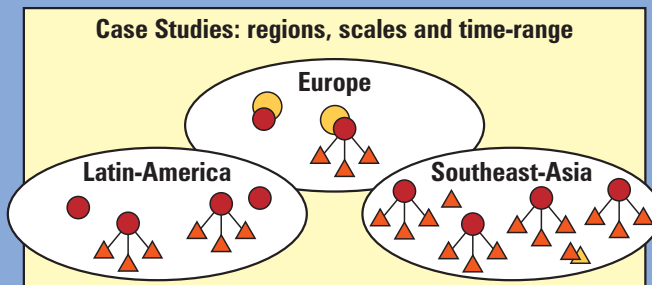


TRANSITIONS

Transitions from an Agrarian to an Industrial Mode of Subsistence – and Beyond. Interaction and Co-Evolution of Social and Natural Systems

CORE RESEARCH QUESTIONS

- How do transitions occur?
- What can we learn from past transitions?
- Can we intervene in contemporary transitions to guide them in a more sustainable direction?



We conceive of transitions as major changes in socio-ecological regime, as qualitative transformation of socio-economic metabolism. The European countries were the first to gradually change from a land- and biomass-based to a fossil-fuel based energy regime, and now the last regions of this planet are following suit. If these transitions obey the historical pattern, a three- to fourfold increase in per capita energy consumption (mainly: fossil fuels) and about the same increase in material consumption will occur, in conjunction with population increase and increasing income, while pressure on land will be somewhat relieved.

But the historical pattern is not always followed; there are strong interactions between local, regional and global processes. Raw material extraction, production platforms for materially and energetically intensive processes, and trade – these three processes allow for the re-distribution of environmental burdens around the globe.

World regions, levels of scale within these regions, and points in time are all part of the design of our case studies, which follow a common protocol for describing socio-economic metabolism and land use.

The analysis is used to support local and regional capacities for intervention along the lines of more equitable and sustainable choices.

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The IFF is a joint institute of the following Austrian universities:

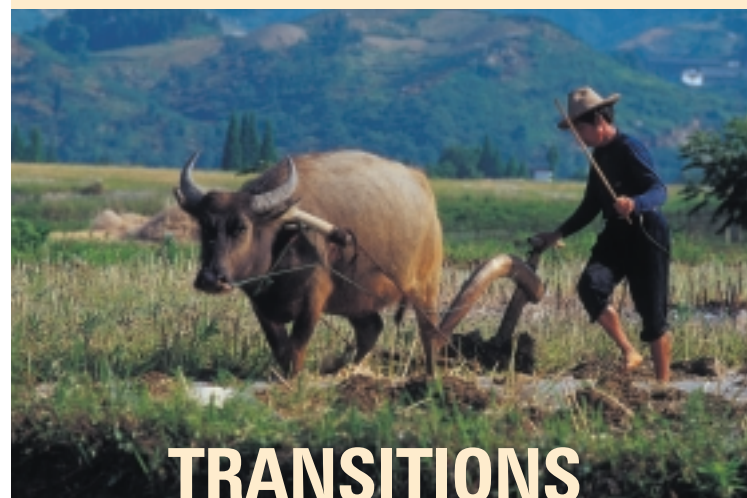


Seed funding for Transitions came from the Austrian Federal Ministry for Education, Science and Culture (bmbwk) within its Landscape Research Program.



bm:bwk

Social Ecology



TRANSITIONS

Transitions from an Agrarian to an Industrial Mode of Subsistence – and Beyond
Interaction and Co-Evolution of Social and Natural Systems



