nalang's favorable position with 289 kg per capita per year. Dy Abra produces significantly less and Tat only half of this amount. The low production per capita in Tat does not come about by a low production per hectare. On the contrary, with 2.86 tons/ha, Tat has the highest figure by far, with Nalang producing only half of that amount and Dy Abra again in-between. This is the characteristic difference between extensive and intensive modes of production (Boserup, 1965); people in Tat, confined to their 22 ha of paddy land, put in much effort per hectare, with some success in terms of output per hectare but

Table 4.4 Quantification of the rMFA categories displayed in Table 4.2 for the three villages

Village			*Dy Abra*	*Tat*	*Nalang*
Population			549	466	702
Arable land (ha)			219	69	175
Total land area (ha)			2260	740	1630
INPUT					
IMPORTS					
Import of consumer goods (IMPcons)					
	for humans (IMPhum)	food (processed and unprocessed)	80	178	5
		sand & cement for construction	86	0	25
		wood & steel for construction	7	0	0
		other consumer goods	49	90	64
	of and for livestock (IMPlive)	feed & young livestock	1	72	7
	for aquaculture (IMPaqua)	feed & breed	0	3	0
Import for extraction (IMPextr)		fuel	11	2	0
		equipment	0.4	0.2	0
Import of agricultural inputs (IMPag)		seeds	31	3	0
		fertilizers	148	24	0
		fuel for agriculture	4	2	6
		equipment	2	0	2
DOMESTIC EXTRACTION (DE)					
Agriculture (AgDE)					
	for humans (AgDEhum)	milled rice	149	99	283
		rice husk and bran	89	0	0
		corn (+cob)	20	0	0
		banana	36	5	23
		fruits, vegetables & herbs	36	49	266
		canna for export	0	77	0
		others food	36	36	4
		others non-food	0	0	308
	for agriculture (AgDEag)	rice husk	0	0	105
		rice seeds	4	0	9
	for livestock (AgDElive)	milled rice as feed	15	36	0
		rice bran and/or husk as feed	26	64	40
		corn (+cob)	1576	4	0
		roots & tubers as feed	26	112	7
		mixed feed, including leaves	33	142	0
		straw from rice as feed	0	0	97
	for aquaculture (AgDEaqua)	leaves from agricultural by-product in fishpond	0	599	0
		rice bran for fish	0	9	0
Extraction (ExtrDE)					
	for humans (ExtrDEhum)	timber	1572	1219	340

		fuel wood & fuel bamboo	308	1133	476
		NTFP non-food	10	151	236
		NTFP food	4	134	87
	for agriculture (ExtrDEag)	green manure	0	19	0
		bamboo for fencing	0	2	252
	by and for livestock (ExtrDElive)	grazing by cattle	1679	1064	335
		cut-and-carry grass	0	150	0
	by and for aquaculture (ExtrDEaqua)	cut-and-carry grass and leaves	0	121	0
Aquaculture (AquaDE)		water vegetable	0	116	0
Minerals (DEmin)		sand and gravel	55	0	0
OUTPUT					
EXPORT					
From livestock and aquaculture (LiveaquaEXP)					
	for humans (LiveaquaEXPhum)	livestock	2	26	10
From agriculture (AgEXP)					
	for humans (AgEXPhum)	milled rice	7	0	49
		cucumber	0	0	71
		banana	0	1	14
		canna	0	77	0
		ginger	0	11	0
	for livestock (AgEXPlive)	corn	1361	0	0
From extraction (ExtrEXP)					
	for humans (ExtrEXPhum)	timber	1550	837	177
		NTFP non-food	0	133	129
		NTFP food	0	92	0
(Human consumption from livestock and aquaculture production)			(31)	(13)	
PRE-CONSUMPTIVE AND PRE-EXPORT LOSSES FROM DE (LostDE)					
From agriculture (LostAgDE)					
	for humans (LostAgDEhum)	corncob waste	2	0	0
		rice husk and bran	89	0	0
	for livestock (LostAgDElive)	corncob waste	153	0	0
From extraction (LostExtrDE)					
	for humans (LostExtrDEhum)	timber processing losses	0	367	0
INPUTS INTO AGRICULTURE, ANIMAL HUSBANDRY AND EXTRACTION					
Import of agricultural inputs (IMPag)		rice seeds	4	3	0
		corn seeds	27	0	0
		other seeds	0	1	0
		fertilizer for rice	46	24	0
		fertilizer for corn	102	0	0
		fuel for agriculture	4	2	6
		equipment	2	0	2
Import for extraction (IMPextr)		fuel and equipment	11	2	0
Import for animals (IMPforlive)		feed	0	67	0

Agriculture for agriculture (AgDEag)	rice seeds	4	2	9
	rice husk	0	0	105
Agriculture for livestock (AgDEforlive)	total feed	1674	358	144
Extraction for agriculture (ExtrDEag)	bamboo for fencing	0	2	252
	green manure	0	19	0
Extraction for livestock (ExtrDEforlive)	cut-and-carry grass	0	150	0
Inputs from domestic live to agric (LiveINPUTag)	animal manure	0	489	53
(Total animal manure)		(838)	(590)	(215)

Areas are given in hectares, the weights of the material flows are given in kilogram per capita per year. In all figures, the first two digits are significant.

concomitant low production per capita and, assuming that people work hard in such circumstances, low returns to labour.[24]

The total productivity of agriculture (TPRODofAg) shows only a small increase compared to rice in Nalang, but great jumps in Dy Abra and Tat. Table 4.4 shows that this is largely due to the corn production in Dy Abra and to a wider range of products in Tat, mainly coming from the swiddens. Table 4.4 also shows that much of this in Tat is fed to the village's livestock and fish, while the corn of Dy Abra, although livestock feed too, is fully exported.[25]

The indicators of productivity of extraction (TPRODofExtr) show that the extractive activities (of timber, firewood, natural grazing, NTFP, etc.) in all villages generate larger flows than the total of agriculture. With Table 4.4 it can be calculated that this even largely holds when natural ('extractive') grazing is left out. In terms of kilograms, therefore, even Tat and Dy Abra, in spite of their intensive agriculture and large amounts of corn respectively, could still be called extractive economies. In terms of flows of extraction per capita, Tat with almost 4 tons and Dy Abra with 3.5 tons are much higher than Nalang. In terms of extraction per hectare, Dy Abra comes closer to Nalang (both around 1 ton per hectare), but Tat remains at almost 3 tons per hectare per year, due to its low total surface. What could be the matter here? It is hard to imagine an extractive system that could deliver a production just as high as irrigated and heavily manured rice fields. Indeed, in Tat the extraction is unsustainable (Hobbes et al., 2007; Chapter 3). Methodologically for rMFA, it is a

[24] The production of rice per hectare per year (one or two crops) concerns the yield of dry white rice as displayed in Table 4.4; the areas of the few swiddens planted in rice have been neglected (while the yields of the swiddens are included).

[25] The figure of Tat is somewhat distorted because of the 599 kg/capita of cassava leaves that are put into the fishponds; it is not known if this effectively acts as fish feed or is in fact more a type of very wet compost making.

Table 4.5 The outcomes of the rMFA indicators in the present study

Indicators	*Dy Abra*	*Tat*	*Nalang*
Standard MFA indicators			
Direct Material Input (DMI) [tons/cap/year]	6.1	5.7	3.0
Direct Material Consumption (DMC) [tons/cap/year]	3.2	4.5	2.5
Physical Trade Balance (PTB) [tons/cap/year]	-2.5	-0.8	-0.3
Material Productivity (MPROD)			
Rice Productivity in kg/cap (PRODof Rice/cap)	167	135	289
Rice Productivity in tons/ha (PRODofRice/ha)	1.64	2.86	1.46
Total Productivity of Agriculture in kg/cap (TPRODofAg/cap)	2046	1232	1142
Total Productivity of Agriculture in tons/ha (TPRODof Ag/ha)	5.13	8.32	4.58
Total Productivity of Extraction in kg/cap (TPRODof Extr/cap)	3572	3994	1726
Total Productivity of Extraction in tons/ha (TPRODof Extr/ha)	0.96	2.77	0.83
Material intensity (MINT)			
Imported Material Intensity of Agriculture in kg/cap (IMINTofAg/cap)	184	30	8
Imported Material Intensity of Agriculture in tons/ha (IMINTofAg/ha)	0.46	0.20	0.03
Total Material Intensity of Agriculture in kg/cap (TMINTofAg/cap)	188	543	427
Total Material Intensity of Agriculture in tons/ha (TMINTofAg/ha)	0.47	3.67	1.71
Total Material Intensity of Livestock keeping in kg/cap (TMINTofLive/cap)	161	575	144
Material incorporation (MINC)			
Material Incorporation of Agriculture, input side (MINCinputsAg)	0.98	0.05	0.02
Material Incorporation of Agriculture, output side (MINCoutputAg)	0.76	0.07	0.12
Material Incorporation of Extraction, output side (MINCoutputExtr)	0.43	0.29	0.18
Total Material Incorporation, output side (TMINCoutput)	0.54	0.24	0.15
Material Incorporation of Consumption (MINCofcons)	0.18	0.16	0.05
Food security			
Actual degree of food Consumption-Sufficiency (ACSfood)	0.98	1.15	1.08
Actual degree of food Self-Sufficiency (ASSfood)	0.67	.44	1.06
Potential degree of food Self-Sufficiency (PSSbare)	0.79	0.96	1.31
Actual Autarky (AAbare)	0.07	0.58	1.31
Potential Autarky (PAfood)	3.30	0.51	1.94

In all figures, the first two digits are significant.

good sign that such a simple indicator is able to pinpoint such environmental risk. Substantively, however, it paints a bleak future for Tat; Table 4.4 shows that 90 percent of Tat's export, hence cash earnings, comes from extraction and the food security indicators (discussed underneath) do not indicate an easy way out if this export would fall away.

Material intensity (MINT)

The group of indicators of material intensity (MINT) looks at the farming system at the input side. It is of special interest to check if the activity-based assessment of modes of production (see section 4.3) is confirmed by the intensity indicators of the rMFA. The intensity of imported material inputs (IMINTofAg) is by far the highest in Dy Abra; Table 4.4 shows that this is mainly caused by the large import of fertilizer. The pattern changes when the total intensity of agriculture (TMINTofAg) is taken. Jumping to close to 4 tons of input per hectare, Tat shows as the most intensive system; Table 4.4 shows that this is largely due to the high manure application. Nalang, which was estimated as the least intensive system, remains close to Tat, however. Table 4.4 shows that the 'input' of bamboo fencing to protect the cucumber fields against roaming cattle is the biggest component here; the intensity would drop to 0.76 tons per hectare if this input would be left out, bringing Nalang much closer to Dy Abra. The indicator of intensity of livestock keeping clearly shows the intensive animal husbandry of Tat, with a feed flow of almost 600 kg per capita. The importance of livestock in Tat appears in Table 4.4 with Tat being the sole village importing livestock feed and the one exporting most livestock per capita. Although there is more livestock in Dy Abra, these animals are not for marketing but for logging and plowing. Overall, the transitional sequence of Nalang/Dy Abra/Tat that was proposed in section 4.5 does not show up in all indicators. The rMFA intensity indicators, although useful in their own right, do not simply represent agricultural transition. Improvements may be possible by using a more subtle system of what flows to include, how to account for the weight of fertilizer versus that of manure, and so on.[26]

[26] Based on approximate production functions it could be proposed to apply a conversion factor of 6 to fertilizer compared to manure. The result then is that Tat with a TMINTofAg of 4.46 tons/ha shows as much more intensive than Dy Abra (2.32 tons/ha) and Nalang (1.77tons/ha). Note also that the sequence of the villages is now the same as in the activity-based assessment.

Material incorporation (MINC)

The indicators of material incorporation in external markets (MINC) show that Dy Abra is the most incorporated, on the input and the output sides of both agriculture and extraction. The indicator for material agricultural inputs (MINCinputsAg), for instance, shows that Dy Abra depends for 98 percent on external inputs, and both Tat and Nalang for a mere 5 percent (caused by the high inputs of animal manure, which is a domestic product). On the output side (TMINCoutput), Dy Abra dominates the picture by its two large flows of exported timber and corn. Nalang remains at a low level of exporting only 16 percent of its net DE, with Tat following at 24 percent. The exports of Tat stem from a variety of physically demanding activities of extraction (e.g. bamboo, bamboo shoots, and timber) and swidden farming (e.g. canna, ginger) on the very steep slopes.

Food security profile

The last group of indicators concerns food security. Table 4.5 shows that the actual degree of food consumption sufficiency (ASCfood) is 1 or above in all villages. This consumption sufficiency is to be expected because no-one was seen starving at the time of the research. Differences in wealth expressed themselves in food quality rather than quantity, such as eating rice and fish in stead of bananas. Subtracting the food import to calculate the actual degree of food self-sufficiency (ASSfood), Nalang remains at almost the same level but the level of Tat plummets to only 0.44, showing this village's dependency on food imports.

'Potential self-sufficiency' (PSSbare) calculates self-sufficiently as a measure of short-term survival potential, assuming that people then would include all edible products ('bare calories') in their diet and stop exporting edible products. Table 4.5 shows that this does not make much difference for Nalang because the village does not export much and most of its food is rice anyway. Tat, with an indicator level of 0.96 in this circumstance, would be able to survive, basically by adding the canna, cassava and potatoes, now exported or fed to the pigs, to the human diet. The village would then loose much of its export income, however, which would be a threat to its bare survival in the somewhat longer run because money would lack to buy fertilizer for the rice fields. In Dy Abra, self-sufficiency does not rise much because its yellow corn is not counted as 'bare calories'; people have no technology to protect the corn from rapid decay after harvest. PSSbare would jump from 0.79 to 2.76, however, if its yellow corn would be added to the diet. People swim in an ocean of corn, so to speak.

The final two ('food autarky') indicators show what would and could happen if people would furthermore be forced to do without their external inputs in agriculture, especially fertilizer. As Table 4.5 shows, nothing much would happen in Nalang because it takes care of all its inputs domestically. Dy Abra however, fully dependent as it is on fertilizer, could then on the short term ('actual food autarky', AAbare) produce only a fraction of the food it needs, even if all bare calories are taken into account. Tat is intermediate in this respect, because of its intensive use of internal sources such as animal and green manure (see Table 4.4). The last indicator ('potential food autarky', PAfood) shows what happens if the villages would adjust their farming systems in order to survive without input and output markets. Table 4.5 shows that Tat hardly has any room left for such adaptation, because it already uses the majority of its available animal manure. The reverse picture is shown by Dy Abra; if the village would be able to use the animal manure that it discards at present, it could feed itself three times over even without fertilizer.

How different these villages are in terms of food security profile! Nalang quietly feeds itself and can continue to do so irrespective of external circumstances. Dy Abra is on a risky course at present but if it manages to keep up its soil quality under the heavy fertilizer load, it still has a very good option of less dependent, more organic agriculture (Hobbes and de Groot, 2003; Chapter 2). Tat is at risk in a deeper sense; it cannot do without food imports; without these it could survive only when eating all its roots and tubers and with that loose its pigs and much of its export; and it has already used up the option of intensive organic agriculture.

4.7 Conclusions and discussion

Taking an overall look at Table 4.5, we notice the strong contrasts between the three villages in terms of productivity, intensity, incorporation and food security. Nalang, with its relatively abundant land suitable for rice production, reaches its high production of rice per capita without high yields (tons/ha), without much external inputs, without great involvement in external markets and with robust options to keep up its basic (food security) independence. Dy Abra, on the other hand, focuses much on (timber) extraction and on non-rice agriculture that is fully fertilizer-based and export-oriented, with concomitant high indicator values on capital intensity of agriculture and market incorporation, which would result in an acute crisis if these markets would fail (a very low 'actual food autarky'). The high fertilizer application and high extraction per hectare point at risks of unsustainability, undermining the soils that should be the basis of the 'organic option' expressed by its high 'potential food autarky'. Tat, finally, squeezed as it is in its narrow valley between very steep slopes, hence possessing neither Nalang's paddy space nor Dy Abra's space of rolling hills, appears to have used all its options already; it is hanging on with the highest intensity of agriculture, the highest production per hectare of agriculture and extraction, but low levels of food self-sufficiency and autarky. For Tat, the risk of unsustainability of its (forest) extraction and, invisible in the table, of its swidden agriculture too, spell a disaster scenario of hunger and out-migration.

In the remainder of this section, these results will be put in a broader context. First, the outcomes of the standard MFA indicators will be compared with those of other case studies. Then, one of these case studies will be used to discuss some of the rMFA indicators developed in this chapter. Finally, the relation between MFA and the more problem-oriented style of doing environmental science is explored.

Indicators in context

Table 4.6 shows a comparison with other cases and societies in terms of the two most important Eurostat MFA indicators. Trinket, studied by Singh and Grünbühel (2003), is one of the isolated Nicobar islands, India, depending mainly on coconuts. SangSaeng, studied by Grünbühel *et al.* (2003), is a small village in remote Northwest Thailand in which glutinous rice, gathering of NTFP and migrant labour are the mainstays of the economy.

The table shows that our three villages are quite comparable with Trinket island and SangSaeng, as well as with pre-industrial Austria. The great jump, obviously, is between all these rural societies and the industrial economies characterized in the last column of the table. This remarkable similarity of rural societies is worthy to note. It also leaves us with a problem, however; the DMI and DMC indicators are much too crude to indicate the wide variety in crucial indicators as discussed in the preceding paragraphs. They do not indicate what is actually going on *within* the broad category of rural economies. As long as isolated Trinket, independent Nalang, incorporated Dy Abra and constrained Tat have comparable DMI and DMC indicators, we obviously need more fine-tuned indicators.

On a more detailed level, the case of Trinket illustrates the perennial problem of 'sand in MFA'. Trinket has a sand and gravel quarry of which most of the products are exported to a neighboring island. These

Table 4.6 Direct Material Input (DMI) and Direct Material Consumption (DMC) indicators of various economies, in tons per capita per year

Indicators	*Dy Abra*	*Tat*	*Nalang*	*Trinket*	*Trinket without sand*	*SangSaeng*	*Austria 1830*	*Industrial Economies*
DMI	5.7	5.4	3.0	6.2	2.7	4.4	5.5	20
DMC	3.1	4.4	2.6	3.8	2.6	3.6	5.5	16

The figures of Dy Abra, Nalang and Tat differ somewhat from those in Table 4.4 because wood now stands at a 15 % water content, equal to the other cases. *Sources:* for Trinket: Singh and Grünbühel (2003), for SangSaeng: Grünbühel et al. (2003), for Austria 1830: Krausmann (2001), and for industrial economies: calculations made by Singh based on Mathews et al. (2000) and Schandl and Schulz (2000).

flows are so large that they greatly influence the indicators. Table 4.6 also gives the figures for Trinket without sand. We then see that the island falls from the top to the bottom rank in DMI and DMC terms in Table 4.6. It is essential to take great care of how to treat such large and non-biomass flows in the MFAs of rural economies and to keep them separate from biomass flows. In all rMFA indicators developed in this chapter, no sand flows are taken up. This assures good comparability with any rural village.

The productivity and intensity indicators of Table 4.5 may be compared with many of such figures worldwide. It may be significant for Tat, for instance, that rice productivity in the nearby Red River Delta, with 5.2 tons of milled rice per ha in 1994 (Cuc and Rambo, 2001), is about 80 percent higher than in Tat. The figure of Tat's intensity of livestock keeping, with approximately 1,150 kilos of feed and fuel inflow per household member in pig-owning farms per year (since some 50 percent of the households in Tat had pigs), may be compared, for instance, with that of factory pig farms in the Netherlands that run at an average material intensity of about 200,000 kilogram per household member per year (consisting of compound feed only).[27] The sensibility of such comparisons depends much on the research context, however, and these issues will not be explored further here.

Rather, we will take a look at the indicators of material productivity (MPROD), material incorporation (MINC), material intensity (MINT) and food security in discussion with Singh and Grünbühel (2003) who provide a multitude of valuable information on Trinket island but fail in the analysis of the transition, incorporation and dependence of the island.

27 This figure is based on Landbouw-Economisch Instituut (LEI) en Centraal Bureau voor de Statistiek (CBS) (2000).

Transition is defined by Singh and Grünbühel as a major shift from one metabolic regime to another[28], and Trinket is said to have gone through a transition when during the 1950s the trade with the outside world changed from an exchange of coconuts and forest products against rice, sugar, clothes etc. to an exchange of processed coconut (copra) against the same products. This flow is 130 kg of copra per capita per year at present. This has certainly led to some changes in the island's metabolism, but would it also show up in the rMFA indicators? Singh and Grünbühel do not provide specific information here but as a general pointer, we may calculate the total copra flow (130 kg times the population of 399), divide this by the total area of the island (4000 ha) and arrive at a production indicator of 0.013 tons/hectare/year. This is not fully comparable with the TPRODofExtr indicator of Table 4.5 but if we do so nevertheless and notice that the figures of the three villages lie between 1 and 3 tons/ha/year, it may be concluded that the metabolic shift in Trinket is not likely to have been 'major'. A second pointer is when we take the total DE of biomass per capita of Trinket (2300 kg/cap/year) that compares well with total DE of the three villages (TPRODofAg plus TPRODofExtr in Table 4.5 lies between 2900 and 5600 kg/cap/year). How could a flow of 130 kg/cap per year indicate a major shift?

With respect to issues of incorporation and dependency, we may notice first that Trinket island imports only very little inputs for agriculture or extraction. With that import at 40 kilograms per capita (fuel) and a DE of 2300 kg/cap, Trinket has a level of material incorporation at the input side of less than 0.02, hence at the same very low level as Nalang and very much lower than Dy Abra. On the output side, the export of copra results in a degree of incorporation (TMINCoutput) of about 0.06, thus much lower than all three villages of this chapter. Only the indicator of the material incorporation of consumption (MINCcons), at the 0.23 level, is higher than of the three villages. This figure is caused by that the inhabitants prefer to eat imported rice, flour and sugar instead of native foodstuffs. It remains quite unclear, however, how Singh and Grünbühel (2003) can say that this lone 0.23 'strongly indicates Trinket's dependency on the industrialized world'.

A true dependency of Trinket is not visible either in the food security indicators. If we would assume that the present 'actual degree of food consumption sufficiency' (ACSfood) of Trinket is around 1, 'food self-sufficiency' (ASSfood) would drop to approximately 0.77 if the import

[28] I leave aside here that in section 4.1, transition is also defined as a shift from a subsistence to a non-subsistence society which, as said, is a different issue altogether.

would fall away, and rise again if people would change their diet (PSSbare). 'Actual food autarky' (Aabare) lies at the same level because the island hardly imports any agricultural inputs. If people would use their internal animal manure source (156 kg/cap per year) for farming, and/or would return to their native extractive foods, they would realize their 'potential food autarky' without food shortages (PA>1).

In this analysis, Trinket shows up as a community that changed its export from a few kilograms of raw products to a few kilograms of copra in the 1950s, without thereby arriving at any level of intensity, incorporation or dependence comparable with the other villages studied here. If any sequence of transitions may be discerned in the data, Trinket is at the first step in a sequence of Trinket/Nalang/Dy Abra/Tat. For real incorporation, Dy Abra may be looked at. For real dependence, Tat is the exemplary village.

The general conclusion here may be that for an MFA-based insight in any village's position with respect to grand issues such as transition, globalization and dependence, the village should be assessed, comparatively with other villages, in terms of a whole set of adequate indicators, such as those of rMFA.

MFA indicators and environmental problems

In the previous sections, environmental problems such as land and forest degradation have been hinted at a number of times, based on the rMFA indicators. The indicators cannot do much more than that; they do not themselves express environmental problems.

In this context, it is relevant to note the distinction between MFA and similar system approaches on the one hand, and the more directly problem-oriented approaches in environmental science on the other.[29] The latter allow for an interdisciplinary analysis, explanation and solution of problems of land degradation, deforestation, pollution, biodiversity loss and so on. Although these approaches have specific limitations[30], they can bring us much further into causes and solutions than MFA can do. Starting out from the concrete human activities that generate the problem (say, growing corn or logging), the analysis and confrontation of chains of effects and chains of norms bring us to identify victims and

29 See, for instance, the Problem-in-Context framework of De Groot (1992).

30 Two limitations of problem-oriented approaches are that they only 'work' when a specific environmental problem is present, and that they do not easily add up to more theoretical insights.

the concrete influence of (policy, advocacy or local) values. Moreover, the causal explanation of the concrete activities may identify the 'primary' actors that decide over these activities, as well as secondary and tertiary actors that influence the primary actors, linked in causal chains of power that may run up to government or World Bank policies. Other elements of such a 'Vaydian' (1983) or 'Action-in-Context' (De Groot, 1992) analysis lead to insight into other (economic, cultural) factors explaining the problematic actions; see Chapter 3.

The problem-oriented analogue of MFA is Substance Flow Analysis (SFA) that focuses on specific problematic (e.g. toxic or eutrophicating) flows rather than the aggregated bulks of MFA.[31] Because of the specificity of the flows in SFA, they may be connected with concrete actors and actor-based explanations and solutions. Following this line of reasoning for local MFA studies, Hobbes et al. (2007; Chapter 3) have linked MFA to problem-oriented analysis by identifying one or more non-aggregate material flows (e.g. the flows of NTFP or swidden products) as 'problematic flows'. These problematic flows were then explained by putting them in their economic, political and cultural context by means of the Action-in-Context framework.

This connection of MFA with actor-based explanation of specific flows adds social and policy-relevant knowledge to the MFA and it provides MFA with a much-desired link to the social sciences (Duchin and Hertwich, 2003; Lifset and Greadel, 2002). For the present rMFA (and maybe for other MFA too), however, it would be much better if such explanations could be connected to the aggregated indicators, instead of to non-aggregated flows. Explaining, say, incorporation may be a much more relevant business than explaining, say, corn. Systematic theory building of local 'Indicators-in-Context', requiring a thorough connection with bio-physical, economic, political-ecological, cultural and geographical theories of land use, has not yet started, however.

General conclusions

Material Flow Analysis remains 'only material flows', hence without containing economic, political and cultural elements. This leaves a world to explore: linkages between MFA with cultural theory to investigate the connections between culture and material economy (Milton, 1996), linkages with time studies to form a more complete 'integrated

[31] The problem-oriented character of SFA may be read in the titles of its publications such as "Nitrogen Pollution in the European Union – Origins and Proposed Solutions" by Van der Voet et al. (1996).

analysis' of the local economy (Giampietro, 2004), linkages with actor-based explanations to put the material flows in their social context (as discussed above), linkages with farming systems analysis that might bring many more data within the reach of MFA studies (Pfister, 2003), linkages with bio-physical data to assess the sustainability of extractive and agricultural flows, to mention only some. In order to walk such roads with success, however, local MFA proper needs a stable basis, as the present chapter has aimed to contribute to, especially concerning the typically rural activities.

The chapter has focused painstakingly on the development of a precise and adequate system of flow categories and aggregated indicators for the MFA of rural communities. The indicators allow for comparisons with national-level MFAs but are geared especially towards quantifying the community's relationship to issues of productivity, transition, incorporation (linked to economic globalization), food security and dependency. The empirical results of the communities in Vietnam, Laos and the Philippines show that, contrary to the standard MFA indicators, rMFA has the capacity to bring great differences between the villages to light, not only of the relatively emergent features such as the productivity of agriculture and extraction but also of the deeper phenomena of transition, incorporation and food security risks. A review of data from Trinket island has suggested, additionally, that the quantification generated by the rMFA indicators facilitates a more critical and precise characterization of a community in terms of these phenomena than standard MFA and a qualitative discussion can do.

