Sino-German Symposium 2006

The Sustainable Harvest of Non-Timber Forest Products in China

Strategies to balance economic benefits and biodiversity conservation

Symposium Proceedings

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PREFACE

Non-timber forest products, or NTFPs, include a large variety of products. In different regions different products are relevant. In China, most prominent are medicinal plants; several thousand plant species form the basis for the traditional Chinese medicine. Many other products are important, for subsistence of the rural poor or even for high value and high revenue export, such as the Matsutake mushroom which is exported mainly to Japan. Only few products, though, like rattan and bamboo, have a huge industry behind them, and have correspondingly been researched intensively. That research lead also to domestication and the establishment of plantations which has taken away to some extent the pressure on the natural resource. Other NTFPs, however, are being over-harvested, some are even regionally extinct. Given the huge number of species harvested, utilized and traded, NTFP management becomes also a biodiversity conservation issue.

The state of knowledge of and research about different NTFPs is extremely unbalanced: much is known about some, and close to nothing about others. NTFPs and their sustainable management for biodiversity conservation constitute a multi-facetted complex system. The challenges are manifold. We are convinced that they can be tackled best by efficient and trustful cooperation of experts from different disciplines and different regions. That was the reason why we convened a first Sino-German Symposium at Georg-August-Universität Göttingen, Germany, 13-17 March 2006, inviting about 10 experts from different research institutions in China and 10 from Germany.

This Symposium was an excellent opportunity to bring together research groups from different institutions of China and Germany – and it is expected that it was the starting point for promising future cooperative activities.

Figure 1: Participants of the Sino- German Symposium 2006 in Göttingen

In this proceedings volume, the presentations given at the Symposium are compiled together with a summary of the final discussions outlining promising future paths of joint research.

An International Symposium like this one can only be organized with the active and proactive support by many. We are indebted to Mr. Haijun Yang, Ms. Marion Hergarten and Mr. Torsten Sprenger for their excellent role in facilitating the smooth flow of the Symposium. Mr Sprenger deserves particular thanks for his efforts in putting together the manuscripts for this Proceedings Volume.

The Sino-German Center for Research Promotion in Beijing, a cooperation between the German (DFG) and the Chinese Science Foundation (NSFC), made the Symposium possible through its financial support. We express our sincere thanks for this support and also for the fact that a high ranking staff of the Center, Dr. Zhao, gave us the honor to deliver the opening address for the Symposium.

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Compiled by: Christoph Kleinn, Marco Stark, Yang Yongping, Horst Weyerhäuser:

The overall goal of the envisioned research cooperation between Chinese and German research institutions is to improve the knowledge base on the sustainable harvest and utilization of NTFPs for the benefit of the rural poor. We argue that the potential of the NTFP resources for this purpose is not yet fully realized and the respective strategies and policies not yet effectively implemented, or, that appropriate policies are lacking.

Truly trans- and interdisciplinary research is required. The large variety of NTFPs and their different characteristics and uses opens up a wide field of research covering various disciplines from natural to social sciences. Figure 1 illustrates the process' of policy formulation, starting with the assessment of existing data and the formulation of information needs; the provision of information and knowledge is an important research issue. The figure also shows the various disciplines involved.

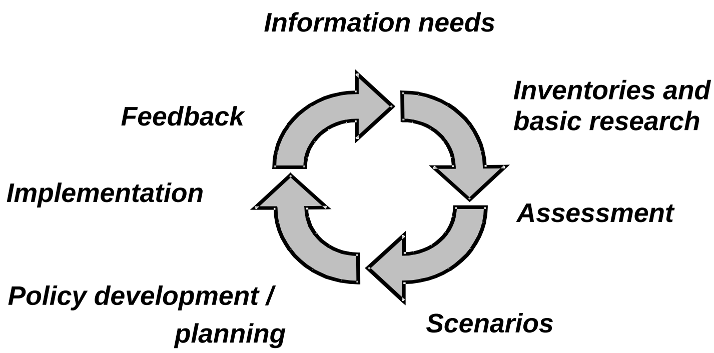

Figure 1. Illustration of the process of policy formulation for the sustainable management of the natural renewable resource "forest" (FAO 2000[1]) – which is directly applicable to the management of NTFPs. In each of the depicted steps, research questions from different disciplines arise.

The overall goal of the Sino-German research cooperation, as stated above, can only be attained by formulating regional or national policies that guide the sustainable management of NTFPs in an overall framework focusing on the sustainable use of the natural renewable

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[1] FAO. 2000. Global forest survey concept paper. FRA Working Paper No 28. 41p.

resource “forest”. Working towards this goal requires a long-term interdisciplinary research cooperation. During the symposium it was agreed that such a collaborative and integrated research project is the mid-term goal, and that the grounds for such an undertaking must be laid step by step in a preparation phase.

Such a preparation phase would include, above all:

1. the identification of specific research topics, as well as conducting smaller collaborative research projects of two to five years duration to answer some of these, and
2. the identification of more partners from relevant research institutions in both countries.

It was agreed during the symposium that specific projects will be proposed to donors in Germany and China (for example the DFG – NSFC program of joint specific research projects) in this year. Such smaller and more focused projects will have a number of advantages, such as;

- specific results can be achieved in a relatively short period of time,
- new hypotheses can be formulated that prepare the framework of a bigger collaborative project (i.e. not only pre-formulated research questions can be addressed), and
- the responsibility for preparing project proposals is distributed among many researchers from both China and Germany, thus exercising cooperative research in an efficient manner.

About one year after the first symposium, we intend to conduct a second workshop that marks the start of the preparation of a larger collaborative Sino-German research project. Designing a proposal for such an international and interdisciplinary research project is a complex undertaking, from a technical and from an organizational point of view. While we expect the research topics and associated methodologies to be well-defined after the initial one-year preparation phase, closer cooperation and direct interaction between Chinese and German scientists is required to bring the project proposal development forward. Therefore, a number of “bi-lateral” exchange visits within the working groups (by research topic) are envisioned before and after the second workshop.

TOPICS FOR SPECIFIC JOINT RESEARCH PROJECTS

During the workshop sessions, participants suggested potential project activities, including corresponding consortia. Potential sources of funding were also discussed. It was stressed that other instruments (i.e. other than focussed joint research projects) should also be used to foster collaboration and the development of joint research ideas. Among these instruments are short or medium term exchange visits of scientists, the exchange of students for internships and theses preparation, and summer schools. Specific plans have yet to be devised for these activities. InWENT, a German organization for education and international development expressed interest in cooperation with regards to longer-term visits of Chinese scientist to Germany.

In the following, specific research topics are presented for which the Chinese and German symposium participants expressed their interest in and commitment to developing more detailed project profiles over the next few months.

Topics are listed in the order as they were proposed during the symposium workshop:

TOPIC 1: DEVELOPING BIOMETRIC METHODS FOR THE INVENTORY OF MUSHROOMS

Various mushroom species are collected in Yunnan. Some of them have a high commercial value and are even exported overseas such as the Matsutake mushroom. While traditional knowledge exists about the productivity of selected mushroom species for specific sites and under specific overall conditions, there is no technique available yet allowing the sound estimation of the existing growing stock and potential yield. This research will focus on statistical techniques on a theoretical basis, but also on the applicability of such a method and its relevance in the context of developing guidelines for the sustainable harvesting of this resource.

Among the tentative research topics are: identification of relevant species and relevant research areas in general, the establishment of a link between plant communities and mushroom abundance as a starting point for modelling, and the identification of the general spatial distribution pattern of mushrooms as a function of different site factors.

Potential partners in this research topic are: Prof. Yang Yongping (KIB, CAS), Dr. Yang Xuefei (KIB, CAS) and Prof. Kleinn (Goettingen). More scientists at the Forestry Faculty of Georg-August-Universität Göttingen are potential partners, as there is a rich expertise on fungi research.

TOPIC 2: MULTI-PURPOSE TREES / MULTI-FUNCTIONAL TREES

Many tree species are a resource for more products and functions than just timber. Bark, leaves, fruits, root parts, etc. are tree products for which specific uses are known for a great variety of species. In addition, relating to topic 1, mushrooms are linked to tree species (mycorhiza).

Therefore, further developing forest management towards fostering and integrating multi-purpose tree species is an important research field. Specific topics include the identification of promising species and corresponding production types, the development of diversified production mechanisms in multi-species ecosystems and of optimal production types for simultaneous production of several products (e.g. fruit and timber), the development of inventory techniques for multi-purpose trees in the remaining natural stands (distribution, species composition, characteristics), the adaptation of silvi-cultural treatments in the context of close-to-nature forest management in those stands, and of harvesting techniques.

Potential partners are: Prof. Lu Yuanchang (CAF), Prof. Yang Yongping (KIB, CAS), Dr. Marco Stark (CMES, KIB/ICRAF), Prof. Dohrenbusch (Göttingen), Prof. Mussong (Eberswalde) and Prof. Phoris (Dresden).

TOPIC 3: SETTING UP A NTFP INFORMATION SYSTEM

NTFPs are a large and diverse group of products. An extremely valuable basis for all research and development work in this context would be a comprehensive information system in which the available relevant information is stored, amended and made available to interested researchers.

Each one of the project topics presented here will produce data inputs for this information system. Even though it is not a generic research project, it is nonetheless of utmost importance and requires a systematic approach to creating a comprehensive and useful knowledge base. Funding for this activity probably needs to be sourced from other agencies than those supporting research projects.

The Kunming Institute of Botany (CAS) might be the best host of such an information system.

TOPIC 4: PRODUCT LINE DEVELOPMENT

For most of the NTFPs not much is known about the product line (commodity/supply chain), i.e. from the harvest in the forest up to the end user. Detailed knowledge about transport channels, value adding, distribution of benefits, final uses etc. will enable the resource planners to improve NTFP management and harvest and identify improved and/or alternative market channels (including organic and fair-trade certification).

Research topics include the analysis and optimisation of the product lines for selected NTFPs, the analysis of the resource management (above all the evaluation of sustainable harvesting techniques) and the analysis of the “social resources” (market and income studies, cost-benefit-analysis). Particular interest in that context has been expressed for the products bamboo, pine-resin, nuts, mushroom and medicinal plants. This topic links to Topic 5.

We still need to identify more partners in the field of socio-economic research and market studies. Potential partners from among the symposium participants include: Dr. Lou Yiping (INBAR), Prof. Phoris (Dresden), Prof. Höfle (Göttingen) and Dr. Marco Stark (CMES, KIB/ICRAF).

TOPIC 5: SOCIAL SCIENCE ASPECTS OF NTFP HARVESTING

While much research on NTFP focuses on natural science research questions of growing stock and production potential, there are also very relevant social science implications which refer mainly to market issues, but also to policy issues when it comes, for example, to the regulation of user rights.

Research topics include conflict management (for example when collection habits conflict with regulations in protected areas), legal frameworks for endangered species (how are they implemented and enforced, and what are the driving forces in policy making), market analysis (commodity chain, who benefits most, the role of local collectors and middlemen, what institutions are concerned with benefit sharing? CB-analysis – this links to Topic 4), policy impacts on forest resource management and livelihoods of local communities, property rights concerned with NTFPs (in nature reserves for example). In this context, though not a research topic, also capacity building for local communities and government is an important issue (how does policy implementation differ from policy intention?)

Among the potential partners are all researchers among the participants who work in economics and policy, including Dr. Zheng Baohua (CDS, YASS), Mr. He Jun (CMES, KIB/ICRAF), Dr. Sikor (Berlin), Dr. Grossmann (Freiburg) and Dr. Krott (Göttingen). More partners among the Chinese scientists need to be identified and should possibly come from governmental and national level research institutions in China.

TOPIC 6: BAMBOO

Although bamboo is probably the most extensively researched NTFP (it is commonly considered a NTFP – although this may be challenged since commercial bamboo comes predominantly from pure bamboo stands), there are still many research questions, in particular with respect to determining the growing stock, sustainable yield regulations and optimizing silvicultural management practices.

Research issues include: the refinement of specific inventory techniques, in particular for tropical bamboo (Note: a link to ongoing INBAR activities is envisaged), monitoring and assessment of bamboo management strategies (including human impacts on biodiversity, and plantation vs. indigenous management), and management and sustainable harvesting schemes for bamboo from natural forests. The last issue refers to an integrated management approach (major challenge: replacement of forest for bamboo plantation) which includes the definition of criteria and indicators for sustainable bamboo management for natural stands and plantations and the development of monitoring mechanisms.

Interested research partners from the symposium include: Dr. Luo Yiping (INBAR), NN (KIB and Southwest Forestry College, China), Dr. Horst Weyerhaesuer (ICRAF). Prof Kleinn (Göttingen) and Prof. Phoris (Dresden).

TOPCIC 7: RELATIONSHIP BETWEEN MUSHROOMS AND MULTIPURPOSE TREES (*FAGACEAE* ETC.)

Given the high economic value of some mushroom species, one of the goals is domestication. While this has been successful for some species, it continues being a problem for others. Basic information for any domestication attempts are the site requirements. This research aims at the identification of these site requirements with a particular focus on the interaction between tree species and mushroom species.

This is a research topic which is combining aspects of Topics 1 and 2 and requires the matching of expertise in mycology, ecology and forestry. Mycology experts are to be identified, possibly from the corresponding research group in Göttingen.

TOPIC 8: HONEY BEES

Honey is an NTFP with large local importance. Compared to plant resources it has different attributes in terms of seasonality, spatial distribution and productivity. Information procurement will depend largely on interviews with honey seekers. Very little systematic research has been done so far on honey as a NTFP. Therefore, research needs to address basic issues, such as an inventory of the abundance of honey bee hives (habitat, abundance, status), the relationship between honey bees and plant communities (maize, barley, *Castanopsis* and other forest species) and the production of bee products (honey, propolis etc.), including their medical and nutritional properties.

Interested research partners from the symposium include: Ms. Jie Dong (IAR, CAS) and researchers from the Chinese Academy of Agricultural Sciences (CAAS); further partners need to be identified.

TOPIC 9: TREE LINE AND ELEVATION RANGE OF NTFPS

The spatial distribution of NTFPs with respect to eco-regions and elevation gradients is another open research question. Basic research would include the establishment of transects along an eco-region gradient and the identification of changes in biodiversity and diversity of NTFPs. This research would also include rural appraisals and interviews with the communities that harvest NTFPs. It will contribute in a very relevant manner to topic 3, the information system. Another important question that can be addressed by this research is how global change possibly affects the productivity and availability of NTFPs, i.e. this research topic does not only have a natural science, but also a strong socio-economic dimension.

Interested research partners from the symposium include: Prof. Yang Yongping (KIB, CAS), Dr. Horst Weyerhaeuser (ICRAF), and Prof. Dohrenbusch (Göttingen); additional scientists with expertise in vegetation sciences, ecology and socio-economy will need to be identified.