IHDP-IT project

Social Ecology



IFF SOCIAL ECOLOGY VIENNA

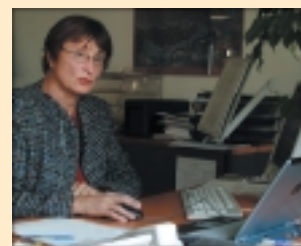
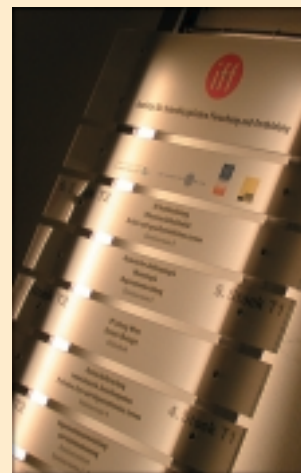
Our research focuses on the relationship between social and natural systems in the context of sustainable development. Natural and social scientists cooperate on various aspects of society-nature interactions:

- Social metabolism
- Colonization of nature and land use
- Environmental history and cultural evolution
- Transition studies



IFF Social Ecology Vienna, directed by Marina Fischer-Kowalski, is a team of fifteen scientists plus administrative personnel, partly on formal university positions, partly financed by independent funding. It is embedded in the Vienna node of the Institute for Interdisciplinary Studies at Austrian Universities (IFF), which has a 35-year tradition of interdisciplinary research, teaching and counselling.

In cooperation with partners at Austrian universities and abroad, IFF Social Ecology offers course modules as part of an interdisciplinary university education tailored to fit the needs of graduate and postgraduate students in the social and natural sciences. A doctoral program on Social Ecology is in preparation.



The project

TRANSITIONS

Transitions from an Agrarian to an Industrial Mode of Subsistence – and Beyond. Interaction and Co-Evolution of Social and Natural Systems

IHDP-IT endorsed project no. E/2001/02
2001–2005

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Lead Research Institution:

IFF Social Ecology Vienna

Institute of Interdisciplinary Studies of Austrian Universities

Sub-Projects, Funding and Partners

Amazonia21, funded by EU-IncoDev; coordinated by ÖAR (Robert Lukesch); partners: PAC: Universidade Federal do Amazonas, BR; Universidad Autonoma de Bolivia; Universidad Central de Venezuela; Universidad Nacional de Colombia; partners in Europe: Free University of Berlin, DE; Lews Castle College, UK; Vrije Universiteit Amsterdam, NL; Wuppertal Institute, DE.

SangSaeng, Thailand, funded by Science Foundation Austrian National Bank; coordinated by IFF Social Ecology

Nicobars, India, funded by Academy of Sciences, Bombay, and EU-START scholarship (IHDP); coordinated by IFF Social Ecology

South East Asia in Transition, funded by EU-IncoDev; coordinated by IFF Social Ecology; partners: SEA: National University of Laos; Chulalongkorn University, Thailand; University of the Philippines at Los Banos; Resources, Environment and Economics, Inc., Philippines; University of Social Sciences and Humanities and Centre for Natural Resources and Environmental Studies, Vietnam. – Europe: CML Leiden University, NL; INRAN National Institute for Nutrition and Environment, I; Autonomous University of Barcelona, E

GEWIN, Social Knowledge and Global Sustainability, funded by Landscape Research Program of the Austrian Ministry for Education, Science and Culture, coordinated by IFF Social Ecology

Transformation of Society's Natural Relations, funded by the Austrian Science Fund; coordinated by IFF Social Ecology; partners: IIASA Laxenburg, A; INSEAD, Fontainebleau, F; Breuninger Foundation, DE.

Upland, funded by EU-IncoDev (submitted); coordinated by IFF Social Ecology; partners: Kunming Institute of Botany, Chinese Academy of Science and Chinese Agricultural University, Beijing, China; National University of Laos; Hanoi National University, Vietnam; INRAN National Institute for Nutrition and Environment and European Commission Joint Research Centre, Ispra, I; Autonomous University of Barcelona, E.

For details on the projects see our website:

<http://www.iff.ac.at/socec>

International research programme

IHDP-IT – Industrial Transformation

To explore pathways towards decoupling economic growth from related degradation of the environment.