As it stands, the rMFA system of categories and indicators developed here allows for the construction of fully integrated databases where any change in raw data immediately results in changes of the indicators. In structure and nomenclature, the system is flexible; flows may be made more explicit or more aggregated, indicators may be dropped or added without raising confusion, e.g. adding the food function of livestock in the food security indicators of nomadic societies. Thus potentially, the rMFA system may become a platform for other scholars searching for cross-national comparison and valid insight.

Acknowledgement

This chapter is based on contributions of the SEAtrans researchers in Vietnam and the Philippines, namely Serge Stalpers, Jiska Kooijman, Le Thi Thu Thanh, Trinh Khanh Chi and Phan Thi Anh Dao, Patrick Heezen, Liesbeth Denis, Sietske Veenman and Orlando Balderama.

Comments on previous versions of the chapter by Ester van der Voet, René Kleijn, Ruth Noorduyn, Wouter de Groot and two anonymous reviewers are gratefully acknowledged.

References

Agbo, V., Sokpon, N., Hough, J. and West, P. (1993) 'Population-environment in a constrained ecosystem in Northern Benin', in Ness, G., Drake, W. and Brechin, S. (Eds.): *Population-Environment Dynamics: Ideas and Observations*, University of Michigan Press, Ann Arbor, pp.283–300.

Amann, C., Bruckner, W., Fischer-Kowalski, M. and Grünbühel, C.M. (2002) *Material Flow Accounting in Amazonia: A Tool for Sustainable Development*, Social Ecology Working Paper, No. 63, IFF, Vienna.

Appadurai, A. (1990) 'Disjuncture and difference in the global cultural economy', *Public Culture*, Vol. 2, No. 2, pp.1–24.

Arnett, J.J. (2002) 'The psychology of globalization', *American Psychologist*, Vol. 57, No. 10, pp.774–783.

Bolhuis, E.E. and Van der Ploeg, J.D. (1985) *Boerenarbeid en stijlen van landbouwbeoefening*, Leiden Development Studies, Leiden.

Boserup, E. (1965) *The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure*, Earthscan Publications, London, reprinted in 1993.

Centraal Bureau voor de Statistiek (CBS) (2000) *Land en tuinbouwcijfers 2000*, LEI, 's-Gravenhage.

Chambers, R. (1994) 'Participatory rural appraisal (PRA): analysis of experience', *World Development*, Vol. 22, pp.1253–1268.

Clay, D., Reardon, T. and Kangasniemi, J. (1998) 'Sustainable intensification in the highland tropics: Rwandan farmers' investments in land conservation and soil fertility', *Economic Development and Cultural Change*, The University of Chicago.

Cuc, L.T. and Rambo, A.T. (Eds.) (2001) *Bright Peaks, Dark Valleys. A Comparative Analysis of Environmental and Social Conditions and Development Trends in Five Communities in Vietnam's Northern Mountain Region*, The National Political Publishing House, Hanoi, 309 pp.

De Groot, W.T. (1992) *Environmental Science Theory. Concepts, Methods in a One-World, Problem-Oriented Paradigm*, Elsevier Science Publishers, Amsterdam, 584 pp.

Duchin, F. and Hertwich, E. (2003) 'Industrial ecology', *Internet Encyclopedia of Ecological Economics*, p.12.

Eurostat (2001) *Economy-wide Material Flow Accounts and Derived Indicators, A Methodological Guide*, Statistical Office of the European Union, Luxembourg.

Galjart, B.F. (1986) *Omwille van de ontwikkelingssociologie*, Countinho, Muiderberg.

Giampietro, M. (2004). *Multi-Scale Integrated Analysis of Agroecosystems*. Florida: CRC Press.

Giménez, G. and Gendreau, M. (2001) 'The effects of economic and cultural globalization on traditional rural communities in Mexico', paper presented at the *Convention of the Inter-*

national Studies Association '*Dislocation of Global Times and Politics of Resistance*, Chicago, 21 February.

Grünbühel, C.M. (2004) *Resource Use Systems and Rural Smallholders. An Analysis of Two Lao Communities*, PhD Thesis, University of Vienna.

Grünbühel, C.M., Haberl, F.H., Schandl, H. and Winiwarter, V. (2003) 'Socioeconomic metabolism and colonization of natural processes in Sangsaeng village: material and energy flows, land use, and cultural change in Northeast Thailand', *Human Ecology*, Vol. 3, No. 1, pp.53–86.

Hobbes, M. (2004) 'Material flows in social context. Applying the MFA and AiC frameworks in the Sierra Madre, Philippines', Paper presented at the *ICOPHIL Conference*, 16–19 June 2004, the International Institute for Asian Studies, Leiden.

Hobbes, M. and de Groot, W.T. (2003) 'Corn and beyond: an exploration of sustainability, indebtedness and future land use of the Sierra Madre forest fringe, Philippines' in: van der Ploeg, J., Masipiqueña A.B. and Bernardo, E.C. (Eds.): *The Sierra Madre Mountain Range: Global Relevance, Local Realities,* CVPED/Golden Press, Tuguegarao, pp.161–174.

Hobbes, M. and R. Kleijn, (Eds.) (2006). *Local Material Flow Analysis in Social Context in Tat Hamlet, Northern Mountain Region*. Working paper 90, Institute for Interdisciplinary Studies of Austrian Universities—IFF, Vienna.

Hobbes, M. and Kleijn, R. (Eds.). (2007). *Local Material Flow Analysis in Social Context at the Forest Fringe in the Sierra Made, The Philippines*. Working paper 98, Institute for Interdisciplinary Studies of Austrian Universities—IFF, Vienna.

Hobbes, M. Stalpers, S. I. P., Kooijman, J., Le, Thi Thu T., Trinh, Khanh C., and Phan, Thi Anh D. (2007). 'Materials flows in a social context: a Vietnamese case study combining the materials flow analysis and action-in-context frameworks'. *Journal of industrial ecology*, Vol. 11, No. 1, pp. 141-159.

Hyden, G. (1980) *Beyond Ujamaa in Tanzania: Underdevelopment and an Uncaptured Peasantry*, Heineman, London.

Johnston, K.J. (2003) 'The intensification of pre-industrial cereal agriculture in the tropics: Boserup, cultivation lengthening, and the Classic Maya', *Journal of Anthropological Archaeology*, Vol. 22, No. 2, pp.126–161.

Kleijn, R. (2001) 'Adding it all up. The sense and non-sense of bulk-MFA', *Journal of Industrial Ecology*, Vol. 4, No. 2, pp.7–8.

Krausmann, F. (2001) 'Land use and industrial modernization. An empirical analysis of human influence on the functioning of ecosystems in Austria', *Land Use Policy*, Vol. 18, pp.17–26.

Lifset, R. and Greadel, T.E. (2002) 'Industrial ecology, goals and definitions', in Ayres, R.U. and Ayers, L.W. (Eds.) *A Handbook of Industrial Ecology*, Edward Elgar Publishing Limited, Glos, pp.3–15.

Matthews, E., Amann, C., Bringezu, S., Fischer-Kowalski, M., Hüttler, W., Kleijn, R.,Moriguchi, Y., Ottke, C., Rodenburg, E., Rogich, D., Schandl, H., Schütz, H., van der Voet, E. and Weisz, H. (2000) *The Weight of Nations: Material Outflows from Industrial Economies,* World Resources Institute Report, Washington DC.

Milton, K. (1996) *Environmentalism and Cultural Theory. Exploring the Role of Anthropology in Environmental Discourse,* Routledge, London.

Netting, R.McC. (1993) *Smallholders, Householders; Farm Families and the Ecology of Intensive, Sustainable Agriculture,* Stanford University Press.

Ossewijer, M. (2001) *Taken at the flood: Marine Resource use and Management in the Aru Islands, Maluku, Eastern Indonesia*, PhD Thesis, Leiden University.

Pfister, F. (2003) *Resource Potentials and Limitations of a Nicaraguan Agricultural Region,* Diss. ETH. No. 15169, Zürich.

Schandl, H. and Schulz, N. (2000) *Using Material Flow Accounting to Operationalize the Concept of Society's Metabolism, A Preliminary MFA for the United Kingdom for the Period of 1937–1997,* Institute for Social & Economic Research (ISER) Working Paper Number 2000–2003, University of Essex, Essex.

Sen, A.K. (1981) *Poverty and Famines: An Essay on Entitlement and Deprivation*, Clarendon Press, Oxford.

Singh, S.J. and Grünbühel, C.M. (2003) 'Environmental relations and biophysical transition: the case of Trinket Island', *Geografiska Annaler*, Vol. 85, No. 4, pp.187–204.

Tiffen, M., Mortimore, M. and Gichuki, F. (1994) *More People, Less Erosion: Environmental Recovery in Kenya,* J. Wiley and Sons, Chichester.

Van Beek, W.E.A. and Banga, P.M. (1992) 'The Dogon and their trees', in Croll, E. and Parkin, D. (Eds.): *Bush Base, Forest Farm: Culture, Environment and Development*, Routledge, London, pp.57–75.

Van der Voet, E., Kleijn, R. and Udo de Haes, H.A. (1996) 'Nitrogen pollution in the European Union – origins and proposed solutions', *Environmental Conservation*, Vol. 23, No. 2, pp.120–132.

Vayda, A.P. (1983) 'Progressive contextualization: methods for research in human ecology', *Human Ecology*, Vol. 11, No. 3, pp.265–281.

Weisz, H, Fischer-Kowalski, M., Grünbühel, C.M., Haberl, H., Krausmann, F. and Winiwarter, V. (2001) 'Global environmental change and historical transitions', *Innovation – The European Journal of Social Sciences*, Vol. 14, No. 2, pp.117–142.

WHO (1985) *Energy and Protein Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation*, Technical Report Series 724, Geneva.

Zuiderwijk, A.B. (1998) *Farming Gently, Farming Fast: Migration, Incorporation and Agricultural Change in the Mandara Mountains of Northern Cameroon*, PhD Thesis, Leiden University.

Cattle in Kashimpur

5

Freely Disposable Time: a System for Time and Cash Integrated Livelihood Assessment

Abstract

This chapter develops a system of livelihood assessment that integrates cash flow and time use data of any household into a single indicator that expresses how much time the household adults have left after satisfying the household's basic needs (e.g. physiological, social, food, fuel, shelter) that they need to provide. This 'freely disposable time' (FDT) may be put to any use such as work for extra consumables, leisure, savings or to invest in the future (education, soil conservation etc). Therefore, FDT is a key condition for any out-of-poverty strategy and for a household's resilience to adapt to changing circumstances. The universally applicable FDT indicator is tested on peri-urban farming livelihoods in India and some typical Dutch households. Used as a poverty indicator, FDT is intrinsically superior to monetary or food-based indicators.

Re-submitted as: Hobbes, M., Van der Voet, E. and Sarkhel, S. Freely disposable time: A system for time and cash integrated livelihood assessment. Re-submitted after revisions to *World Development*, April 2009.

5.1 Introduction

Creating sustainable livelihoods to eliminate poverty is today's adage in rural development (Singh & Gliman, 1999; Hussein, 2002; Ellis, 2000). As a format to capture the notoriously complex intricacies of rural livelihoods, the Sustainable Livelihoods (SL) approach has evolved from the late 1980s onwards, based on Sen's (1981) entitlements and the work of Chambers and Conway (1992), Scoones (1998) and Ellis (2000). Various SL frameworks are now in use, e.g. by the FAO, DFID, World Bank, CARE and UNDP. Designed primarily as a guide towards a richly textured qualitative understanding (Scoones, 1998), the SL frameworks have only a limited value for comparative objectives. The qualitative results of SL analyses cannot be benchmarked against quantitative standards such as poverty lines and they cannot be used to compare different rural household types within a single region, or households across regions or nations, or to characterize households' development over time. It would be quite useful, therefore, if the livelihoods approach would be enriched with a system that generates a *universally applicable indicator that integrates fundamental aspects* of any livelihood strategy outcome. This is the thrust of the present chapter.

Universal applicability implies that the indicator system should be applicable to all livelihood types and levels (rich and poor, rural and urban, developing or industrialized countries). This criterion rules out all indicators expressed in terms of food or health, because these become largely invariable above a certain income level. The criterion of integration of fundamental aspects of livelihoods, in our view, implies that the indicator should integrate livelihood outcomes in terms of *cash and time*. A household income may be low, for instance, but if this household still avails of time to invest in more income generating activities, learning, leisure, tree planting or anything else it may desire, it should be assessed as fundamentally less poor than a household with the same income that needs al its time to provide that income.

Universally applicable indicators are already in wide use. Well-known examples are GNP per capita, the Human Development Index and poverty/wealth indicators that relate incomes or expenditures to standards of basic needs, such as the 'one dollar per day' poverty indicator, the food energy intake method and the cost-of-basic-needs (CBN) method (Ravallion, 1994; Ravallion & Bidani, 1994; Wodon, 1997). The CBN approach establishes the cost of a fixed or a locally variable bundle of needs as foundation of the income poverty line, abstracting away from the question if this income actually results in basic needs provision of all household members (Streeten, 1979: 137).

All these indicators suffer from a lack of integration. The economic indicators lack the time dimension. Bardasi and Wodon (2006) are another example of non-integration, focusing as they do on the time aspect while leaving out the cash element. The Human Development Index lacks true integration because it aggregates its components in an arbitrary manner. The same holds for multi-dimensional poverty indicators that tend to just add up the various 'life satisfactions' (Rojas, 2008).

The present chapter proposes an indicator that integrates all needs that are readily translated in monetary terms (e.g. cost of food, healthcare or school) as well as basic needs that are primarily expressed in time terms, *i.e.* hours per day needed for sleep, care, community participation and so on. Besides, it satisfies the criterion of universal applicability (defined previously), as will be proven later. Its synthetic result is named *freely disposable time* (FDT). FDT is not leisure time. FDT describes *the number of hours per day that a household's productive adults have left after fulfilling the basic needs (of food, shelter, physiological needs, social obligations, care of the children, elderly and sick, etc.) that they need to supply for themselves and their dependents*. FDT is a resource that may be put to many uses. One is leisure, but others are for instance to work more hours for luxurious goods or to send a child to college. The key of FDT assessment is that cash expenditures are converted into their time equivalent through the income per hour of the household. High-income households will therefore have a higher FDT than low-income households with the same basic needs. These same high income households may of course display low levels of leisure and rich people may be very busy. In FDT terms; these households have a profile of spending little of their FDT on leisure.[32]

We have chosen for the time dimension to express the indicator because of time's foundational and universal character. Since time can usually be exchanged, fully or partially, for cash on the local labor market, FDT outcomes may be translated to locally valid cash outcomes ('freely disposable income') if desired.[33]

32 We prefer the term 'profile' over the term 'strategy' used in Sustainable Livelihoods frameworks. 'Strategy' wrongly presupposes that all that households do is the result of future-oriented planning. The SL approach does not differentiate between basic needs and freely disposable elements and therefore the SL 'strategy' is all that people are seen doing, while the FDT 'profile' is what people are seen doing *with their freedoms*.

33 It should be noted that FDT and incomes are sometimes strongly fenced in by regulations and context; someone living on social security for instance, is not allowed to work and the FDT is therefore not transformable into cash. Besides, often people have to work a minimum amount of hours to keep their jobs.[0]

Against this background, the objective of this chapter is to develop, document and illustrate a universally applicable system that assesses Freely Disposable Time of households as an outcome of the household's relevant behaviors. In our examples, some bias will be towards relatively poor farming households because these households provide the technically most difficult nut to crunch, e.g. due to subsistence production that often provide a large proportion of people's actual wealth status. The chapter focuses first of all on the *structure* of time and cash integrated assessment, implying that issues of quantification of basic needs are of only minor concern here. In the illustrations of the FDT system, we will use quantifications of basic needs that are grounded in common sense, field data and relevant literature, but without lengthy justifications.[34]

The chapter is structured as follows. The next section will address some theoretical issues in order to give more depth to the system's basic choices. In section 5.3, we discuss two precursors of the FDT system. Section 5.4 gives the formal description of the FDT system. Section 5.5 focuses on the characteristics of FDT compared to other livelihood indicators, illustrated through a hypothetical example. Section 5.6 then discusses the application of the FDT system in Kashimpur village (near Calcutta, India), with some households from the developed world added for comparison and to prove the system's universal applicability. Section 5.7 provides a lean version of FDT designed to minimize data intensity. A discussion of the system's characteristics, position and applicability rounds off the chapter.

5.2 Stocks, flows and poverty lines

Noteworthy of the economic (or food) indicators of poverty and wealth is that they all represent concepts of *flow* (calories per day, dollars per year etc.) rather than concepts of *stock* (assets, capabilities, capacities, capitals, resources). The FDT indicator also belongs to the flow-based category. A focus on flows is something that the developers of the livelihood approach have explicitly tried to avoid. It is emphasized that flow measurements only represent specific points in time and should therefore not be regarded as fundamental (Carter & Barret, 2006). This argument does not seem quite pervasive, however. First, because flows can serve as asset indicator, if sufficiently averaged over time and space

[34] FDT adds some basic needs specified in time terms (e.g. care needs) but we assume that these are not intrinsically more difficult to assess than present basic needs specified in cash (CBN) or food (FAO) terms.

(Reardon & Vosti, 1995: 1497). Second, because flows are future-oriented. They can be extrapolated to reveal asset dynamics. Households may be poor (in assets) but getting richer (in flow terms), for instance, or the reverse. Third, although assets do add to short-term resilience, especially poor households survive primarily on flows. Their assets are usually simply not substantial enough to bridge time spans of a year or more, which is the very reason that they usually rely on 'maximin' strategies rather than maximizing average outputs. Besides, as described by Reardon *et al*. (1994) for Africa and Romero (2006: 192) for the Philippines, farmers often even *invest* from flows, e.g. constructing terraces little by little each year as incomes allow. This is the "autarchic accumulation" mentioned by Carter and Barret (2006: 189).

On the philosophical plane, the 'flows stocks' issue relates to the Basic Needs *versus* Capabilities debate, since basic needs are made operational as flow parameters such as income or, as we will do below, of hours (of care, leisure, social contacts etc.) per day. Capability theorists such as Sen (1987) and Alkire (2002) criticized the basic needs approach (e.g. Streeten, 1979; Streeten *et al*., 1981; Stewart, 1985) for being commodity-focused, insensitive to the importance of freedom, too relativistic to be made operational, and so on. As elegantly analyzed by Reader (2006), however, the basic needs approach is in fact in no way inferior to the capabilities theory on all these accounts. We conclude that an indicator of freely disposable time in flow terms (i.e. hours per day), used as stand-alone parameter or additional to stock measurements, is certainly worth a try.

The FDT concept is applicable to the rich and the poor alike, and may therefore be used as a universal poverty or wealth indicator. What is the fundamental poverty line? This is when FDT = 0 h/day, meaning that people need all they can do, *i.e*. all the time they have and all the cash they can generate with it, to satisfy their basic needs. At this level, people are trapped in poverty, without time or cash left to allocate to improvement in the future. Below the FDT = 0 line, people live in chronic deficits of sleep, food, care or cash.

Reardon and Vosti (1995) have proposed the term 'investment poor' for households that avail of only a little more than bare basic needs satisfaction, assuming that they will spend this little surplus on expanded consumption rather than investment (in knowledge, in soil and water conservation, social capital etc.) Investment poverty may easily be translated in FDT terms, e.g. setting FDT = 2 h/day as the 'investment poverty line' over the FDT = 0 h/day as the absolute poverty line.

Very high incomes imply that the acquisition of basic needs requires only very little time in income generation activity. Yet, everybody has only 24 hours per day and needs some 10 of those for sleep, self-care and leisure. On a scale of 24 hours per day, therefore, all very high incomes will converge between 13 and 14 h/day of FDT, while the relatively poor will be assessed in an area between FDT = 0 h/day and, say, 6 h/day. This pattern differentiation is good if we are interested more in the poor than in the rich. Moreover, this pattern expresses the decreasing marginal utility of income at high income levels.

5.3 Precursors of FDT

Two rural assessment systems have laid the foundations for the FDT.

Rural Material Flow Analysis (rMFA)

Material Flow Analysis (MFA; Eurostat, 2001) assesses material inputs, outputs and stocks, e.g. in kilos per capita per year, of social systems on scales varying from sub-national to supra-national regions. MFA has been applied, for instance, to analyze the 'material intensity' of economic growth of various countries (Matthews *et al.*, 2000). Under the label of 'rural material flow analysis' (rMFA), Hobbes (2005) adapted the MFA principles for application on the level of rural households, with the objective to generate indicators that relate material flows to various themes in rural development, such as incorporation in external markets, productivity and food security. Basic needs play a key role especially in the food security indicators, because the human caloric and protein needs are the common denominators of all of them. The five food security indicators of rMFA express actual and potential food sufficiency and autarky (in case of failing markets). Hobbes (2005) applied the rMFA system on three villages in Laos, the Philippines and Vietnam. The villages showed up with quite different profiles in terms of the food indicators that well reflected not only their present food security position but also their deeper characteristics of resilience and risk. Thus, rMFA is an example of how a consistent set of relatively simple data can yield quantitative insights of key importance, and much of its structure has been carried over into the present chapter.

Land-time budget analysis

Giampietro (2004) has developed a rural household assessment system called 'land-time budget analysis'. Central in this analysis is the performance of the time and land budgets that people have available. The approach covers the whole portfolio of livelihood activities. The starting point of the analysis is the total amount of hours per year available in the studied group (society, village, household). Various categories that resemble basic needs are deducted from this amount. The first category is the time needed for maintenance by sleeping, eating, etc., followed by time needed for reproduction (e.g. for leisure and education, plus the total time of the non-productive household members such as the children, disabled and elderly), called 'social overhead', and by the time needed for household chores, farming for auto-consumption and to pay for taxes and agricultural inputs. The time left can be used to produce cash, either on or off farm. Giampietro suggests applying a parallel system for the availability of land, and combining the outcomes of two assessments would enable the calculation of 'net disposable cash', which is a key economic performance indicator of the group under study.

Land-time budget analysis does not offer a coherent system of data categories and calculation rules, which hampers application in empirical cases (Pastore *et al.*, 1999; Gomiero & Giampietro, 2001; Grünbühel & Schandl, 2005). Moreover, the analysis does not make a consistent choice to distinguish basic needs from freely disposable resources. Basic food needs are not subtracted from net disposable cash, for instance, irrespective of whether the household grows its own food or buys it on the market (Giampietro, 2004: 396). In other cases (e.g. Pastore *et al.*, 1999), the whole food expenditure is subtracted from net disposable cash without reference to whether this expenditure is basic or not. Yet, the principle of household-level time budget analysis that spans all livelihood activities and needs has been a major source of inspiration of the present chapter.

5.4 The FDT assessment framework

The FDT system uses data on how people spend their time and cash on various categories. All cash expenditures are converted to time expenditures using the household's income per hour. For instance, if five hours of work bring in 100 $, then spending 100 $ is the equivalent of spending five hours of work. The present section will describe the details of the FDT system. It is able to incorporate many real world complexities, such as that (1) households are multi-people entities with different basic needs per person, (2) farming households may produce fully or partly for subsistence, (3) people may live temporarily or chronically with deficits of basic needs, (4) income elements consist not only of wages but also of own firm or farm profits, remittances, rents and gifts, and (5) households may also receive or give aid in time or material forms. On the other hand, simplifying measures have been taken in order to save space. We refrain from intra-household differentiation of FDT, for instance (just like monetary indicators usually do).[35]

Research units

The composition of a household is important for FDT. A young child, for instance, adds to the household's basic needs but its freely disposable time does not make a relevant difference for the household. Therefore, the FDT assessment focuses on the freely disposable time of only the 'productive adults' (PAs), with the other members of the household present in the analysis in the form of adding to the basic needs (of food, care etc.) that these PAs have to provide. Some non-PA members may also help out in several respects, e.g. doing chores or adding minor income components. This then is added as gifts or aid to the PAs' account. This way, the FDT system is fully sensitive to household composition and the poverty impact of handicaps and chronic illness. The time span of the appraisal should preferably cover a full year, so as to include seasonal variation. The time and cash expenditures are expressed per day, however, so that the summation of time expenditures and time balance of the time/cash equivalents over all categories both equal 24 hours.

Livelihood activities and basic needs

Table 5.1 provides the classification of livelihood activities used for the field study in Kashimpur, India. The list is exhaustive and blends the most important categories in time allocation studies (Shelley, 2005) and the main expenditure components of consumer-expenditure surveys (BLS, 1997). Most of the categories have a basic need component, expressing a relatively broad definition of the term that includes, for instance, the care need of children and a minimum of leisure time, e.g. to maintain social contacts. For the Kashimpur case study, the caloric food needs have been quantified following international standards, while the other basic needs have been based on the local situation using key respondents, e.g. the minimum time it takes to keep up a basic house or cook a basic meal, differentiated by household size, or the minimum amount of cash needed to have access to a mobile phone for

[35] It may be noted that even though the FDT system as presented here does not differentiate between male and females in the household, non-monetary contributions to the household (care, cooking, chores, fetching water etc.) are fully accounted for in the FDT system. Contrary to monetary indicators, FDT does not suggest that making money (usually a male job) is the only thing that counts.

Table 5.1 Categories of human activities and basic needs (referred to as A, B, C...i in Figure 5.1) to be provided by the producing adults (PA) of the households in the Kashimpur case study, India complemented with values used in the Dutch case study. Basic needs mainly follow guesstimates based on minimum requirements in the local situation estimated by key respondents and secondary sources, such as the social welfare minimum in the Netherlands. Cash is expressed in US$ per day (1 US$ = 40 INR = 0.7 euro). Care basic needs exclude care that can be given simultaneously with cooking, chores etc.

Activities & needs provided by PA	*Basic needs in Indian case study*	*Basic needs in Dutch case study*
Physical inactivity (h/d)	8 per PA (guesstimate)	same
Leisure (h/d)	2 per PA (guesstimate)	same
Self care (h/d)	0.75 per PA female, 0.4 for PA male (guesstimate)	same
Care (h/d)	1 for non-active elderly, plus 2 if 1 or 2 children, 3 if 3 or 4 children (guesstimate)	same
Chores (h/d)	1 for small, 1.5 for average, 2 for big household (guesstimate)	same
Cooking (h/d)	1.5 for small/average, 2.5 for big household (guesstimate)	1 per household (guesstimate)
Food	1200 kcal/d for 0-4years, 1700 kcal/d for 4-8years, 2000 kcal/d for 8-12 years, 1967 kcal/d for PA female, 2540 kcal/d for PA male, etc. (FAO/WHO/UNU,1985)	1.4 $/d for 0-4years, 2.1 $/d for 4-12 years, 2.6 $/d for PA female, 2.9 $/d for PA male, etc. (guesstimate)
Water consumption	15 liter/d for small household, 24 for average household, 36 for big household (guesstimate)	Included in non-caloric consumption
Fuel for cooking	10 GJ/cap/y (Sanga & Jannuzzi, 2005).	Included in non-caloric consumption
Shopping (h/d)	0.3 per household (guesstimate)	same
School for PAs (h/d)	0	0
School for dependents ($/y)	10 per child of primary school age (guesstimate)	70 per child of primary and secondary school age
Non-caloric consumption ($/d)	Between 0.05 and 0.16 per household, depending on household composition (based on guesstimates on sub-categories)	Between 24 and 33 per household, depending on household composition (based on guesstimates on sub-categories)
Durable goods renewal / depreciation ($/y)	18 for small, 19 for average, 20 for big household (guesstimate)	429 per household (guesstimate)

Activities & needs provided by PA	Basic needs in Indian case study	Basic needs in Dutch case study
Saving and investment	0	0
Income generation	0	0
Interest/rents/gifts paid ($/y)	32 per household (guesstimate)	71 per household (guesstimate)
House taxes, mortgage, rent, renewal ($/d)	0.03 per household (no taxes, only building materials guesstimate)	15.8 (social well-fare minimum rent & cost taxes)
Community work (h/d)	0.2 per household (guesstimate)	0.1 per household (guesstimate)
Religious activities (h/d)	0.1 per PA (guesstimate)	0 (guesstimate)

emergencies and to acquire a second-hand bicycle. The basic need figures for the Dutch case study have been added. The needs expressed in time are kept equal to the Indian case study, except for cooking. For the Dutch monetary basics we used our own guesstimates, combined with data on minimum wage, governmental subsidies for housing, and minimum welfare standards. Access to internet and a TV have become basic, for instance, to participate in Western societies.