TOPIC 10: TRANSITION ZONES BETWEEN FOREST AND OTHER LAND USE TYPES

Although it seems contradictory to the definition of the term “NTFP” – these non-timber forest products are also found outside the forest. For example, tree bark and wild fruits harvested from non-forest trees are also considered NTFP. It is a general trend in forestry research to also recognize the tree resource outside the forest (‘forest landscapes’ or ‘land use mosaics’ at a landscape level) as a resource that is relevant from a forest and ecosystem utilization and management point of view.

The research questions include how the species composition changes along a transect that starts from the forest and extends into the open land, and whether a specific niche can be identified (with respect to various site factors) where the latter is an important issue also for domestication attempts.

Interested research partners from the symposium include: Prof. Lu Yuanchang (CAF), Dr. Horst Weyerhauser (ICRAF) and Prof. Kleinn (Göttingen).

CONCLUSION

The symposium achieved its goal of forming research partnerships and identifying specific research topics in the field of sustainable management of non-timber forest products. While a relatively great number of different institutions actively involved in research and development initiatives on the management of natural renewable resources, including NTFPs, were present at the symposium, more partners need to be identified in the process of developing the envisaged larger Sino-German research project. The symposium has been a gratifying opportunity to start the process of establishing and further developing the Sino-German cooperation in a field of research that has not only local and national importance, but is also of great regional and global value. We envision this partnership to develop into a long-term joint research initiative with the next two to three years.

RESEARCH ON NON-TIMBER FOREST PRODUCTS: A REWARDING SUBJECT FOR JOINT PROJECTS BETWEEN CHINESE AND GERMAN RESEARCH INSTITUTIONS

- A background paper -

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Non-timber (or Non-wood) forest products (NTFPs) are defined as goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests (FAO, 1999); they include products used as food and food additives (edible nuts, mushrooms, fruits, herbs, spices and condiments, aromatic plants, game), fibers (used in construction, furniture, clothing or utensils), resins, gums, and plant and animal products used for medicinal, cosmetic or cultural purposes. Non-timber forest products have long been an important component of the livelihood strategies of people living in or adjacent to forest areas. Several million households world-wide depend heavily on these renewable resources for subsistence and/or income, and the FAO estimated that eighty percent of the population of the "developing" world use NTFPs to meet some of their health and nutritional needs (FAO 1997). However, NTFPs are seldom the primary source of household income, since their supply is largely seasonal.

A study by Jansen *et al.*, (1991) showed that nearly 6000 species of rain forest plants in Southeast Asia have economic uses. While over 150 NTFPs worldwide have been identified as significant commodity in international trade (the most important tropical products are rattan, brazil nuts, gum arabic, bamboo and spices) it is more difficult to quantify national trade, which may be very substantial (Tropenbos International (2005)).

NTFPs have attracted considerable interest as a component of sustainable development initiatives in recent years due to their ability to support and improve rural livelihoods while contributing to environmental objectives, including biodiversity conservation. The eco-friendly and people-friendly connotations associated with NTFPs have supported some products to fill in a niche in international trade: the small, but rapidly growing fair-trade market. However, despite this positive image, there is no guarantee of a beneficial outcome and the utilization of NTFPs requires the same measure of planning and control that is required for timber in order to be sustainable. Decisive factors in the sustainable use of NTFPs include government involvement, the ability of local people to claim and enforce use rights (NTFPs are in most cases openly accessible), market transparency and access, and pressure on the resource (Tropenbos International (2005). Higher value is often associated with higher harvest levels and more intensive management. Unlike the larger number of less valuable NTFPs, those with a high market value are often not harvested in a benign way, and many are lost to the poor as other stakeholders take over control.

Domestication of NTFPs can be a way to intensify production (through higher yields, improved and/or more consistent quality, and control over timing of harvest), secure producer rights and reduce pressure on wild resources. Its risk are that domestication of wild-harvested products can lead to genetic homogenization, reduce the economic value of wild systems (up to the point where natural forest land is being cleared to grow domesticated NTFPs on a larger scale) and lead to transfer of benefits from one group of stakeholders to another (Belcher, 2003).

Despite more than a decade of research and targeted development projects, systematic understanding of the role and potential of NTFPs in conservation and development (i.e. how to enlarge its benefits for rural communities and the environment) remains weak. This is especially true for China where research and development efforts have only recently addressed the issue of sustainable utilization of NTFPs. The rich variety of non-timber forest products in Southwest China, many of which have been used by people for centuries, has been well-documented by Pei (Pei, 1985; 1996), and Zu and Jiang (2001) to name just a few. Zu and Jiang (2001) point out that more than 6000 plant species growing in China are being used for medical purpose, among which more than eighty percent grow wild in the forest. However, the fast process of modernization, urbanization and globalization not only increasingly adds more entries to the list of extinct species (i.e. rapidly reduces biodiversity), but also leads to the gradual and irretrievable loss of indigenous knowledge on the uses of medicinal plants and other NTFPs.

Despite the rich knowledge on medicinal plants, past research and development efforts have rarely thought of setting up an inventory and monitoring system, nor have they addressed management issues related to these and other NTFPs in China. Only the Matsutake mushroom (*Tricholoma matsutake*) has gained considerable research and development attention due to the fact that its economic value has rapidly increased in recent years as a result of rising demand in Japan. This mushroom grows wild in the Northeast and Southwest of China and is sold fresh and dried in local and the domestic market, but the largest portion is exported to Japan.

Among the many non-timber forest products that are being extracted by rural households from natural and planted forests and plantations in the mountains of Yunnan province, mushrooms and medicinal plants (both in many species and varieties), as well as walnuts, pine nuts, wild vegetables, eucalyptus oil and honey play an important role in the household economy. Examples exist for institutional arrangements aimed at the sustainable utilization of NTFPs in communal forests for those products that are valuable (and thus threatened by over-exploitation), such as Matsutake. These are good examples to learn from and improve upon and as emphasized in FAO's State of the World's Forests (2003): "*if benefits are to be provided on a sustainable basis to local communities and to countries at large, more effective controls may be required to maintain populations of NTFPs at productive levels. The means to accomplish this will vary, but they must be built on sound economic and ecological principles, and often on traditional institutions*".

Since enacting a logging ban in all natural forests in China under the Natural Forest Protection Program (NFPP) in 2000, people that traditionally use forest products (i.e. wood and non-timber products) for subsistence and income needs, have seen their resource base diminish substantially. The Sloping Land Conversion Program (SCLC; enacted in 1998) has further reduced upland farmers' production options as SLCP land cannot be used to grow other crops in-between the trees, even when trees are young and leave plenty of space for intercrops. However, the use of NTFPs in natural or planted forests is normally not restricted so that they have been increasingly exploited without a long-term view towards their sustainable use. The World Agroforestry Centre (ICRAF) and the Forestry Department in Baoshan prefecture, Yunnan province have started a pilot project to assist smallholder upland farmers to domesticate selected medicinal forest plants with high commercial value. Since they are not considered as crop species, they can be grown on SLCP land. Increased household income and reduced pressure on wild resources are the prime benefits of such an agroforestry system.

ICRAF has been working closely with the Department of Ethnobotany at the Kunming Institute of Botany (KIB) since it started to build research ties with China in 1995. In 2004, ICRAF and KIB jointly founded the Center for Mountain Ecosystem Studies (CMES) to collectively work towards understanding the causes and effects of past and current landuse changes in biologically and culturally diverse mountain areas in Southwest China. Joint research has been conducted in Northwest Yunnan that aims to generate concrete recommendations for development and policy on improved community-centered natural resource management.

Northwestern Yunnan has become of particular research interest in recent years because the mountain watersheds harbor great biological and cultural diversity, and are one of just a few places on earth recognized as both a Global Biodiversity Hotspot and Global 200 Priority Ecoregion. The area has recently been declared a World Natural and Cultural Heritage site by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). Northwest Yunnan (an area covering almost 70 000 km2) is home to more than 15 officially-recognized ethnic groups. These groups pursue complex livelihoods, based on a wealth of knowledge, beliefs, and institutions for maintaining the region's diverse landscapes. Forests account for more than 60 percent of the land area of northwest Yunnan, and provide crucial ecological and economic services, such as wildlife habitat, water retention and regulation, and soil erosion control. Forest ecosystems are also an important grazing habitat for livestock, and provide local populations with food, fuel, medicines, building materials, and valuable non-timber forest products (NTFPs).

Based on case studies conducted in Northwestern Yunnan, Xu and Wilkes (2004) conclude that biodiversity loss in the region is mainly driven by land use and land cover change and that market driven loss is currently a major threat, especially for NTFPs. Cross-border trade with the Southeast Asian neighbors plays a significant role. Xu and Wilkes (2004) observe this as indicative of what is occurring in many global biodiversity hotspots. They point out that market information is primarily supplied by outsiders who engage in collection or procurement of local produce and who are unconcerned about sustainability of harvesting. However, buyers and traders are in many cases the only link for rural communities (especially in remote areas) to the market. Xu and Wilkes (2004) also point out that NTFPs are liable to agricultural product tax, but enforcement is difficult.

The studies conducted by KIB and ICRAF point to important knowledge gaps that may lead to serious exploitation and unsustainable use of the natural resource "NTFP", among them the following five:

1. lack of basic knowledge on germplasm and non-existing or incomplete inventory;
2. no in-depth and long-term monitoring and institutional arrangements to ascertain sustainable extraction levels of major NTFPs;
3. insufficient market transparency for communities' (in terms of quality, price, markets for NTFPs);
4. only general, superficial knowledge of NTFP domestication and little understanding of the effects of domestication on product quality and price and the conservation of wild sources; and
5. no existing research on the full length of the commodity chain for major non-timber forest products and the various actors in the chain.

Based on the current state of knowledge on the use and management of NTFPs in Yunnan, Southwest China, and other parts of the world, answers to the following research questions are being sought:

- What are the most important NTFPs in terms of market value, their abundance (or scarcity) and their ecologically importance for the ecosystems in which they grow?
- Have they and the environments they grow in been delineated, inventoried and monitored? (Note: this is a crucial base for developing sustainable management techniques, particularly for those species that are in danger of over-exploitation).
- What are current management regimes (amount, frequency and methods of collection) for these NTFPs, what are/were the traditional practices, how have these changed over the past decade, and what have been the effects on their abundance or scarcity and on biodiversity in general? Are there indications that harvest levels are decreasing and is there a link to changes in forest area/structure? Are local communities aware of these processes and associated effects?
- What are the economic benefits obtained at household, local and provincial level from selected NTFPs (in absolute terms and in relation to other forest); how are they being processed (i.e. which value added processes are being done) and traded (commodity chain assessment)?
- What role do NTFPs play at domestic and regional (Southeast Asian) level? What product and amounts go into border trade and into the international market?
- How can smallholder upland dwellers benefit more from the use of NTFPs, i.e. what value-added measures can they take at household and community level, such as processing, labeling, packaging and trading? How can ownership, control over resources, market knowledge and access be improved for the benefit of poor upland communities?
- Which species are suitable for domestication; what agroforestry systems provide productive models for growing NTFPs on-farm; what are the effects of on-farm production of NTFPs on quality, price and on existing wild sources?
- What are the existing institutional arrangements to sustainably manage NTFPs; do they provide a model to learn from and improve upon? What recommendations can be drawn from these and other experiences that can feed into applied research projects and policy recommendations?

To initiate a Sino-German research cooperation appears particularly promising at this point in time, because research and development on NTFPs in Southwest China has recently gained significant attention from the Chinese government and donor organizations. The State Forest Administration (SFA) of China with support from the Ford Foundation and the World Agroforestry Centre is currently planning a national conference and workshop on the sustainable use of NTFPs in China. The conference will review China's NTFP policy within the National Forestry Management Framework and identify innovative approaches for sustainable community-based NTFP management. The proposed Sino-German research initiative can be linked to this significant event that will not only guide future research & development work in China, but also lay the ground for international research cooperation.

OBJECTIVES OF SYMPOSIUM

The symposium aimed to assess and review the state of knowledge on the use of non-timber forest products in terms of their importance for rural livelihoods and the effects of NTFP extraction on biodiversity in Southwest China. Symposium outputs will form a base for future Sino-German research that intends to focus on the sustainable management of NTFPs as part of a holistic natural resource management concept in one of the important biodiversity hotspots of the world.

Specific symposium objectives included:

1. To create an up-to-date knowledge base on past and current research and development work on NTFPs, including a list of major species and products according to their utilization and their importance for rural livelihoods (for both subsistence and cash economy);
2. To understand the threats of NTFP use on the maintenance of local and global biodiversity and identify those species that are rare and under threat of extinction;
3. To assess the importance of selected NTFPs for domestic and cross-border trade and identify key enabling and restricting market characteristics;
4. To appraise the potential for sustainable management of the resource, domestication and improved marketing of NTFPs (including institutional arrangement for communities' shared use and trade of products, as well as value-added processing, labeling, packaging and transport);
5. To develop a set of recommendations for future research on the sustainable utilization of NTFPs that not only support targeted development action, but also translate into policy recommendations in a holistic natural resource management context.

The symposium is viewed as the initial crucial step in laying the base for a long-term research collaboration and scientific exchange between German and Chinese institutions. The symposium in Germany has provided scientists from the Chinese Academy of Sciences at the Kunming Institute of Botany and its Chinese partner institutions an opportunity to interact with a large number of German scientists who are experts in the same field of research, and to visit and get to know relevant institutions and field projects in Germany.

REFERENCES

Belcher, B.M. (2003): Comment: What is an NTFP? International Forestry Review 5 (2): 161-168.

Jansen, P.C.M., Lemmens, R.H.M.J., Oyen, L.P.A., Siemonsma, J.S., Stabast, F.M. & van Valkenburg, J.L.C.H., (eds.) (1991): Basic list of species and commodity grouping (Plant Resources of Southeast Asia). Wageningen, the Netherlands: Pudoc.

FAO (1997): State of the World's Forests 1997. Rome, Italy: FAO.

FAO (1999): FAO Forestry – Towards a harmonised definition of non-wood forest products. Unasylva 50 (198).

FAO (2003): State of the World's Forests. Rome, Italy: Food and Agriculture Organization of the United Nations.

Pei, S.J. (1985): Preliminary Study of Ethnobotany in Xishuangbanna, Journal of Ethnopharmacology 13: 121-137.

Pei, S.J. (1996): Ethnobotany of Indigenous Non-wood Forest Products in Xishuangbanna of Yunnan in Southwest China. In S. K. Jain (ed.). Ethnobiology in Human Welfare. New Delhi, India: Deep Publications.

Tropenbos International (2005): Digital reference guide: non-timber forest products. Accessed on 20th June 2005 from Tropenbos International website: http://www.tropenbos.nl/DRG/NTFP.htm,.