The IT Project is an international, multi-disciplinary research initiative aimed at understanding complex society-environment interactions, identifying driving forces for change, and exploring development trajectories that have a significantly smaller burden on the environment on a global scale. IT research is based on the assumption that important changes in production and consumption systems will be required in order to meet the needs and aspirations of a growing world population while using environmental resources in a sustainable manner. Through its five key research foci on energy and material flows, food, cities, information and communication, and governance and transformation processes, IT research aims at building upon the foundations of a variety of disciplinary research approaches in the social, technical and natural sciences.

<http://www.vu.nl/ivm/research/ihtdp-it>



Industrial Transformation

IHDP

The International Human Dimensions Programme on Global Environmental Change is an international, interdisciplinary and non-governmental research programme, aiming at the development and integration of research on the human dimensions of global environmental change.

<http://www.ihdp.uni-bonn.de/index.html>



IHDP

■ **Analysis of local material flows helps us to understand transition processes – subsistence agriculture is gradually integrated into the market economy with unsustainable effects on production and consumption patterns.**

This study adapts indicators of national bio-physical accounting systems to the local level and relates them with a qualitative assessment of economic and cultural change in a single community. Indicators are derived from material and energy flow accounting methods and address two major objectives: Firstly, to identify mutual influences between the global and the local level. Secondly, to assess future potentials of environmental pressures and impacts that can be expected to occur as such communities follow a path of further modernization.



The IFF Social Ecology study takes a close look at a small rice-farming community in Northeast Thailand. Physical as well as socio-cultural aspects are dealt with in order to examine society-nature relations on the local level. The indicators developed portray a society in the midst of transition and rapid modernization. This becomes apparent when comparing the results to those of similar studies in traditional and industrial societies. What we see is a community struggling to adapt to global influences, while at the same time maintaining subsistence with traditional coping mechanisms.

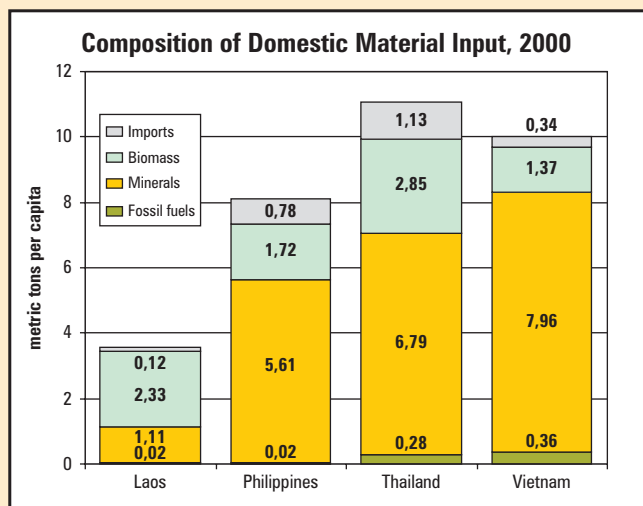
In order to document ongoing transitions a **re-study** is envisioned for 2004. Gathering data at a third point in time lays the foundation for a unique documentation of the continuous change of a rural village in the developing world.

■ Grünbühel, C. M., Haberl, H., Schandl, H., and Winwarter, V. 2003. Socio-economic Metabolism and Colonization of Natural Processes in SangSaeng: Material and Energy Flows, Land Use and Cultural Change in Northeast Thailand. *Human Ecology* 31(1): 53–86.

■ Weisz, H., Fischer-Kowalski, M., Grünbühel, C. M., Haberl, H., Krausmann, F., and Winwarter, V. 2001. Global Environmental Change and Historical Transitions. *Innovation* 14(2), pp. 117–142.

■ Grünbühel, C. M.; Schandl, H., Winwarter, V. 1999. Agrarische Produktion als Interaktion von Natur und Gesellschaft: Fallstudie SangSaeng. *Social Ecology Working Paper*, 55.