Formal principles of the FDT system

Figure 5.1 shows the FDT assessment framework. It starts out with the classification of categories (A, B, C, ...i) on which households may spend time and/or cash. The first (upper left-hand corner) element of the Figure is the calculation of the basic needs that have to be provided for by the PAs, based on the household composition.

The three blocks in the upper left-hand corner together assess the degree to which, within each category, the productive adults have *'acquired'* more or less than the household's basic needs, *i.e.* a surplus or deficit in that category. 'Acquired' is defined as self-produced plus received as remittance, rent, help or aid (in cash, time or equivalents). 'Self-produced' may denote cash from the labor market or food from the farm but also self-'produced' hours of sleep, leisure, self-care or care given to dependents. 'Help' may refer to, for instance, the grandmother assisting with the children. 'Aid' may be food aid from the government or free seedlings supplied by an NGO. The deficit/surplus calculations will often require conversions between the field-level data and the units in which the basic need is defined, e.g. from bags of rice to calories. As the Figure shows, surpluses and deficits are kept separate. Each category has either a surplus with the deficit set at zero, or the reverse. This allows keeping track of how households may suffer chronic deficits or may create more time for work and other categories may by accepting

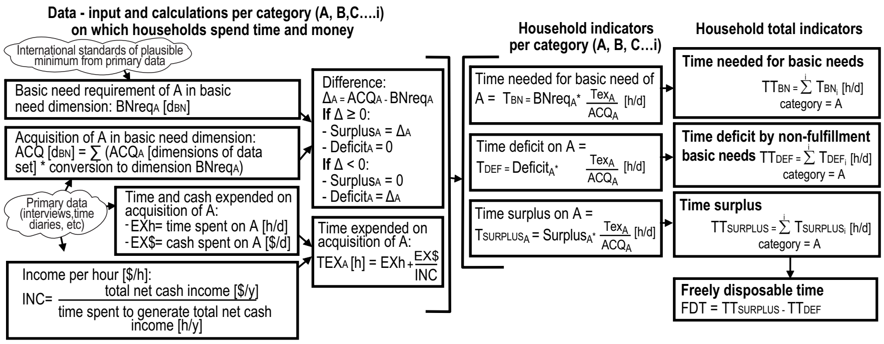


Figure 5.1 Freely disposable time: the empirical system (livelihood assessment). All elements are expressed per producing adult (PA) member of the household per day.

- A, B, C….i = categories of time and cash expenditures of the household (e.g. sleep, food, care).
- $BNreq_A$ [d_{BN}] = basic need requirement of A for the household to be provided by the producing adults (PA) in the basic need dimension (e.g. hours, cash, kcal, liters).
- ACQ_A [d_{BN}] = acquisition of A; total available of A for the household calculated by summing all that is provided by the household and aid received. If it concerns a category with a positive basic need element, it is expressed in the basic need dimension by using conversion factors (e.g. kcal per food product, wage paid for buying labor time).
- ΔA = difference between what is acquired and required of A.
- $Surplus_A = \Delta A$ if more is acquired than required of A; DeficitA = $-\Delta A$ if less is acquired than required of A.
- EXh = time spent on A by the producing adults (PA) (summation over all categories equals 24 hours).
- EX$ = cash spent on A by the household (e.g. A bought, labor bought for A, support of labor bought for A). (For the income generation category, EX$ reveals the net earnings and rents with a negative sign, because "received" = – "expended").
- INC = net cash income of the household per hour. INC includes all cash influx into the household.
- TEX_A = time/cash integrated time equivalent expended on acquisition of A by buying and self-provision by the producing adults (PA) expressed in hours by using INC (summation over all categories equals 24 hours).
- TBN_A = time/cash integrated time equivalent needed to satisfy the basic need of A.
- $TDEF_A$ = time/cash integrated time equivalent deficit on A by non-fulfillment of the basic need of A.
- $TSURPLUS_A$ = time/cash integrated time equivalent surplus on A after fulfillment of the basic need of A.
- TTBN = total time/cash integrated time equivalent needed for satisfying all basic needs.
- TTDEF = total time/cash integrated time equivalent deficit by non-fulfillment of basic needs.
- $TTSURPLUS_A$= total time/cash integrated time equivalent surplus after satisfying all basic needs.

temporary deficits. Categories with a basic need at zero automatically show surpluses, except for the savings/investments category where a deficit will show up for households with a negative cash balance.

The next three (lower left-hand corner) blocks of the system assess the time equivalence of the time and cash that the productive adults *spend on* the acquisition of each category. Expenditures may be incurred in time (EXh), in cash (EX$) or both, e.g. if such care is self-produced (EXh) and supplemented by hiring a nanny (EX$). Cash income is defined as negative cash expenditure, so that over all categories including income generation and savings, the EX$'s add up to zero. As Figure 5.1 shows, all cash expenditures are converted to the equivalent hours of working time by using the cash income per hour of the household (INC) as conversion factor, with INC including all cash influx components (wages, marketed farm produce, remittances, pensions, rents etc.), divided by the numbers of hours involved in getting that income. This is then added to the direct time spent on the category (EXh) to obtain the time/cash integrated time equivalents expended (TEX) on the category. In formula, TEX = EXh + EX$/INC. Over all categories, TEX adds up to 24 h/day per PA, because EXh expresses all that the PA actually does during the day and the sum of all EX$'s is zero.

The income per hour may be very high, and hence the EX$/INC factor very low, for households that live primarily on rents, welfare, remittances or other non-labor income, since they spend hardly any time on its acquisition.[36] Note however that INC cannot be used to calculate what the household might earn if it would convert some of its FDT into cash; the wage that should be taken then should reflect the household's position on the local labor market.

This system with acquisition and expenditure running parallel for each category can handle all real-life complexities and is conceptually robust, e.g. if basic needs are added or set to zero. The parallelism is found back, for instance, in that if the actor sleeps for 8 hours, this is entered into both accounts; the actor has acquired 8 hours by spending 8 eight hours. The most complex example is mixed subsistence/commercial agriculture. Of its subsistence part, the harvest is entered into the acquisition account (e.g. in the food category as kcal), its time expenditure is entered as EXh in the expenditures and its cash inputs are entered as

[36] Households that live on non-labour income only could be said to need zero hours for its acquisition, creating an infinite INC and error flags all over the database queries. This is only a technical problem, however, solved by allocating any minor time slot to the acquisition.

EX$ in the food category. The commercial part of the agriculture is an element in the income-generation activities (Table 5.1), with the net profits entered in the acquisition account and (with negative sign) in the expenditure account (EX$). The time spent on it is again an EXh in the expenditures account. Regular farm maintenance is under the time and cash spent as inputs but if farmers are really investing, e.g. in land acquisition or terracing, this could be kept separate under the savings/ investments category to keep this visible.

With these inputs, the next column of Figure 5.1 calculates the time/ cash integrated time indicators per category. The structure of the formulas is simple. If, for instance, the basic food need of a household is 4000 kcal/day per PA and if the actual acquisition is 6000 kcal/day per PA, and if the PAs spend a time/cash equivalent (TEX) of 3 hours per day on this, the *time needed to acquire the basic food need* (TBNfood) is two-thirds of this time or, formally in the system,

$$(4000 \text{ kcal/day}) * \frac{3 \text{ h/day}}{6000 \text{ kcal/day}} = 2 \text{ h/day for each PA.}$$

Along this line, we get:

- TBN, being the time/cash integrated time equivalent required per PA to satisfy the household's basic need in the category.
- TDEF, being the time/cash integrated time equivalent per PA expressing the degree to which the household lives with a deficit compared to the basic need in the category.
- TSURPLUS, being the time/cash integrated time equivalent per PA expressing the degree that the household lives with a surplus compared to the basic need in the category.

Finally, the household's aggregate indicators sum the outcomes of the indicators per category over all categories. Keeping the time deficits and surpluses separate can help identify chronic problems of households and also enables a tracing of how households may use temporary deficits e.g. to create more working time in harvest, disaster or sickness periods. Basic needs would not be basic needs if this could continue for a long time, however. In the longer run and in a principled outlook, deficits should subtract from the surpluses. Therefore, the aggregate of all surpluses minus all deficits is called freely disposable time (FDT).

5.5 Characteristics of Freely Disposable Time

In this section, we will give a simplified numerical example to illustrate the FDT system and investigate what it says about poverty compared to some widely used poverty indicators. Table 5.2 shows an FDT assessment of a single-actor household living a life composed of only six time/cash categories, focusing on five different profiles of how this actor spends his/her FDT.

Illustrating FDT with a simplified example

Table 5.2, first column, starts out with the six categories of on which the actor spends time and/or cash.

The overarching columns each assess one livelihood profile. The first is an arbitrarily set initial profile, the second gives the FDT profile for if the actor would devote all his/her energies on the accumulation of savings, and so on. For each of those, five columns summarize the FDT assessment. The first columns show the basic needs requirements (BN) on all categories. The second and third columns depict all the time and cash the actor spends on the categories (EXh and EX$). The T_{BN} and T_{SUR} reflect the time/cash integrated time equivalents needed to satisfy the basic needs and the surplus times left after the basic needs have been fulfilled. Because the actor has no time deficits, the total of the time surpluses equals FDT.

In this example the category of sleep, self-care and leisure has a basic need requirement of 10 h/day in total. In the initial profile, the actor spends 14 h/day on this category, meaning that this category contained 4 h/day of surplus time. The basic need to keep the household in order without any household appliances is 2 h/day and the actor's time expenditure is indeed 2 h/day. Consequently, this category contains no surplus or freely disposable time. There is no basic need for labor, so that these hours are freely disposable time. This time is always cancelled out, however, irrespective of wage and hours worked, by the cash received for it (EX$ with the minus sign). In our case, working for 8 hours results in (8 h/day) – (8 $/day) / (1 $/h) = 0 h/day of surplus time. The cash earned is spent on other categories, to buy food for instance, and may make FDT visible there. Indeed, the actor spends 5 $/day on food which, at the given wage of 1 $/h, is equivalent to 5 hours of work. The BN of the food category has been set at 4$/day, equivalent to a 2000 kcal/day food basket. Thus, out of the 5 hours time/cash integrated time, 4 h/day is needed to satisfy the basic need (T_{BN}) and 1 h/day could be spent on other categories (T_{SUR}). Further, we see that the

Table 5.2 Freely disposable time (FDT) profiles of a hypothetical single-person household

	Initial profile					*Full savings/investment behavior*					*Effect of household appliances*					*Effect of deep investment*					*Effect of food crisis*				
	BN	EXh	EX$	TBN (H)	TSUR (H)	BN	EXh	EX$	TBN (H)	TSUR (H)	BN	EXh	EX$	TBN (H)	TSUR (H)	BN	EXh	EX$	TBN (H)	TSUR (H)	BN	EXh	EX$	TBN (H)	TSUR (H)
Sleep, etc.	10h	14	0	10	4	10h	10	0	10	0	10h	14	0	10	4	10h	14	0	10	4	10h	10	0	10	0
Chores	2h	2	0	2	0	2h	2	0	2	0	1h	1	0	1	0	2h	2	0	2	0	2h	2	0	2	0
Labor	0	8	-8	0	0	0	12	-12	0	0	0	9	-9	0	0	0	8	-16	0	0	0	12	-12	0	0
Food	4$	0	5	4	1	4$	0	4	4	0	4$	0	5	4	1	4$	0	5	2	0.5	10$	0	10	10	0
Other goods	2$	0	3	2	1	2$	0	2	2	0	2$	0	4	2	2	2$	0	10	1	4	2$	0	2	2	0
Saving/inv.	0	0	0	0	0	0	0	6	0	6	0	0	0	0	0	0	0	1	0	0.5	0	0	0	0	0
TOTALS		24	0	18	6		24	0	18	6		24	0	17	7		24	0	15	9		24	0	24	0
FDT (h/d)			6					6					7					9					0		
Income ($/d)			8					12					9					16					12		
Expend. ($/d)			8					6					9					16					12		
Poverty line ($/d)			6					6					6					6					12		
Income above PL ($/d)			2					6					3					10					0		

Only six cash/time categories are distinguished for ease of calculations. The overarching columns denote various behavioral choices of the actor. For each choice, the columns show the basic needs (BN), the empirical behavior in time and cash expenditures (EXh and EX$), the resulting time/cash integrated time equivalents needed to satisfy the basic needs (TBN) and the surpluses (TSUR) per day. FDT equals the sum of the surpluses (because there are no deficits in this example). For comparison with FDT, the last four rows mention monetary indicators. The poverty line equals the cost of basic needs. The last row is income above the poverty line.

actor spends the remaining 3 \$/day on other goods, which is equivalent to 3 h/day of time/cash integrated time. Assuming a basic need of other goods of 2 \$/day (for light, heating, clothes etc.), 1 h/day is FDT. All cash now being spent, nothing goes to the savings category. Note that three balances are under full control here. One is the *time* balance of how the day is actually spent (EXh) adding up to 24 hours over the six categories. The second is the *cash* balance (EX\$) adding up to 0 \$/day. The third is the *time* balance of the time/cash equivalents, the summation of TBN and TSUR over all categories, adding up to 24 h/day. Adding up all time surpluses, FDT is 6 h/day; the actor may be poor but not desperately so, because 6 hours per day available to make choices with is substantial. The choice the actor apparently makes, then, is to spend much of this capacity on leisure.

What could this actor do alternatively with his freely disposable time? By way of illustration, the next profile in Table 5.2 shows the effect of a rigorous 'savings/investment strategy' in which the actor gives up all above-basic sleep, leisure, food and goods and puts all FDT to work for the savings/investment category. The actor now works for 12 h/day (24 minus the basic needs for sleep, self-care, leisure and chores), which brings in 12 \$/day, out of which 4 \$/day is needed for the basic needs of food and 2 \$/day for other goods. The remaining 6 \$/day, equivalent to (6 \$/day) / (1 \$/h) = 6 h/day of FDT, is in the savings category. Note that all the while, the FDT total has stayed the same 6 hours per day. In the FDT system, the actor does not get better off (higher FDT) by working more hours, and neither does he get poorer when foregoing luxuries in order to save or invest. He does get a higher FDT, however, when wages rise compared to basic need prices, or when investments begin to pay off. The next two profiles are examples.

The third profile in Table 5.2 depicts the situation after the actor has decided to buy time-saving household appliances from the saved cash. The basic need of the chores has now dropped to 1 h/day. Consequently, FDT rises to 7 h/day. If the actor then decides to go back to the original levels of sleep, self-care, leisure and food, he/she can work one hour more and spend the extra 1 \$/day cash on goods, rising to 4 \$/day.

Alternatively, the actor may decide to invest the saved cash in some 'deep', out-of-poverty strategy, e.g. through vocational training or building terraces for new crops. In Table 5.2 we assume that as a result of the investment, the wage has risen to 2 \$/h. Bringing his sleep, self-care, leisure, chores and labor time back to the initial levels, the actor earns 16 \$/day, out of which he/she spends 5 \$/day to bring food consumption back to the 2500 kcal/day level. This now only costs 0.5 h/day of FDT due to the doubled wage. Of the remaining 11 $/day, the actor spends 10 on other goods, leaving 1 $/day (0.5 h/day) for savings. FDT now stands at 9 h/day.

Real poverty, as said, is when FDT = 0. In Table 5.2 this has been simulated by a food crisis that puts the price for the basic food basket at 10 $/day. The only option left for the actor is to work maximum hours for bare survival.

FDT versus monetary poverty indicators

The two lines below FDT in Table 5.2 show the incomes and expenditures (on food and other goods) of the various profiles and circumstances, allowing a comparison of FDT, income and expenditure as poverty indicators. One striking difference is that with the income indicator, the actor following an investment strategy is assessed as better off than before he decided to do so, even though the only thing the actor in fact does is work all his/her hours, neglecting everything else in life. According to the expenditure indicator on the other hand, the same actor is assessed as poorer than before (cf. Van Campenhout 2006: 410). All the while, the only thing that in fact has happened is that the actor spends his/her freely disposable time (the same FDT of 6 h/day) in a different manner.

Even more saliently, the totally stuck actor without any options left (FDT = 0) due to the food crisis is assessed as better off than before by both the income or expenditure indicators. This major problem can be circumvented when basic needs are included in the picture, e.g. subtracting the cost of basic needs from the actual income. The cost of basic needs in the first four columns is 4 + 2 = 6 $/day. In the last column it is 10 + 2 = 12 $/day. The bottom line of Table 5.2 gives the incomes above the poverty line. The last column now stands at zero, in accordance with FDT. Note however, that this is only the case if the rise of basic needs is indeed a rise in *monetary* expenditures (e.g. for food). If the actor would be confronted with a crisis in *time* terms, e.g. when being disentitled to gather firewood in a nearby forest or when burdened with the care for a HIV/AIDS patient, the cost-of-basic-needs method is liable to miss this mark completely, contrary to the FDT assessment.

5.6 Empirical test of the FDT system

Applications of the FDT system to hypothetical households may serve to illustrate many of its characteristics, as shown in the preceding section. We also found it necessary, however, to confront the system with real-word cases in order to develop it fully and test its workability and coherence in practice. Farming households in the village of Kashimpur, at some 40 km north-east of Calcutta, India, were selected for the field test. The main reason for this choice was the complexity of livelihoods. The households in Kashimpur grow many different of crops in three different seasons. Some land is owned; other land is share-cropped. Some of the harvest is used for subsistence; another part is sold. Most households have some cattle that they feed from all kinds of sources and use to supply milk for the family but also to sell. Several farmers are also part-time milk middlemen, going round the village to sell their own but also their neighbors' milk. Other household members are factory workers or part-time sewers, shopkeepers, students, teachers or singers. Others have a petty trade such as selling biscuits at the markets. Some households gather firewood for cooking; others buy firewood, or gas, coal or dung cakes. Some households hire labor for house cleaning or agriculture; others hire draught animals for plowing. Some have their own wells for irrigation; others do or do not pay to receive water from private or village wells. Local measurements contain 'maunds', 'paunds', 'bighas', 'bunches', 'bags' and many others. If the FDT system could handle this, it could handle anything.

Thirty-three households were randomly selected from a list of inhabitants containing all households engaged in farming. One dropped out during the field work, resulting in a sample of 32 households, comprising 116 productive adults[37] and 27 dependents. Productive adults were interviewed, with elderly supplying additional details. Data gathering was carried out by the third author (economist) and a research assistant during 2005 and 2006, focusing on the livelihood components, with overall time use (3-day recall) and cash flows added. Interviews for the time study were held in a 10-day rhythm, while the others were scattered over time. Data were entered in an Access database structured through the FDT framework.

[37] Productive adults were defined as all non-handicapped or chronically ill individuals between 13 and 60 years of age. The 13 years limit was chosen because schooling up to 12 years of age was set as a basic need. Above that age, the choice to work or go to school is free, *i.e.* part of FDT.

Two households were added from the industrialized world. One is the first author's own in the Netherlands, chosen because of perfect data availability. This is a household with three young children, a somewhat higher than modal income and no special features in expenditure pattern. Two situations were studied, one with *au pair* help and one without, in order to show the effect of this choice on FDT. The second household is only semi-empirical because the data were compiled from informal information. It represents a single mother in the Netherlands, full-time employed for a minimum wage, receiving some subsidies on house rent, child care and child support. Table 5.1 shows the underlying basic needs figures.[38]

The methodological experience gained in the empirical study was that the database design had to be adapted several times to accommodate newly found complexities but that it worked smoothly in the end, generating the FDTs from the primary data with a few mouse clicks. The substantive results are summarized in Table 5.3, showing the time/cash integrated time needed to satisfy basic needs (TBN), time/cash integrated time surpluses (SUR) and deficits (DEF) for five Kashimpur households and the three Western cases. We will discuss some of the categories.

Taking a look at the 'food' row first, it shows that most productive adults (PA) in Kashimpur spend some 2 to 3 h/day on its provision, depending on their households' composition, the efficiency of their subsistence agriculture and their cash income per working hour (INC). The richest household in Kashimpur has only one member with a very high income; hence only 0.3 h/day for basic food need. Several Kashimpur households display significant food deficits. This is often found in food studies in India (Chandrasekhar & Ghosh, 2003).The food surpluses in the Dutch households refer not so much to extra calories but to the use of more luxurious food products (the basic need in Table 5.1 was assessed as cost of basic food basket).

The "school" category has basic needs as per Table 5.1 that depend on the number of children in primary school age as well as the PAs' in-

[38] To deal with children being sent to daycare in these households, we divide care need for children into 'family care' and 'daycare'. The former includes time needed for helping children to dress, bring them to school, read a bedtime story, etc., which can only be provided by people in the house, e.g. PA's, au-pairs or grandparents. Daycare then refers to the need for children to be looked after for the rest of the day at daycare or school or as a secondary activity during the household chores or leisure time. The time expenditures and needs on this category have been left out in the examples, but the financial costs of daycare are taken up as basic need in the non-caloric consumption category.

Table 5.3 Time/cash equivalent time expenditures and total time/cash integrated indicators and incomes of eight empirical households

	Kas. poor 1 (2 PA, 2 dep.)			Kas. poor 2 (2 PA, 3 dep.)			Kas. middle 1 (3 PA)			Kas. middle 2 (5 PA)			Kas. rich (1 PA)			Dutch middle 1 (2 PA, 3 dep.)			Dutch middle 2 (2PA, 3dep.,helper)			Dutch poor (1 PA, 3 dep.)		
	TBN	SUR	DEF	TBN	SUR	DEF	TBN	SUR	DEF	TBN	SUR	DEF	TBN	SUR	DEF	TBN	SUR	DEF	TBN	SUR	DEF	TBN	SUR	DEF
Phys. Inac.	8.0	0.2	0	8.0	0	0.1	8.0	0.6	0	8.0	0.6	0	8.0	0	0.4	8.0	0	0.0	8.0	0.3	0	8.0	0.0	0
Leisure	2.0	0.0	0	2.0	0	0.3	2.0	1.4	0	2.0	1.4	0	2.0	3.5	0	2.0	0.3	0	2.0	1.2	0	2.0	0.0	0.5
Self care	0.6	1.9	0	0.6	2.5	0	0.6	2.6	0	0.6	2.7	0	0.4	3.5	0	0.6	0.7	0	0.6	0.7	0	0.8	0.6	0
Care	1.0	2.0	0	1.5	1.0	0	0	0	0	0	0	0	0	0	0	1.4	3.6	0	0.7	3.7	0	3.0	1.0	0
Chores	0.8	0.5	0	1.0	0.3	0	0.5	0.4	0	0.4	0.4	0	0.5	0.2	0	1.0	0.1	0	0.3	0.4	0	1.5	0.2	0
Cooking	1.0	0.7	0	1.3	0.3	0	0.7	0.4	0	0.5	0.3	0	1.5	0.2	0	0.5	0.0	0	0.3	0.1	0	1.0	0.0	0
Food	3.4	0	0.6	2.4	0	0.3	3.0	0	0.4	2.3	0.1	0	0.3	0	0.0	0.2	0.6	0	0.3	0.6	0	0.6	0.1	0
Non-cal. cons.	0.5	0.0	0	0.6	0.6	0	0.5	0.1	0	0.3	0.4	0	0.0	0.1	0	0.9	0.7	0	0.8	0.7	0	2.8	0.2	0
Dur. goods	0.1	0.0	0	0.1	0.1	0	0.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.1	0	0.0	0.1	0	0.1	0.1	0
Saving/inv.	0	0	0.0	0	0.8	0.0	0	0	0.2	0	2.0	0	0	0.4	0	0	0.7	0	0	0.5	0	0	0	0.0
School	0.1	0.0	0	0.1	0.0	0	0	2.3	0	0	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0
Housing	0.1	0.0	0	0.1	0.1	0	0.1	0.1	0	0.0	0.0	0	0.0	0.0	0	0.3	0.9	0	0.3	0.9	0	1.5	0.0	0
Others		0.5	0	1.0	0.5	0.0	0.7	0.5	0	0.4	0.5	0	0.6	3.2	0	0.2	1.1	0	0.2	1.3	0	0.3	0.6	0.0
	1.2																							
TOTALS	18.6	6.0	0.6	18.5	6.2	0.7	16.3	8.3	0.6	14.6	9.4	0.0	13.3	11.2	0.4	15.2	8.8	0.0	13.5	10.5	0.0	21.7	2.8	0.5
FDT		5.4			5.5			7.7			9.4			10.8			8.8			10.5				
Inc./hh ($/d)		1.0			2.4			1.1			5.3			7.3			230			230			58.8	
Inc./cap ($/d)		0.25			0.48			0.37			1.06			7.25			46.0			38.3			14.7	

The Kashimpur (Kas.) households in India include a variable number of producing adults (PA), dependents (dep.), consisting of children and elderly, and have mixed livelihoods that include farming. The Dutch middle class household is composed of university employees with three young children. The Dutch poor household represents an unskilled single working mother with three young children. TBN = time/cash equivalent time needed to acquire basic needs (as defined in Table 5.1). DEF = time/cash equivalent time due to non-fulfilment of basic need. SUR = time/cash equivalent time spent on above basic-provision. TOTALS refer to totals of TBN (TTBN), TDEF (TTDEF) and TSUR (TTSURPLUS). FDT= freely disposable time = total time surpluses minus total deficits. All numbers except the incomes are in hours per day per PA, averaged over the PA and over the year. The incomes (per household or per capita) are cash after taxes, in US $ per day (1 US$ = 40 INR = 0.7 euro).

come per hour. Surpluses express that not only children but also PA's go to school, e.g. a 14 years old going to high school. "Savings and investments" expresses the household's cash balance, divided by the income per hour. The net incomes per household and per capita are taken up in the last two rows for comparison with FDT. One major difference between the FDT and income indicators is that the three poorest households in Kashimpur are way below the 1 $/day poverty line, but not destitute in FDT terms. With freely disposable time of some 5 to 8 hours per day for each productive household member, they have substantial time left that can be spent on various uses, such as (in Kashimpur), wage labor, leisure or care for their children. A second difference is in the sequence of the second and third household. The second is much higher in income but much lower in FDT. The household composition plays a major role here.

The first column of Table 5.3 overviews the poorest household in Kashimpur. This household creates some 10 percent of its time surpluses through the food deficit. It spends its 6 hours of surplus time on above-basic care, self-care, cooking, chores and religion. The profile of this household is to keep the female PA away from wage work and concentrate on keeping up a well-organized, clean and proper family, despite of very low cash income.

The second household of Table 5.3 represents another way of being poor, and yet not so poor, in Kashimpur. Its higher income reflects its stronger market orientation; the male PA is involved in milk sales and van driving. Much of the time surpluses are created by this and is again put to care, self-care and other non-cash activities, but not fully as in the previous household; 0.6 hours per day is spent on 'luxury' goods (non-caloric consumption surplus) and 0.8 hours per day to savings (15 percent of surplus time).

The third column in the Table introduces the middle-level households in Kashimpur. As the low income illustrates, it has a low involvement in the market, a characteristic that it shares with the first household. The major difference between the two is that the middle class household is investing, albeit not in savings but in sending one teenage PA to school (see the surplus of 2.3 hours per day in that column).