Xu, J. and Wilkes, A. (2004): Biodiversity impact analysis in northwest Yunnan, southwest China. Biodiversity and Conservation 13: 959 – 983.

Zhu, Z. and Jiang, C. (eds.) (2001): Non-timber forest products and forest biodiversity in China. Beijing, China: International Academic Publishers / Beijing World Publishing Corporation.

FOREST INVENTORIES: RESOURCE DATA PROVISION AS BASIC COMPONENT OF SUSTAINABLE MANAGEMENT OF THE FOREST RESOURCE, INCLUDING NON-WOOD FOREST PRODUCTS

by

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1 ABSTRACT

An overview of basic technical characteristics of forest inventories with reference to designing inventories for non-wood forest products is given in this paper, and challenges and research issues addressed. In conclusion, many of the basic principles of forest inventories can be applied to the inventory of many non-wood forest products; There are, however, obviously some special characteristics of NWFPs that need particular attention in inventory planning, field measurements and analysis. Probably, for many non-wood forest products, an efficient integration of local knowledge is required to make inventories workable and efficient.

2 INTRODUCTION

Data and information are a basic element in decision making, in particular when the manager is dealing with a complex production system, such as forests. Inventories of renewable natural resource are tools to collect data that are being converted to information to support the sustainable management and sustainable utilization of the target resource. However, an inventory of a renewable natural resource is a complex undertaking, and provision of information is a considerable investment that should pay off. It is always an optimization process because resources (time and budget) are limited and must be optimally allocated. This is true for timber inventories, but it is much more so for the inventory of non-wood forest products (NWFPs) many of which are relatively rare and unevenly distributed over the area of interest which makes them a difficult object for inventory.

In the optimization process of an inventory, the usefulness of all possible information sources needs to be considered, among them maps, prior inventory reports, satellite imagery, aerial photographs, expert knowledge, interviews with owners and users of the resource are among these information sources. The most comprehensive information source about the biophysical status of the resource, however, is direct field observations, wherever possible. It is only there in the field, that direct observations of many of the attributes of interest can be done.

Forest inventories do usually refer to larger areas and field observations can not be done over the entire area of interest. Field inventories, therefore, base on sampling: observations take place only at a specifically selected subset of the population of interest. From these sample observations, extrapolations are calculated to produce estimations of the attributes of interest for the entire population.

It has often been discussed what a “good forest inventory” is. However, there is no such thing yet like a “good practice guide for forest resource inventory”. There are so many possibilities to carry out a “good inventory” that it is probably impossible to set up such a guide (it is probably much better to list bad practices that are to be avoided!). However, there is one criterion which is some times referred to as the overall goal of each inventory, and this is credibility: an inventory should be carried out, justified and reported in such a way that the results are credible. To achieve credibility, a number of sub-criteria need to be fulfilled like transparency of methods, complete and illustrative reporting, but, above all, methodological soundness. If the methods used are not sound and consistent, then it is practically impossible to achieve credibility.

In this paper, basic principles of forest inventory in general and of statistical sampling applied to the inventory of forest and renewable natural resources are presented and discussed. Then, specific challenges of inventories for NWFPs and for research in that field are identified and discussed.

3 BASIC CHARACTERISTICS OF FOREST INVENTORIES

When a natural renewable resource is to be managed the general objective is to do that in a sustainable manner so that, also on the long run, the resource base is maintained or even improved in quantitative and qualitative terms. Sustainability is one of the most modern concepts which in the meantime is being discussed in many sectors, in particular known in the context of sustainable development. In fact, the principle of sustainability had been invented and first described in the forestry context, where early in the 18th century a mining engineer, Carl von Carlowitz, recognized that the rapidly growing mining industry threatened the forest resource through over-utilization – which would have meant on the long run that the survival of the mining industry was threatened, as well. That was one of the reasons to introduce a more reasonable approach to wood harvesting and the term “sustainability” was coined (“Nachhaltigkeit” in German).

Information is considered one of the vital pillars of sustainable management. Only when the basic characteristics of the natural renewable resource are known to a sufficient degree it can be guaranteed that harvesting does not exploit the resource. Major components of that information are the answers to the questions

- how much is out there at a given point in time (growing stock)?
- what is the quality?
- where is it?
- what is the growth (including all components of natural dynamics like mortality and regeneration)?
- how much can be harvested (accessibility, detection functions, ownership restrictions)?

A great part of that information can be produced by sample based inventories, be it temporal ones of permanent ones.

Information requirements are there on various geographical levels. A forest owner is interested in stand-wise information to plan for silvicultural treatments, harvesting operations and selling forest products; he or she requires information on a local basis. The government of a country or province wishes to know about the development of the forest resource, for example to guarantee the livelihoods of rural communities or to attract investors to establish a wood based industry. The government needs then large area information which has many commonalities to the local information but is different in a number of aspects.

Forest information is also produced on a global level: since the Earth Summit in 1992, various international conventions are in place which require the governments to report to the international community on various aspects that do also have to do with the forest resource; we refer here, for example, to the Convention on Biological Diversity CBD, to the Convention to Combat Desertification CCD and the Framework Convention on Climate Change UNFCCC. The signatory countries are obliged to report to these international processes on a regular basis and that requires that they do permanently generate up-to-date information also about their forest resource; that requires a national forest inventory. Then, international organizations such as the Food and Agriculture Organization of the UN (FAO) compile information and publish results on the state of the world´s forests.

While NWPFs are now included as "Special Study" into the reports of the global Forest Resource Assessment (FRA) of FAO, it is mostly on a local level where information on that resource is required and where the question of an NWFP-inventory may come up.

4 FOREST INVENTORIES AS COMPLEX PROJECTS

Forests are complex ecosystems and complex production systems. While the early forest inventories were exclusively about guiding and optimizing wood production, focused on wood volume in terms of quantity and quality, the objectives are much wider nowadays. While wood production does still play an important role, forests are seen as a resource in a much more comprehensive manner: it is not only wood which is produced but a long list of other tangible products, the NWFPs, including fruits, mushrooms, bamboo, rattan, ornamental plants, and bush meat. In many regions medicinal plants play an economically much more important role than timber! But it is also the services that forests offer which are of interest for monitoring and for sustainability issues: forests, for example, help maintaining water clear, they serve as recreation area, they filter the air, produce oxygen, they prevent and control erosion, and they are home to many plants and animals such conserving biodiversity.

This certainly incomplete list of forest functions makes clear that an inventory which intends to provide information on some of these features is bound to result in a complex project.

The overall complexity arises from the complexity of the target object "forest" itself, and from the conflicting interests in the forest as resource or ecosystem, but also from the mere size of many of the inventory projects: when a forest inventory is to cover a larger area by sample plots, then a high degree of complexity comes in from an organizational and logistical point of view: a sampling protocol needs to be devised, appropriate staff needs to be found, field teams put together, training given, transport organized, supervision, data entry and data management need to be organized. As in any complex undertaking, errors will come in at different stages, which should be accounted for when reporting the results.

5 WHERE DOES THE INFORMATION COME FROM: INFORMATION SOURCES USED IN FOREST INVENTORIES

When information on a complex object is needed, the planners will naturally resort to all available sources of information. In a one-shot forest inventory, one is interested in the current status quo, so that only up-to-date data are of interest. The most up-to-date data come from field measurements and recent remote sensing imagery (aerial photographs of satellite imagery) – and these two are, in fact, the most important sources of information that are being evaluated and analyzed in forest inventory studies. However, the usefulness of remote sensing for NWFP inventories is still to be verified, maybe it can serve as a proxy in modeling approaches.

Field measurements and remote sensing both have their specific strengths and problems: while remote sensing imagery allows for a synoptic view and provides an immediate impression of forest area distribution and fragmentation over a larger area, it does not offer the possibility to make observations of many of the core variables in forest inventories such as species composition, diameter distribution, density of regeneration, or signs of utilization of wood and non-wood products, indicators of biodiversity. Field measurements allow for all these measurements but are more tedious and less precise when it comes to the estimation of areas. It is commonly accepted, though, among forest inventory experts, that a forest inventory requires field observations. A solely remote sensing based study may actually be caked a forest mapping exercise – and not a forest inventory. This is some times causing severe confusions.

There are many other information sources that are being used as ancillary information and as planning tool; among them, maps are most indispensable. Without useful maps, any inventory faces severe problems and the generation of a work-map will be the first step to be undertaken. In cases where maps are outdated or of limited accuracy for the area of interest, the maps must be adjusted and updated.

For many NWFPs, however, the most valuable source of information for inventory planning is probably local knowledge and experiences of experts or staff who participated in former inventories. It is those people who have the specific knowledge of the region of interest and may help to efficiently guide an inventory exercise. The integration of local knowledge and sample based NWFP-inventories is certainly a field worth to be closer looked at.

6 SAMPLING: AN IMPORTANT STATISTICAL TOOL IN FOREST INVENTORIES

Sampling is an important and essential methodological element of natural resources inventories. Soundness of sampling is an important component of overall credibility, where we refer exclusively to statistical sampling, not to other approaches like purposive or subjective sampling. Statistical sampling follows strict rules. Not-observing these rules means that the data can not, in a strict sense, be analyzed along statistical procedures but produce case-study results without the possibility of extrapolation.

If we wish to produce scientifically defendable results, we need to adhere to the principles of statistical sampling. However, cost does obviously also play also a role and there might be situations in which the decision maker is happy with information which is not backed by statistical soundness.

Sampling studies can be broken down into three major technical design elements: (I) sampling design, (II) response design and (III) estimation design. In addition to that, a number of organizational and logistical issues need to be addressed like in any other project. This refers mainly to practical implementation and dissemination of results.

The sampling design defines the technique that is being used to select the sample elements. The very basic sampling design is simple random sampling. However, this is practically not used in natural resources inventories, because more efficient designs are available, such as stratified sampling, cluster sampling, systematic sampling. Sampling technique and sample size are important factors for statistical precision. It is, therefore, worthwhile to do a detailed and proper planning. Most forest inventories base on systematic sampling, both for reasons of statistical precision and for practicality. The detail planning, however (referring mainly to size and type of the systematic grid applied) needs to be adjusted to the particular situation and conditions of the specific inventory and there is not one single optimal sampling design for all situations.

The response design defines the sample elements themselves and the observations/measure-ments that are to be taken there. Usually, in natural resources inventories, sample plots are used that have some spatial extension, such as circles of a defined radius or squares of defined side length. On these sample plots, observations are made on the target attributes such as trees dimensions, forest structure, dead wood, soil and also NWFPs. Definition of plot type and size depends on statistical and practical considerations. Experiences from forest inventories are very useful in this context for inventories of NWFPs as well. From a statistical point of view, it is best to design the sample plots such, that a maximum of variability is present within each single plot. By that, a maximum of variability is captured per plot which leads to a reduction of the standard error, because the variability between plots is kept small.

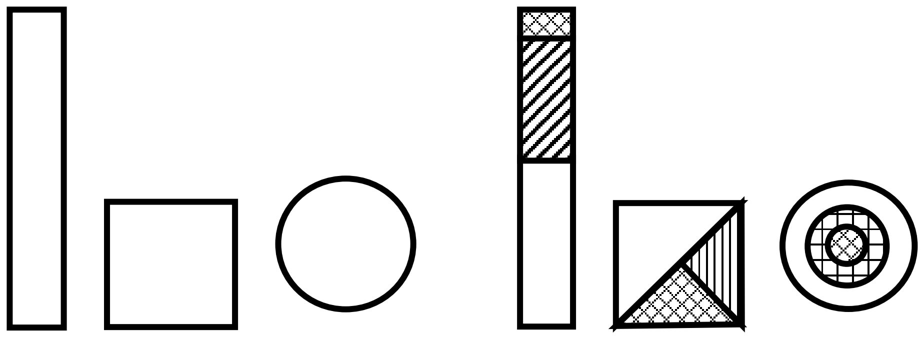

Figure 1: Illustration of fixed area sample plots. Left: typical plot shapes. Right: the same plot shapes as nested plots where several sizes of sub-plots are nested; in each one of the sub-plots, specific dimension ranges (for example tree diameters) are observed.

Given the typical spatial structure of plant communities, we may assume that objects (trees, plants) that are close to each other exhibit more similar characteristics than those at farther distance. The consequence is then, that, from a statistical point of view an elongated plot design that covers various different conditions is to be preferred over a compact plot like a circle or square plot. The latter, however, are more practical in terms of implementation under many conditions.

The definition of the response (i.e. plot-) design is a compromise between statistical considerations and considerations of practical implementation. Typical plot shapes as used in forest inventory are the rectangle, the square and the circle (see Figure 3). A variation are nested plots, where several sub-plot sizes are nested; then, on each one of the sub-plots different diameter classes of trees are observed (see Figure 3). That principle of using sub-plots may also be applied when inventorying NWFPs where the more abundant objects (like trees) are observed on a smaller plot and rarer plant species NWFPs are searched on larger plots. Such an approach had been followed by Kleinn et al. (1995) in a forest inventory project in Nepal where medicinal plants were also to be inventoried.

Besides these fixed area plots there are other plot types which are also called variable area plots, because the respective plot area varies from sample point to sample point depending on particular characteristics of the stand. Examples of these techniques are distance methods such as k-tree sampling (where, from a sample point the k nearest trees/plants are measured) and the so called relascope sampling where trees around the sample point are included with a probability proportional to their basal area (see Figure 4). While k-tree sampling (or k-object sampling) is appealing because there is always the same number of objects per sample point, it is problematic for rare objects, because the distance to the k-th object may be large and nearer objects may be overlooked.

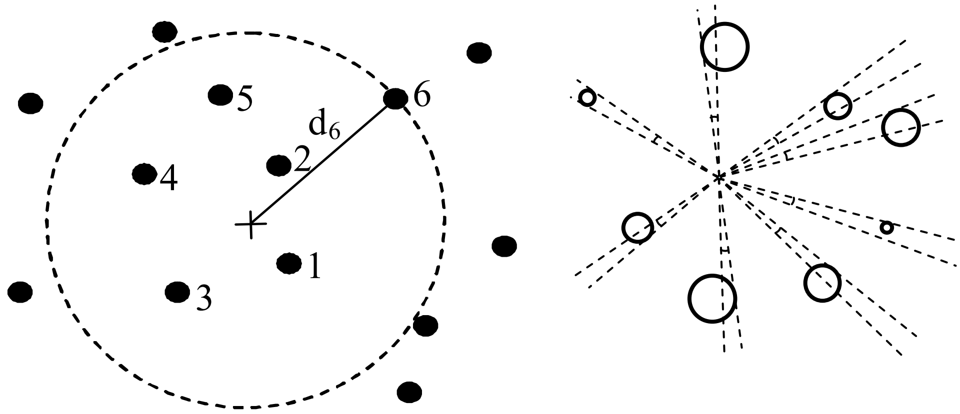

Figure 2: Further plot types used in forest inventories and ecological surveys. Left: point-to-tree distance sampling where the size of the circular plot is determined by the distance to the kth tree, in this example k=6). Right: relascope sampling (or Bitterlich sampling or angle count sampling), where, from a sampling point, all trees are observed which appear wider than a pre-defined observation angle.