■ **The first national Material Flow Account for Southeast Asian economies shows that rapid economic growth is linked to increasing extraction and exploitation of natural resources.**



The IFF Social Ecology project »Southeast Asia in Transition« studied ongoing socio-economic and related ecological transition processes in four Southeast Asian countries: Thailand, Laos, Vietnam and the Philippines. Based on an indicators approach combined with a multi-criteria perspective, the consortium of six Southeast Asian and four European partners aimed at both evaluating past development policies with respect to sustainability and informing future planning and policy implementation. One tool used to describe the natural relations of these economies was Material Flow Accounting (MFA). Standard indicators such as Direct Material Input show rapid growth mainly due to increased use of construction materials and fossil fuels as well as an increased output of manufactured goods for export. Thailand currently consumes 11 tons of natural resources per capita, followed by Vietnam (10 tons per capita) and the Philippines (7,4 tons per capita). Laos is lowest with only 3,6 tons per capita. These values compare with an average Direct Material Input of the countries of the European Union at 16,6 tons per capita.

A final project workshop held in Vienna in June 2003 helped to develop a participatory sustainability strategy for the region of Southeast Asia.

Country reports for Thailand, Laos, Vietnam and the Philippines will be available in January 2004. For further information contact Heinz Schandl (heinz.schandl@univie.ac.at) or Clemens Grünbühel (clemens.grunbuehel@univie.ac.at).

■ Schandl, H. and Grünbühel, C. M. (guest eds.). 2004. Southeast Asia in Transition. Special Issue of *International Journal of Global Environmental Issues*. forthcoming.

■ Schandl, H., Grünbühel, C. M., Haberl, H. and Weisz, H. 2002. Handbook of Physical Accounting. Measuring bio-physical dimensions of socio-economic activities. MFA – EFA – HANPP. Vienna: Federal Ministry of Agriculture and Forestry, Environment and Water Management.

■ **Is much of Latin America to be characterized as an »extractive economy«, in support of US-American, European and Japanese consumption? How much of the pressure on the Amazonian natural frontier results from foreign demand?**

The Latin American region has a specific socio-metabolic profile, different from historic agrarian societies, and different from present-day core industrial regions. This profile can be characterized by high energetic and material consumption, and low income. When looking at international trade, we find Latin American countries exporting large amounts of materials (both minerals and biomass) for a moderate and often declining price, while importing goods of a lower material and energy intensity. The pattern of transition is away from sustainability: material and energy consumption rise faster than population (which also shows marked increases) and income, and the pressure on land and biomass use is rising as well. The repercussions of this transition can be observed on all levels of scale, down to peripheral localities in the Amazonian region.

Pan-Amazonian universities collaborate in qualifying young scientists, administrators and regional policy actors to understand and better manage these transitions by offering academic training programs and a special doctoral program for sustainability. For these programs, the IFF Social Ecology team has developed conceptual tools and a methodology guide for material and energy flow analysis on different scale levels (see pdf of »Handbook of Physical Accounting« at <http://www.iff.ac.at/socec>); these materials are being translated into Spanish and Portuguese.

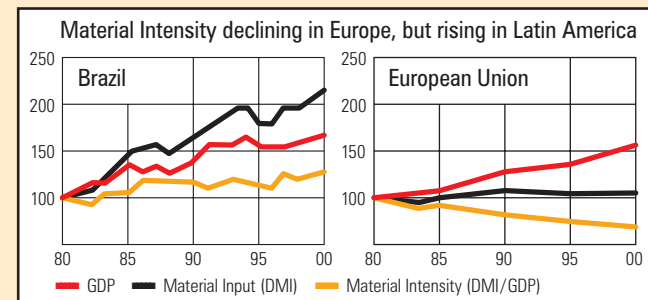


Figure: In Brazil (see above), Chile and Venezuela, Direct Material Input (black line) rises above GDP (red line). Therefore, these economies are becoming more materially intensive (grey line). This contrasts to the European Union (see above) where material intensity is declining.

»Social Metabolism and Sustainable Development«

IHDP-IT workshop at the Centro de Economia Energetica e Ambiental (CENERGIA) of the Universidad Federal de Rio de Janeiro, Brazil, 13. February 2003.

■ Amann, C.; Bruckner, W.; Fischer-Kowalski, M.; Grünbühel, C. M. 2002: Material Flow Accounting in Amazonia: A Tool for Sustainable Development. *Social Ecology Working Paper*; 63.