The fourth household is around the FDT median of Kashimpur. The relatively high income of 1 $ per capita per day is mainly derived by marketing farm produce, cottage industry and trade. The surplus time is spread relatively evenly to support one PA student, to save, to buy some surplus food and non-caloric goods, to enjoy surplus sleep and leisure, and to give above-basic care. This 'flat' profile is the sum of what the preceding two households do with their lower surplus times.

The next three columns summarize the richest household in Kashimpur. It concerns the traditional landed gentry (*zamindar*) of the village, in a single person household. This person leads a materially simple life, without spending significant parts of his FDT on surplus non-caloric consumption or food. Combined with this, half of this income (equivalent to 0.4 h/day) ends up in the savings and investments category. His surplus time is largely spent on very high levels of leisure, self-care and community work, a large part of which may be interpreted as maintenance and investments in social capital.

The two Dutch middle class cases differ only in the presence of an *au pair* helper. The rise in FDT indicates the overall efficiency of this choice. Per separate category, the major effect of the helper is that some savings are sacrificed (lower surplus) to have more rest, more leisure and a better organized house (higher surpluses).

The final household in the Table represents the poor in the industrialized world: a single mother with three children working full time for a minimum wage. She has a leisure deficit due to all the hard work. Whereas the Indian household hardly spends time on housing, this mother still has to work 1.5 hours per day for her basic housing need despite government house rent subsidy; the costs of housing are much higher in the Netherlands than in India. It should be noted here that the children are sent full-time to daycare, so that the mother is able to work. This is only affordable due to high government subsidies; the costs that the actor herself has to pay is taken up as basic need in the non-caloric consumption. Still, the FDT is lower than those of the poor of Kashimpur; being a single mother she has to work continuously to make both ends meet on the basic need level. Without the house and child subsidies, her FDT would become negative.

5.7 An option for minimizing data intensity

The FDT assessment system developed here offers full insight in the key elements of livelihood strategies. The data requirements are high, however, and it serves to explore if a lean version could be designed for broad FDT surveys without sacrificing the core principles and too much empirical insight. We explore one option here. It drops detail for instance in the contributions of non-productive household members and in possible deficits per basic need category, but retains all basic advantages of time/cash integration. The protocol runs as follows.

(1) As in the full FDT system, the household composition needs to be known in some detail, to generate all the basic needs elements of the household.

(2) The next step is to translate these basic needs into time and cash requirements for the productive adults, mainly using local data. Examples are (a) the drinking water need will be translated into either water fetching time or water buying cash or a mixture of these, (b) most consumables can be translated directly into cash needs, (c) the food requirement (in kcal/day) can be split into auto-produced food (kcal) and bough food (cash); the auto-produced food in its turn can be translated into hours of work and cash for the necessary inputs. All time and monetary units can now be added up to produce a *cost of basic needs (CBN*), composed of the requirement *in hours (tCBN)* plus the requirement in *cash (cCBN)*.

(3) The total cash income of the productive adults needs to be known, *i.e.* the sum of net wages, agricultural and other profits, pensions, remittances and so forth, in monetary units per year. Next to be assessed are the total hours worked (per year) by the same adults to general that cash. The division of the two delivers the income per hour *(INC)*.

(4) Dividing first through the number of productive household members, the *time needed to satisfy the basic needs is: TBN = tCBN + cCBN/INC*. Freely disposable time is: *FDT = 24 – TBN*.

5.8 Conclusion and discussion

This chapter has developed a system of time/cash integrated livelihood assessment that is both conceptually coherent and empirically robust. Because a wide range of basic needs can be incorporated in this system, it is intrinsically superior to any partial system, e.g. those based on monetary or food parameters only.

‘Freely disposable time’ (FDT) is defined as the time that productive household members have left after satisfying the basic needs of the household that accrue on them, *i.e.* their own plus those that the non-productive members cannot supply for themselves, such as care and food. Freely disposable time can be put to any use allowed by regulations and markets, e.g. to work on the labor market or on farm for above-basic consumables, for savings, for sending a child to college, for investments in landesque capital such as terraces, or to leisure, to build social capital by investing in the community, to join a training course, to migrate out, to give above-basic care to the children and so forth.

FDT is people's freedom to enjoy the present or to invest in the future (*cf*. Alkire, 2006: 246).[39] Relating FDT to some characteristic terms in livelihoods studies, a household's freely disposable time is the basis for its adaptive capacity, its freedoms, its capacity to invest, the cornerstone of its resilience and the negative of its vulnerability.

The particular mixture of FDT spending that households display may be called their FDT profile. An FDT of zero implies that people need all their energies to satisfy their household's basic needs and are trapped in work for bare survival. FDT = 0 is the absolute poverty line in the FDT system. Following Reardon and Vosti (1995) and Carter and Barrett (2006), an FDT above zero (e.g. FDT = 2 h/day) may be necessary for households to engage successfully in out-of-poverty strategies.

The key formula of the FDT system is that for each category that people can spend time or money on, the time/cash integrated time equivalent to satisfy the basic needs equals the time directly spent on it plus the cash spent on it, converted to hours per day through the income per hour. This income per hour comprises all cash income components (wages, profits, remittances, pensions etc.) divided by the time spent on the acquisition of this income. Households can have deficits or surpluses on each category, also expressed in hours per day. The sum of surpluses minus the deficits is FDT.

In order to test if the system could cope with real-world details and surprises, it was applied to complex, peri-urban farming households in India. FDT was assessed as 5.4 and 5.5 hours per day for two poor households, while the median household had FDT = 9.4 and the richest came out at 10.8 hours per day. An example middle-class household in a developed country with three small children was found to have around FDT = 8.8 hours per day and a poor example household in a developed country was found to stand at FDT = 2.3 hours per day.

39 Looking at land degradation issues more specifically, Reardon and Vosti (1995) assert that the criterion for poverty in environment-poverty analysis should be people's "ability to make minimum investments in resource improvements to maintain or enhance the quantity and quality of the resource base". In the same vein, Burger and Zaal (2009) regard farmers' investments in the quality of the land as the key determinant in the bifurcation between the pathways of Malthusian degradation and neo-Boserupian restoration under circumstances of growing land scarcity. Note that for households to really invest in the future, environmental or otherwise, they do not only need the investment capacity expressed in FDT plus the necessary knowledge, but also a motivation to invest, which will depend largely on expected yields and risks of the investments. In land use decisions, this translates to a high degree to the presence of good soils and markets (Burger & Zaal, 2009; Hyden *et al*., 1993) but also to risk-reducing institutions (e.g. Rahman *et al*., 2008).

Poverty indicators may be classified in four directions. First, poverty lines may be set as absolute or as relative to the rest of the population, in which the absolute poverty lines may be international standards or nationally or locally differentiated (Ellis, 2000). Second, poverty indicators may either aim to describe the situation of single households ('micro') or of distributions over larger wholes such as nations ('macro') (e.g. Foster *et al.,* 1984; Grosse *et al.,* 2008). Third, poverty indicators may express either some form of objectified poverty or people's own perceptions, either purely subjective (Rojas, 2008) or 'intersubjective' as in participatory wealth ranking (Van Campenhout, 2006). The FDT concept obviously belongs to the absolute/micro/objectifying group in this spectrum, along with the well-known income, expenditure and cost-of-basic-needs (CBN) indicators. The fourth direction in which poverty indicators can be classified is the distinction between mono-indicator and 'multi-dimensional' poverty concepts (Kakwani & Silber, 2008). Along that line, FDT is found in an intermediate position. It is obviously a mono-indicator system but on the other hand, the basic needs that it can incorporate have a much wider range than the usual monetary indicators, because time-related basic needs (needs for care, social obligations, participation in society etc.) are included; see Table 5.1 as an example.[40]

The relationships between FDT and the other members within the absolute/micro/objectifying/mono-indicator group are easy to investigate, as shown already in Tables 5.2 and 5.3. As are all the indicators of this group, FDT may easily be lifted to the macro level, forming an 'FDT head count' or any other FDT index. With respect to subjective poverty, FDT might show a better correlation with subjective poverty than do the other members of the objectifying group, because of its inclusion of ba-

[40] Another dimension hardly found in the literature is that poverty assessment may be fully empirical or more potential. The FDT system as developed here is of a purely empirical nature, based on the household's actual behavior. Households are not always efficient FDT maximizers, however, e.g. when they choose to spend much time with their children or grow much of their own food *in lieu* of heading full-steam to the most attractive labor market and hire a nanny. The empirical FDT will therefore tend to be somewhat lower than a potential FDT that would be calculated if all 'inefficiencies' would be removed. Potential FDT assessment would result in a more foundational poverty assessment, e.g. if potential FDT = 0, people cannot improve their situation anymore by fine-tuning the efficiency of their behaviors. The same difficulty, by the way, is encountered by the monetary indicators. Households that voluntarily grow their own food are assessed as poorer (less income) than if these households had worked more on the labor market and bought their vegetables in the supermarket. The income analogue of potential FDT is potential income, i.e. what a household *could* earn if it would put all its energies to maximum income generation.

sic needs that are primarily written in time terms (Tiwari, 2008; Floro, 1995). Another promising line for further research is the degree to which FDT might capture important aspects of multi-dimensional poverty in a single indicator.[41] In fact, studies may be designed to assess a wide array of indicators (monetary, FDT, subjective, relative and multi-dimensional) by means of single interviews.

Being a single quantitative measure, FDT is highly suitable for comparisons over places and over time, e.g. to compare nations or to monitor trends. Moreover, a focus on poverty is only one extreme in the whole array of possible applications of the FDT concept. For the rich, the poor and any household in-between, FDT can be used, for instance, in scenario studies, e.g. on (a) the effects of different livelihood strategies (*cf.* Table 5.1), (b) the effects of shifts in prices, incomes or social assistance levels, (c) the effects of time-saving support, e.g. when wells are drilled close to homes or when solar cookers supplant long hours of firewood gathering, (d) the impact of shifts in household-level care needs due to childbirth or HIV/AIDS, and many others. Other FDT applications may work the other causal way around, *i.e.* studying the effect of changes of FDT on, for instance, investments in education, sustainable land use or out-of-poverty action. Another avenue for further research is that FDT may be differentiated between household members, e.g. male and female.

Finally, a note on the universality of FDT. As said, the FDT system is *applicable* to all types of households in all types of circumstances. This does not imply, however, that the *value of* one hour of FDT is the same for all households in all circumstances. Even though time may to a high degree to be said be a universal good, the actions that households may undertake with this time and the effectiveness of these actions will vary much. One element of this has already been acknowledged in this chapter, stating that the degree to which FDT may be converted into cash depends on the local labor market and the household's position on it (e.g. skills). If the household has not relevant skills yet, it may have to invest its FDT first into skills acquisition – but what if there is no accessible

[41] FDT will always remain a broad economic indicator, that may represent economic well-being and the basis that economic well-being may form for non-economic aspects of well-being such as health, reputation or the quality of friendships. In the same broad sense, also poverty is an economic concept. Equating poverty to a lack of total well-being is nonsensical, both subjectively (Tiwari, 2008) and objectively, as if the rich cannot be unhappy or moderately poor people cannot live a full life. The latter is illustrated by Rojas (2008) who first goes to great theoretical length to equate poverty with lack of life satisfaction in all dimensions, and then goes to great empirical lengths to show that this is untenable.

market for skills acquisition either? In fact, it may be said that the transformation of FDT into any kind of output depends on many factors in the local economic and cultural landscape and the household's position in it. The analogue with the monetary indicators is that it is good to have a system of universal applicability to assess incomes but then, the value of what a household can actually do with one dollar still varies much. How much time, for instance, can one dollar buy? Some questions for further research concerning the value of FDT have been put already in the foregoing, e.g. on the effect of FDT on investments and the effect of prices on FDT.

In the present chapter, most emphasis has been put on the detailed version of the FDT assessment system. As the simplified protocol has indicated, lean versions of FDT assessment are feasible as well, and intermediate choices can be made. In an overall methodology, broad quickscans can be mixed with a smaller number of in-depth assessments in order to enhance empirical quality within budget limits (Lanjouw & Lanjouw, 2001). For international and comparative work with FDT, it is important that studies work with a comparable set of basic needs categories and levels.[42]

All in all, we hope to have shown that the Freely Disposable Time concept is a promising avenue for further investigation, combining as it does the conceptual rigor and comparability of single-parameter livelihood indicators with the empirical detail and groundedness of multidimensional approaches. Since FDT captures household capacity to invest in the future, FDT assessment can play a role in many research and policy contexts.

Acknowledgement

The data were gathered in the framework of the project "Treatment of water for irrigation and potable use (TIPOT)" (www.qub.ac.uk/sites/TiPOT) co-funded by the European Union. We thank the people of Kashimpur for their kindness and patience. We thank the Ramakrishna Vivekananda Mission, Calcutta, India for its support, and two anonymous reviewers for their insightful comments.

[42] To a large extent, equality in basic need assumptions is more important than exact empirical grounding. FDT is sensitive, for instance, to sleep and self-care requirements of humans. Setting the basic need at 8 or at 9 hours per day makes a full hour difference in the FDT. Apart from what is actually true or not, it is important that FDT studies make the same choice.

References

Alkire, S. (2002). *Valuing freedoms*. Oxford: Oxford University Press.

Alkire, S. (2006). Needs and capabilities. In S. Reader (Ed.), *The philosophy of need* (pp: 229-251). Cambridge: Cambridge University Press.

Bardasi, E. & Wodon Q. (2006). Measuring time poverty and analyzing its determinants: Concepts and application to Guinea. *Economics Bulletin,* 10(10), 1-7.

BLS, Bureau of Labor Statistics (1997). BLS Handbook of methods. http://www.bls.gov/opub/hom/homtoc_pdf.htm

Burger, K. & Zaal, F. (Eds.) (2009). *Sustainable land management in the tropics: Explaining the miracle*. Ashgate Publishers.

Carter, M. R. & Barratt, C. B. (2006). The economics of poverty traps and persistent poverty: An asset-based approach. *Journal of Development Studies*, 42(2), 178-199.

Chambers, R. & Conway, R. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century. IDS Discussion Paper*, No. 296. Brighton: Institute of Development Studies.

Chandrasekhar, C. P. & Ghosh, J. (2003). The calorie consumption puzzle. The Hindu Business Line, Feb.11.

Ellis, F. (2000). *Rural livelihoods and diversity in developing countries*. Oxford: Oxford University Press.

Eurostat (2001). *Economy-wide material flow accounts and derived Indicators: A methodological guide*. Luxembourg: Statistical Office of the European Union.

FAO/WHO/UNU (1985). *Energy and protein requirements. World Health Organization Technical Report Series* 724. Geneva: World Health Organization.

Floro, M. S. (1995). Economic restructuring, gender and the allocation of time. *World Development,* 23(11), 1913-1929.

Foster, J., Greer, J. & Thorbecke, E. (1984). A class of decomposable poverty measures. *Econometrica*, 52(3), 761-766.

Giampietro, M. (2004). *Multi-scale integrated analysis of agroecosystems*. Florida: CRC Press.

Gomiero, T. & Giampietro, M. (2001). Multiple-scale integrated analysis of farming systems: The Thuong Lo Commune (Vietnames uplands) case study. *Population and Environment, 22*(3), 315-352.

Grosse, M., Harttgen, K. & Klasen, S. (2008). Measuring pro-poor growth in non-income dimensions. *World Development,* 36(6), 1021-1047.

Grünbühel,C. M. & Schandl, H. (2005). Using land-time-budgets to analyse farming systems and poverty alleviation policies in the Lao PDR. *International Journal of Global Environmental Issues, 5*(3/4), 142-180.

Hagenaars, A. & De Vos, K. (1988). The definition and measurement of poverty. *The Journal of Human Resources,* 23(2), 211-221.

Hobbes, M. (2005) Material flow accounting of rural communities: Principles and outcomes in South East Asia. *International Journal of Global Environmental Issues, 5*(3/4), 194-224.

Hussein, K. (2002). *Livelihoods approaches compared: A multi-agency review of current practice*. Department for International Development, Overseas Development Institute, UK: Finesse Print.

Hyden, G., Kates, R. W. & Turner, B. L. (1993). Beyond intensification. In B. L. Turner, G. Hyden & R. W. Kates (Eds.), *Population growth and agricultural change in Africa*. (pp. 410-439). Gainesville: University of Florida Press.

Kakwani, N. & Silber, J. (2008). Introduction: Multidimensional poverty analysis: Conceptual issues, empirical illustrations and policy implications. *World Development*, 36(6), 897-991.

Lanjouw, J. O. & Lanjouw, P. (2001). How to compare apples and oranges: Poverty measurement based on different definitions of consumption. *Review of Income and Wealth*, 47(1), 25-42.

Matthews, E., Amann, C., Bringezu, S., Fischer-Kowalski, M., Hüttler, W., Kleijn, R., Moriguchi, Y., Ottke, C., Rodenburg, E., Rogich, D., Schandl, H., Schütz, H., Van Der Voet, E., & Weisz, H. (2000). *The weight of nations: Material outflows from industrial economies*. Washington: World Resources Institute.

Pastore, G., Giampietro M., & Ji Li. (1999). Conventional and land-time budget analysis of rural villages in Hubei province, China. *Critical Reviews in Plant Sciences, 18*(3), 331-357.

Rahman, S. A., De Groot, W. T. & Snelder, D. J. (2008). Exploring the agroforestry adoption gap: Financial and socioeconomics of litchi-based agroforestry by smallholders in Rajshahi (Bangladesh). In D.J. Snelder & R.D. Lasco (Eds.), *Smallholder tree growing for rural development and environmental services* (pp. 227-243). Dordrecht: Springer.

Ravallion, M. (1994). Measuring social welfare with and without poverty lines. *The American Economic Review, 84*(2), 359-364.

Ravallion, M. & Bidani B. (1994). How robust is a poverty profile? *The World Bank Economic Review*, 8(1), 75-102.

Reader, S. (2006). Does a basic needs approach need capabilities? *The Journal of Political Philosophy*, 14(3), 337-350.

Reardon, T., Crawford, E. & Kelly, V. (1994). Links between non-farm income and farm investment in African households: Adding the capital market perspective. *American Journal of Agricultural Economics, 76*(5), 1172-1176.

Reardon, T. & Vosti, S. A. (1995). Links between rural poverty and the environment in developing countries: Asset categories and investment poverty. *World Development*, 23(1), 1495-1506.

Rojas, M. (2008). Experienced poverty and income poverty in Mexico: A subjective well-being approach. *World Development*, 36(6), 1078-1093.

Romero, M. R. (2006). *Investing in the land: Agricultural transition towards sustainable land use in the Philippines forest fringe*. Unpublished doctoral dissertation, Institute of Environmental Sciences, Leiden University, Leiden.

Sen, A. K. (1981). *Poverty and famines: An essay on entitlements and deprivation*. Oxford: Clarendon.

Sen, A. K. (1987). *The standard of living*. Cambridge: Cambridge University Press.

Sen, A.K. (1999). *Development as freedom*. New York: Knopf Press.

Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis. IDS Working Paper*, No. 72. Brighton: Institute of Development Studies.

Shelley, K. J. (2005). Developing the American time use survey activity classification system. *Monthly Labour Review,* June 2005.

Singh, N. & Gilman, J. (1999). Making livelihoods more sustainable. *ISSJ 162/1999. UNESCO.* Oxford: Blackwell Publishers.

Stewart, F. (1985). *Basic needs in developing countries.* Baltimore, MD: Hopkins University Press.

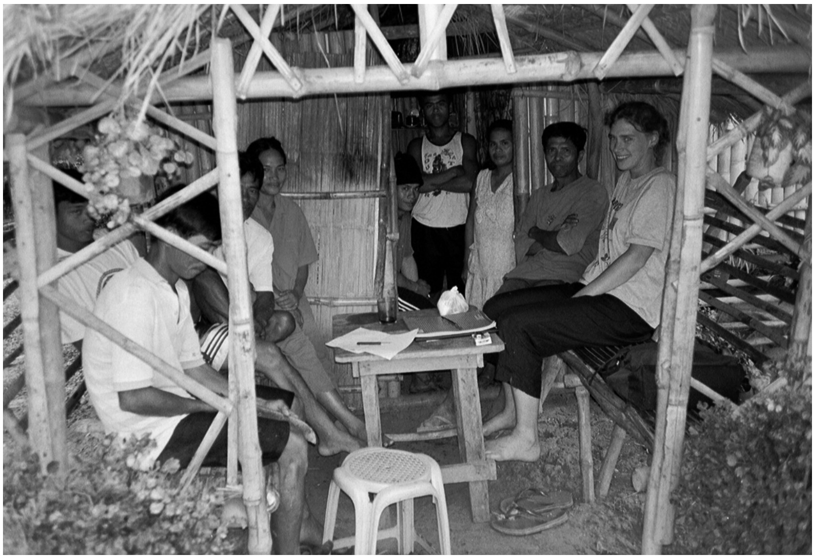
Streeten, P. P. (1979). Basic needs: Premises and promises. *Journal of policy modeling,* 1, 136-146.

Streeten P. P., Burki S. J., ul Haq, M., Hicks, N. & Stewart F. (1981). *First things first: Meeting basic needs in developing countries.* New York: Oxford University Press.

Tiwari, M. (2008). Poverty and wellbeing at the 'grassroots': How much is visible to researchers? *Social Indicators Research,* Online First, DOI 10.007/s11205-008-9316-6.

Van Campenhout, B. F. H. (2006). Locally adapted poverty indicators derived from participatory wealth rankings: A case of four villages in rural Tanzania. *Journal of African Economies,* 16(3), 406-438.

Wodon, Q. (1997). Food energy intake and cost of basic needs: Measuring poverty in Bangladesh. *Journal of Development Studies,* 34(2), 66-101.



Group interview in Masipi

6

Discussions on Land Use Studies and Development Indicator Design

This chapter provides a number of discussions that draw on material of the preceding chapters together. Section 6.1 starts out with three substantive discussions and conclusions based on an overview of land use patterns and indicators found in the villages studied in Chapters 2, 3, 4 and 5 and the explanations underlying them. They can be read as three separate essays. In Section 6.2, the utter simplicity of the explanation of land use in Chapters 2 and 3 triggers a critique on the dominant methodology in the land use branch of rural development studies, adding to a theme set by Overmars et al. (2007) and touched upon already in Chapter 1. Section 6.3 concludes the chapter with the exploration of expanding Freely Disposable Time (FDT) to a community-level indicator. This indicator serves as an outlook on a line of further research.

6.1 Three land use themes

Table 6.1 gives an overview of the land use situation in four villages studied in the thesis: Nalang in Laos (Chapter 4), Tat in Vietnam (Chapters 3 and 4), Dy Abra in the Philippines (Chapters 2 and 4) and Kashimpur in India (Chapter 5). The section starts out with a reflection on classification and indicator-making, based on one column in the Table. The second theme is picked up through an overview of the Table as a whole, and ends with a reflection on the status of land use theories. The third theme is again triggered by a single column in the Table, and discusses the need of adequate terminology in rural development.

Column 2: phases of agriculture

In the second column of the Table, the villages have been typified according to the classification of Todaro (1994: 304), who sketches the 'standard' course of agricultural development as a pathway of ongoing commercialization (incorporation in terms of the indicators of Chapter

4). The first phase then is subsistence agriculture (1), after which follows a phase of 'diversified' agriculture (2) in which subsistence activities have become mixed with market-oriented crops. Finally, farmers enter into a phase of fully commercial (3) agriculture in which they specialize on the most profitable crop in their context.

Already the second column on its own gives rise to some reflections. Nalang is certainly on the 'subsistence' extreme here but the art of living in Nalang (which is a place like any other where people like to be able to pay school fees and bus tickets) is to add a good cash earner to the subsistence basis. Since this crop is only for cash there is no need to spread risks and people can choose for the one best option (which happened to be cucumbers in Nalang). In other words, this is more like making a step directly from Todaro's stage 1 towards Todaro's phase 3, rather than first through stage 2. The people in Tat, on the other hand, are fully in Todaro's 'diversified' category (phase 2), growing as they do many crops, raising livestock and extracting many products from the forest, blended into an intricate farming system for market and subsistence. But can this be regarded as a phase, i.e. something on the way of developing towards phase 3? The analyses of Chapters 3 and 4 show

Table 6.1 Overview of land use in four Asian villages

	PHASE in Todaro's (1994) classification	*Natural resource extraction*	*Material intensity*	*Food security risk*	*Long term sustain.*	*Population density*	*Market access*	*Thünian zone*
Nalang (Laos)	1 (+ 3)	High	Low	Low	+	Low	Medium	Ext.
Tat (Vietnam)	2	High	High	High	-	High	Medium	Ext.
Dy Abra (Philippines)	3 (+ 1)	High	Low	Medium	0	Medium	Medium	Ext.
Kashimpur (India)	3 (+ 1)	Low	Medium	Medium	+	High	Very good	Int.

The second column positions the villages in Todaro's (1994) classification, with 1 = subsistence phase, 2 = diversified phase and 3 = commercial phase. The third column refers to extraction of the natural resources without people investing in the maintenance of the resource, such as hunting, logging, gathering firewood and forest products and fishing. The fourth column overviews the amount of material inputs in the agricultural activities. The fifth column refers to the potential autarky indicators of Chapter 4 that denote the dependency on external markets for food security. The sixth column gives an estimation of the long-term sustainability of the land use systems, based on fieldwork knowledge. Explanation of quantifications: 0 = neutral, + = positively and - = negatively corresponding with long term sustainability. The seventh column summarizes the relative population densities. The last two columns refer to the markets. The first summarizes the access to markets and the last column gives the prediction of land use intensity as envisaged by the theory of Von Thünen of land use zones around metropoles. 'Ext.' refers to the extensive zone and 'Int.' refers to the intensive zone.

that Tat is in a dead-end street rather than on a development pathway. The people of Tat are exploiting each and every niche in their environment to rock bottom. And since they live in a diverse environment, this exploitation is diverse. The village of Dy Abra, on the other hand, falls nicely within Todaro's category of commercial/specialized agriculture. It is noteworthy, however, that Dy Abra did not arrive there through a 'diversified' phase. The village had a subsistence focus when, in the late 1980s, it fell *en block* for the yellow corn traders who brought input credits and promises of a stable cash crop market (Hobbes and Kleijn, 2007). Kashimpur village, finally, does not appear to fit into Todaro's classification at all. Lying on the outskirts of the Calcutta metropolis, it grows everything the city needs, from rice to gourds to potatoes to jute to bell peppers and so on, fully commercial but in a wide variety.

This leads to a conclusion that must be quite familiar to many rural development scientists. Types of farms and types of villages do exist, and making typologies can make much scientific sense; see for instance the farming styles concept in section 6.2, the farming intensity indicator of Boserup (1965), or the 'space-based, labor-based, capital-based' classification of section 4.3. This is restricted to a *descriptive* sense, however. Any temptation to put the types on a development sequence, as if farmers logically or usually go from one 'phase' to the other, must be resisted because it can be downright misleading.

The Table as a whole and the status of land use theories

The last three columns of Table 6.1 depict the position of the villages in terms of the spatial/temporal core gradient of two land use theories, discussed in Chapters 2 and 3. One is the population density gradient of the Malthusian/Boserupian theory group, which relates rural development (or disaster) primarily to the effects of rising population density. The second is the proximity-of-markets gradient of Thünian theory that relates rural development primarily to the penetration of urban markets and culture into their rural hinterlands. The third is the level of land use intensity that could be expected, intuitively, from the village's position on the Thünian gradient.