Spatial cluster plots area widely used in forest inventory. There, one cluster plot consists of several sub-plots, each one being one plot as described above. By that, a larger area per plot is covered causing more variability to be collected. A plot design that has been proposed for rare and clustered elements is adaptive cluster sampling, where the clusters adapt to the occurrence of the target objects. That design has been repeatedly applied to NWFP inventories.

Finally, the estimation design defines the analysis procedure and consists of the appropriate estimators that allow making unbiased estimations. One is not free in the choice of the estimator but the estimators need to be exactly conforming to the sampling and response design where, in some cases, estimation is a complex issue, for example when using k-tree sampling as plot design (Kleinn and Vilcko 2006). The estimators for mean and variance from simple random sampling are well known. However, there are sampling designs for which more than just one estimator is available. Then, one needs to choose between them; each one is likely to produce different estimations. One would choose the estimator for which the estimated standard error is smallest, i.e. precision highest.

Results from forest inventories are usually reported on a per-hectare basis – while observations are made on a per-plot basis. That means that the per-plot observations need to be converted to per-hectare values. This is done for fixed area plot designs by so-called expansion factors.

7 MODELS

Forest inventories utilize and depend on models. This has to do with the fact that various variables need to be observed which can not be directly measured. The most typical example is timber volume or biomass which are usually predicted by models that have easily measureable attributes like species, diameter and height as input variables, called volume functions or biomass functions. Also the observation of basal area makes a model assumption, namely that the stem is a perfect circle (which it is not). While we know that the models are not perfect and carry certain errors, we depend on them until better approaches are being developed.

There is a long history of development of basic models for forest inventory. Volume functions, for example, are there for many regions and many species and species groups where building such a model is a laborious undertaking.

It is assumed that inventories of many NWFP will also require adequate modeling, also for the more simpler exercises like the inventory of tree-related NWFPs: for bark harvesting, bark volume models need to be known (depending also on the harvesting technique), for fruit harvesting models are needed that allow predicting fruit load as a function of, for example, tree diameter, crown diameter, crown length and tree height. And in the case of fruits, the accessibility is also a point: growing stock is not the same like the stock available / technically accessible for harvesting. Of course, the fruit load of a tree can also be estimated by sampling techniques, but this is too tedious for an inventory.

8 SPECIFIC ASPECTS OF NWFP INVENTORIES

It is neither easy nor straightforward to talk about NWFP inventories in general, because different products obviously require different inventory techniques. An overall optimal technique does definitively not exist and the planning must be essentially done on a specific NWFP by NWFP basis (Kleinn et al. 1995).

For NWFPs which are tree parts – such as bark, roots, fruits, leaves – standard forest inventory techniques can directly be applied to estimate number of stems per area unit. Additional models or sampling techniques are then required and need to be applied to estimate the per-tree amount of resource. So this is fairly straightforward.

For all other (non-directly-tree-related) NWFP (such as medicinal plants, tubers, ornamental ferns and palms, bee honey, wildlife/bushmeat), there are some special characteristics which make sample based inventories difficult, among them

- scarcity,
- seasonality and
- detectability.

Because of the complex nature of NWFPs, the first question to ask is whether a biophysical inventory of the sampling-type is required – implying high cost and efforts and considerable planning and evaluation efforts -, whether a stand-alone NWFP inventory pays off or whether it should be combined with a default forest inventory.

It is probably local knowledge that plays a crucial role in any NWFP resource inventory study. The local collectors have the knowledge to identify the target species and have an idea of its distribution, can therefore support and guide the inventory planners. Also, market survey type of studies will provide (at least some) insight in the resource base and its development over time; again, it is not only the observation what there is on the market, but above all the interviews with the collectors and traders about their experiences over the past period.

9 RESEARCH TOPICS

From the above description of the characteristics of forest inventories and, in particular, NWFP inventories, it becomes clear that there are various research topics to be addressed. In the following, some are listed – where the selection may have some personal bias.

Some of the issues are of a more technical nature, such as

- Integration of data sources. While field observations are indispensable in all forest resource inventories, available ancillary information in reach need to be used. In forest inventories, this refers mainly to remote sensing, for NWFP inventory it refers mainly to the integration of local knowledge; because local knowledge does not occur in standardized formats and because forest inventory experts are usually not experts in interviewing techniques, this integration is a challenge.
- For field observations, efficient sampling techniques for the estimation of the growing stock of rare events need to be devised; it is somewhat open to the author, whether this is a feasible undertaking at all. Some techniques, like adaptive cluster sampling, have been proposed – but the practical problems are still unresolved and the experiences not overly convincing yet.
- Sampling techniques must also become simpler in implementation and estimation. Rural communities, for example, that are responsible for the sustainable management of a forest area and its products will have to give evidence of the sustainability of their resource management, they urgently need inventory techniques that are easily understood and implemented. This is a wide field.
- Assessment and evaluation of error sources. In resource inventories, many error sources exist. They are usually not duly taken into account and the standard error remains commonly the only error quantity given.

Forest inventory research, however, does not only have its technical side, but many more aspects worth to be researched into:

- The interdisciplinary implementation of forest resource inventories at a landscape level is still in its early stages. In addition to the technical issues, many organizational and balancing efforts are required.
- Capacity building and, above all, capacity maintenance is another serious issue. This is, of course, not only a research issue; but research is directly linked to that problem: If forest and natural resource inventory courses at universities are schematic and do not focus on problem solving and the whole range of issues touched upon in a forest inventory, we'll fail on the long run to educated capable experts.
- Maybe the most crucial issue, and an extremely difficult one at the same time, is that of a smooth integration of forest inventory into the policy process and the clear definition of information requirements that shall be served by a resource inventory. It is not clear at all that there is a direct relation between information quality and quality of decisions. It is, therefore, very difficult to define what minimum / optimum information is required for decision makers to make optimal decisions. Surprising enough, this very basic question crucial for any inventory of renewable natural resources is still largely unanswered.

10 CONCLUSION

This paper gives a brief introduction into the technical and research field of forest inventories with special reference to their application for data collection on non-wood forest products. It is certainly incomplete in terms of description and in terms of the list of research topics. However, it is hoped that it shows that forest inventory is not a merely technical issue but has many more aspects to be considered. If it is not a very specific timber inventory for a plantation company, for example, a forest inventory is a truly interdisciplinary exercise in which the lead planners and researchers need to have a good command of a variety of skills, among them statistical sampling techniques, human resource management, planning of logistics, presentation of results and communication skills when it comes to defending the inventory and its results before unjustified (and also justified) criticism. Of course, all these skills are also required in many other types of projects.

Baseline information is the starting point of many natural resource management projects. The author expects that forest data provision, notably forest inventories and the know-how about it, will be in increasing demand, also when it comes to feed the great international processes with hard data (such as the Convention on Biodiversity, the Convention to Combat Desertification and the UN Framework Convention on Climate Change).

REFERENCES

Bhandari N. and C. Kleinn. 2003. On the sustainable management of non-timber forest products (NTFPs) in the High Mountains in Nepal. ETFRN News 38/03, p. 33-35.

FAO 1998. FRA 2000 Terms and Definitions, FRA Working Paper No.1, 19p (http://www.fao.org/forestry/fo/fra/publications.jsp?lang_id=1)

Kleinn C, R Laamanen, SB Malla. 1996: Integrating the assessment of non-wood forest products in a large area forest inventory - experiences from Nepal. Proceedings International Conference on Domestication and Commercialization of non-timber forest products in agroforestry systems, 19-23. February1996, ICRAF, Nairobi. FAO Non-Wood Forest Products Series No. 9, p23.31.

Kleinn C and F Vilčko. 2006. Design unbiased estimation for point to tree distance sampling. Canadian Journal of Forest Research 36(6):1407-1414.

FOREST MANAGEMENT SYSTEMS AND DIVERSIFIED PRODUCTION - PRINCIPLES OF SUSTAINABLE MANAGEMENT OF RENEWABLE RESOURCES

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ABSTRACT

Since the UN conference in Rio 1992 the term ”sustainability” seems to have developed to a world-wide buzzword. But recognizing the fact that we are about to reach our limits not only with respect to non-renewable resources, but increasingly also towards renewable resources, leads to the necessity to apply sustainable development to all economic development planning’s. Sustainability is not a new thought: In forest land use (of central and Western Europe), the principle of a sustainable management has been used since the beginning of the 18th century and has been applied more or less consistently for at least 200 years. Many centuries of uncontrolled ”plenter forestry” which was oriented only at the need of the users but not at the production capacity of the forest lead to a considerable forest degradation. The result was the development of different sustainable management systems in European silviculture of which many are still in use today. An essential condition for sustainable management is a thorough inventory that quantifies the potential increment and thus prevents overexploitation. This is also valid for non-timber forest products (NTFPs), which range from woody plant species such as bamboo or rattan to products that only have certain relationships to forest ecosystems, e.g. resins, mushrooms, spices, medical plants. Due to the diversity of NTFPs and types of use there are no general rules for controlling their sustainable management. Moreover the rules must be adjusted for each single product group. Today's understanding suggests that sustainability criteria should not only be reduced to the relationship of growth and yield. Sustainable management also includes soil fertility, biodiversity and ecosystem stability. Certification systems, which have been proved as positive control tools for forest management, also need to be developed for and applied on the different ways of utilizations of NTFPs.

INTRODUCTION

Since the 1990s, the concept of sustainability or sustainable development became an important task of all political and economic programs. This new way of thinking lead to the UN conference in Rio de Janeiro / Brazil in 1992 where 180 nations signed the “Convention of Biological Diversity” to make sustainability to a general principle of human activities. Nowadays, we define sustainability as the effort for the compatible integration of all activities of an enterprise into its ecological, social, cultural, ethnical, and religious surrounding.

But Rio was – in a global perspective – not the first shock for mankind in terms of fear for unsuccessful sustainability. Exactly 20 years ago, in 1972, Dennis Meadows and his co-workers from the Massachusetts Institute for Technology (MIT) published an impressing study. At that time all thoughts were focussed on non-renewable resources, such as iron ore, natural gas or coal. It was clear to everybody that these resources are limited. The new message, however, was that the commonly used way to calculate the availability, was completely wrong. The calculation was mostly based on the current average consumption: When we calculate this for example for coal, the stock of estimated 5000 billion metric tons will last for about 2300 years. But as in many relations growth is not developing proportionally (linear), but exponential like the world population. When we take these realistic growth rates for our forecast into account, the coal supply will not be enough for the next 2000 years, but only 111. This is just an example; the situation can be even more severe for other resources.

The awareness that the limits of non- renewable resources are predictable was im important signal for a more sustainable use of resources in principle. Apparently sustainable management can only be applied on renewable resources. Hence this is not applicable on iron, gas or coal, but on forests and timber. After all, a forester was the first in Europe who used the term “sustainable“ and demanded a sustainable forest management to guarantee unlimited harvest for the future. Carl von Carlowitz wrote the book Silvicultura oeconomica after he had seen the good results of the French forest inventory in the 17th century. And he wrote this book in a period, when many forests in central Europe were devastated and in bad condition. Timber in the forest was mostly used according to the uncontrolled so-called plenter system, harvesting primarily the biggest trees. As a consequence, people used the timber that they needed without caring for renewing the production base. In connection with intensive grazing activities, the results in large areas of Central Europe were destroyed forests and devastated landscapes. Foreseeable

The most successful strategy to avoid uncontrolled use and overuse was the knowledge about the growth potential of the forests. If people know the growth they can use renewable resources sustainably. The precondition for this knowledge is a good inventory, and this was already the conviction of v. Carlowitz when he saw the large inventory programs in France.

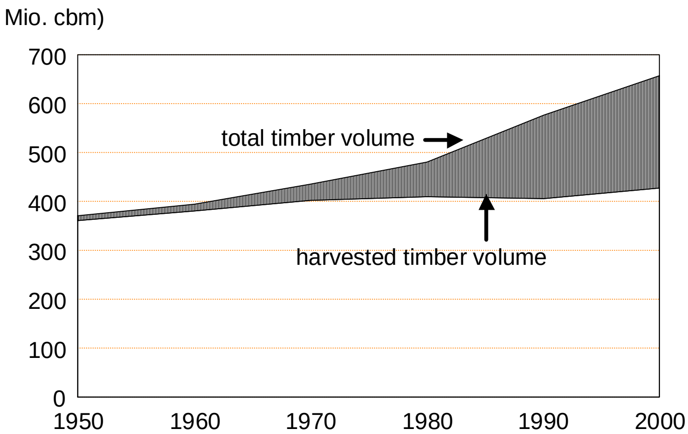

Figure 1 Wood increment and harvest in Europe 1950-2000

The impression arises, that sustainability was mainly a result of scarcity. But even at that time thoughts on sustainable management in context with forest inventory was not a new discovery. Already in the late middle age, there are examples of pre-industrial enterprises like saltworks with a tremendous demand for fire wood which had a fundamental interest in a sustainable supply of the raw material. Some enterprises used the forest in a very responsible way and despite great demand of firewood the timber stock in the forests increased, others harvested careless with the result of overused and devastated forests. The first simple methods of a sustainable forest use were dividing the total available forest area into patches of same size. The number of patches depended on the rotation period. The typical form of forest management in former times, coppice, had an average rotation period of 15 to 20 years. Hence, it was necessary to have 15 to 20 patches in order to harvest just one patch every year. Later on, sophisticated and better methods of forest inventory were developed and applied. Nowadays, in Central Europe we have the highest forest stock volume we ever had for the last centuries.

According to an international assessment (UNECE/FAO 2003), the development of total timber volume increment in the forests and the harvested timber volume is more and more drifting apart (Fig. 1). While the harvest of about 400 Mio. m³ remains on the same level for more then three decades, the timber increment has increased from 450 Mio. m³ in the middle of the 1970s to about 660 Mio. m³ today. Only about 60% of the total wood increment is currently used according to this assessment. Therefore, in Europe we observe an increasing over-fulfilment of sustainability principles in the forest. After the comparison of two very detailed forest inventories in Germany from 1987 and 2002 it could be shown that this European trend of restrained harvest intensity has reached significant extents particularly in Germany: the degree of wood mobilization is not higher than 55%.