■ Fischer-Kowalski, M. and Amann, C. 2001: Beyond IPAT and Kuznets Curves: Globalization as a Vital Factor in Analysing the Environmental Impact of Socio-Economic Metabolism. *Population and Environment* 23(1): 7–47.

■ Giljum, S. 2003: Biophysical Dimensions of North-South Trade: Material Flows and Land-Use. Doctoral thesis at the University of Vienna.

■ **Results from a local Material and Energy Flow Analysis indicate the archipelago's integration and dependency on the global market with high potential for unsustainable land use in the future.**



Material and Energy Flow Analysis (MEFA) addresses the biophysical exchanges between society and nature as well as with other societies by way of trade. The method was applied to a small island of hunter-and-gatherers cum horticulturalists in the Bay of Bengal. Results indicate that the islanders, though still largely subsistent – they engage in hunting, gathering, fishing, and pig-rearing – increasingly rely on the production of copra, dehydrated coconuts, for export in order to obtain market goods such as cloth, rice, sugar, and fossil fuels. However, as dependency on the global market is increasing, the islands have become highly vulnerable to the demand for copra and fluctuations in its price at the regional and global levels. Whether to counter the falling prices or simply to meet rising consumption levels, it is the production of copra that must be increased. Consequently, we find a gradual replacement of forest land by coconut plantations.

A large part of the analytical work was supported by a START-IHDP Fellowship. Alongside the ongoing study in time-series, a project for 2004 is envisioned wherein the biophysical aspects of society-nature interactions are analysed within the framework of cultural change.

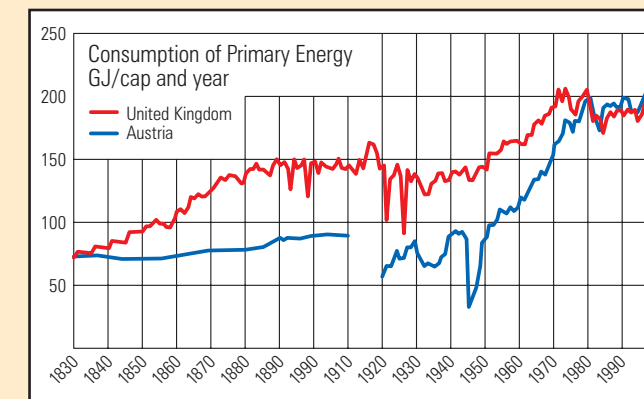
■ Singh, S. J., Grünbühel, C. M., Schandl, H., Schulz, N. 2001. Social Metabolism and Labour in a Local Context: Changing Environmental Relation on Trinket Island. *Population and Environment* 23(1). 71–104.

■ Singh, S. J., Grünbühel, C. M. 2004. Environmental Relations and Biophysical Transitions: The Case of Trinket Island. *Geografiska Annaler* 86B (1).

■ Singh, S. J. 2003. In the Sea of Influence: A World System Perspective of the Nicobar Islands. *Lund Studies in Human Ecology* 6. Lund University Press.

■ **A socio-ecological perspective on the industrial transformation reveals new patterns, disparities and convergence in the nature of the industrialization process.**

A socio-ecological perspective on industrial transformation based on bio-physical indicators such as resource use and land use reveals new characteristics of this process: the United Kingdom, the first industrialiser, and Austria, a latecomer in industrialization, show similarities with regard to energy use prior to the industrial take-off despite significant differences in their social and cultural make-up. Around 1800 both economies operated at a similar level of primary energy consumption of about 70 GJ per capita per year. Until the 1950s the UK's energy consumption was far greater than Austria's. With respect to available energy Austria has rapidly caught up since then and both economies have now converged in a new pattern of late industrial energy use. The report portrays these two different pathways of resource use and economic development in a comparative manner and presents a comprehensive data annex.



This project is part of a larger research effort in **cooperation** with the Breuninger Foundation's research programme on »Europe's Special Course« headed by Rolf Peter Sieferle; and with the network on »Energy, physical work and economic growth« headed by Robert U. Ayres.