In the population density column, there are two 'highs' (Tat and Kashimpur). Both are interpretable in terms of the population-centered theories, albeit quite different ones. Tat is a Malthusian place, with the population wedged in a narrow valley floor between steep mountain slopes, and the unsustainable land use system heading for a crash. The strong ethic identity of the people in Tat is an obstacle to out-migration, so that a fully Malthusian scenario of ever-deepening degradation and poverty is likely to develop. The situation in Tat looks in many respects like the mountainous 'areas of refuge' in Africa such as the Mandara mountains in Cameroon (Zuiderwijk, 1998), where people managed to develop intricate farming systems that could sustain high numbers of people. When population densities rose even higher, many of these areas escaped from Malthusian disaster because the surrounding plains were pacified by the colonial powers, which allowed the mountain people to settle there. Other areas were saved when rising population densities combined with a strong expansion of nearby urban markets and an influx of urban ideas and capital, creating, for instance, the seminal 'miracle of Machakos' (Zaal and Oostendorp, 2002). No such favorable contextual factors are visible for Tat, however.

Lying close to Calcutta, Kashimpur presents a different endpoint of rising population density. It is a product of Boserupian 'involution' (e.g. Geertz, 1963), where people go through a long process of ever-increasing labor intensity on ever-smaller plots, coupled with a slow but irrevocable decline of labor productivity – but without system crash. The proximity of the city is probably decisive here. It forms a secure market for a wide variety of crops with which every micro-niche in the land use system can be filled; it can absorb excess labor and supply off-farm income; and it guarantees relatively high land prices so that farmers are not immediately at rock bottom if they sell out.

Table 6.1's columns on natural resource extraction, food security and especially long term sustainability do point at this fundamental difference between Tat and Kashimpur. This is one of the reasons why assessing these elements is essential for any village-level analysis. Another, more indirect way to distinguish Tat from Kashimpur is to compare the actual intensity of land use (column 4) with what it should be according to Thünian (geographic-economic) logic, i.e. the village's position in a national-level Thünian zonation of extractive, extensive and intensive land use (column 9). Tat shows up as an anomaly in this respect. There is no Thünian logic for land use to be intensive, and yet it is. This points at a community for which it is impossible (in this case due to physical and ethnicity reasons) to spread out and find an extensive land use equilibrium with the environment.

It may be noted that in this analysis, land use theories such as the Thünian and Boserupian perspectives on agricultural intensity and development have been used without any reference to their actual truth content. Are these theories true or not? (And, by the way, should not all 'grand theories' be rejected to begin with?) Taking 'common property theory' (or the 'tragedy of the commons' as it is usually known in the environmental community) as his point of departure, Brox (1990) recommends to stop the endless bickering about the truth content of this and any other grand theory. In stead, he proposes to regard these theories as schemes that lie fully in the *methodological* realm. They can then be applied as analytical tools to find out which part of the studied world complies with the theory and which part of the studied world deviates from the theory, and then ask why. This is exactly what I have done here with Thünian theory, wondering why Tat's land use intensity deviates from the Thünian expectation. The same was done in Chapters 2 and 3 with respect to the explanation of land use in the Philippines and Vietnam case studies. (All the while, it may make sense to continue discussing the theories' truth content, but that is quite another matter.)

Column 3 and the need of adequate terminology for rural development

This section ends with a discussion of the units of analysis in rural development. Do we study farmers, land users or people's livelihood activities? A discussion on the need of adequate terminology follows.

Column 3 of Table 6.1 displays the level to which the inhabitants of the villages rely on the extraction of natural resources (mainly logging and gathering of non-timber forest products) in addition to their farming (arable and livestock) activities. As shown in Chapters 2, 3 and 4, the contributions of the extractive activities to people's livelihoods are substantial. In terms of biomass flows, the share of extracted products in the village total is even greater. It is only in the peri-urban village of Kashimpur that extraction (mainly of some firewood) drops to a minor component (Chapter 5).

Rural areas in developing countries are supposed to be populated by "farmers". But where are they, really? Only the inhabitants of Kashimpur, the least rural of our four villages, can be said to be farmers in the way they use the land. All the others are land users involved in a mixed farming/extraction land use system.

Countless are the examples of farmers that have been given wheelbarrows to help them haul manure from the stables to the fields, and then immediately put the wheelbarrows to work to start a petty trade and move out of farming as quickly as possible. Because, why farm? Being a taxi driver can be so much more prestigious, comfortable, secure and profitable. It is very much a Western notion, rooted in our romantic view of the countryside and our desire that an occupation ('beroep', in Dutch) should somehow also be a calling ('roeping', in Dutch) to assume that people who are seen engaged in farming activities also want to be a farmer and define themselves as such.

True, many people also in the developing countries do comply with this Western notion to some degree. In Brazil, being cattle rancher on an unending *latifunda* is truly a calling (Cleuren, 2001). In the Philippines, many older land owners who invest in trees and terraces express that leaving a healthy farm to the next generation is something intrinsically good (Romero, 2006). And in Africa, many densely populated areas are regions of "deep attachment" which is a factor that greatly supports people's propensity to invest in the land (Hyden et al., 1993). For so many others, however, farming is just something you happen to do to make a living at the place where you happen to be, exchangeable with any other thing you might do or place you might move to. In my field notes of a case study among the Pala'wan indigenous people from the uplands of Palawan (Philippines), respondents declared that their great dreams were (1) a road to the plains and (2) education for the children so that these could get non-farming jobs. Calling *all* these rural dwellers "farmers" loads their land-based activities with unjustified normative connotations and confines our vision on their motivations. In fact for many millions of rural dwellers, any sensible out-of-poverty strategy is an out-of-farming strategy.

Thus, for general use, the terms of 'land user' and 'land use system' are superior to the terms of 'farmer' and 'farming system' for the two reasons of precision (including as they do people's non-farming land use types) and freedom of normative loading (a land user is someone who uses land, without implicit connotations of that this should somehow be a person's identity or desire).

Because of the dominance of the 'farming' perspective on the rural areas, the enormous importance of non-land based incomes to rural dwellers has been slow to gain recognition in the rural development discipline. One example is remittances. The relaxed and sustainable nature of Cape Verdean agriculture, for instance, may have to do less with Cape Verdean soils and markets than with the constant influx of remittances from Cape Verdeans abroad, massively converting their *soudade* into cash flows. As noticed already in Chapters 2 and 3, non-land incomes, either self-generated or received from other areas, play a key role in many land use decisions, e.g. enabling people to invest in the land and switch to sustainable land use. This forms a methodological reason to broaden the perspective from 'land use' to the whole of rural people's livelihood activities. As has been explicated in Chapter 3, in order to arrive at a decision with respect to any livelihood activity (e.g. to plant rice), people tend to compare the merits of that option with those of others out of, potentially, their *whole* livelihood repertoire. In other words, a grounded explanation of any livelihood activity (land or non-land) requires insight in the whole of people's livelihood repertoire.

This can be said to be the achievement of the Livelihoods Approach, discussed in Chapter 5. It focuses the rural researcher on this whole array of what rural people can do, based on the full array of their assets and capabilities ('capitals'). To the outsider of rural development studies, all this may sound like a vague play of shifting words. There is a very basic sort of progress, however, in approaching rural areas as places lived in by rural dwellers engaged in a rich array of livelihood activities rather than as places lived in by farmers engaged in farming systems.

If we see people doing what they are doing (farming, other land use, other livelihood activities), how will we call that whole of their activities? At this juncture, it serves to note the general drive of rural development scientists (and anthropologists etc.) to defend 'their' farmers against the arrogance of corporations and governments that depict third world farmers as stupid, uninterested in the future, the root cause of all underdevelopment and unsustainability problems, i.e. as people that may only be forced or at best 'uplifted into' the solutions thought out by the development professionals. Countless are the works of rural development scientists devoted to the elucidation of local knowledge systems, the great capacities of farmers to respond to change, methods to do respectful research with farmers, and so on, and quite justifiably so (e.g. Chambers et al, 1989; Van der Ploeg, 1991; Warren et al., 1995; Scoones et al., 2007; Mortimore, 1998).

A less fortunate outcome of this phenomenon has been that the 'wholes of what people are doing' tended to become described in respectful terms. One example is when Blaikie and Brookfield (1987) wanted to move away from the term of 'farmer' for the reasons I just described, they did not choose for the neutral 'land user' but for the respectful 'land manager' (*cf.* Walker, 2005). Who, however, in our four villages are land managers? In Kashimpur, probably, all land users may be called that way, handling as they will tend to do their tiny lots with great care. In Dy Abra, the home gardens may probably be called 'managed', as may be the corn fields to some extent. As for the forest, however, people will just run in and log as many trees as they can as long as the weather is good and the authorities look the other way. The same picture holds for Tat, where people overall are involved in maximum exploitation rather than management. Blindly labeling all this as land management is self-deceiving.

In the Sustainable Livelihoods Framework (see Chapter 5), the whole of livelihood activities that people carry out is called their 'livelihood strategy'. The same criticism of misplaced respect applies here. Even if people could be assumed to have strategies to some extent, it is nonsensical to assume that *what they happen to do during a day* is equal to that strategy, without any place for contingency, inconsistency, ephemeral aims, mistakes, escapism and all those things that make humans human. For the same reasons, we should refrain from the term 'livelihood system'. Purely descriptive terms such as 'livelihood profile' (cf. the 'FDT profile' of Chapter 5) could be used to characterize livelihood differences or dynamics.

If we define development as the improvement of livelihoods, rural development may now be said to be about the improvement of the livelihoods of rural dwellers that may display various livelihood profiles. The degrees to which these people or livelihoods may be described as 'farmers', 'land use systems', 'managers' or 'strategies' are open questions to be addressed empirically (if of any interest at all).

6.2 Rational choice and the wave of inductivism

This section offers an expansion of the discussion on indicators, frameworks and theories already touched upon in Chapter 1.

Chapters 2 and 3 have shown that a fully satisfactory explanation of the land use decisions of the land users in the studied villages is reached by the rule that the farmers first fully exploit their most profitable option, then the next most profitable, and so on. In others words, rational choice theory offered a fully adequate explanation. In retrospect, this is nothing surprising. Though rational choice has been criticized for a myriad of (often good) reasons (e.g. Elster, 1985; Green and Shapiro, 1996), this attack has not made any real inroads into the domain where rational choice theory was originally designed for in the 1950s (e.g. Friedman, 1953), which was the aggregate choice of actors in market situations. Aggregate choice is obviously what has been the focus of Chapters 2 and 3; nothing there is about the particular choices of particular farmers. So, what we in fact find is that the land use choices of the land users are, to them, economic choices. This, as said, is not surprising.

Why is the prevalence of rational choice, with all the advantages of good explanations and straightforward predictions that it brings along, not found by so many more land use studies? It is quite unlikely that land use choice for all land users in the world except the ones living in the villages of Chapters 2 and 3 would be un-economic. Non-economic considerations might prevail on some land indeed, such as people's front gardens or multi-purpose home gardens, or sacred forest, or land in conflict situations and suchlike (Pugh, 1996). Other land may not have been touched significantly by human decision-making at all yet, such as tropical forest or desert. But for regular agricultural land, i.e. land used by actors that somehow make a living off this land, why should not all this land be used with principles of rational choice prevailing?

The 'standard' methodology of explanatory land use studies in developing countries has the following general structure (see Overmars et al., 2007: 440). First, some village or region is selected, along with some dependent variable, e.g. crop choice or investment intensity. Then, a number of 'candidate' explanatory (independent) variables are listed, such as the age of the head of household, the off-farm income and the soil type. Subsequently, heads of households are interviewed to estimate these variables for their household and land. Then follow a lot of correlations between the independent and the dependent variables. Many of these correlations will be statistically insignificant, but some of them may not, indicating that, for instance (e.g. Romero, 2006),

- older household heads have a little more propensity to plant corn
- sandy fields are a bit less under corn
- sloping fields are also a bit less under corn
- households with a somewhat higher income have a higher propensity to also plant some trees.

Jointly (in some composite formula that basically adds up the factors), these factors then explain a certain percentage of the variance of the dependent variable.

What have we learned here? We have not learned, for instance, that farmers plant corn simply because it is the most profitable crop in this region, except when the soil is too sandy or too sloping. We have not learned that trees here are simply the most profitable long-term investment, so that farmers with some cash to spare tend to plant them. Because prices and yields of crops are invariable over the region, they cannot be variables in the analysis, and the basic (rational choice) explanation of land use is not accessible with this method. As a result, the method can only reveal some hardly relevant *variations on* the basic explanatory scheme, and not what in fact the basic explanatory scheme *itself* is.

What we have looked at here, methodologically, is a standard case of statistical *induction* in land use studies, as prevails in econometrics and GIS-based geographic work (Overmars and Verburg, 2005). Inductive methods start with observations of reality and then try to find regularities in these data. These regularities are then declared to be a general pattern. Contrarily, deductive methods follow the "empirical cycle" where hypotheses are deducted from theories or causal models and then tested with observations of reality that can falsify or verify the theory or causal model. Overmars et al. (2007) give a more subtle gliding scale between the purely inductive and deductive extremes, but more importantly here, they add proof that working on the same question and the same region, a simple deductive (rational choice) model can generate land use predictions with the same statistical power as inductive analysis. To this they add that, due to its groundedness in causal theory (e.g. a rational choice model), deductively gained explanatory knowledge is truly causal knowledge and therewith intrinsically superior to explanatory knowledge that is inductively arrived at. Besides, deductive results are more relevant for predictive purposes because contrary to the inductive result, the deductive model can predict responses to new phenomena (e.g. new crops). Overmars et al. (2007) conclude that land use studies "should become more deductive". In the same vein, Pugh (1996) concludes that land use studies should primarily follow deductive approaches to the extent that land use is economically driven – which, in my opinion, is a very large extent.

Others have a more outspoken opinion on the wave of inductivism. Bulte (2008) discusses the "econometric [i.e. inductive] approach to cross-country studies" that collect and then regress information on many countries' development on a vast number of variables that may explain the variation. It is not difficult to generate correlations in abundance, and it is "a fun way to pass a rainy afternoon" as Bulte adds, but where is the proof of causality? Where is the insight in mechanisms?

With respect to rural development studies, Marsden (2004: 130) states that while the discipline has generated "quite a flurry of rich empirically engaged work" in the last decades, "actual theoretical development has reached something of a hiatus". Rural development is not only about land use, of course, but the land use side of the discipline does contain a number of theoretical frames, such as rational choice theory and the Malthusian, (neo-)Boserupian, common property and Thünian perspectives on land use change (see Section 6.1) that are highly supportive for a deductive turn of the discipline. All these theoretical elements may become the core of interconnected empirical studies and function as focal points for theoretical progress. One example is the concept of farming 'calculi', developed by Van der Ploeg (1991). Calculi are logically coherent modes of reasoning that all have a rational choice basis but focus on different farming goals (e.g. having a healthy and resilient farm versus having a lot on money on the bank). Calculi and their allied 'farming styles' may co-exist for a long time in the same region and are quite relevant when it comes to farmers' responses to market and other opportunities. The types, causes and effects of different farming styles may be studied (and in fact are, e.g. Gerritsen, 1995; Van der Ploeg, 2000; Thomson, 2002) and serve as one of the focal points for deduction-driven progress in rural development studies.

6.3 Community development: expanding the FDT indicator

The FDT indicator developed in Chapter 5 is said there to captures people's freedoms, people's capacity to invest. This suggests – because development can be seen as the results of investments – that some rather direct link must exist between FDT and development. In this section, the potential to use FDT as the basis for a development indicator is explored. The term 'explored' should be taken quite literary here. Contrary to FDT itself, the expanded indicator is only a first result, as yet not scrutinized and untested. The indicator being of the synthetic kind, however, it is based on explicit assumptions and a coherent line of reasoning, which makes it open to conceptual and theoretical progress. In line with the preceding section and the explanatory schemes derived at in Chapters 2 and 3, rational choice theory supplies the underlying model.

Sustainable rural development usually speaks about the world of the relatively poor in developing countries for which development is a prime goal. And, focusing as it does on rural areas, it is to a large extent not only about individual farmers and households but also about rural communities. For an indicator on community development, communities should be defined as the sum-total of the individual households plus the community-level features ('system characteristics'). Examples of the latter are cultural features, the physical infrastructure (roads, community buildings, village irrigation scheme etc.) and the institutional infrastructure (rules and organizations). The importance of the community-level features is well illustrated by Romero (2006), who studied the investments of Philippine farmers in the quality of their land. Even though all these investments were essentially individual actions (making terraces, planting trees etc.), the econometric analysis showed a large influence of the 'village dummies', that is, the village where the household was located, as a factor independent from the household-level factors. In other words, even individual investment actions have a community-level influence. This influence will of course be even greater when investment actions are essentially collective actions, e.g. the improvement of the village road, the restoration of the village irrigation scheme or establishing a village cooperative. For this reason, we take it that rural development is *community* development, defined as the economic betterment of individual households and community-level features *together*, in some mixture where either the individual or the community level may predominate.

How does economic betterment come about? It may be due to luck, e.g. when terms of trade improve. Or it may be due to external support, e.g. development aid. The most general and fundamental development, however, is internally rooted, i.e. based on people's own agency and investment. It is on this type of development that this section will focus.

The investments of rural people and rural communities may be of many kinds. They are individual or collective actions aiming at physical, cognitive or institutional improvement, with typical examples of planting trees, making terraces, learning to improve nutrient management, building a primary school, sending children to secondary school, building a village cooperative or restoring a village irrigation system. Investments such as these may be unsuccessful. Newly built terraces may wash away, the newly established village council may be usurped by the state, or the new irrigation scheme may become infested with malaria mosquitoes. On the whole, however, rural communities are not stupid and not inclined to take much risk. We may take it, therefore, that on the community level and over time, investments such as these will contribute to development indeed. We may say, therefore, that the higher the investment level (e.g. in dollars or hours per year), the steeper will be the development curve. In other words, investment level is associated with *rate of development*. If we add the assumption that all developmental investments will have basically the same developmental effect (the same internal rate of return, the economists would say)[43], we end at the equation that is the basis of the community development indicator:

- Level of investment = rate of development

Sometimes, investments generate instantaneous results. Paying a contractor to construct a drinking water well, for instance, may immediately create better child health and higher female FDT (due to the reduction of water fetching time). Quite often, however, investments take time to pay out, e.g. when planting trees, creating a village lending scheme or send-

[43] It could also be taken that if developmental actions are collective actions, social capital of the community should be factored in. If social capital is low, investment in collective actions does not result in much development. In the present section, we work the other way around, with social capital factored into the investment concept. If people spend energy (FDT) on collective action and social capital is low, the resulting actual investment will be low. Either way, social capital enters into the final result (the 'maxDEVrate' formula), and in the same manner.

ing a child to college. This time lag may be safely ignored, however, if we look at a somewhat longer term and on a collective level such as a village. On the village level, one household will start in one year and another in the next, so that the total effect will be evened out over the years. In other words, even though the time lag may be important for specific actions of individual households, a long-term community level indicator may safely work with the basic, 'timeless' equation.

Development is generally supposed to be something good. An important question for the (self-)analysis of a community therefore is: what *could be the maximum* rate of development here, i.e. the maximum investment level?

The key to the answer has been given already in Table 5.1 of Chapter 5. One column there depicts an actor who lets go of all above-basic leisure, housing, care giving, food etc. and spends all his freely disposable time (FDT) on income generation to create a largest possible cash surplus (i.e. cash above what is needed for basic needs). This cash surplus equals FDT **x** maxEFF, in which maxEFF is defined as the efficacy (net wage, profit etc.) of the actor's best income-generating activity. Since FDT is written in hours per day and maxEFF in dollars per hour, the cash surplus level is in dollars per day. The whole cash surplus can be spent on developmental investments. In other words, the maximum level of investment is found as FDT **x** maxEFF dollars per day.

Cash surplus generation cannot satisfy all possible development needs. It may be, for instance, that the actor himself or herself has to acquire new skills, which can be realized largely only through the investment of *time* rather than cash. The same 'time route' as opposed to the 'cash route' may come about by the actor's preference, e.g. when wanting to plant one's trees himself rather than paying others to do it. How may this be expressed in monetary terms, so that the time and cash routes become comparable? The general economic answer here is: through the opportunity cost of labor. Investing is the same as foregoing direct consumption. The actor going to school could have spent these hours working. In general terms, the foregone consumption when spending one hour on any activity equals what one could have earned if that hour had been spent working for wage or profit, which is equal to maxEFF in our definitions.[44] In practice, there will always be some mixture of both

[44] This is not one of my favorite assumptions. Would going to a training course in the evening hours indeed have this opportunity cost in reality or in the experience of the actor? In the present explorative phase of the indicator, it serves to accept the assumption, however.

routes, so that we may define a ratio **m**, being the part of FDT with which the cash route is chosen, compared to (1-**m**) that describes the part with which the time route is chosen. The total maximum rate of investment can now be written as

- **m x** FDT **x** maxEFF + (1-**m**) **x** FDT **x** maxEFF

which equals FDT **x** maxEFF for any **m**. In other words, even though the two routes have a quite different appearance for the actors and in the field, the degree to which the one is chosen or the other (**m**) does not make a difference for the overall level of foregone direct consumption, i.e. investment level.

Development should be sustainable. In terms of the previous paragraph, an investment cannot be considered an investment in a better future if the investment itself undermines this future. This holds even if the investors themselves would not be concerned. In other words, this condition expresses the normative position of the outsider, in this case the indicator designer. From the same position, it can be said that external effects of the investments should stay within certain bounds. An example is that if restoration of a village irrigation scheme would have the effect that a downstream community now suffers from severe water shortages, the village action should not qualify as development. A third normative condition concerns quality of life in the community during the investment period. For a single actor and on a short term, it cannot be said that anything would be basically wrong if the actor would spend all his/her FDT on maximally productive work in order to generate and invest as much as possible. After all, the FDT concept guarantees that all the actor's basic needs are still met. For a whole community and on a longer term, however, it would appear that we cannot simply add up all available FDT of the households and then assume this can all be put to maximally productive work. Many children need more than basic care, for instance, and many people cannot work in just any activity. Somehow, some safety margin needs to be built in to guarantee an acceptable quality of life on the community level. In summary, the formulation of this normative aspect is that for investments to be able to classify as developmental, they should lie within acceptable boundaries of risk (on sustainability, health etc.), of external effects (on biodiversity, other communities etc.) and of reduction of quality of life during investment. In the formulas below, we will follow a notation of **!! RISK**, **!! EXT** and **!! QL** to express the notion of 'within acceptable boundaries of risk, external effects and quality of life reduction'.

We can now make the first step to move from the single-household level (with FDT **x** EFF) to the community level, i.e. a sum of households plus the community features. The sum of households first of all generates a sum of FDTs (**Σ FDT**). Because all households have different skills and different access to employment markets (e.g. through private social capital), they all have a different best possible paying job or self-employment (maxEFF). Taking this up in the indicator would make the formula (and the fieldwork) hopelessly complicated however. For quick-scan applications of the indicator, it will make sense to work with one generalized maxEFF for the whole village, e.g. taking the locally general wage for semi-skilled labor as a proxy of the efficacy of any sensible action that people might undertake (on-farm, off-farm, individual or collective). If the indicator would be applied in a more elaborate assessment of development options in a specific locality, we may take a weighted average of the efficacies (wage, profitability) of a number of different but all locally sensible activities, e.g. factory work, basic agriculture or agroforestry.[45] Under these assumptions, the sum-of-households element of the community generates a 'sum-of-households maximum development rate' of **ΣFDT** multiplied by the general or weighted **maxEFF.**

In order to grasp the community-level element (system characteristic) of the community, we first need to introduce a factor **α**, defined as the degree to which an action is a collective action. This factor is 1 for purely collective actions (e.g. restoring the village irrigation system or building a village cooperative) and 0 for purely individual actions. However, in the light of Romero's (2006) finding in the Philippines, purely individual actions may in fact not exist in rural areas in developing countries. Thus, the minimum of **α** might be taken as 0.2 or so. For other actions, **α** can be chosen on an intuitive basis, e.g. based on fieldwork. Success of collective action depends on collective social capital (**CSC**).[46] As the World Bank puts it, collective social capital refers to the norms and networks that enable collective action (http://go.worldbank.org/C0QTRW4QF0). This includes the presence of trust, rules and leadership that enable people to prevent having to build up trust, overcome

[45] If data allow, more differentiation is possible, e.g. distinguishing between household types and action types. If the maxEFF option is only of limited availability, households may be set to cascade down to the next profitable activity, as shown in Chapters 2 and 3 concerning land use options.

[46] Here we follow De Groot and Tadepally (2006) in the explicit distinction between private social capital *sensu* Bourdieu (1986), denoting the resources the actor has access to through his or her social relations with others, and collective social capital *sensu* Putnam (1993) as a characteristic of groups that facilitates cooperation for mutual benefit.

rifts and jealousies, design constitutional and operational rules (Ostrom, 1990) and find leadership from scratch if collective action would be required. In other words, collective social capital can be regarded as the absence of collective action transaction cost. There are several formal and intuitive ways to assess collective social capital (e.g. De Groot and Tadepally 2006, and see the World Bank site above).

In the indicator formula below, **CSC** is built in as another multiplicative factor. This implies that for use in the indicator, the **CSC** factor should be set between 0 and 1. If **CSC** = 1, everything in the village is fully set for the collective action already. There are no transaction cost that subtract from the sum-total of individual capacities. On the other extreme, if **CSC** = 0, collective action is *de facto* impossible even if the sum of individual capacities (**ΣFDT**) would be high; people simply loose all their FDT energies in quarrelling about trust, rules and leadership.

In the formula below, **α** and **CSC** are combined in the form of [1 **-** **α** (1 **- CSC**)]. This relatively complex form is only technical; it prevents unnatural definitions, e.g. that CSC should be put at 0 if collective social capital is high. The formula shows that if **CSC** = 1 ('perfect' social capital), the outcome of the formula is 1 for any **α**, meaning that all FDT can be put to productive work. The same outcome is arrived at if the action is purely individual (**α** = 0). If collective social capital is only half-way good (**CSC** = 0.5) and the action has a collective component of 40 percent (**α** > = 0.4), the portion of ΣFDT that can be put to productive work is [1 – 0.4 (1 – 0.5)] = 0.8 (80 percent). The other 20 percent is dissipated in organizing the collective action component.

The formula of maximum development rate on the community level now becomes:

- **maxDEVrate = ΣFDT x maxEFF x [1 - α (1 - CSC)] !! RISK !! EXT !! QL**

in which:

– **maxDEVrate** [$/day] = maximum development rate = the maximum rate of development attainable by a community
– **ΣFDT [h/day] = the sum of all freely disposable time = total time left after satisfaction of all basic needs of all productive household members and the basic needs of the dependents that accrue to them; see Chapter 5.**
– **maxEFF** [$/h] = the general or weighted efficacy (wage, profitability) of well-productive actions accessible to the households.
– **α** [1] = degree to which an action generating maxEFF is a collective action.

– **CSC** [1] = collective social capital = the degree of absence of collective action transaction cost.
– !! **RISK** = provided the action stays within acceptable risk boundaries.
– !! **EXT** = provided the action stays within acceptable external effect boundaries.
– !! **QL** = provided that quality of life remains on an acceptable level.[47]

This formula represents the conceptually most perfect expression of the community-level maximum development rate. One further step may be advisable, however, that makes the formula less perfect but more substantive. This concerns the !! **QL** element. The element could be replaced by a 'standard' norm that households should be left with at least 2 hours of freely disposable time in order to take care of above-basic life qualities. The time available for productive work would then be reduced to FDT – 2 hours per day. Accepting this arbitrary choice, the !! **QL** element can be dropped and the formula becomes:

- maxDEVrate $= \Sigma(\text{FDT} - 2) \times \text{maxEFF} \times [1 - \alpha\,(1 - \text{CSC})]$!! RISK !! EXT

in which all elements have been defined already.