THE QUALITY OF FOREST INVENTORIES

The comparison of the two national forest inventories did not only deliver surprising results in terms of mobilisation degrees. Unexpected high was the calculated average annual increment of 12 m³ per hectare and year. Even if there are some methodical reasons within the assessment for the great wood increment, the growth potential of the European forests has changed due to ecological changes during the last decades. In spite of the so called forest decline that could explain a decreasing growth trend we have a strong increase due to higher carbon dioxide concentration in the atmosphere along with increasing inputs of nitrogen. Additionally, we observe longer vegetation periods and higher average temperature which increases photosynthesis activity. The expected negative impact of drought due to reduced precipitation und warmer summers has not yet influenced the growth dynamic in most parts of Central Europe. Hence, in short and middle term perspectives, foresters see the principle of sustainability for the renewable resource timber in Central Europe not at risk.

To sum it up it can be said that the sustainable management of renewable resources

3. is not a new idea
4. needs adequate inventory and
5. is influenced by environmental changes.

WHAT DOES SUSTAINABLE FOREST MANAGEMENT INCLUDE?

In the first chapter all aspects on sustainable forest management were focused on the timber production with regard to of timber volume and in a wider sense carbon sequestration. Sustainability however, means more and should relate also to timber quality and ecosystem stability. This includes health and vitality for the forest stand as well as long-term soil fertility. Under these conditions, the principles of sustainable forest management should include the following objectives:

6. Ecologically adapted silviculture (conservation or increase of forest area, harvest adapted to growth potential)
7. Effective forest protection
8. Improvement of long-term stability
9. (Attractive forest-landscape scenery)

THE FOUR PRINCIPLES OF A SUSTAINABLE FOREST MANAGEMENT

PRINCIPLE 1: ECOLOGICALLY ADAPTED SILVICULTURE

This indicates the conservation and the support of natural processes of the forest ecosystem. In detail this principle does not allow a direct disturbance of nutrient cycles, thus clearcuts should generally not be applied. Instead, a promotion of natural regeneration concepts should be favoured. Furthermore, only a very limited application of chemicals, such as herbicides and insecticides should be accepted. In order to improve the biological vigours, more ecological niches, i.e. a higher portion of dead wood, should be created. Finally, an ecologically based game management is an essential condition for a sustainable forest management, at least in Central Europe.

PRINCIPLE 2: EFFECTIVE FOREST PROTECTION

This goal can be approached on different levels: First of all a minimum area of forest reserves such as nature reserves, biosphere reserves or national parks should exist. These areas may have different levels of protection. The portions of completely protected area in countries with multifunctional forest management system can me much lower compared to countries with a segregation system. That means a clear separation between areas with 100% production function and others which are entirely protected.

On the operational level within a forest management the trend towards more mixed stands is obviously the most effective concept in order to stabilize our forests and to create good conditions for an effective forest protection. It is expected that a higher diversity in tree species will support a higher diversity of the other components of a forest ecosystem which will improve resisting power against biological (insects), chemical (air pollution) and physical (climate) stresses. Furthermore mixed stands might have a higher stability against mechanical (storm) hazard.

PRINCIPLE 3: IMPROVEMENT OF LONG-TERM STABILITY

This goal is linked with principle No. 2, the effective forest protection, but is more focused on long term stability. According to our current knowledge it should be approached by the already mentioned concepts of a higher level of biodiversity. Diversity of species, particularly tree species, a higher genetic variety of stand structures shall reduce the risk for forest ecosystems which are faced with significant environmental changes. Tree species with different ecological demands and stress tolerance will statistically reduce the risk to lose complete ecosystems.

PRINCIPLE 4: ATTRACTIVE FOREST-LANDSCAPE SCENERY

The demand to include also aesthetic aspects on landscape level into the principles of a sustainable management is certainly the most controversial thought. Here we should distinguish between countries with a high population density and high expectations of the public toward the recreation function of forest land. In Germany, there are big expectations in terms of landscape aesthetic and recreational functions which need to be respected in sustainable management plans. On the operational level, this implies an improvement of forest margins and a special focus on an attractive landscape, i.e. a balanced and reasonable mixture of forests, intensively used agricultural land and other areas such as settlements and streets.

NON-TIMBER FOREST PRODUCTS

All explanations above were related to the sustainable management of forests. Can we simply apply these principles to non-timber forest products? NTFPs are commonly defined as 'all products derived from biological resources found on forest land but not including timber, fuelwood or medicinal plants harvested as whole plants'. NTFPs include

Table 1: Overview about different kind of NTFP

• Edible plants • Food • Edible oils • Spices • Fodder • Medicinal products • Rattan • Bamboo • Cork • Ornamental plants • Chemical components	• Edible animal products • Terrestrial animals • Animal products • Fish and aquatic invertebrates • Insect products • Wildlife products and live animals

According to estimations from the European Tropical Forest Research Network, up to 2000 non-timber forest products can be listed today and there is still an increasing trend for more products (Gopalakrishnan et al. 2005). In terms of the economic value the importance of NTFPs is concentrated on a few products only, mainly bamboo and rattan (Paudel and Chowdhary 2005). Nevertheless, NTFP experts see urgent need for adequate NTFP inventory methods. During the conference of the European Tropical Forest Research Network (ETFRN) at FAO, in Rome / Italy from May 4-5th, 2000, Wong presented a review of NTFP inventories (Wong, 2000).

She concluded that

- the variety of life forms and distributions represented by NTFPs mean that traditional forest inventory techniques cannot be adapted easily for NTFPs.
- there is a lack of properly researched NTFP-specific sampling designs and measurement techniques.
- lack of theoretical models means that it is difficult to determine the sustainability of NTFP harvesting.
- there has been little cross-disciplinary exchange of ideas and methods suitable for use with NTFPs.
- There is no service that provides effective communication of advice to field workers and communities

Summarized, there are some aspects which can and should be improved in order to come closer to a more sustainable management of these products with a promising future. An adequate inventory is without doubt an essential precondition for a sustainable management of non timber forest products, but there are still other problems.

CONFLICT POTENTIALS WITH NTFPS

In Central Europe non-timber forest products were very important for livelihood and the economy for more than 1000 years. In the middle ages, the economic value of grazing in forests (pigs, sheep, goats, cattle, horses) was much higher than the revenue for timber production. Already at that time, the promotion of a certain NTFP was automatically a decision against other functions and products of the forest. High grazing intensities in the woods destroyed the forests for many generations. In the Mediterranean countries this experience was already made some thousand years ago.

Nowadays, this conflict does not exist any more in Germany. But we still have the internal conflict of a diversified production with changed actors. Today it is not cattle, pig, and sheep, but red deer, roe deer and hare. Game has developed to the most important non-timber forest product in Germany and at the same time has a negative impact on the regeneration and healthy development of forests. High deer populations will not be able to destroy the forest as for example goats did in the past, but they can harm the stand and timber quality. This is also a big economic problem because a main goal of German forestry is the production of quality wood. Even though this conflict between silviculture and hunting has been calmed down in recent times due to a more ecologically adapted wildlife management, we have to consider that the promotion of NTFPs can produce conflicts with other objectives of a forest management. There are several examples from all parts of the world where comparatively severe conflicts exist between the use of timber and non-timber forest products (Ndoye and Tieguhong 2004, Trauernicht and Ticktin 2005, Pulido and Caballero 2006). But there are also examples where even in bioreserves the sustainable use of NTFPs can be compatible with nature protection goals (Kiehn 2004).

OUTLOOK

Non-timber forest products are of increasing importance for the economy of many countries, particularly in the tropics and subtropics. The most important sector for non-timber forest products is Asia (Mahapatra 2005), followed by Africa (Obebode 2005) and South- and Central-America. Interest in non-timber forest products (NTFPs) is increasing rapidly; internet-based search engines find more than 350000 entries for NTFP. On a simple level the prognosis for the sustainable development of this highly diverse product group is not too difficult: NTFPs are according to the definition closely linked with forests. Therefore, sustainability for NTFPs can only be ensured if there is a long-term stability and sustainability of forests. On a world-wide level, however, the forecast is not very optimistic. The world’s population follows an exponential growth curve and at the same time we have dramatic losses of forest area with an annual net loss of about 10 Mio. hectares. Consequently, the average forest area per capita is decreasing dramatically: in 1960 t 1.2 ha/capita were calculated; 35 years later this ratio has decreased to only 0.6! According to a model of Gardner-Outlaw and Engelman (1999), we expect only 0.4 ha forest / capita in 2025. With respect to these data, the prognosis for a sustainable management of non-timber forest products for the next decades cannot be too optimistic. The big advantage of non-timber forest products in comparison with timber production, however, is the expectation of annual income due to short(er) production periods. While the conventional products require many years to produce, it is possible to develop annual income from many non-timber forest products. Common sense management can produce NTFPs sustainably to make them a permanent part of forest productivity (Jones 2004). This is without doubt an important factor for the great interest in NTFPs.

REFERENCES

Engelman, R.., Gardner-Outlaw, T., 1999: Mensch, Wald! Report über die Entwicklung der Weltbevölkerung. und die Zukunft der Wälder. Stuttgart

Wong, J. 2003: Developing needs-based inventory methods for non timber forest products. Proceedings European Tropical Forest Research Network, Rome / Italy,

UNECE/FAO, 2003: Trade and sustainable forest management United Nations Economic Commission for Europe. Forest Products. Annual Market Analysis 2002–2004. Timber Bulletin, Vol. 56.

FAO. 2004. FAO Yearbook of Forest Products 2002. Rome.

UNECE/FAO. 2004. Forest Products Annual Market Review 2003-2004. Timber Bulletin, Vol. 57.

Pulido, M. T. , Caballero, J, 2006: The impact of shifting agriculture on the availability of non-timber forest products: the example of Sabal yapa in the Maya lowlands of Mexico. Forest Ecology and Management, Vol. 222, No. 1/3, pp. 399-409

Trauernicht, C. Ticktin, T. 2005: The effects of non-timber forest product cultivation on the plant community structure and composition of a humid tropical forest in southern Mexico. Forest Ecology and Management, , Vol. 219, No. 2/3, pp. 269-278

Odebode, S. O. 2005: Contributions of selected non-timber forest products to household food security in Nigeria. Journal of Food, Agriculture & Environment, Vol. 3, No. 3/4, pp. 138-141

Mahapatra, A. K. , Tewari, D. D. 2005: Importance of non-timber forest products in the economic valuation of dry deciduous forests of India. Forest Policy and Economics, Vol. 7, No. 3, pp. 455-467,

Gopalakrishnan, C. , Wickramasinghe, W. A. R. , Gunatilake, H. M. , Illukpitiya, P. 2005: Estimating the demand for non-timber forest products among rural communities: a case study from the Sinharaja Rain Forest region, Sri Lanka. Agroforestry Systems, , Vol. 65, No. 1, pp. 13-22,

Paudel, S. K. , Chowdhary, C. L. 2005: Managing rattan as a common property: a case study of community rattan management in Nepal. Journal of Bamboo and Rattan, Vol. 4, No. 1, pp. 81-91

Jones, S. G. 2004: Non-timber forest products: Potential for sustainable forest income. General Technical Report - North Central Research Station, USDA Forest Service, No. NC-239, pp. 98-105

Kiehn, K. O. 2004: Options for non-timber forest product management in the Condor Bioreserve, Ecuador: an examination and recommendations. Journal of Sustainable Forestry, Vol. 18, No. 2/3, pp.237-255

Ndoye, O. , Tieguhong, J. C. 2004: Forest resources and rural livelihoods: the conflict between timber and non-timber forest products in the Congo Basin. Scandinavian Journal of Forest Research, Vol. 19, No. supplement 4, pp. 36-44

Guan BaiJun 1999: The development strategy of non-timber forest products in the world. World Forestry Research, V.

SECONDARY METABOLITES AND THEIR BIOLOGICAL ACTIVITIES FROM MUSHROOMS UNDER FOREST IN CHINA

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ABSTRACT

As a part of our search for naturally occurring bioactive metabolites from higher fungi, we investigated the chemical constituents of the basidiomycetes and ascomycetes fungi (Albatrellus confluens, Albatrellus dispansus, Boletus edulis, Boletopsis grisea, Cortinarius tenuipes, Cortinarius vibratilis, Daldinia concentrica, Engleromyces gotzii, Hydnum repandum, Hygrophorus eburnesus, Lactarius deliciosus, Lactarius hirtipes, Lactarius rufus, Polyporus ellisii, Russula cyanoxantha, Russula foetens, Russula lepida, Russula nigricans, Sarcodon leavagatum, Sarcodon scabrosus, Shiraia bambusicola, Thelephora aurantiotincta, Thelephora ganbajun, Tremella aurantilba, Tricholomopsis rutilans, Tylopilus plumbeoviolaceus, Xylaria euglossa), and isolated a number of novel terpenoids, phenolics and nitrogen-containing compounds. The isolation, structural elucidation and biologically activity of the new compounds are discussed.

1 INTRODUCTION

China is extraordinary rich in higher fungi. To date about 10,000 species of fungi have been reported from the vast territory of China. Among them, nearly 6000 species, belonging to about 1200 genera, are higher fungi (excluding lichens). Higher fungi in bio-resources belong to the very productive biologically sources which produce a large and diverse variety of secondary metabolites. We have been interested in the biologically active substances present in untapped and diverse source of higher fungi from China. The isolation, structural elucidation and biologically activity of the new compounds before 2002 have been reviewed previously.[1,2]

Recently several dozen new natural products and bioactive compounds were found in selected mushrooms on the basis of using our knowledge on the collection of fruiting bodies, strain preservation, fermentation, biologically screening and chemical investigation of higher fungi. The isolation, structural elucidation and biologically activity of the novel terpenoids, phenolics and nitrogen-containing compounds from basidiomycetes and ascomycetes fungi (*Albatrellus confluens, Albatrellus dispansus, Boletus edulis, Boletopsis grisea, Cortinarius tenuipes, Cortinarius vibratilis, Daldinia concentrica, Engleromyces gotzii, Hydnum repandum, Hygrophorus eburnesus, Lactarius deliciosus, Lactarius hirtipes, Lactarius rufus, Polyporus ellisii, Russula cyanoxantha, Russula foetens, Russula lepida, Russula nigricans, Sarcodon leavagatum, Sarcodon scabrosus, Shiraia bambusicola, Thelephora aurantiotincta, Thelephora ganbajun, Tremella aurantilba, Tricholomopsis rutilans, Tylopilus plumbeoviolaceus, Xylaria euglossa*) will be reviewed.