■ Krausmann, F., Schandl, H. and Schulz, N. B. 2003. Long Term Industrial Transformation: A Comparative Study on the Development of Social Metabolism and Land Use in Austria and the United Kingdom 1830–2000. *Social Ecology Working Paper* 70.

■ Martinez-Alier, J. and Schandl, H. 2002. Special Section: European Environmental History and Ecological Economics. *Ecological Economics* 41 (2): 175–176.

■ Schandl, H. and Schulz, N. B. 2002. Industrial Ecology: United Kingdom. In: *Handbook for Industrial Ecology*, ed. by Robert U. Ayres and Leslie W. Ayres, Cheltenham: Edward Elgar, p. 323–333.

■ Singh, S. J., Grünbühel, C. M., Schandl, H., Schulz, N. 2001. Social Metabolism and Labour in a Local Context: Changing Environmental Relation on Trinket Island. *Population and Environment* 23(1). 71–104.

■ Singh, S. J. 2003. In the Sea of Influence: A World System Perspective of the Nicobar Islands. *Lund Studies in Human Ecology* 6. Lund University Press.

■ **Industrialisation has not only increased the area and labour productivity of Austria's agriculture but has also transformed locally closed low-input systems into throughput systems having global environmental impact.**

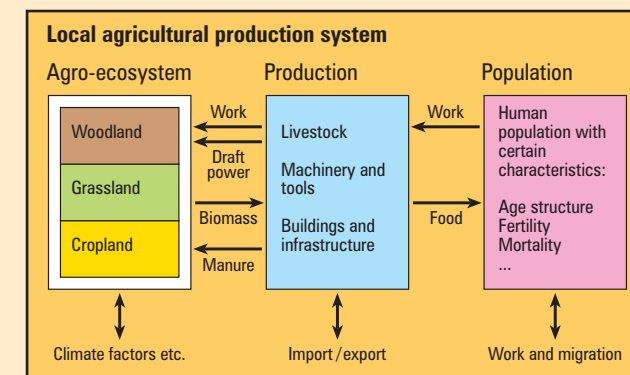


Figure: Model for material and energy flows in local pre-industrial agricultural production systems. Pre-industrial agricultural production systems consist of three subsystems: the agro-ecosystem, the population system and the production system, the latter including farmsteads, machinery, artefacts and domesticated farm animals. The population system provides a certain labour force which by means of technology transforms and maintains the agro-ecosystem and extracts biomass. This biomass is the energetic basis for sustaining both the production and population systems. The respective flows of materials and energy can be quantified and used to analyse the historical transformation of local land-use systems.

Three villages in different agro-ecological zones of Austria serve as case studies for the IFF Social Ecology team to analyse the transformation of agricultural production systems during industrial modernization. In the early 19th century land use was integrated at the local level and socio-economic imports and exports of biomass, energy and fertilizer were very low compared to internal turnover. Livestock was an integrating element in all studied cases, providing draught power, fertilizer, raw materials and food. 85–98% of all biomass turnover passed through the livestock compartment. 19th-century modernization of agriculture helped to optimise the production system and led to increased outputs but not yet to the type of structural transformation which was triggered by the introduction of fossil-fuel powered technology in the 20th century. Fossil fuels not only increased labour and area productivity, but also material and energy throughput as a whole. This resulted in the disintegration of the locally closed land-use systems, in spatial separation and concentration, and in a new type of throughput system integrated at the national and global levels.

■ Krausmann, F. 2004. Milk, manure and muscular power. Livestock and the transformation of preindustrial agriculture in Central Europe. *Human Ecology*, in print.

■ Krausmann, F. 2003. Land Use and Socio-economic Metabolism in Pre-industrial Agricultural Systems: Four 19th Century Austrian Villages in Comparison. *Social Ecology Working Paper*, 72.

■ Haas, W. and Krausmann, F. 2004. What do social systems consume? A case study at the local level. *Journal of Industrial Ecology*, forthcoming.