In these expressions, the !! **RISK** and !! **EXT** operators remain theoretically vague. This should not be really frightening however. If the indicator is applied in specific villages, it will usually be easy to assess if an activity is too risky. Tree planting, regular agricultural work, improved water management or off-farm factory work are very unlikely to have significant risks, implying that the !! **RISK** condition is satisfied. On a higher level of sophistication, the !! **RISK** component may to an important extent be assessed through the rMFA framework elaborated in Chapter 4, especially with respect to food security. Jointly, the rMFA indicators of potential degree of food self sufficiency, actual food autarky and potential food autarky give insight in the short-term and long-term risk entailed in land use options, especially those connected with market failures. Also for rural situations, a simple sustainability assessment may be added, e.g. through the local balances of major natural resource flows, soil nutrients and soil organic carbon. The rMFA of Chapter 4 gives some principles already, and other MFA approaches are available for this purpose too, such as (simplified versions of) Van der Voet's (1996) nitrogen flow analysis or the NUTMON framework of Wageningen University (www.nutmon.org). The !! **RISK** threshold could be set that none of the balances should be significantly below zero, i.e. no sig-

[47] For a single actor and purely individual action, there is only one FDT, $\alpha = 0$ and !! QL may be dropped, so that the indicator collapses into FDT x maxEFF !! RISK !! EXT.

nificant net depletion. The externalities component **!! EXT** may be quite important for rich cities that pollute much and use up much land elsewhere to satisfy their food and energy needs. For most of the communities encountered in rural development studies however, external effects will often be negligible except in obvious cases such as the upstream-downstream impacts of irrigation water consumption or when communities engage in illegal logging or extraction of resources on the territory of other villages, such as Dy Abra and Tat discussed in Chapters 2 and 3.

"The **!! RISK** and **!! EXT** assessments will be more difficult if the indicator would be applied on larger scales or without field knowledge. It may then be chosen to drop the normatively laden development concept from the indicator and rename it as 'maximum investment level' (also in dollars per day):

- maxINVlevel $= \Sigma(\text{FDT} - 2) \times \text{maxEFF} \times [1 - \alpha (1 - \text{CSC})]$

in which:
– **maxINVlevel** [$/day] = the maximum level of investments attainable by a community

and all other elements have been defined already.[48] It should then be borne in mind, however, that investment is not development *per se* or acceptable on other accounts. The community's actions may now include, for instance, soil mining, biodiversity depletion or groundwater over-exploitation.

One of the advantages of synthetic indicators such as the one developed here is that they do not express some expert's opinion that certain things 'add up' in some way, but that they tell a whole story in which each assumption and each outcome in the storyline is open to discussion, as well as the final, integrated 'plot'. This means that the community development indicator makes sense not only as an assessment tool for the outsider working on the basis of extensive field study and large databases, but also if translated into locally understandable terms and then applied, with each step open for discussion, in a participatory manner. The indicator then acts as a framework for discussion and joint analysis by outsiders and the community together. In other words,

48 It may be noted that the subtraction of 2 hours per day from FDT has been motivated from a normative position before and is yet not dropped from the purely empirical maxINVlevel formula. This follows Reardon and Vosti (1995) who state that people are not likely to invest if they have only very little income above their basic needs; see also Chapter 5.

participatory application of the indicator may deliver many entry points for formal or informal learning between scientists, villagers, authorities and development agents. This would appear to me as a promising avenue for further exploration.

One aspect that may strengthen participatory applications (as well as theory building on the longer term) is that with only a single modification, the investment indicator changes from a capacity assessment into a *reality* assessment, i.e. a statement with an empirically testable truth claim. This modification is the introduction of a factor that we may call 'motivation' (MOT), defined as the degree (between 0 and 1) to which people actually put their available investment capacity to investment action. The formula is:

- **actualINVlevel = Σ(FDT - 2) x maxEFF x [1 - α (1 - CSC)] x MOT**

in which:

– **actualINVlevel** [$/day] = the actual level of investments by a community

– **MOT** = the actual degree to which the community puts its investment capacity (= the foregoing part of the formula) to investment action

and all other factors have been defined already. If desired, the MOT factor may be broken down into a cascade of several motivational subfactors, such as the degree to which people are willing to use their FDT for productive work, the degree to which maximally productive work is chosen, the degree to which the revenues are invested in stead of consumed, and so on (MOT = mot1 x mot2 x mot3 etc.). Going through all assumptions and factors (FDT, maxEFF, α, CSC, mot1, mot2 etc.) and the structure of the formula as a whole will help communities to grasp and work on all their opportunities and choices for (or against) development.

For efficient formal applications, indicators should be supplied with frameworks to estimate the various factors of the indicator formulas. For the indicator developed in this section, only the FDT factor has a coherent framework yet (Chapter 5), but more may be developed. Preferably, single-factor frameworks should be integrated in order to express the indicator in a most efficient manner. This would boil down to finding a single way to formulate all overlapping elements of the frameworks and to shed all elements that do not 'feed into' the overall synthesis. This should be balanced very consciously with the possible disadvantages, however, the most salient of which is that the frameworks would loose too much of their separate relevance. It might be efficient for the present indicator, for instance, to reduce the many variables of rMFA to just the basics needed for the !! **RISK** assessment, but what if later it may turn out that many of the other rMFA indicators cannot be calculated anymore due to lack of just a few but essential data?

Methods for *data gathering* connected to the indicator are quite worthwhile to look into, because costly fieldwork is often necessary due to paucity of documented statistics at the village and household levels in developing countries. Very wide margins between 'precision' versus 'quick scan' methods exist for each separate factor of the indicator. FDT intrinsically needs household-level cash flow and time use measurements but data gathering intensity may vary between daily visits on the one hand versus single-visit assessments of overall incomes, expenditures and time use on a number of typical days; see also the quick-scan section in Chapter 5. Village-level ΣFDT may be assessed by visiting all households but also through a stratified sample, in which the strata may be determined through a factor analysis of a survey but also through a quick PRA-type (people-based) wealth ranking. MaxEFF may be assessed per household member but may on the other extreme, as said, also be guesstimated for a village as a whole. As discussed previously, the same picture holds for the other factors. Combining all data in a single, integrated dataset is not essentially difficult. The database that has been constructed to generate FDT in Kashimpur in Chapter 5, for instance, already contains all data for calculating the whole of Chapter 4's rMFA. All these field-level methodological issues may better wait, however, until a principled discussion on the merits of the development indicator itself has been rounded off. This then is the only place in this whole dissertation, I declare with some pride, where my science is not supply-driven (or fundamental, as others might put it).

References

Blaikie, P.M. and Brookfield, H.C. (1987). *Land degradation and society.* London: Methuen.

Bourdieu, P. (1986). The forms of capital. In: Richardson, J. G. (Editor). *The handbook of theory and research for the sociology of education.* New York: Greenwood, pp. 241-258.

Boserup, E. (1965). *The conditions of agricultural growth: The economics of agrarian change under population pressure.* London: Earthscan, reprinted in 1993.

Bremser and Barsky (2004). Utilizing the balanced scorecard for R&D performance measurement. *R&D Management, 34 (3), pp. 229-238.*

Brox, O. (1990). The common property theory: Epistemological status and analytical utility. *Human Organisation*, 49, pp. 227-235.

Bulte, E. (2008). Weak links. *The broker,* 10, p.28 (www.thebrokeronline.eu).

Chambers, R., Pacey, A. and Thrupp, L. A. (Editors) (1989). *Farmers first: Farmer innovation and agricultural research*. London: Intermediate Technology Publications Ltd.

Cleuren, H. M. R. H. (2001). *Paving the road for forest destructor: Key actors and driving forces of tropical deforestation in Brazil, Ecuador and Cameroon*. PhD Thesis, Leiden University.

De Groot, W. T. (1992). *Environmental science theory: Concepts, methods in a one-world, problem-oriented paradigm*. Amsterdam: Elsevier.

De Groot, W. T. and H. Tadepally (2008). Community action for environmental restoration: a case study on collective social capital in India. *Environment, Development and Sustainability*, 10, pp.519–536.

Dubin, R. (1978). *Theory building*. (revised edition). New York: Free Press.

Edwards-Jones, G., Davies, B. and Hussain, S. (2000). *Ecological economics: An introduction*. Cornwall: MPG Books, Ltd.

Elster, J. (1985). *Sour grapes: Studies in the subversion of rationality*. New York: Cambridge University Press.

Friedman, M. (1953). *Essays in positive economics*. Chicago: Chicago University Press

Geertz, C. (1963). *Agricultural involution: The processes of ecological change in Indonesia*. Berkeley, CA: University of California Press.

Gerritsen, P. R. W. (1995). *Styles of farming and forestry: The case of the Mexican community of Cuzalapa*. Wageningen: Wageningen Agricultural University.

Green, D. P. and Shapiro, I. (1996). *Pathologies of rational choice theory: A critique of applications in political science*. Yale: Yale University Press.

Hobbes M. and Kleijn R. (Editors) (2007). *Local material flow analyses in social context at the forest fringe in the Sierra Madre, the Philippines*. Social Ecology Working Paper, No. 98, IFF, Vienna.

Hyden, G., Kates, R. W. and Turner, B. L. (1993). Beyond intensification. In: Turner, B. L., Hyden, G. and Kates, R. W. (Editors). *Population growth and agricultural change in Africa*. Gainesville: University of Florida Press, pp. 410-439.

Labuschagne, C., Brent, A. C. and Van Erck, R. P. G. (2005). Assessing the sustainability performance of industries. *Journal of Cleaner Production*, 13, pp. 373-385.

Marsden, T. (2004). The quest for ecological modernisation: Re-spacing rural development and agri-food studies. *Socioligia Ruralis*, 44 (2), pp. 129-146.

Mortimore, M. (1998). *Roots in the African dust: Sustaining the drylands*. Cambridge: Cambridge University Press.

Newman, J.R. and R.K. Schreiber (1984). Animals as indicators of ecosystem responses to air emissions. *Environmental Management,* 8 (4), pp. 309-324.

Noorbakhsh, F. (1998). A modified human development index. *World Development,* 26 (3), pp. 517-528.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Overmars, K. P. and Verburg, P. H. (2005). Analysis of land use drivers at the watershed and household level: Linking to paradigms at the Philippine forest fringe. *International Journal of Geographical Information Science*, 19 (2), pp. 125-152.

Overmars K. P., de Groot W. T. and Huigen, M. G. A. (2007) Comparing inductive and deductive modeling of land use decisions: Principles, a model and an illustration from the Philippines. *Human Ecology,* 35, pp. 439-452.

Pugh, C. (1996). Methodology, political economy and economics in land studies for developing countries. *Land Use Policy,* 3, pp. 165-179.

Putnam,R. D. (1993). The prosperous community: Social capital and public life. *The American Prospect*, 13(1), pp. 35-42.

Reardon, T. and Vosti, S.A. (1995). Links between rural poverty and the environment in developing countries: Asset categories and investment poverty. *World Development*, 23 (1), pp.1495-1506.

Rees, W. E. (1992). Ecological footprints and appropriated carrying capacity: What urban economics leaves out. *Environment and Urbanization,* 4 (2), pp. 121-130.

Romero, M. R. (2006). *Investing in the land: Agricultural transition towards sustainable land use in the Philippines forest fringe*. PhD Thesis, Leiden University.

Scoones, I., Thompson, J., and Chambers, R. (2007). *Farmers first – retrospect and prospect: Reflections on the changing dynamics of farmer innovation in agricultural research and development in preparation for the farmer first revisited workshop*. Institute of Development Studies (IDS), University of Sussex, 12-14 December 2007.

Smith, P.G.R. and J.B. Theberge (1987). Evaluating natural areas using multiple criteria: Theory and practice. *Environmental Management* 11 (4), 447-460.

Thomson, D. (2002). Understanding diversity in farming behaviour using “farming styles”. *Wool Technology and Sheep Breeding,* 50 (3), pp. 280-286.

Todaro, M. P. (1994). *Economic development*. 5th Edition. Singapore: Longman Singapore Publishers Ltd.

Van der Ploeg, J. D. (1991). *Landbouw als mensenwerk: Arbeid en technologie in de agrarische ontwikkeling*. Muiderberg: Coutinho.

Van der Ploeg, J. D. (2000). Revitalizing agriculture: Farming economically as starting ground for rural development. *Sociologia Ruralis*, 40 (4), pp. 497-511.

Van der Voet, E. (1996). *Substances from cradle to grave: Development of a methodology for the analysis of substance flows through the economy and the environment of a region, with case studies on cadmium and nitrogen compounds*. PhD Thesis, Leiden University.

Walker, P. A. (2005). Political ecology: Where is the ecology? *Progress in Human Geography,* 29 (1), pp. 73-82.

Warren, M. D., Slikkerveer, L. J., and Brokensha, D. (Editors) (1995). *The cultural dimension of development: Indigenous knowledge systems*. London: Intermediate Technology Publications Ltd.

Zaal, F. and Oostendorp, R. H. (2002). Explaining a miracle: Intensification and the transition towards sustainable small-scale agriculture in dryland Machakos and Kitui districts, Kenya. *World Development,* 30 (7), pp. 1271-1287.

Zuiderwijk, A. B. (1998) *Farming gently, farming fast: Migration, incorporation and agricultural change in the Mandara mountains of northern Cameroon*. PhD Thesis, Leiden University.

Cutting up the logged tree in Dy Abra

7

Conclusions

This chapter provides conclusions based on the material presented in the preceding chapters. It is organized in conclusions on land use, on traditional and rural (rMFA) material flow analysis, on the 'freely disposable time' (FDT) and 'community development' indicators, on method and on perspectives for rural development science. The first sets of conclusions start out by mentioning the overall research questions developed in this study's Introduction (Section 1.7).

On land use

The overall research questions in Section 1.7 were:

– Can land use be explained in direct relation with rational choice theory and land use theories based on rational choice?
– Can plausible development pathways and effective policy options be designed by using explanatory theory and methods?

1.

Spatial land use patterns in the studied villages in the Philippine uplands can be explained fully through rational choice theory. People plant the crop that is most profitable on the given location. The predominant location feature in this context is slope. Of the three major crops (rice, corn and banana), rice is most profitable on flat land, corn on medium slopes and banana on steep slopes. The boundaries between the three zones may wax and wane with changing prices of inputs and outputs. New crops with other profit-to-slope characteristics may alter the pattern drastically. In a perfectly concave landscape, slope-dependent profitability results in a small-scale crop zonation dependent on distance from the valley center. This is a full analogue of Von Thünen's original large-scale zonation dependent on distance to market on perfectly flat land. It is Von Thünen in the mountains. (Chapter 2)

2.
In the villages studied in the Philippines and Vietnam, rational choice based explanatory methods (AiC) as well as population and market-based theories of land use change were applied to explain land use. In both countries, the key to the explanation of land use was the limited availability of favored options. The land users focus first on the most profitable option and switch to the next-favored option if the first one is fully used, and so on until they have spent all their motivation or time. For the Philippine villages, land use scenarios were developed based on the dynamics of corn as the most important crop, called "doing nothing", "sustainable yellow corn" and "sustainable livelihood diversification". (Chapter 2) The Vietnamese scenario emphasizes the role of commercial forces in unsustainable resource exploitation and the opportunities that the external markets may bring such as sustainable forestry and pig raising. Perhaps of more importance is absence of the government regulation that is necessary to prevent a Malthusian collapse. A sentiment of pity with the poor stands in the way of this regulation. (Chapter 3)

3.
In the studied villages in the Philippine uplands, swidden (slash-and-burn) agriculture was what people did in order to establish banana plantations in the Sierra Madre forest. Seen on a larger scale, therefore, swidden agriculture represents the cutting edge of the expansion of permanent agriculture into the forest and not, as often assumed, a farming system with any intrinsic economic logic. (Chapter 2)

4.
Thünian distance to market determines the spatial expansion of bananas and logging in the studied Philippine villages. Bananas are planted until a short distance from the feeder road is reached, where profits have fallen to zero. Contrary to the case of bananas, the zero-profit distance of logging in the Sierra Madre forest lies far beyond the horizon. This implies that safeguarding the unique biodiversity of the Sierra Madre requires regulation that is forceful enough to counterbalance a strong economic driver. (Chapter 2)

5.
In the uplands of Vietnam, Tat village represents a constrained agro-ecosystem with a population density that cannot be relieved by out-migration. Like in many other such places in the world, people have developed an intensive, diverse and strongly integrated land use system. In Tat, this system has become unsustainable. People need the cash gener-

ated by an unsustainable extraction of natural resources to pay for the very inputs of their major food crop. (Chapter 3)

6.
Near the city of Calcutta (India), the village of Kashimpur shows an intensive farming system with high population densities that is sustainable because the urban market is secure and nearby, and offers off-farm opportunities. The difference between the consequences of the high population densities between Tat and Kashimpur can also be traced through Thünian theory. Kashimpur neatly fits into the Thünian logic of intensive agriculture near the city, but Tat is far removed from the intensive zone and its system is in fact an anomaly. (Chapter 6)

7.
Making classifications of types of land use systems or types of villages can help in building descriptive theory, e.g. by enabling cross-regional comparison. One distinction proposed in Chapter 4, for instance, is between space-based, labor-based and capital-based agriculture. It is misleading, however, to attach an assumption of evolutionary development sequence to these types, as if they are 'phases' with some self-driven logic. (Chapter 6)

8.
Rural development and land use science need adequate terminology. Describing the rural areas of the developing world as spaces lived in by farmers tends to limit the research perspective to only one land use type and burden the research with normative connotations. Respectful terms assuming that all land users do land 'management' and that the sum of what they do is a 'strategy' are prone to mislead the researcher. The rural spaces are lived in by rural dwellers that have often very broad (even partly urban) livelihoods and, just like us, often very non-strategic behaviors in daily life. (Chapter 6)

On bulk and rural (rMFA) material flow analysis

The overall research questions on material flows in Section 1.7 were:
- Can MFA be extended so that it may include explanations of relevant material flows?
- Does MFA as applied on the local level indeed fail to link up directly with any of the substantive themes of rural development?
- If so, can MFA be redeveloped into a framework that does link with key themes of rural development and may generate synthetic indicators for concepts of these themes?

9.
Aggregate ('bulk') material flow analysis (MFA) does not connect with causal chains of explanation. Concrete, disaggregated material flows may however be subject of explanation, e.g. through the Action-in-Context framework, creating a 'socially extended MFA'. Socially extended MFA gives access to much stronger policy recommendations than MFA on its own. (Chapter 3)

10.
Aggregate MFA is an inadequate framework to link up with important themes in rural development, which is exemplified by the MFA in Tat (Chapter 3), by a comparison of various MFA case studies (Chapter 4) and by a study on Trinket island that combines aggregate MFA with qualitative discussions and leads to ungrounded conclusions on transition, incorporation and dependency (Chapter 4).

11.
'Rural material flow analysis' (rMFA) is a system of material flow accounting that generates household or village-wide indicators of land use productivity, land use intensity, material incorporation in external markets (globalization) and a series of five indicators of food security that express food sufficiency at present but also under possible future scenarios (e.g. when markets would fail). The rMFA system is flexible in structure and nomenclature so that indicators can easily be added or omitted, depending on the research objectives and research population (e.g. farmers or nomads). (Chapter 4)

12.
Three rural villages (Dy Abra in the Philippines, Tat in Vietnam and Nalang in Laos) have been analyzed through the rMFA framework. All villages turned out to have a mixed economy, with extractive and agricultural flows side by side. The rMFA indicators show that Tat was characterized by high, probably unsustainable, resource exploitation, organic recycling and high land productivity, combined with low agricultural production per capita. The village depended on food imports and options to secure its food procurement in the future seemed exhausted. Dy Abra was highly incorporated in external markets of agricultural inputs (fertilizer) and outputs (yellow corn and timber), while not using any of its own resources for soil fertilization. Its food self-sufficiency was very low, but a transition of its farming system to more organic farming would establish food independence from the market, if needed. Nalang was the reverse of Tat in various ways, combining relatively extensive land use with ample food supply per capita. People earned their cash by extraction of forest products and specializing on a single inten-

sive crop (cucumber). Nalang's overall system shows the lowest level of market incorporation and the most secure food situation. Thus, rMFA supplied critical and quantitative characterizations of the villages with respect to important rural phenomena. (Chapter 4)

13.
Neither aggregate MFA nor rMFA make any connection to environmental problems (e.g. unsustainability or pollution) explicit. Problem-oriented environmental frameworks rather than rMFA may therefore be superior tools in applied work that searches for environmental problems and solutions rather than system insight. Socially extended MFA (Chapter 3) may be seen as a compromise between the two worlds.

On the 'freely disposable time' (FDT) and 'community development' indicators

The overall research questions on livelihood indicators of Section 1.7 were:

- Is it possible to develop a universal (and synthetic) poverty/wealth indicator that integrates cash and time, and therewith more truly represents household capacities to invest in the future?
- Can this indicator actually be applied through a framework that is robust enough to handle complex real-world situations around the world?
- Might this indicator be expanded to include the community level and indicate capacity for sustainable community development?

14.
'Freely disposable time' (FDT) is defined as the time that the productive members of a household have left after fulfilling the basic needs of themselves and the basic needs that accrue to them through the dependent household members. Freely disposable time can be spent on any purpose, e.g. on above-basic care giving or extra leisure, or to work extra hours to acquire above-basic housing, consumer goods or social status, or to invest in the future, e.g. to build terraces on the farm, build more effective institutions, expand the irrigation system or send a child to college. In other words, FDT equals Sen's "freedoms" and represents a household's resilience to adapt to changing circumstances and its capacity to invest in its development. A level of FDT = 0 expresses that people spend all their energies on bare survival (basic needs) and are caught in the poverty trap. FDT = 0 is the absolute poverty line. (Chapter 5)

15.
FDT depends on people's time use as well as their income. The FDT assessment system developed in Chapter 5 is conceptually coherent, universally applicable and able to handle very complex livelihoods. The latter is illustrated by an application on the land users in peri-urban Kashimpur, India. The former is illustrated by also including some European households in the dataset. FDT can be used to characterize any household, rich or poor. Used as a poverty indicator, FDT is substantively superior to any system that uses only time, food or monetary units to assess poverty, such as the "1 $/day" poverty line or the cost-of-basic-needs (CBN) method. Even the latter method is insensitive, for instance, to the effect of changing *time* burdens of households, e.g. when long hours of firewood procurement are annihilated by a solar heater or when HIV/AIDS patients are added to a household. FDT expresses these impacts immediately.

16.
A framework that calculates FDT has been implemented in a database that integrates 140 tables through 210 queries to generate the FDT of households. Through this database, FDT has been assessed empirically for households in Kashimpur (India) and three European cases (two middle class and one single mother with a minimum wage and three children). Some of the Kashimpur households had a very low income but a relatively high FDT that was used for schooling or to keep the mother at home and provide 'above-basic' household and child care quality. The poorest households in both India and the Netherlands spent 2 to 3 hours per day to satisfy their basic food and other basic daily consumption needs. The poor Dutch household had a lower FDT (2.3 hour per day) than the poor in Kashimpur (about 5.5 hour per day). In other words, the European household had much less freedom to do anything else than work for basic needs. It must be added here, however, that not only the cost but also the quality of basic goods and services is higher in Europe than in India (e.g. basic housing, communication and health care). (Chapter 5)

17.
Contrary to FDT which has been supplied with conceptual perfection, a full assessment system and an empirical test in Chapter 5, the community development indicator of Chapter 6 has only an explorative status. The community development indicators start out from the total FDT available in a community. It then adds factors of the profitability of work opportunities, the degree to which this work is private or collective action, collective social capital, and risk of unsustainability, external effects and quality of life reduction. The indicator expresses a commu-

nity's maximum rate of development. If a motivational factor is added, it expresses a community's actual rate of development as a potentially testable hypothesis. The development indicator can be assessed 'from the outside' but may also prove to be a stimulating analytical vehicle for a joint discovery of a community's development opportunities and choices by outsiders and community together. (Chapter 6)

On method

18.
Malthusian, Thünian, Boserupian and other broad theories of land use change offer broad 'schemes of explanation'. My own land use pattern of prices and slopes dependent crop sequence (Von Thünen in the mountains, Chapter 2) is another of such schemes of explanation. These schemes of explanation can be used, and have been used in this thesis, without any reliance on their truth content. Looking at Tat, for instance, it does not make much sense to reject Thünian theory because Tat deviates from it. Rather, it makes sense to ask *why* Tat deviates from it, i.e. why Tat follows a different logic than the Thünian scheme. Or, if in a Philippine upland village we find bananas on less steep slopes than corn, it does not make much sense to reject the Thünen-in-the-mountains pattern found in Chapter 2. Rather, it makes sense to ask why the deviation from the scheme occurs. Is it non-rational choice, e.g. because the bananas are a sacred grove? Or is it rational choice but with different factors, e.g. the choice of a farmer who wants to escape from the dependencies that come with corn? (Chapters 2, 3 and 6).

19.
Notwithstanding this general, purely methodological applicability of any theory, progress in a discipline is generally equated with the growth of truth content of theory. In this respect, inductive and deductive methods perform quite differently. The prices and slopes dependent explanatory scheme of Chapter 2, for instance, could not have been found, and neither can it be tested elsewhere, by any inductive method, because prices are invariable over the villages. Furthermore, inductive studies have a low cumulative capacity, since they are not connected to a single theme, theory or model as deductive studies are. (Chapters 1 and 6)

20.
In order to grow, a discipline's theories and models need to be tested, which implies that their key concepts need to be made quantifiable, e.g. through indicators. The methodologically superior indicators are synthetic, that is to say that they express a coherent underlying model. All

indicators developed in the present thesis are of that nature. (Chapter 1) The key concepts of rural development for framework and indicator building are those that are sufficiently perennial to serve as loci for the accumulation of theory, such as development, poverty, globalization, household strategies, land use dynamics and social capital. (Chapter 1)

On perspectives for rural development studies

21.
The 'community development' indicator expresses a concept that stands central in millions of communities in the developing world. Further research into this indicator could therefore be very fertile for both theory and practice. As said in conclusion 17, even when not fully quantifiable yet (if it will ever be), it can be put to work as a series of questions for joint analyses of communities and outsiders, e.g. how much freely disposable time do we have? what do we do with it? what could we do with it? what factors would be key factors here if we would want to work more effectively towards a better future? (Chapter 6)

22.
Actor-based approaches can produce explanatory insights that can link rural to urban and global actors. This is quite valuable for rural development studies in general but also to material flow analysis (MFA). 'Socially extended MFA' should find its value on larger system levels or broader issues where MFA has already proven its relevance, forming a much desired link with the social sciences. (Chapter 3)

23.
With respect to the FDT indicator, one essential next step is to embed the concept and framework in wider welfare and poverty research. How does FDT relate to really felt, multi-dimensional poverty and happiness across the world? Does a level of FDT = 0 indeed express a more real poverty trap than a level of cash income just sufficient for basic cash needs? Can FDT be measured in quick scans? After some basic answers have been found here, FDT can become the pivot in many questions on causes (e.g. what are essential factors to improve FDT?) and effects (e.g. when does FDT improvement lead people to invest, and out of poverty?)

24.
Actor-based approaches can only start out from concrete human activities and are therefore not suited to contextualize indicators as such. Systematic theory building of rural 'Indicators-in-Context' (explaining FDT, explaining food security, explaining incorporation etc.) requires a

thorough connection with bio-physical, economic, political-ecological, cultural and geographical theories, and is a promising path of research. Examples are to connect FDT with theories on poverty and time use, and to connect the rMFA food indicators with food security theory and methods.

Soaking jute stalks in Kashimpur

Summary

This dissertation represents a confluence of rural development studies and sustainability science. Its aim is to contribute significantly to the growth of sustainable rural development as a systematic discipline.

Chapter 1 forms the introduction. It contains an overview of substance and methodology of the two 'mother disciplines' and then develops the questions of the dissertation as a whole.