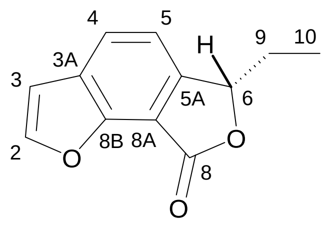
2 CONCENTRICOLIDE, AN ANTI-HIV AGENT AND OTHER COMPOUNDS FROM THE ASCOMYCETE DALDINIA CONCENTRICA

Although anti-HIV-1 drugs now available have improved the quality of the lives of HIV/AIDS patients, the rapid evolution of new HIV clades and drug resistant variants in AIDS patients urged the search for new anti-HIV-1 agents and targets. A large variety of natural products including alkaloids, flavonoids, coumarines, lignans, phenolics, triterpenoids, saponins, sulfated polysaccharides, phospholipids, quinines and peptides with anti-HIV-1 effect have been described, and for a portion thereof the target of interaction has been identified.[3] Natural products provide a large reservoir for screening of anti-HIV-1 agents with novel structure and anti-viral mechanisms.

A novel benzofuran lactone, named concentricolide (**1**), was isolated along with the four known compounds (friedelin, cytochalasin L-696,474, armillaramide, russulamide) from the fruiting bodies of the xylariaceous ascomycete *Daldinia concentrica*. The structure of concentricolide was established by spectroscopic methods and X-ray crystallographic analysis. Its anti-HIV-1 activity was tested. Results showed that concentricolide inhibited HIV-1 induced cytopathic effects. The EC_{50} value was 0.31 μg/ml. The therapeutic index (TI) was 247. Concentricolide exhibited the blockage (EC_{50} 0.83 μg/ml) on syncytium formation between HIV-1 infected cells and normal cells.[4]

Except concentricolide (**1**), a new homologous series of 3-alkyl-5-methoxy-2-methyl-1,4-benzoquinones (**2-4**) with chain length C_{21} to C_{23} were isolated from the fruiting bodies of *Daldinia concentrica* [5] A pair of novel heptentriol stereoisomers, hep-6-ene-2,4,5-triols 6 and 7, were isolated from the culture broth of *D. concentrica*, besides three known compounds, i.e., 2,3-dihydro-5-hydroxy-2-methyl-4H-1-benzo-pyran-4-one (**5**), 3,5-dihydroxy-2-(1-oxobutyl)-cyclohex-2-en-1one (**8**), and pyroglutamic acid (=5-oxo-L-proline; **9**). [6] Compound **5** was reported as a metabolite from the rice culture solution of the fungus *Phialophora gregata* and shown to have biological activity against soybean cells.[7] Compound **8** has also previously been isolated from the culture broth of the fungus *Nodulisporium sp.* and found to have chlorosis activity, which was stronger against monocotyledons than against dicotyledons.[8]

The identification of aromatic steroid hydrocarbons bearing a methyl group at positions 1, 2, 3, 4, or 6 in sediments and petroleum has been puzzling since possible steroidal precursors have not yet been reported in living organisms. Two new aromatic steroids (**10** and **11**) were isolated from the fruiting bodies of *D. concentrica*, of which compound **11** bears an unusual methyl group at position 1. We propose that the origin of these compounds is derived from the transformation undergone by their precursor due to microbial action. Compounds **10** and **11** could be the long-sought, biological precursor steroids for organic matter in Earth's subsurface. [9] Another two new compounds, 1-isopropyl- 2, 7-dimethylnaphthalene (**12**) and 21-acetyloxyl-16, 18-dimethyl-10-phenyl-6,13,14-trihydroxyl-[11]-cyto-chalasa-7,19-diene-1-one (**13**), were also isolated from the fruiting bodies of *D. concentrica* [10].



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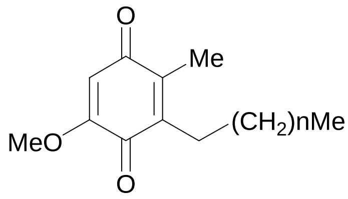
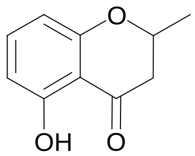


2 *n*=19
3 *n*=20
4 *n*=21



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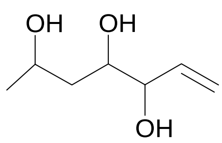

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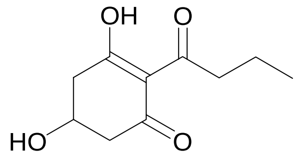

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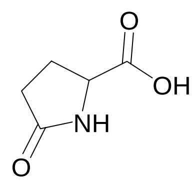

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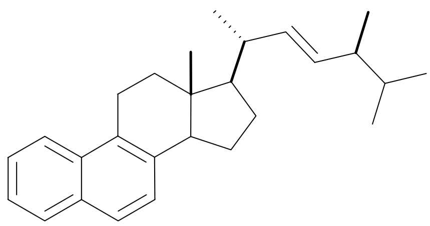

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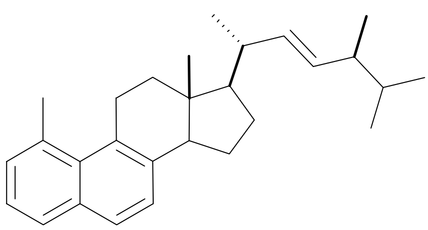

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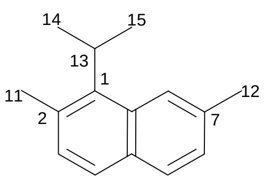

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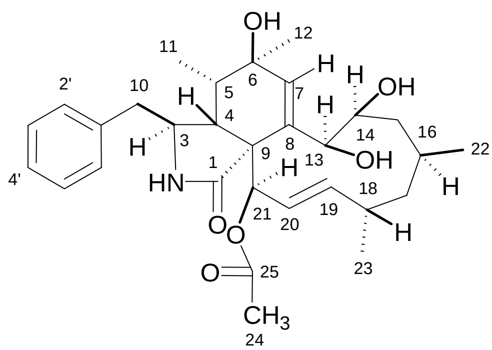


13

Figures 1 to 13: Different compounds of the ascomycete *Daldinia concentrica*

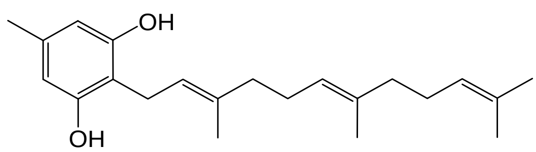
3 GRIFOLIN, A POTENTIAL ANTITUMOR NATURAL PRODUCT BY INDUCING APOPTOSIS IN VITRO FROM ALBATRELLUS CONFLUENS, AND OTHER RELATED COMPOUNDS FROM SAME GENUS

Grifolin (**14**) is a natural biologically active substance isolated from the fruiting bodies of *Albatrellus confluens*. We, for the first time, have described a novel activity grifolin, namely its ability to inhibit the growth of tumor cells by the induction of apoptosis. Grifolin strongly inhibited of tumor cells lines: CNE1, HeLa, MCF7, SW480, K562, Raji and B95-8. Analysis of acridine orange (AO)/ethidium bromide (EB) staining and flow cytometry showed that grifolin possessed apoptosis induction activity to CNE1, HeLa, MCF7 and SW480. Furthermore, the cytochrome *c* release from mitochondria was detected by confocal microscopy in CNE1 cells after a 12 h treatment with grifolin. The increase of caspase-8, 9, 3 activities revealed that caspase was a key mediator of the apoptotic pathway induced by grifolin, and the under-expression of Bcl-2 and up-regulation of Bax resulted in the increase of Bax: Bcl-2 ratio, suggesting that Bcl-2 family involved in the control of apoptosis. Owing to the combination of the significant antitumor activity by inducing apoptosis and natural abundance of the compound, grifolin holds the promise of being an interesting antitumor agent that deserves further laboratory and in vivo exploration.[11]

In the course of screening for novel naturally occurring fungicides from mushrooms in Yunnan province of China, the ethanol extract of the fruiting bodies of *Albatrellus dispansus* was found to show antifungal activity against plant pathogenic fungi. The active compound was isolated from the fruiting bodies of *A. dispansus* by bioassay-guided fractionation of the extract and identified as grifolin (**14**) by IR, 1H- and 13C-NMR and mass spectral analysis. Its antifungal activities were evaluated in vitro against 9 plant pathogenic fungi and *in vivo* against the plant disease of *Erysiphe graminis*. *In vitro, Sclerotinina sclerotiorum* and *Fusarium graminearum* were the most sensitive to grifolin, and their mycelial growth inhibition were 86.43 and 80.90% at 0.1 μg/ml, respectively. Spore germination of *F. graminearum*, *Gloeosporium fructigenum* and *Pyricularia oryzae* were almost completely inhibited by 12.5 μg/ml of grifolin. The curative effect of grifolin (**14**) against *Erysiphe graminis in vivo* were 65.52% at 100 μg/ml.12

In the previous report, the effects of albaconol (**15**) from *Albatrellus confluens* on *vanilloid* receptors were studied electrophysiologically on rat ganglion neutrons as well as on recombinant cell lines expressing rat VR1 receptor.[13] Lately, the effect of albaconol (15) on the growth inhibition of human tumor cell, DNA topoisomerase (topo)-mediated DNA cleavage and direct DNA break was investigated. Albaconol (**15**) inhibited significantly the growth of human chronic myelogenous leukemia K562, lung adenocarcinoma A 549, gastric adenocarcinoma BGC-823 and breast carcinoma Bcap-37 cell line, the IC_{50} values were 2.77±0.14、2.58±0.88、1.45±0.05、1.10±0.31 μg/mL, respectively. Albaconol (**15**) stabilized and increased the topo II-mediated DNA cleavable complex and inhibited the religation activity of topo II in a dose-dependent manner, but it failed to affect the activity of topo I. Albaconol (**15**) has the break activity on pBR322 DNA at relatively high concentration, but no effect on macromolecule DNA of K562 cells. These results strongly suggested that albaconol (**15**) targeted specifically to DNA topo II and that this is one of the mechanisms of antitumor action of albaconol; the direct action of albaconol (**15**) on DNA may partly contributed to its antitumor activity at high concentration.[14]

The contraction and desensitization induced by albaconol (**15**) and the influence of capsazepine, capsaicin and extracellular Ca^{2+} were investigated to see whether the actions were mediated via a specific VR receptor in guinea pig trachea spiral strips *in vitro*. Both albaconol (**15**) and capsaicin were contractors of tracheal smooth muscle, but albaconol (**15**) was not so potent as capsaicin, with –log (M) EC_{50} values of 4.23±0.18 (n=10) and 7.33±0.21 (n=10) respectively. 2.5, 5.0 μM capsazepine competitively antagonized the contractile response to albaconol (15), with -log (M) pK_B values of 6.60±0.39 (n=10) and 7.36□0.45 (n=10) respectively. Albaconol (**15**) increased the contraction induced by a low dose of capsaicin (10^{-10}-10^{-9}M), but non-competitively antagonized the contraction induced by a high dose of capsaicin (10^{-8}-10^{-3} M). Either albaconol (1, 100 mM) or capsaicin (3.0, 10 μM) was able to desensitize the isolated guinea pig bronchi to subsequent addition of albaconol. Capsazepine (5.0 μM) significantly prevented the desensitization induced by either albaconol (1, 100 μM) or capsaicin (3, 10 μM). Extracellular Ca^{2+} was essential for albaconol to induce excitation, but it unaffected albaconol- or capsaicin-induced desensitization. The results suggested that albaconol (**15**) induce contraction and desensitization of guinea pig trachea *in vitro* as a partial agonist for VR.[15]



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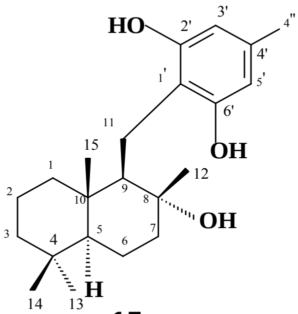

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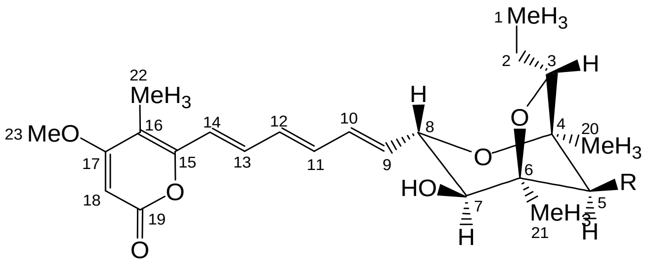


16 R = OAc
17 R = OH

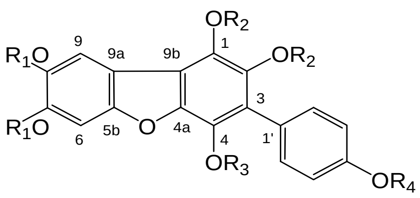
Figures 14 – 17: potential antitumor natural products

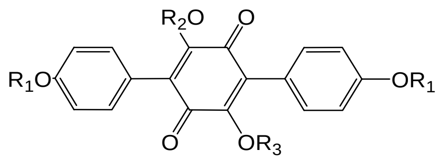
Albaconol (**15**) inhibited lipid peroxidation in rat liver homogenate with IC_{50} value of 104.2 μg/ml compared with butylated hydroxyanisole (BHA, IC_{50} 40.4 μg/ml) and vitamin E (IC_{50} 127.2 μg/ml). Albaconol increased SOD activity with EC_{50} value of 106.3 μg/ml, and BHA (EC_{50} 19.9 μg/ml).[16]

The basidiomycete *Albatrellus confluens* when grown in culture produces a polyene pyrone mycotoxin, aurovertin E (**17**), along with aurovertin B (**16**). This was the first example of the occurrence of aurovertins in macromycetes.[17] The aurovertins, metabolites from the fungus (anamorphic ascomycetes) *Calcarisporium arbuscula*, are a group of acute neurotoxic substances which act as potent inhibitors of ATP synthesis and ATP hydrolysis catalyzed by mitochondrial enzyme systems.[18-21]

4 RADICAL SCAVENGING ACTIVITY OF NATURAL P-TERPHENYLS OBTAINED FROM THREE EDIBLE MUSHROOMS INDIGENOUS TO CHINA AND OTHER NATURAL P-TERPHENYLS

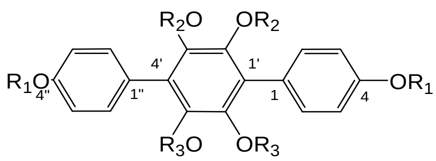
Ten natural *p*-terphenyl derivatives (**18-27**) obtained from the fruiting bodies of three edible mushrooms (*Thelephora ganbajun, Thelephora aurantiotincta, Boletopsis grisea*) indigenous to China were assessed on the DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity. The compounds **18-20** showed potent DPPH radical scavenging activities comparison with the well known strong activitor BHA (butylated hydroxyanisol) and α-tocopheral. It was found that the free radical scavenging activities of **19** (EC_{50}=0.07) was stronger than BHA (EC_{50}=0.09) and α -tocopherol (EC_{50}=0.25), that of **18** (EC_{50}=0.12), **20** (EC_{50}=0.13) were similar to BHA and stronger than α-tocopherol. The formation of furan rings and the numbers and position of hydroxy groups in the molecular structure of *p*-terphenyls are found to be important for modulating free radical scavenging activity.[22]



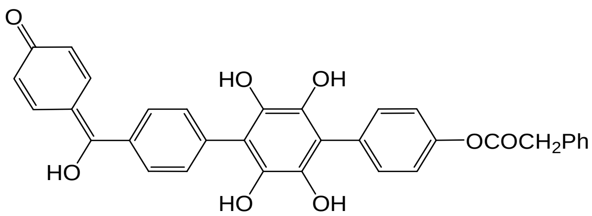


18 R_1=R_2=Ac, R_3=R_4=H
19 R_1=R_3=R_4=H, R_2=Ac
20 R_1=R_4=H, R_2=R_3=CH_2COPh
25 R_1=R_2=R_3=R_4=Ac

21 R_1=R_3=CH_2COPh
22 R_1=R_3=H, R_2=Me
24 R_1=R_2=R_3=H



23 R_1=CH_2COPh, R_2=R_3=H
26 R_1=R_2=Ac , R_3=H

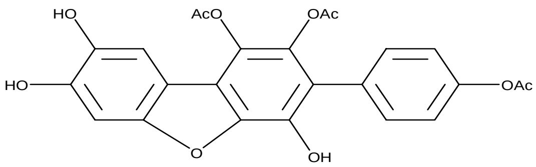


27

Figures 18 – 27: Ten natural *p*-terphenyl derivatives

A metabolite with *p*-terphenyl core, named sarcodan (**28**), was isolated from the fruiting bodies of the basidiomycete *Sarcodon leavagatum*.[23] Another nitrogenous metabolite with p-terphenyl core, sarcodonin δ (**29**), together with two known *p*-terphenyl metabolites (**7** **8**), was isolated from the fruiting bodies of the basidiomycete *Sarcodon scabrosus*.[24]

Terphenyls are aromatic hydrocarbons consisting of a chain of three benzene rings. There are three isomers, in which the terminal rings are *ortho-, meta-*, or *para*-substituents of the central ring. Most of the natural terphenyls are *p*-terphenyl derivatives. The chemical investigation of *p*-terphenyls as one class of the pigments of mushrooms began in 1877.[25] In recent years, it has been reported that some terphenyls exhibit significant biological activities, e.g., potent immunosuppressants, neuroprotective, antithrombotic, anticoagulant, specific 5-lipoxygenase inhibitory, and cytotoxic activities (see section 5). In addition, by comparison with other types of complex natural products, terphenyls are easily synthesized since they contain fewer (or no) chiral centers. It is also interesting to note that some popular edible mushrooms are rich in *p*-terphenyls; this is a sign that the toxicity of at least some *p*-terphenyls is low. Because of their promising biological activities and important properties, terphenyls have generated increasing research interest.[25]



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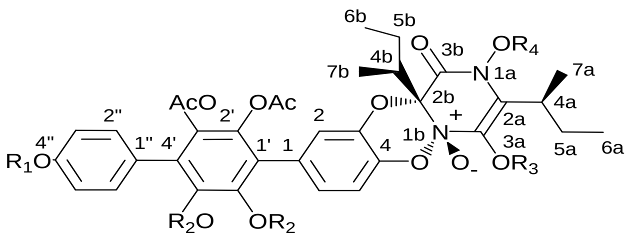


29 R_1=H R_2=H R_3=H R_4=Me

Figures 28, 29: sarcodan (28) and sarcodonin δ (29)

5 ANTIFUNGAL SESQUITERPENOID FROM LACTARIUS NECATAR AND OTHER COMPOUNDS FROM GENERA LACTARIUS AND RUSSULA

The mushrooms belonging to the genus Lactarius (family Russulaceae, Basidiomycotina) form a milky juice when the fruiting bodies are injured. In the great majority of *Lactarius* species, different kinds of sesquiterpenes play an important biological role, being responsible for the pungency and bitterness of the milky juice, the change in the air of the color of the latex, and constituting a chemical defense system against various predators such as bacteria, fungi, animals, insects.[26] Most of *Lactarius sesquiterpenes* belonging to the classes of lactaranes, secolactaranes, marasmanes, isolactaranes, norlactaranes, and caryophyllanes were believed to be biosynthesized from humulene.[27-30]

Rufuslactone (**30**) is an isomer of a previously described lactarane 3, 8-oxa-13-hydroxylactar-6-en-5-oic acid γ-lactone (**31**) from *Lactarius rufus*. Its structure was elucidated on the basis of spectroscopic means. Rufuslactone (**30**) showed the antifungal properties against plant pathogenic fungi.[31] *Alternaria brassicae* was the most sensitive to Rufuslactone (**30**), and its mycelial growth inhibition was 68.3 at 100 μg/ml.

A sesquiterpene of humulene type, named 2β,3α-epoxy-6Z, 9Z-humuladien-8 α-ol (**32**) together with a known compound lactarinic acid was isolated from the fruiting bodies of *Lactarius hirtipes*. For the subdivision Basidiomycotina, fungal sesquiterpenes formed via the humulane-protoilludane biosynthetic pathway are also characteristic. However, no representative of humulene type of sesquiterpenes has ever been isolated so far from higher fungi. Compound **32** was found as the first humulene-type sesquiterpene in higher fungi.[32] Five new humulane-type sesquiterpenes, mitissimols A (**33**), B (**34**), and C (**35**), and a mixture of mitissimyl A oleate (**36**) and mitissimyl B oleate (**37**), were isolated from the fruiting bodies of *Lactarius mitissimus*.[33] Their structures were elucidated on the basis of comprehensive spectroscopic techniques and necessary chemical methods. The relative stereochemistry of **33** was determined by single crystal X-ray diffraction analysis.

Two new red azulene pigments (**38, 39)** were isolated from the fruiting bodies of the basidiomycete *Lactarius deliciosus* together with one known pigment (**40**).[34] Other two new azulene pigments, 1-formyl-4-methyl-7-(11-hydroxyl) isopropylazulene (**41**) and 4-methyl-7-isopropylazulene-1-carboxylic acid (**42**), were isolated from the fruiting bodies of the basidiomycete Lactarius hatsudake.[35]

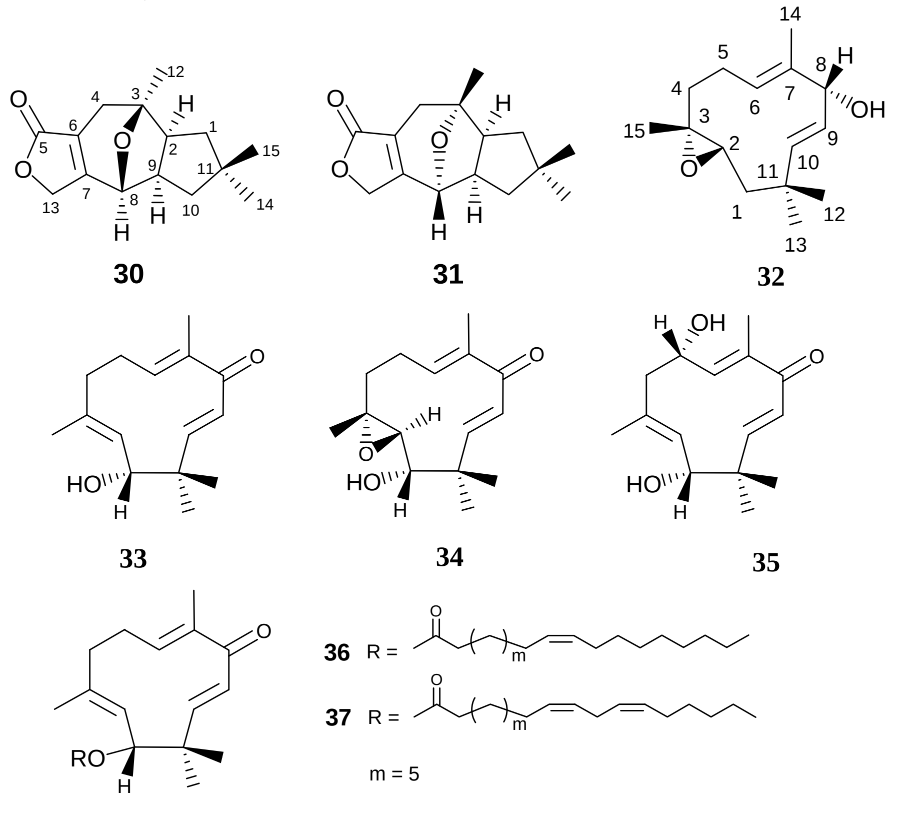


Figure 30 – 37: described chemical compounds

A new marasmane sesquiterpene, named lactapiperanol E (**43**), was isolated from the fruiting bodies of *Russula foetens* together with a known sesquiterpene lactapiperanol A (**44**).[36] Sesquiterpenes possessing the marasmane skeleton are known for more than 50 years.[37] Marasmic acid was found as an antibacterial substance in *Marasmius conigenus*,[38] and its 9-hydroxy derivative, detected in another basidiomycete, displayed antifungal, cytotoxic and phytotoxic activity.[39]

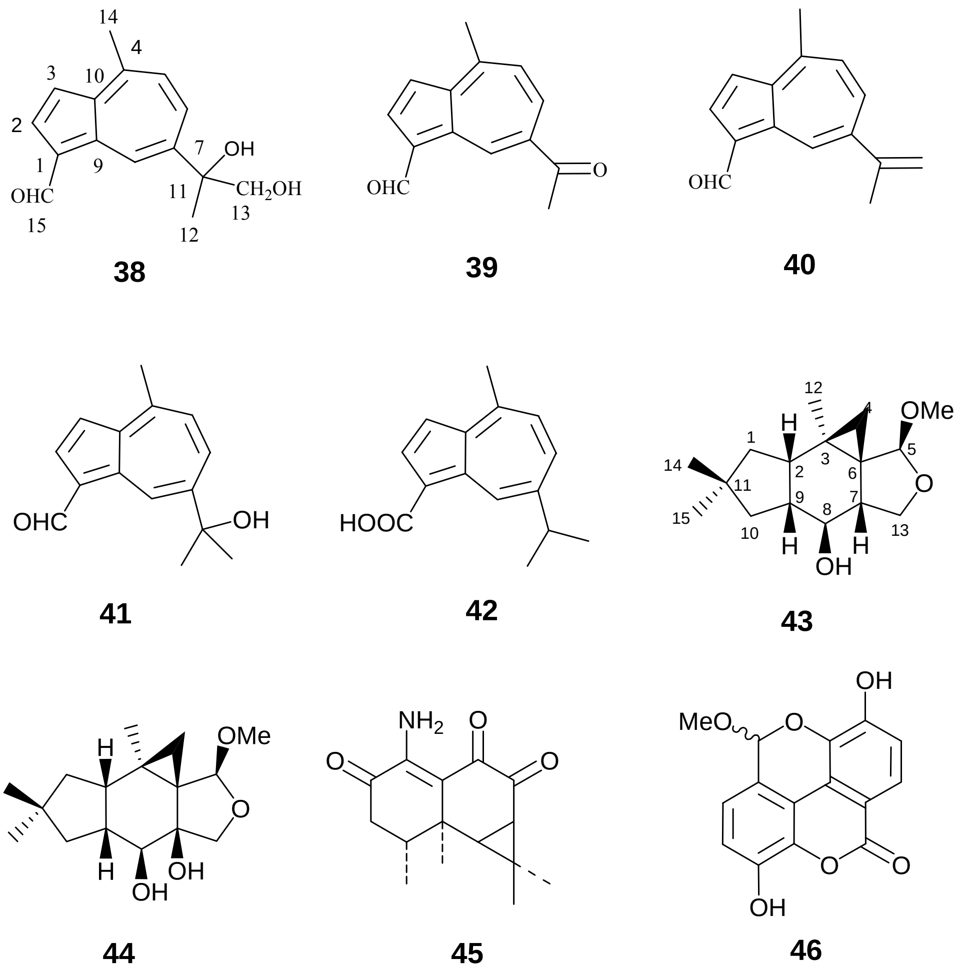


Figure 38 – 46: described chemical compounds

Velutinal and its fatty acid esters represent interesting examples of prodrug.[40-41] In most fungi only the esters are present which are cleaved to velutinal in case of injuries at the fruiting bodies.[42] Pilatin is an antibiotically active marasmane derivative from the culture of *Flagelloscypha pilatii*. It is a higher oxidized derivative of marasmic acid, cause frameshift mutations in *Salmonella typhimurium*, inhibits the growth of bacteria and fungi and is highly cytotoxic.[43] The Russulaceae family is one of the largest in the subdivision Basidiomycotina in Witthaker's kindom of Fungi and comprises hundreds of species.[44] While secondary metabolites occurring in the fruiting bodies of European *Lactarius* species have well been investigated, the *Russula* mushrooms have received less attention, notwithstanding the larger number of existing species.[45] Our recent chemical constituent investigation on *Russula lepida* led to the identification of some new terpenoids.[46-48] The minor constituent of *Russula lepida* was further investigated. A novel nitrogen-containing aristolane sesquiterpenoid compound, lepidamine **45**, was isolated from the fruiting bodies of Basidiomycete Russula lepida. It is the first aristolane-type sesquiterpene alkaloid isolated from nature.[49] It is also interesting that nigricanin (**46**), the first ellagic acid related derivative from higher fungi, has been isolated from the fruiting bodies of the basidiomycete *Russula nigricans*.[50] Ellagic acid and its derivatives are widely distributed in plants, but are rare in fungi. Ellagic acid and its derivatives are known to display multiple biological activities such as DNA damaging[51] or acting as antioxidants.[52] In the case of actinomycete, e.g., *Streptomyces chartreuses,* only the antibiotics D 329C, chartreusin, and elsamicin have been isolated; and these compounds have been reported to display antibacterial, antineoplastic, and antileukaemia activities.[53-55]

6 PIGMENTS FROM *PULVEROBOLETUS RAVENELII* AND *XYLARIA EUGLOSSA*

A new butenolide-type fungal pigment, pulverolide (**47**) was isolated from the fresh fruiting bodies of *Pulveroboletus ravenelii*.[56] *Xylaria euglossa* is a rot-wood-inhibiting ascomycete, mainly occurring on stumps and fallen branches of forested areas in the Southwest of China.