Chapter 2 focuses on the explanation of land use change in four villages close to the rainforest in the Philippine uplands. The basis of the study is the application of two frameworks from sustainability science. The four villages lie on a gradient of distance to the major markets, varying between a village with year-round accessibility and an isolated village with recent immigrants. Irrigated rice, yellow corn and bananas are the most important agricultural crops, but all villages were also involved in (illegal) logging in the forest. The differences in land use between the villages could not be explained by their differences in population density or distance to market. Rather, it appeared that the slope of the land was the decisive factor. The relative profitability of the crops was strongly dependent on slopes, with rice as best on flat land, corn on mild slopes and bananas on steep slopes. Since rice/corn/banana is also the sequence of profitability on these slopes, farmers first plant rice on flat land until slopes become too steep and corn becomes more profitable, then plant corn if they have time left and then follow with banana if time is still available, until at some distance form the road, transport cost becomes too high and profits drop to zero. Through these mechanisms, agricultural incomes were highest in the village with most of the flat land, and land use was fully predictable through the local slope patterns. In a hypothetical perfectly concave landscape, a land use zonation arises with the zones arranged by distance from the valley center, fully analogous to the classic Thünian pattern of zones around the city on perfectly flat land. It is Von Thünen in the mountains, with the same underlying micro-economic cause. Chapter 2 ends with an exploration of policy scenarios that address the problems of unsustainability of the corn system and forest exploitation.

Chapter 3 focuses on Tat, a village in the uplands of Vietnam, and explores the possibility and the advantage of connecting two frameworks from the Industrial Ecology branch of sustainability science, material flows analysis (MFA) and Action-in-Context (AiC), to each other. Tat is inhabited by the ethic Tay and lies in a narrow valley between mountai-

nous slopes. The valley floor was fully occupied by rice fields, and slash-and-burn agriculture was practiced on the slopes. Furthermore, people gathered several timber and non-timber products in the forest, mainly on the territories of other villages because their own forest was already depleted. The village was connected to the lowland market by a road that was built in 1992 and was being improved at the time of the research.

The material flow analysis that follows the standard ('bulk') MFA framework was completely dominated by the road works, with flows per capita close to those in industrial societies. This is an incidental indication the standard MFA is not a fully adequate tool for village-level analysis. A more structural indication of this problem is that the MFA of a hypothetical sustainable scenario, in which the land use system of Tat is fundamentally changed, is virtually indistinguishable from the MFA of the present situation. The conclusion is that standard MFA is not connected to important themes in rural development.

Separate material flows (of timber, rice etc.) did generate an adequate system description, however, as well as an adequate problem description if strengthened with additional data. It appeared that the cash earned in the village was based on unsustainable and partly illegal biomass flows, and that this cash was needed to a large extent to finance food import and fertilizer import to produce the (rice) subsistence crop.

In order to enable an explanation of the unsustainable material flows (and with that, arrive at adequate policy recommendations), the AiC framework was applied. On the level of the land users, the general explanation turned out to hinge around the limited availability of favored options. The two most attracted options, were limited in space (in the case of rice growing) or in time (in the case of broomgrass gathering). The next-best two options, broomgrass and timber, were limited in time or market, respectively. People put their remaining energies in slash-and-burn agriculture, even though this was hardly profitable and very tough work. As was the case in the preceding chapter, this is a 'cascade down the options' explanation, and fully based on rational choice theory.

Besides enabling explanations such as these, AiC contains an 'actors field' element that traces the causal linkages between the land users and other actors that influence the land user decisions. Main drivers turned out to be commercial market chains that included traders and government actors. The government actors were mainly present through deliberate non-action. Motivated by sentiments and bribes, they closed their eyes to illegal activities in stead of protecting the people against themselves.

Based on this 'socially extended MFA' analysis, sustainable policy options could be designed that included improvements in the rice system, alternative forest products, value-added industry and out-migration. Overall, markets were not only the cause of unsustainability but also offered opportunities for a sustainable future.

Chapter 4 develops the framework of rural material flow analysis (rMFA), based on the idea that material flows can express more about rural communities than standard MFA does. The rMFA first inventories all separate flows and subsequently puts them in a classification that (1) keeps the sources and destinations of the flows visible, (2) distinguishes between economic sectors as well as human or animal systems and (3) is flexible in structure and terminology. These categories may then be modeled into synthetic indicators that express important phenomena in rural development, such as productivity, intensity, incorporation and food security. The rMFA has been applied to three villages, namely Nalang (Laos), Tat (Vietnam; Chapter 3) and Dy Abra (Philippines; Chapter 2).

Rice was the most profitable crop as well as the staple food and people were inclined to grow as much of it as they can. The productivity and intensity of the rice farming tells much about the availability of land that is suitable for rice. Tat displayed the highest land productivity (tons per ha) for rice, with Dy Abra in the middle and Nalang lowest. The reverse sequence showed up for the production per capita. This shows the scarcity of rice fields in Tat. People spend much labor on the small area, resulting in a high yield per hectare but low yields per working hour. The reverse is true for Nalang, where people can afford to grow only one cropping in the rainy season, without the need to irrigate. The figure on intensity (material input per hectare) is highest in Tat, which confirms these findings.

Incorporation is the degree to which people draw their inputs from or deliver their outputs to external markets. Especially incorporation on the input side (e.g. seeds, fertilizer) is often seen as a form of dependency. Of the three villages, Dy Abra showed up as the most incorporated, on both the input and output accounts. Nalang showed the reverse image, with a high level of food autarky. Farmers grew cucumbers for the market in the dry season in order to assure cash income. In Tat, the agriculture was largely independent from the markets but the extracted forest products were basically all exported. This was necessary to buy food and fertilizer.

rMFA generates five indicators of food security. The first shows the degree to which food is available in the village compared to what people need according to international standards. This indicator was around 1 for all three villages. The second indicator shows the degree to which this food is grown by the villagers themselves. This figure remained at 1 for Nalang but was less than 0.5 for Tat, showing the importance of food imports there. The third indicator of food security calculates the degree to which the villages could feed themselves if food imports would fall away (e.g. due to exploding food prices) and in order to compensate for this, people would eat all food they now export or feed to livestock (e.g. cassava or corn). In that case, people in Tat would still not have enough, while they would have an enormous surplus of corn in Dy Abra. In other words, Dy Abra is quite dependent on the fertilizer market but not on the food market. The fourth indicator calculates how much food people would have (compared to what they need) if not only the food market but also the input markets would fall away. This 'actual food autarky' indicator shows that there would not be much left to eat in Dy Abra, that Tat would again fall back to the famine level of 0.5 while Nalang would hardly be disturbed by all these events. The final, and 'deepest', food security indicator has been called 'potential food autarky' and expresses the food situation (again as ratio of available and needed food) if the agricultural system would be adapted to put all available manure to use in food production. This does not deliver much extra in Tat because all manure is in fact used already in Tat's intricate farming system. This is very different for Dy Abra, where much unutilized manure is present. Potentially, Dy Abra could feed itself well without exchange with any market. Even for Dy Abra there is of course nothing desirable *per se* to such a situation, if only because households would be poorer than they are now. Potential autarky is relevant as a measure of resilience, however, and strengthens farmers' bargaining position.

On a quantitative quality level, the indicators support a number of important insights. In Nalang, the ample availability of suitable land resulted in a high yield per capita and a low dependence on external circumstances. On that safe subsistence foundation, the farmers accessed the market through the cucumber cash crop. Dy Abra was on a pathway with more short-term risk, focusing as it did on timber extraction and a market crop that heavily depended on fertilizer. With that, it had high indicator values on capital intensity and market incorporation, and would fall into an acute crisis if markets would fall away (low 'actual autarky'). The high levels of fertilizer use point to a risk of unsustainability but at the same time, there were many options left for a more organic and less dependent agriculture ('potential autarky'). In Tat, risks were of a much deeper kind. The high levels of extraction from the forest point to unsustainability, but this extraction was necessary because it took care of 90 percent of the cash income – income that the village could not do without because it needed to buy much of its staple food on the market. Tat would be able to supply only 60 percent of its food needs if the extraction itself or the extraction market would fail. Thus, the indicators teach us that a village such as Tat, with its sophisticated organic agricultural system, is actually much worse off than a village such as Dy Abra that focuses on a single, fertilizer-based commercial crop. In Dy Abra, the risks were more visible, but much more superficial at the same time. The village of Nalang, finally, well-endowed with land and relying on a simple rice system, could look at a secure future in both the short and long run.

Chapter 5 is dedicated to the development of a framework that generates an indicator called "freely disposable time" (FDT). This indicator integrates data on time use and cash flows of households into a single number (hours per day) that expresses how much time the productive household members have left after satisfying the basic needs of themselves and the basic needs they need to supply for other household members (e.g. children and the sick). Basic needs concern food, shelter, social participation, care needs and so on. The framework is founded on an exhaustive list of categories on which people spend time and money, such as sleep, work, care and chores. Basic needs per day are specified for each category, such as 2500 kcal of food per male adult, some cash for communication, three hours of care giving if there are three children, zero hours for work, and so on. In combination with data on household composition, this enables to determine the needs that the productive household members have to supply. This in turn is compared with the degree to which the household actually avails of these categories, so that surpluses or deficits can be assessed. The next step is to determine how much time the productive household members have needed to supply these (TEX). This is done by adding the actual time they spent on it plus the amount of cash spent on it, expressed in equivalent time. Equivalent time is calculated through the household income; e.g. if one hour of work delivers 10 $, spending 10 $ is equivalent with spending one hour. Summed over all categories, these time/cash time equivalents end up at 24 hours per day for each productive household member. With the help of the surpluses and deficits on the basic needs, it can be calculated how much of the TEX has been needed for the basic needs (TBN) and how much of it represents deficit (TDEF) or surplus (TSUR). "Freely disposable time" (FDT) equals the sum of all surpluses minus the deficits.

FDT is not the same as leisure time, and neither is it available instantaneously. People may for instance work hard on the land, a business or job in order to secure a degree of above-basic housing, consumer goods, mobility, health care and so on. FDT represents the time that people *can* make free and spend freely, e.g. on leisure but also to invest in improving the farm, work for luxuries or work to send a child to college. In other words, FDT expresses the capacity that people have to make choices – their 'freedoms' in Sen's terminilogy. With that, FDT is a fundamental indicator of poverty and wealth. The fundamental poverty line is when FDT = 0 hours per day, implying that people need all their time and all the cash they can generate with it to satisfy their basic needs. On that level, people have nothing left to invest in a better future. If FDT is below zero, people can only live in chronic deficits of sleep, health, food or cash. Because everybody needs some 10 hours per day for basic sleep and self-care, some 13 to 14 hours of FDT is characteristic for the very rich. The FDT of the very poor ranges from below zero to, say, 6 hours per day. 'FDT profiles' describe how people spend their freely disposable time, e.g. on work for consumables, work for savings, or leisure or learning.

The FDT system has been tested on four complex households (two poor, one middle, one rich) in Kashimpur village near Calcutta (India) and two simpler households (one middle, one poor) in the Netherlands. The Indian households were composed of farmers that work for subsistence as well as the market, and also engaged in various other jobs and trades. The Dutch households represented an academic family with one and a half income and three young children, and a family of a single mother with a minimum wage and three young children. In Kashimpur, the productive members of the poor households needed 2 to 3 hours per day to secure basic food while the poor household in the Netherlands needed the same time for other basic goods. The FDT profiles showed that the two poorest Kashimpur households, even though truly poor, still availed of enough FDT to make the choice to keep the wife away from employment and concentrate on housekeeping and supply ample care to the children (household 1) or to buy some luxury goods and put some cash aside as savings (household 2) . One of the middle-FDT households in Kashimpur has a very low income (0.37 dollar per capita per day, which is way below the global poverty line of 1 dollar per capita per day) but relatively much FDT (7.7. hours per day), which was used, among others, to allow a young household member to study in stead of work. The poor household in the Netherlands had a lower FDT (2.3 hours per day) than had the poor in Kashimpur (about 5.5. hours per day). It should be noted here however that basic needs in the Netherlands are higher than in India. Partially, this creates no difference in real welfare because the same goods and services just happen to be more expensive in the Netherlands. For another part, the basic needs difference does create a real welfare difference. Basic health insurance in the Netherlands, for instance, is not only much more expensive but also much better than in India.

Because the FDT framework integrates time and money, it is able to incorporate many basic needs, also those that are primarily written in time terms, such as the time needed for care for children and the sick. Moreover, it does not only reflect the welfare effects of changes in cash terms (e.g. loss of a job) but also of changes in time terms, such as the loss of a forest so that more time is needed for firewood, or the arrival of a solar cooker or a HIV/AIDS patient in the household. For this reason, and because FDT expresses to a high degree the freedom that people have to make choices, FDT has a much deeper meaning than the globally used poverty and welfare indicators that are based on cash or food only. In Chapter 5, this is illustrated by means of different strategies and circumstances of a hypothetical household.

FDT may be a good candidate for research into the correlation with subjectively felt poverty (and happiness). FDT also has a direct relevance for sustainability in rural areas, because the key to the transition to sustainable agriculture is that farmers invest in their land (e.g. terraces), learning and innovation. FDT expresses exactly how much investment capacity rural households have. Finally, FDT is a new instrument with the potential to compare household types within regions and across regions, countries, cultures and times. Uniformity of methods to study time and cash needs and expenditures is essential to foster this comparative potential. Looking at health care, for instance, it might be established what sort of care package may deliver a life expectancy of, say, 65 years in both India and the Netherlands, and that 'equal welfare package' may then be translated into different insurance costs in the two countries.

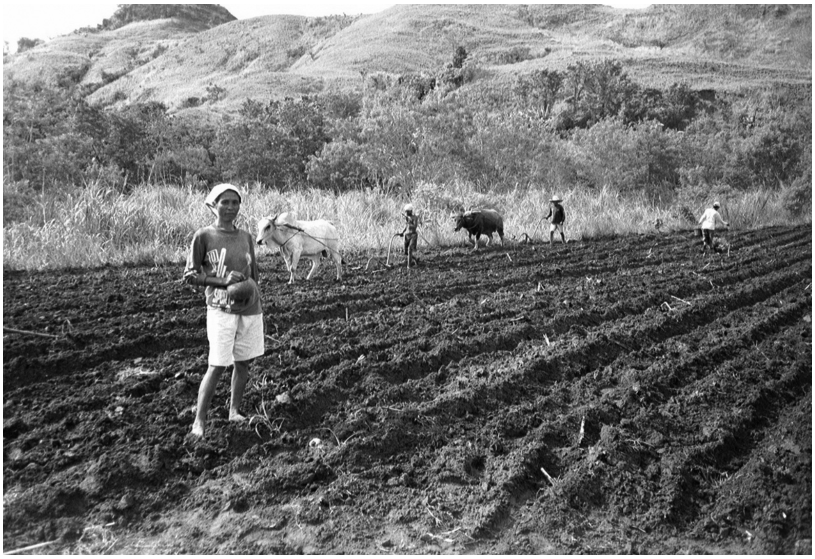
Chapter 6 comprises a number of discussions that are all based on material from more than one chapter.

Section 6.1 discusses three themes on land use change, all based on a Table that overviews the five villages studied in preceding chapters. The first theme concerns the temptation to treat typologies of villages or faming styles as phases of development. The second theme focuses on the status of population and market based theories that predict the intensity of land use. It is seen, for instance, that the population densities in Tat and Kashimpur are both very high but totally different in nature and consequences. The primary thing to do for making good use of these 'grand theories', however, is to abstain from all claims and bickering about their substantive truth content and use them as methodological tools that separate in each empirical case what can be explained through the theory's causal logic and what is identified as anomaly. The third theme in this section discusses adequate terminology for rural development. Often, the rural areas in the developing countries are assumed to be lived in by 'farmers' that have 'strategies'. The implicit assumptions and values that come with these terms often mislead the researcher.

Section 6.2 goes deeper into issues of indicators and epistemology that were already touched upon the first chapter. Chapters 2 and 3 have shown that profitability (the central concept in rational choice theory) has been able to fully explain land use change and patterns in the studied villages. Surprisingly, this factor does not emerge from the usual explanatory methods of land use studies. This is the consequence of the common choice to use statistical-inductive methods that search for correlations between the dependent variable (e.g. land use change) and a series of independent variables. Partially, the latter variables are usually derived from rational choice in some more or less vague manner, but without representing its central concept. The (often weak) correlations that are then found do therefore not represent causal insight and do not reveal central mechanisms. Central mechanisms can be found, however, through deductive use of explanatory (causal) models such as rational choice.

Section 6.3 is devoted to an exploration of how the indicator "freely disposable time" (FDT) (Chapter 5) could serve as a broad indicator of development at the village level. FDT expresses the capacity of households to invest in the future. Based on FDT, it can be calculated how much (in dollars per day) a household could maximally invest. In that calculation, the household lives on the level of its basic needs and invests all its FDT in (a) work that delivers cash that is subsequently put into development, such as having a well drilled or sending a child to college, or (b) direct individual or collective development actions such as plant trees, follow a training course, build a village cooperative or improve the irrigation system. The latter type of activities may be expressed in monetary terms through the profitability of work ('maxEFF') in the indicator formula. Stepping up from the household to the village level, all investment capacities of the households are added up but a new, village-level factor appears as well, which often has great influence on the effectiveness of individual as well as collective action: collective social capital (CSC). The sum of FDTs and CSC are combined through a factor α that expresses the degree of influence of CSC on an action's effectiveness. The central assumption of the indicator is that the higher the effective investments, the higher the rate of development of the village. Development also has to be sustainable, however, and for that reason only those activities are taken up that fall between boundaries of acceptable risk (e.g. on physical sustainability or health), acceptable external effects (e.g. on biodiversity or other villages) and acceptable quality of life during investments (implying that on the village level, not all FDT should spent on developmental actions only). Jointly, these factors determine the synthetic indicator of 'maximum rate of community development'. This is an indicator of *capacity*. Addition of a motivational factor ('MOT' in the formula) then expresses which part of the capacity is actually 'put into development', therewith assessing the actual rate in which a village develops (or falls apart). The indicator can be quantified by means of integrated frameworks, databases and fieldwork. Informal quantifications and discussions on underlying assumptions (including basic needs) may however also be used to discover, jointly with the communities themselves, what factors and mechanisms determine their development or lack thereof, and identify options for change.

Chapter 7 presents the results of the study in the form of 24 conclusions. The most important ones relate back to the central questions of Chapter 1 and deal with the adequacy of rational choice theory, Thünian land use patterns, the avoidance of closed terminology, the connections of MFA with the themes of rural development, the content and use of the FDT indicator and the importance of deductive and actor-based methodology.



Planting corn in Puerta

Samenvatting

Ruraal rekenen

Concepten en cases van landgebruik, duurzaamheid en integrerende indicatoren

Dit proefschrift laat een samenvloeiing zien in de vakgebieden van rurale ontwikkeling en milieuwetenschappen ('sustainability science'). Het doel van de dissertatie is om effectief en significant bij te dragen aan duurzame rurale ontwikkeling als systematisch vakgebied.

Hoofdstuk 1 vormt de inleiding. Een belangrijk deel bestaat uit een overzicht van inhoud en methodologie van de twee 'moederdisciplines'. Geconstateerd wordt daarna dat een systematisch vakgebied het meest gebaat is bij theorievorming rond blijvende inhoudskernen en een nadruk op deductieve methoden, raamwerken, indicatoren en verklarende theorie. Dit, geconfronteerd met de feitelijke stand van zaken en kansen, levert de vraagstellingen van de dissertatie als geheel.

Hoofdstuk 2 vertelt een verhaal over landgebruikveranderingen en de verklaringen daarvan in vier dorpen aan de voet van het Sierra Madre gebergte in het noordoosten van de Filippijnen. De dorpen liggen op een gradiënt van laagland naar hoogland en waren zo geselecteerd dat ze in verschillende mate van afstand tot de markt weerspiegelen. De basis van het onderzoek was het toepassen van twee raamwerken uit de duurzaamheidskunde. De centrale vraag van het onderzoek kwam uit twee theorieën van landgebruikveranderingen. De vraag luidde in hoeverre bevolkingsdichtheid of de afstand tot de markt de verschillen in landgebruik konden verklaren, of dat andere factoren een belangrijke rol zouden spelen.

Het dorp Masipi-East was bereikbaar via een goed begaanbare weg. Dy Abra was moeilijker bereikbaar. Puerta kon alleen te voet worden bereikt. De "pioniersnederzetting" lag nog verder in de bergen aan de rand van het bos. In deze nederzetting woonden recent geïmmigreerde mensen uit de Ifugao provincie, die zich settelden aan de bosrand. De vier belangrijkste landgebruiktypen (rijst, maïs, bananen en hout) in de dorpen zijn beschreven in termen van biomassa stromen (in kilo's per capita per jaar). Op deze manier konden de dorpen worden gekarakteriseerd als primair gericht op rijst en maïs (Masipi-East), op maïs (Dy Abra) en op bananen (Puerta), en allemaal actief betrokken in illegale houtkap. De biomassa-stromen in het "pioniersdorp" bestonden voornamelijk uit rijst en wat banaan. De geldstromen van de dorpen laten een beeld zien waarin in Masipi duidelijk het meeste werd verdiend, gevolgd door Dy Abra en als laatste het "pioniersdorp".

Het antwoord op de onderzoeksvraag luidde dat zowel de bevolkingsdichtheid als de afstand tot de markt (in dit geval de afstand tot de snelweg) geen verklaring gaven voor verschil in landgebruik tussen de dorpen. De hellingen van de velden rond de dorpen bleek de doorslaggevende factor te zijn. Het handeling-in-context (AiC) raamwerk is gebruikt om inzicht te krijgen in de mechanismen die hier achter zitten. Door middel van interviews zijn motivationele factoren geïdentificeerd die van belang bleken voor bepaalde vormen van landgebruik (bijvoorbeeld de productiviteit, risico's, prestige, voedselkwaliteit en avontuur) en gescoord op de verschillende landgebruikactiviteiten. Geïrrigeerde rijst scoorde goed op bijna alle motivaties. Het cultiveren van maïs kwam op de tweede plaats, al bracht dit gewas grote financiële risico's met zich mee omdat de meeste boeren geld voor de kunstmest moesten lenen bij geldschieters of de maïshandelaar om direct na de oogst terug betalen tegen hoge rentes. Met één misoogst kon dit al leiden tot een schuldenlast en het gevangen raken in een afhankelijkheidsrelatie met de handelaren. Bananen kwamen op een derde plaats. Belangrijk bij dit gewas is dat het een tijd duurt voordat er geoogst kan worden en er een groot risico van verlies door tyfoons is. Voor de bananenvelden is de afstand tot een begaanbare weg wel belangrijk, want bananen zijn moeilijk te transporteren. Kleinschalige houtkap scoorde goed als inkomstenbron en mannelijk avontuur, zonder grote risico's ook al was het illegaal. Het was echter wel seizoensgebonden. Voor de Ifugao pioniers lagen veel motivaties anders, omdat zij veel meer bezig waren met het opbouwen van een nieuw bestaan en veel nadruk legden op onafhankelijkheid.

Geïrrigeerde rijst was het superieure gewas in de motivatielijst en de boeren plantten daarom zoveel mogelijk rijst, tot aan de grens waar de opbrengsten daalden omdat het land niet vlak genoeg was en maïs een rendabelere optie was. Maïs is minder gevoelig voor helling en was nog steeds rendabel vanaf de 'rijstgrens'. Daarom werd maïs verbouwd op de meer hellende bodems tot aan de plaats waar de opbrengsten te laag werden. Op die steile hellingen was banaan echter nog steeds rendabel en werd dus daar geplant. Het verklaringsschema is dus als volgt: mensen doen wat het meeste opbrengt totdat de beste optie 'vol' is (in dit geval door de steile hellingen), waarna de tweede optie wordt uitgevoerd indien die nog rendeert, tot ook die optie 'vol' is, enzovoorts. Op die wijze krijgt het dorp met het meeste vlakke land de meeste rijst (en inkomen), en het dorp met de steilste hellingen de meeste banaan (en armoede). Dit verklaringsschema toont een opvallende gelijkenis met de klassieke landgebruiktheorie van Von Thünen, waar de afstand tot de markt de rentabiliteitscurves bepaalt. In deze case studie vormden de hellingen in het landschap in plaats van de afstand tot de markt de verklarende variabele onder de rentabiliteitscurves. Dit verklaringsschema, gemengd met inzichten in de rol van wegen en patronage, kan gebruikt worden als analytisch instrument om op andere plaatsen, met misschien ook andere factoren zoals cultuur en bodem, landgebruikpatronen te begrijpen. Het kan ook gebruikt worden om scenario's te beschrijven voor de lokale toekomst of beleid, zoals in Hoofdstuk 2 verder is uitgewerkt.

Hoofdstuk 3 geeft de resultaten weer van onderzoek dat gedeeltelijk van dezelfde aard is als beschreven in het tweede hoofdstuk (alleen uitgevoerd in één dorp in het noorden van Vietnam), maar vooral dieper ingaat op de raamwerken van de *materiaalstroomanalyse* (MFA) en *handeling-in-context* (AiC) die gecombineerd toegepast werden. In de Industriële Ecologie, waartoe MFA behoort, ontbreekt systematisch sociaalwetenschappelijk onderzoek naar de oorzaken achter de materiaalstromen. In navolging van Kytzia en Nathani's "economisch uitgebreide MFA" geeft dit hoofdstuk een voorbeeld van een algemenere "sociaal uitgebreide MFA".

Het dorp Tat wordt bewoond door de Tay etnische minderheid en ligt in een smal dal in een gebergte. Het dal is geheel opgevuld met rijstvelden; velden voor brandlandbouw ('slash-and-burn', het afbranden van een stuk bos voor het enkele jaren kunnen telen van rijst, gember etc.) lagen op de steile hellingen van de berg. Verder verzamelden de inwoners producten uit de bossen en hielden ze ook wat vee. Tot 1992 was het dorp voornamelijk op zelfvoorziening gericht, maar sinds 1992 is het dorp bereikbaar via een goed begaanbare weg, waardoor de markt diep is doorgedrongen in het dagelijks leven. De komst van elektriciteit heeft de vraag naar geld nog verder doen toenemen. Zoals we zo zullen zien, exploiteerden de mensen het merendeel van hun bestaansbronnen onduurzaam.

De klassieke geaggregeerde MFA indicatoren, waarin de materiaalstromen in zeer grote "bulk" categorieën worden opgeteld, lieten weinig zien in termen van duurzaamheid. De materiaalimporten waren 10,6 ton per capita per jaar tijdens het onderzoek, waarmee het dorp vergelijkbaar was met een industriële samenleving qua materiaalstromen, terwijl het een heel ander soort samenleving is. Als de aanleg van de weg, die tijdens het onderzoek plaatsvond, buiten beschouwing werd gelaten, bleef er echter maar 0,4 ton per capita per jaar aan materiaalimporten over. Een hypothetische MFA van een duurzaam Tat, waarin het dorp zijn agrarische systeem zou veranderen naar zelfvoorziening in rijst en waar onduurzame praktijken (zoals illegale houtkap) zouden hebben plaatsgemaakt voor duurzame (zoals herplantingsbossen, minder mensen, varkenshouderij), liet in termen van "bulk" materiaalstromen vrijwel geen verschil zien met het onduurzame Tat (zonder weg) van tijdens het onderzoek. Geconcludeerd kan worden de "bulk" indicatoren van de klassieke MFA niets relevants zeggen op lokale schaal. Gesteld in termen van hoofdstuk 1: de klassieke MFA methodologie uit de duurzaamheidskunde is niet verbonden met belangrijke inhouden in rurale ontwikkeling.

Afzonderlijke materiaalstromen (van hout, rijst, vlees etc.) lieten wel een goede systeembeschrijving zien en leverden samen met enige additionele data ook een bevredigende probleembeschrijving. Biomassa vormde de belangrijkste stromen. Geld werd verdiend met het exporteren van hout, niet-hout bosproducten (voornamelijk bamboescheuten en gras voor bezems) en agrarische producten. De oorsprong van het hout en de bamboescheuten bevond zich niet binnen de grenzen van het dorp omdat daar alles al op was. Het merendeel van de agrarische producten die werden geëxporteerd (pijlwortel, cassave en gember) kwamen van de brandlandbouwvelden. Met het verdiende geld kochten de mensen voornamelijk rijst en kunstmest. Vrijwel alle geëxporteerde producten hadden een onduurzame basis, terwijl de mensen deze onduurzame en illegale activiteiten nodig hadden om hun voedsel en rijstproductie, dat wil zeggen de basis van hun bestaan, te kunnen betalen.

Karakteristieke beleidsaanbevelingen die door een dergelijke analyse worden opgeroepen zijn dat er aan gezinsplanning gedaan moet worden en dat het bos beschermd moet worden door strikte overheidsregulering. Om beter inzicht te krijgen in de drijfveren van de actoren, en daarmee ook op meer gefundeerde toekomstscenario's en minder symptoombestrijdende beleidsopties, was dit het punt van waaruit het sociaalwetenschappelijk onderzoek verder is gegaan. De onduurzame materiaalstromen zijn uitgekozen om verder in hun sociale context te plaatsen.

Om de oorzaak van deze probleemstromen te begrijpen is inzicht nodig in alle inkomensactiviteiten van de mensen. Bijna al het inkomen was afkomstig van natuurlijke hulpbronnen. De algemene verklaring van het landgebruik in Tat is vergelijkbaar met die van de case studie in de Filippijnen uit het tweede hoofdstuk, namelijk een beperkt aanbod van de favoriete opties. Rijst was de superieure optie, gevolgd door het verzamelen van gras voor bezems. Deze twee opties waren wel duurzaam, maar onderhevig aan sterke beperkingen: de rijstproductie werd beperkt door ruimte en het verzamelen van gras werd beperkt door tijd, doordat het een seizoensproduct is. Hierna kozen de mensen voor de een na beste opties, zijnde het verzamelen bamboescheuten en houtkap, beide onduurzame activiteiten. Maar de illegale houtkap heeft geen stabiele markt en bamboescheuten zijn ook seizoensgebonden. Wat de mensen na uitputting van deze opties nog aan energie over hadden stopten ze in de onduurzame brandlandbouw, ook al was het financieel geen aantrekkelijke optie en tevens heel zwaar werk. Veehouderij werd wel het hele jaar door gedaan, maar werd beperkt door grote kans op ziektes.

De ‘actorenvelden’ van AiC laten zien hoe de opties en motivaties van de mensen in Tat die de onduurzame activiteiten uitoefenen causaal gekoppeld waren aan activiteiten van andere actoren. Allereerst waren er economisch gedreven ketens, waarin handelaren en markten de sturende krachten waren achter de onduurzame activiteiten. De aanleg van de weg heeft dit mogelijk gemaakt. Een ander soort actorenketen hing samen met de risico’s die kleefden aan het uitvoeren van illegale activiteiten. Hier hielpen de overheidsambtenaren de illegale stromen om sociale redenen (medeleven) en voor privévoordeel (omkoping), in plaats van de lokale mensen te beschermen tegen zichzelf en externe commerciële krachten. Op basis van de analyse van sociale oorzaken konden toekomstpaden met duurzame opties worden bedacht voor effectief beleid, bestaande uit het verhogen van de rijstproductie, duurzame nietrijstproductie met comparatief voordeel ten opzichte van het laagland, ontwikkeling van een industrie met toegevoegde waarde, en migratie. Markten waren dus niet alleen de oorzaak van onduurzaam gedrag, ze boden ook mogelijkheden voor een duurzame toekomst.

De MFA gaf een systeembeschrijving en het vertrekpunt voor de verklaring-en- oplossingaanpak van AiC. AiC gaf MFA een uitleg van de materiaalstromen om beter houvast te krijgen op toekomstscenario’s en beleid. De combinatie van de raamwerken heeft dus zeker een meerwaarde en kan op alle schaalniveaus worden toegepast.

Hoofdstuk 4 ontwikkelt het raamwerk van de “rurale materiaalstroom analyse” (rMFA), ontstaan uit het idee dat materiaalstromen voor rurale gemeenschappen meer kunnen uitdrukken dan de gewone MFA kan. De rMFA inventariseert eerst alle afzonderlijke stromen en categoriseert ze vervolgens zo (1) dat de oorsprong en bestemming zichtbaar worden, (2) dat ze de gewone economische sectoren volgen zoals landbouw en extractie (bijvoorbeeld van bosproducten, grazen) (3) dat ze flexibel zijn in structuur en nomenclatuur en (4) dat de systeemgrenzen een onderscheid maken tussen mens en dier. Vervolgens worden de categorieën tot indicatoren gesynthetiseerd die gerelateerd zijn aan belangrijke rurale verschijnselen zoals incorporatie in externe markten, productiviteit en voedselzekerheid. De methode wordt toegepast op drie dorpen: Nalang in Thailand, Tat in Vietnam en Dy Abra in de Filippijnen. De laatste twee dorpen zijn al geïntroduceerd in hoofdstukken 2 en 3. Onderstaand wordt een aantal indicatoren besproken aan de hand van de case studies.

Productiviteit en intensiteit zijn begrippen gekoppeld aan het transitieconcept. Transitie staat voor een verandering in de aard van het agrarische systeem, gedreven door een afnemende productiviteit. Veelal wordt een onderscheid gemaakt tussen extensieve, intensieve en industriële landbouwsystemen, met transities daartussen. Omdat de grenzen op de gradiënt en de relatie tussen intensiteit en productiviteit niet geheel eenduidig zijn, is het advies om in navolging van Boserup eerst kwalitatief te bekijken welk soort systeem het betreft aan de hand van het aantal oogsten per jaar en daarna te kijken of de intensiteit- en productiviteitindicatoren dit ook aanwijzen. In de case studie zijn voornamelijk indicatoren voor de productiviteit van rijst van belang omdat iedereen zelfvoorzienend in rijst wil zijn. De indicatoren vertellen daarom veel over de ruimte in de dorpen. Tat had de hoogste grondproductiviteit (ton per hectare), gevolgd door Dy Abra en dan Nalang. Het omgekeerde geldt voor de productiviteit in ton per capita. De hoge opbrengst per ha in Tat was te verwachten gezien het kleine stukje land dat de mensen ter beschikking hadden en waar de mensen dus met veel zorg hun rijst verbouwden. Nalang daarentegen had veel geschikt land en hoefde dus niet zo intensief te verbouwen (zelfs maar een rijstoogst per jaar) om een goede opbrengst per capita te krijgen. Ook de lage productie per capita in Tat weerspiegelt het ruimtegebrek aldaar; de grote hoeveelheid arbeid per hectare resulteerde in een hoge opbrengst per hectare, maar een lage opbrengst per capita. De intensiteit-indicatoren laten zien hoeveel materialen er in het agrarische systeem gestopt worden. Zoals verwacht verbouwde Tat het meest intensief. De mensen in Tat en Nalang gebruikten vooral lokale materialen terwijl de mensen in Dy Abra, hoewel in kilo's niet zoveel, bijna alleen kunstmest importeerden.

Voor de incorporatie-indicatoren is onderscheid gemaakt tussen incorporatie in de markt voor inputs en de markt voor outputs. Het maakt een groot verschil of je als boer afhankelijk bent van de markt voor je inputs of dat je alleen maar je producten naar de markt brengt. Dy Abra scoorde hoog op alle incorporatie-indicatoren zowel voor het kopen van inputs voor de landbouw, als het verkopen van landbouwproducten en hout. Nalang liet het tegenovergestelde zien: het was een echt zelfvoorzienend dorp met weinig integratie in de markt. De boeren teelden komkommers voor de markt nadat de rijst geoogst was, zodat ze toch ook een cash inkomen hadden. Tat liet relatief lage cijfers zien voor de landbouw, maar exporteerde relatief veel van de extractie: dit was heel belangrijk omdat het verdiende geld voor agrarische inputs en voor voedsel werd gebruikt.

Ten slotte zijn er vijf voedselzekerheid-indicatoren. De eerste, die laat zien hoeveel voedsel er beschikbaar is ten opzichte van wat de mensen nodig hebben, lag in alle dorpen rond de 1. De volgende indicator laat zien in welke mate de samenleving zichzelf voedt (dus zonder voedselimporten). Deze 'actuele mate van voedselzelfvoorziening' was voor Nalang hetzelfde als de eerste, terwijl Tat voor meer dan de helft van haar voedselbehoefte afhankelijk bleek van voedselimporten. De derde indicator laat zien in welke mate de samenleving zichzelf zou kunnen voeden indien (bijvoorbeeld door een mondiale voedselcrisis) voedselimport onmogelijk wordt, en de mensen ter compensatie daarvan al het eetbare in het dorp tot voedsel zouden maken. De mensen in Tat zouden dan iets meer te eten hebben dan het geval was bij de tweede indicator, omdat ze nu het voedsel voor het vee en de export zelf zouden eten. Dit zou een problematische situatie worden omdat het inkomen uit die gewassen en het vee dan ook zou verdwijnen. De mensen in Dy Abra zouden in dit scenario echter een enorm overschot van maïs hebben. Dit dorp is dus zeer afhankelijk van de kunstmestmarkt, maar niet van de voedselmarkt. De laatste twee indicatoren weerspiegelen voedselautarkie waarmee ze meer over het productieproces zeggen. De 'actuele autarkie' laat zien wat mensen over hebben als niet alleen de voedselmarkten zouden wegvallen, maar ook de input markt. De indicator laat zien dat dan er voor de mensen in Dy Abra weinig eten meer zou overblijven, dat ze er in Nalang weinig van zouden merken, en dat ze in Tat slechts iets meer dan de helft van het voedsel zouden overhouden. De laatste indicator, 'potentiële autarkie, laat zien wat er gebeurt als vervolgens het landbouwsysteem wordt aangepast door gebruik te gaan maken van alle intern beschikbare dierlijke mest. In Tat leverde dit niets extra op, omdat daar alle dierlijke mest reeds gebruikt werd. Dy Abra laat het omgekeerde beeld zien. Daar was veel ongebruikte mest beschikbaar en de mensen zouden goed kunnen overleven zonder kunstmest. Een dergelijke isolatie van de markt is op zich niets wenselijks, maar het feit dat een dorp potentieel zonder markten kan overleven is wel een maat voor robuustheid en versterkt de positie van de boeren in onderhandelingen.

De indicatoren geven op een kwantitatief kwaliteitsniveau een aantal belangrijke inzichten. Nalang had relatief veel land (voor rijst) en daarmee samenhangend een hoge productie per capita, terwijl het nauwelijks afhankelijk was van externe omstandigheden. Op die veilige basis van voedselzekerheid zorgde de komkommerteelt voor aanvullend cash inkomen. Dy Abra was op een meer risicovol pad, met een focus op (hout)extractie en een van kunstmest afhankelijk marktgewas. Het had dus hoge indicatorwaarden voor kapitaalintensiteit en marktincorporatie en zou in een acute crisis raken als de markten weg zouden vallen (lage 'actuele autarkie'). De grote hoeveelheden kunstmest wijzen op het risico van onduurzaamheid, maar er waren nog vele opties voor meer organische landbouw en minder afhankelijkheid ('potentiële autarkie'). Tat liep een veel dieper risico. De zeer hoge extractie uit het bos duidt op onduurzaamheid, terwijl deze extractie zorgde voor 90 procent van de export en dus het geldinkomen. Het dorp kon niet zonder voedselimporten die betaald moesten worden met dat inkomen, en had nauwelijks mogelijkheden over om de landbouw te intensiveren op een organische manier. Tat zou nog maar 60 procent van zijn mensen kunnen voeden als de export zou wegvallen, bijvoorbeeld door de onduurzaamheid van de extractie. De indicatoren leren ons dus dat een dorp als Tat, met een boeiend zeer uitgedokterd organisch landbouwsysteem, er feitelijk veel slechter aan toe was dan een dorp als Dy Abra, waar slechts één, en commercieel, gewas geteeld werd. De risico's waren daar veel zichtbaarder maar ook veel oppervlakkiger. Nalang, tenslotte, liep nauwelijks risico's en kon op basis van zijn eenvoudige rijstsysteem ontspannen naar de toekomst kijken.

Hoofdstuk 5 is gewijd aan de ontwikkeling van een raamwerk voor het bepalen van de indicator genaamd "vrij besteedbare tijd" (FDT). Het integreert data over tijdsbesteding en geldstromen op huishoudniveau tot een enkelvoudige indicator die uitdrukt hoeveel tijd de productieve volwassenen in een huishouden over hebben na het bevredigen van de basisbehoeften van henzelf en de basisbehoeften van hun afhankelijken (bijvoorbeeld kinderen en zieken) voor zover die op hen rusten. Basisbehoeften betreffen voedsel, onderdak, sociale participatie, zorg voor ouderen en kinderen, en dergelijke. Het raamwerk kent een uitputtende lijst met categorieën waaraan mensen tijd en geld besteden, zoals slapen, eten, werken, zorgen, huishouden doen. Per categorie wordt bepaald hoeveel ervan als basisbehoefte per dag nodig is, bijvoorbeeld twee uur zorg voor één kind en drie uur voor twee kinderen, acht uur slaap, 2500 kcal voedsel per mannelijke volwassene, etc. Dit vormt de basis van het systeem. In combinatie met data over de samenstelling van het gezin kan per categorie de hoeveelheid waarin de producerende volwassenen moeten voorzien bepaald worden. Dit wordt vervolgens vergeleken met wat het huishouden daadwerkelijk heeft, waarmee duidelijk is of er een overschot of tekort is in een categorie. De volgende stap is om te achterhalen hoeveel tijd de productieve volwassenen van het huishouden besteed hebben aan het verkrijgen daarvan (TEX). Dit wordt gedaan op basis van de daadwerkelijke tijd die ze eraan besteden plus de hoeveelheid geld, omgerekend naar tijd. Het omrekenen van geld in tijd wordt gedaan op basis van het inkomen van het huishouden: als 1 uur werken 10 $ oplevert, is 10 $ equivalent aan 1 uur. Gesommeerd over alle categorieën is de tijd/geld tijd equivalent (TEX) 24 uur per productieve volwassene per dag. Met behulp van tekorten of overschotten aan basisbehoeften kan uitgerekend worden hoeveel TEX nodig is om de basisbehoefte te bevredigen (TBN), en hoeveel van de TEX een tekort (TDEF) of een surplus (TSUR) is. “Vrij te besteden tijd” (FDT) is gelijk aan het totaal van overschot minus tekort.

FDT is niet gelijk aan vrije tijd of tijd die per direct beschikbaar is. Mensen kunnen bijvoorbeeld hard werken op het land of in loondienst om zich te verzekeren van een mate van ‘beter-dan-basis’ consumptie, woonruimte, mobiliteit, gezondheidszorg enzovoorts. FDT is de tijd die mensen vrij *kunnen* maken en besteden naar keuze, bijvoorbeeld als meer vrije tijd maar ook om te werken aan het verbeteren van de landbouw, of aan loondienst voor consumptiegoederen of om een kind naar de universiteit te sturen. FDT weerspiegelt dus de capaciteit die mensen hebben om keuzes te maken – hun ‘vrijheden’ in de terminologie van Sen. Hiermee is FDT een fundamentele armoede/rijkdom indicator. De fundamentele armoedelijn is als FDT = 0 uur/dag, wat betekent dat mensen al hun tijd en al het geld dat ze daarmee kunnen genereren nodig hebben om in hun basisbehoeften te voorzien. Op dit niveau kunnen mensen niets meer doen om in hun toekomst te investeren. Als FDT onder de 0 uur per dag komt kunnen mensen slechts leven met chronische tekorten aan slaap, voedsel of geld. Omdat iedereen minimaal 10 uur per dag nodig heeft om te slapen, te eten etc., blijft er 13 à 14 uur FDT over voor de heel rijke mensen. De FDT van echt arme mensen ligt tussen de ca. 0 en 6 uur per dag. ‘FDT profielen’ beschrijven hoe mensen hun FDT verdelen over verschillende categorieën (scholing, werken voor luxe goederen, luieren, investeren enzovoorts).

Het FDT systeem wordt getest aan de hand van vier huishoudens (twee arm, een middel en een rijk) in het dorp Kashimpur bij Calcutta (India), en twee huishoudens (een middel en een arm) in Nederland. De Indiase huishoudens bestaan uit boeren die deels telen voor zelfvoorziening en voor de markt maar ook allerlei soorten ander werk doen. De Nederlandse huishoudens zijn een gezin van academici met anderhalf inkomen en drie jonge kinderen, en een gezin van een alleenstaande moeder met een minimuminkomen en eveneens drie jonge kinderen. In Kashimpur zagen we bijvoorbeeld dat arme huishoudens 2 à 3 uur per producerende volwassene per dag kwijt waren voor hun basisvoedsel, terwijl het arme Nederlandse huishouden een zelfde tijd per dag kwijt was aan andere basisgoederen zoals luiers, kleren, en dergelijke. De FDT profielen laten zien dat de twee arme Indiase huishoudens weliswaar arm waren, maar toch FDT genoeg hadden om ervoor te kiezen om de vrouw des huizes niet te laten werken zodat die zich geheel op het huishouden en zorg voor kinderen kon richten (huishouden 1) of om enige luxe goederen te hebben en wat te sparen (huishouden 2). Een van de midden-FDT huishoudens in Kashimpur had een heel laag inkomen (0.37 dollar per capita per dag, dat wil zeggen ver onder de mondiale 'poverty line' van 1 dollar per capita per dag), maar relatief veel FDT (7.7 uur per dag) dat onder andere gebruikt werd om te investeren in de opleiding van een jongere die zou kunnen werken. Het arme Nederlandse huishouden had een lagere FDT (2.3 uur per dag) dan de armen in Kashimpur (ongeveer 5.5 uur per dag). Daarbij moet wel worden aangetekend dat de basisbehoeften in Nederland hoger liggen dan in India. Soms heeft dat geen welzijnseffect omdat de betrokken goederen in Nederland gewoon duurder zijn. Soms heeft dat wel een welzijnseffect; de basisgezondheidsverzekering, bijvoorbeeld, is in Nederland niet alleen veel duurder, maar ook veel beter dan in India.

Omdat het FDT raamwerk tijd en geld integreert kan het vele basisbehoeften in zich opnemen, ook die welke primair in termen van tijd staan, zoals de behoefte aan zorg van kinderen of zieken. Hierom, en omdat FDT in belangrijke mate laat zien welke vrijheid mensen hebben om keuzen te maken, heeft FDT een veel diepere betekenis dan de wereldwijd in gebruik zijnde armoede-indicatoren die alleen in termen van geld of voedsel werken. Dit wordt in Hoofdstuk 5 geïllustreerd aan de hand van verschillende strategieën en omstandigheden van een hypothetisch huishouden.

FDT lijkt een goede kandidaat voor onderzoek naar de correlatie met subjectief gevoelde armoede (en geluk). FDT heeft ook een directe relevantie voor duurzaamheid in rurale gebieden. De sleutel voor de transitie naar duurzame landbouw is immers dat boeren investeren in hun land (bijvoorbeeld in terrassen), kennisopbouw en innovatie. FDT vertelt precies in hoeverre boeren de mogelijkheid daartoe hebben. FDT is een nieuw instrument dat potentie heeft om verschillende huishoudtypen binnen een regio of land of tussen verschillende landen, culturen en tijden te vergelijken. Uniformiteit in methoden van onderzoek naar tijd- en geldbestedingen is dan noodzakelijk. Om internationale vergelijkbaarheid te bevorderen is vooral discussie en onderzoek naar het vaststellen van de basisbehoeften noodzakelijk. Terugkomend op het verschil in basisgezondheidszorg in Nederland en India, bijvoorbeeld, kan gekeken worden naar een zorgpakket dat een gemiddelde levensverwachting van 65 jaar oplevert, en kan dat pakket worden doorvertaald naar verzekeringskosten in Nederland en India.

Hoofdstuk 6 bevat een aantal discussies die gemeen hebben dat ze zich baseren op materiaal van meerdere hoofdstukken tegelijkertijd.

Paragraaf 6.1 bespreekt drie thema's over landgebruik gebaseerd op een tabellarisch overzicht van de vijf dorpen die in dit proefschrift zijn bestudeerd. Het eerste gaat over de verleiding om op zich nuttige typologie van bedrijven of dorpen onterecht te interpreteren als fasering van ontwikkeling. Het tweede landgebruikthema in deze paragraaf gaat, eveneens gebaseerd op de overzichtstabel, over de status van bevolkings- en marktgerelateerde landgebruiktheorieën, die de intensiteit van landgebruik voorspellen. Besproken wordt dat hoewel bevolkingsdichtheid in Tat en Kashimpur ongeveer even hoog zijn, de aard en gevolgen totaal verschillend zijn, wat ook ondersteund wordt door andere indicatoren in de tabel. Echter, in plaats van moeizame discussies te beginnen over het inhoudelijke waarheidsgehalte van deze 'grand theories' kunnen we ze beter gebruiken om te onderzoeken wat ze in ieder empirisch geval afzonderlijk verklaarbaar maken en wat ze als anomalie identificeren. Het derde landgebruikthema gaat over adequate terminologie voor rurale ontwikkeling. Vaak wordt het platteland van de ontwikkelingslanden geacht bewoond te worden door boeren die strategieën hebben. De impliciete aannamen en waarden die hiermee gepaard gaan misleiden vaak de onderzoeker.

Paragraaf 6.2 gaat dieper in op de discussie rond indicatoren en methodologie. Hoofdstukken 2 en 3 hebben laten zien dat rentabiliteit (het centrale concept in rationele keuzetheorie) de keuzen voor landgebruik op dorpsniveau doorslaggevend kan verklaren. Verrassenderwijs komt deze simpele verklaring niet naar voren uit de gangbare verklarende methoden voor landgebruik. Dit komt doordat veelal statistisch-inductieve methoden gebruikt worden, die correlaties laten zien tussen de afhankelijke variabele (landgebruik) en een reeks onafhankelijke variabelen. Deze onafhankelijke variabelen zijn meestal wel op een min of meer vage wijze afgeleid van rationele keuzetheorie maar laten het centrale concept niet zien. De (meestal zwakke) correlaties die gevonden worden geven daarom geen causaal inzicht en leggen de kern van de verklaring niet bloot. De centrale mechanismen kunnen wel gevonden worden door deductief gebruik van verklarende (causale) modellen zoals rationele keuze. Voor deductie moeten sleutelconcepten van theorieën of modellen worden geoperationaliseerd en daarom zijn indicatoren zo belangrijk.

In paragraaf 6.3 wordt verkend hoe de indicator “vrij te besteden tijd” (FDT) (hoofdstuk 5) zou kunnen dienen als basis van een brede indicator voor ontwikkeling op dorpsniveau. FDT reflecteert de capaciteit van huishoudens om te investeren. Met behulp van FDT kan worden uitgerekend, in dollars per dag, wat een huishouden maximaal zou kunnen investeren. In die berekening leeft het huishouden op het niveau van de basisbehoeften, en investeert het alle FDT in (a) loon of winst opleverend werk waarvan de opbrengst wordt geïnvesteerd in ontwikkeling, bijvoorbeeld het laten slaan van putten of naar school sturen van jongeren, of (b) directe individuele of collectieve ontwikkelingsacties (zoals bomen planten, een training volgen, een dorpscoöperatie oprichten of het irrigatiesysteem verbeteren). Deze laatste activiteiten worden in de indicator in geld uitgedrukt met behulp van de alternatieve aanwending van de arbeid in loon of winst opleverend werk (‘maxEFF’ in de indicator). Van huishoudniveau naar dorpsniveau wordt de investeringscapaciteit van alle huishoudens bij elkaar opgeteld maar wordt ook het dorpsniveaukenmerk toegevoegd dat in rurale gebieden in ontwikkelingslanden veel invloed heeft op de effectiviteit van individueel en collectief handelen: het collectief sociaal kapitaal (‘CSC’) en de mate waarin een activiteit hiervan afhankelijk is (α genoemd). Aangenomen wordt dat hoe hoger de investeringen zijn hoe hoger het ontwikkelingstempo van het dorp is. Daarbij moet ontwikkeling ook duurzaam zijn en daarom worden activiteiten alleen in de dorpsontwikkeling indicator opgenomen als ze binnen grenzen liggen van aanvaardbare risico’s (op bijvoorbeeld fysieke duurzaamheid en gezondheid), aanvaardbare externe effecten (op bijvoorbeeld biodiversiteit of andere dorpen) en een aanvaardbare kwaliteit van leven (op dorpsniveau mag niet alle FDT op langere termijn worden ingezet). Met deze factoren is de indicator ‘maximaal tempo van dorpsontwikkeling’ ontwikkeld. Dit is een *capaciteits*-indicator. Motivaties (‘MOT’) bepalen daarna welk deel van deze capaciteit daadwerkelijk wordt besteed aan investeren, en daarmee wordt het *actuele* tempo waarin het dorp zich ontwikkelt uitgerekend. De indicator kan formeel gekwantificeerd worden door middel van geïntegreerde raamwerken, databases en veldwerk. Informele kwantificering en discussies over onderliggende aannamen kunnen echter ook worden ingezet om samen met gemeenschappen te ontdekken en te analyseren welke factoren en mechanismen hun ontwikkeling, of het gebrek daaraan, bepalen en mogelijkheden voor verandering te identificeren.

Hoofdstuk 7 geeft de resultaten van het proefschrift weer in de vorm van 24 conclusies. De belangrijkste daarvan grijpen terug op de centrale vragen van hoofdstuk 1. Ze behandelen onder andere de doeltreffendheid van rationele keuzetheorie, het bestaan van Thüniaanse landgebruikpatronen in de bergen, het vermijden van gesloten terminologie, de verbinding van MFA met centrale thema's van rurale ontwikkeling, de inhoud en gebruik van de FDT indicator en het belang van deductieve en 'actor-based' methoden.

Working for SEAtrans in Ho Chi Minh

Curriculum Vitae

Marieke Hobbes followed secondary education at the Stedelijk Gymnasium in Leiden from 1988 to 1995. In that year, she took up Anthropology and Sociology of non-Western Societies at Leiden University, specializing in 'Environment and Development', which included courses at the Center of Environmental Sciences (CML) and a self-arranged curriculum of half a year of courses and fieldwork at the University of the Philippines in Los Baños. For the fieldwork for her masters thesis, Marieke sought collaboration with the Palawan Tropical Forestry Protection Programme on Palawan Island in the Philippines. This case study tells a story on the effects of a co-management strategy on the indigenous upland dwellers (Pala'wan). She graduated (*cum laude*) in December 2000.

From 2001 to 2004 Marieke worked at CML for the EU sponsored project called "Southeast Asia in Transition" (SEAtrans), a joint effort of ten European and Southeast Asian universities. Her contribution concerned the adaptation, communication and application of the "Action-in-Context" framework with the other partners, the organization and leadership of the fieldwork in villages in Vietnam and the Philippines and the writing of project reports and articles for this dissertation. From 2004 to 2006, she worked for the EU sponsored TIPOT project that focused on the subterranean purification of drinking water polluted with arsenic in West Bengal, in cooperation with European and Indian partners. Her contribution was the design of user-friendly systems and the optimal market chain (builders, governments, certifiers, etc.) and 'willingness to pay' and socio-economic, cultural and land use research in an Indian village combined with work specifically for this dissertation. With financial support of CML, the PhD dissertation was finished early 2009. Marieke then took up a job as knowledge officer at Hivos, a development organization.