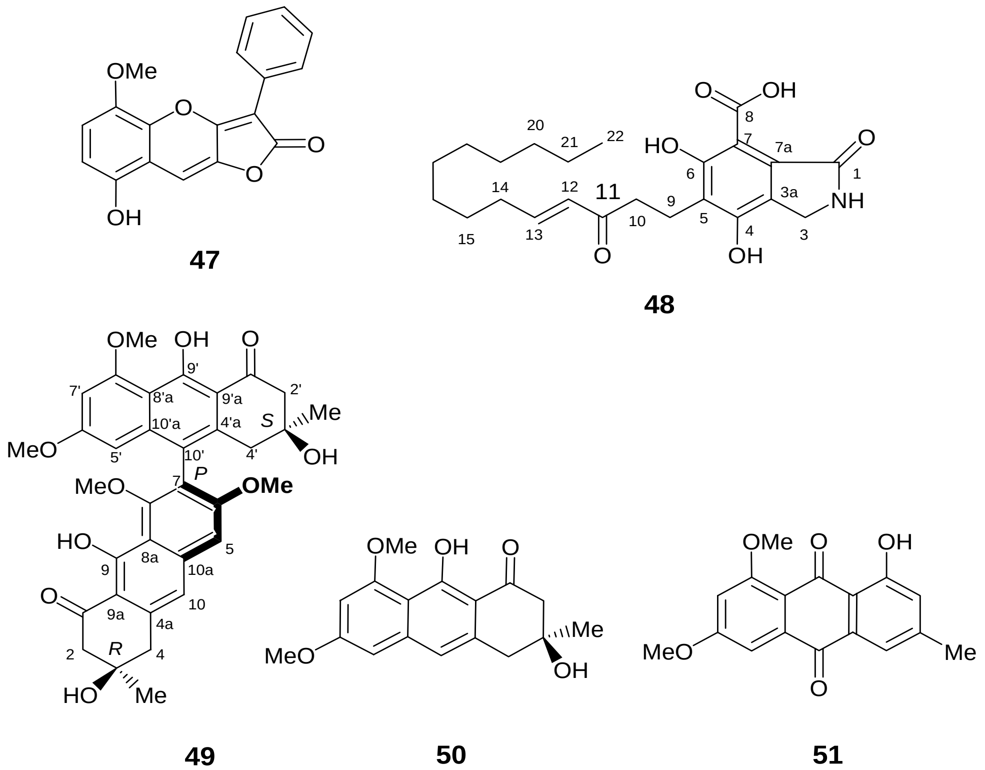


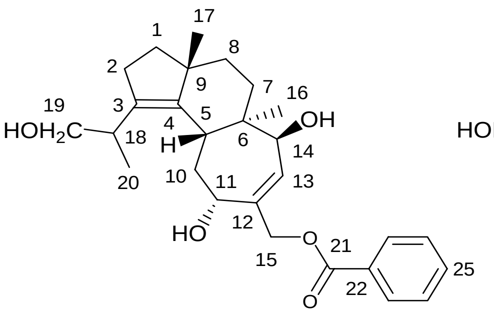
Figure 47 - 51: described chemical compounds

Many unique secondary metabolites have been found in the fungi of this genus. During the study of *Xylaria* sp., various new metabolites had been discovered, including cytochalasins, globoscin, lactones, maldoxin, sesquiterpenoids, xylaramide, xylarin, and xyloketals.[57] We have carried out a detailed chemical investigation on the fungus Xylaria euglossa and isolated a new nitrogen-containing compound, xylactam (**48**), along with two known alkaloids, penochalasin B 2 and neoechinulin A from extracts of the fruiting bodies.[57]

A new pigment, 8,8’-O,O-dimethylphlegmacin A (**49**), was isolated from the fruiting bodies of ascomycete *Xylaria euglossa* along with two known fungi pigments (**50**) and (**51**). The structure of compound **49** was established as (3R, 3'S, P)-2,2',3,3'-tetrahydro-3,3',9,9'-tetrahydroxy-6,6',8,8'-tetramethoxy-3,3'-dimethyl-[7,10'-bianthracene]-,4'(1H,1'H)-dione on the basis of spectroscopic means. Its absolute configuration was deduced from the CD and ^{1}H-NMR spectra. It is the first isolation of a phlegmacin type pigment from an ascomycete.[58]

7 DITERPENOIDS FROM SARCODON SP. AND HYDNUM SP.

Novel cyathane-type diterpenoids, scabronines G, H and sarcodonin I (**52-54**) were isolated from the fruiting bodies of the basidiomycete *Sarcodon scabrosus* together with four known diterpenoids: allocyathin B_2, sarcodonin A, sarcodonin G and scabronine F.[59,60] *Sarcodon scabrosus* is a mushroom belonging to the family *Thelephoraceae* and has a bitter taste.



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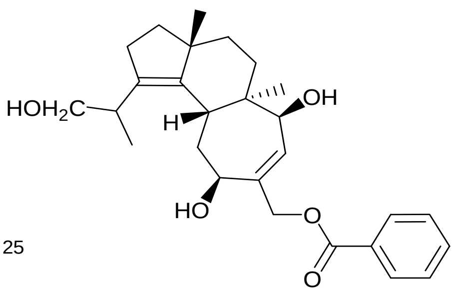

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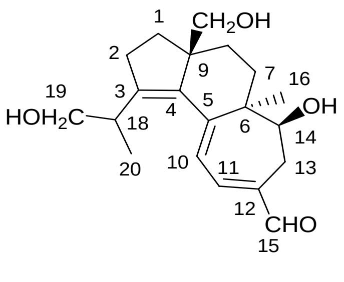

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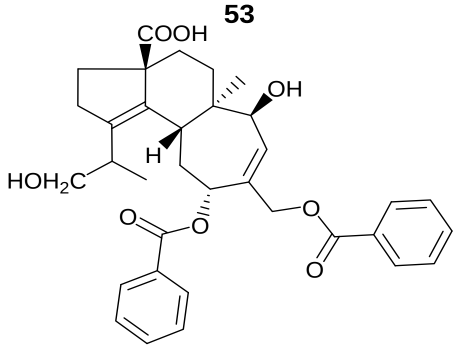

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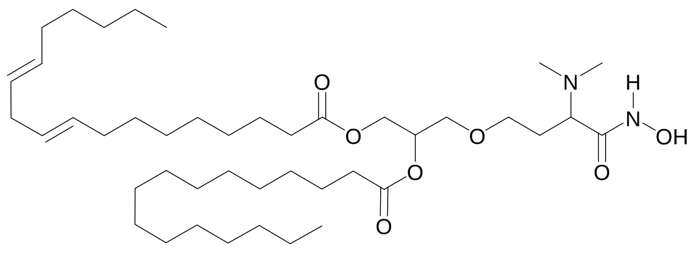
Figure 52 - 55: described chemical compounds

Diterpenoids, including sardonins A-H, scabronines A-F and scabronines L and M have previously been isolated from this mushroom as the bitter principles.[61-63] All thses diterpenoids posses a cyathane skeleton consisting of angularly condensed five-, six and seven-membered rings and show stimulating activity of nerve growth factor (NGF)-synthesis *in vitro*.

Eleven compounds have been isolated from the fruiting bodies of the basidiomycete Hydnum repandum. Their structures were established as sarcodonin A, scabronine B (**55**), 3 β-hydroxy-5α, 8α-epidioxyergosta-6, 22-dien , (22E, 24R) -ergosta-7, 22-diene-3β, 5α, 6β-triol, (22E, 24R)-ergosta-7, 22-diene-3 β-ol, benzoic acid, 4-hydroxylbenzaldehyde, 4-monopropanoylbenzenediol, ethyl-β-D-glucopyranoside, thioacetic anhydrid , (2S, 2'R, 3S, 4R)-2-(2-hydroxytricosanoylamino) hexadecane-1, 3,4-triol by spectral methods. Among them, sarcodonin A and scabronine B were reported firstly from *Hydnum* genus, and the other compounds were isolated from this fungus for the first time.[64]

8 MISCELLANEOUS

A novel N-containing compound, vibratilicin (**56**), was isolated from the fruiting bodies of the basidiomycete *Cortinarius vibratilis*.[65] Compound **56** is a representative of the rare natural products containing hydroxamic acid moieties, and can be viewed as a derivative of neoengleromycin from the fungus *Engleromyces goetzii*.[66]



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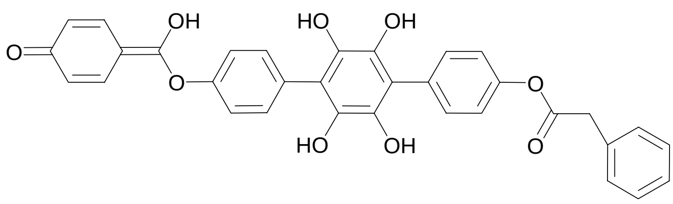

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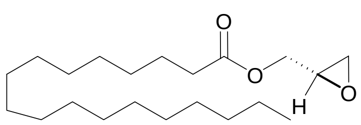

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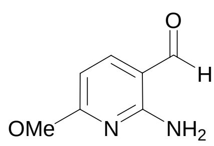

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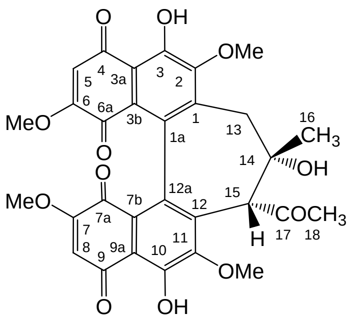
Figure 56 - 59: described chemical compounds

Fruiting bodies of the basidiomycete *Thelephora aurantiotincta* contain a *p*-terphenyl, named aurantiotinin A (**57**), together with ganbajunin C and atromentin.[67] Fruiting bodies of the basidiomycete Cortinarius umidicola contain a natural pyridine derivative (3-aldehyde-2-amino-6-methoxypyridine, **59**), together with (R)-glycidyl octadecanoate (**58**).[68]

An unique fungal pigment, hypocrellin D (**60**), together with three known perylenequinone derivatives hypocrellin A (**61**), B, C, was isolated from the fruiting bodies of *Shiraia bambusicola*.[69] The ROESY experiment and CD of hypocrellin D required that the absolute configuration of the asymmetric carbons of the alicyclic ring of **60** be the same as those of hypocrellin A; i.e. 14S and 15R. *Shiraia bambusicola* (Hypocreaceae), an ascomycete parasitic on bamboo twigs, is recorded only in China and Japan.



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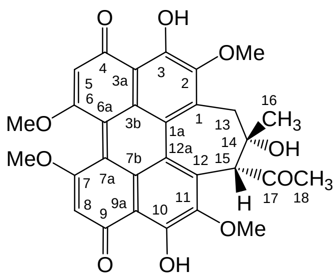

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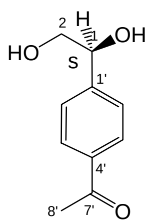

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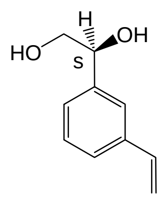

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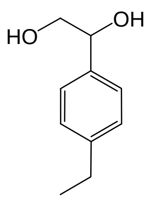

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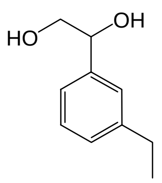

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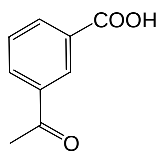


66

Figure 60 - 66: described chemical compounds

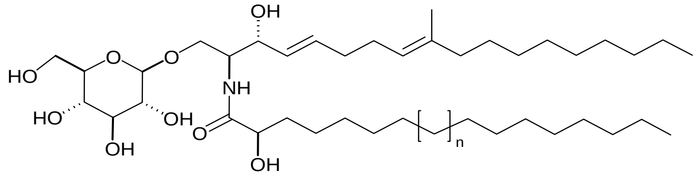
It has been commonly used as medicinal fungi under the name of “Zhu Huang” in China for treatment of rheumatism and pneusomia in traditional Chinese medicine (TCM). Previously new perylenequinone pigments hypocrellin A-C and shiraiachrome A-C have been isolated from *S. bambusicola* as fungal metabolites which exert photodynamic activity towards bacteria and fungi.[70,71] Lately the methanolic extract of the mycelium of the fungus *S. bambusicola* was found to show significant cytotoxicity in the A-549 and HCT-8 solid tumor cells. Subsequent bioassay-guided fractionation in HCT-8 in vitro led to the isolation and characterization of shiraiachromes A and B as two major cytotoxic principles.[72] A series of new perylene derivatives related to shiraiachrome-A and -B as well as calphostin-C have been synthesized and evaluated for their cytotoxicities, antiviral activities, and inhibitory activities against protein kinase C.[72]

The basidiomycete *Boletus edulis* when grown in culture produces two phenyl-ethanediols, 1-(3-ethenylphenyl)-1, 2-ethanediol **62** and 1-(4-acetylphenyl)-1, 2-ethanediol **63**, together with three known compounds 1-(3-formylphenyl)-ethanone **64**, 1-(3-ethylphenyl)-1, 2-ethanediol **65** and 1-(4-ethylphenyl)-1, 2-ethanediol **66**.[73] Compound **62** was usually used as a kind of rubber composition, and was isolated for the first time as a new natural product.

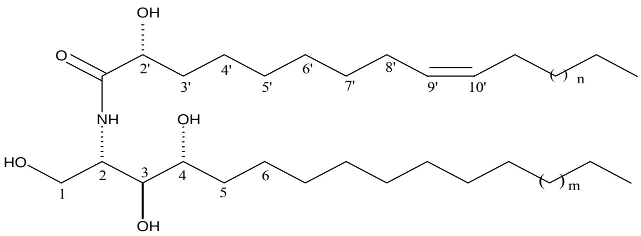
Five cerebrosides, including three new ones named cortenuamide A (**67**), cortenuamide B (**68**) and cortenuamide C (**69**), were isolated from the fruiting bodies of the Basidiomycetes *Cortinarius tenuipes*. The structures of those compounds were elucidated as (4E,8E)-N-D-2′- hydroxytetracosanoyl-1-O-β-D-glycopyranosyl-9-methyl-4, 8-sphinga-dienine (**67**), (4E, 8E)-N-D-2′-hydroxytricosanoyl-1-O-β-D-glyco- pyranosyl-9-methyl-4,8-sphingadienine (**68**), (4E, 8E)-N-D-2′-hydroxyl- docosanoyl-1-O-β-D-glycopyranosyl-9-methyl-4,8-sphingadienine (**69**), (4E, 8E)-N-D- 2′-hydroxyoctasanoyl-1-O-β-D-glycopyranosyl-9-methyl-4, 8-sphingadienine and (4E, 8E)-N-D-2′-hydroxypalmitoyl-1-O-β-D-glyco-pyranosyl-9-methyl-4,8-sphingadienine by spectral and chemical methods.[74] A new ceramide, named hygrophamide (70), was isolated from the fruiting bodies of the Basidiomycetes Hygrophorus eburnesus. The structure of the compound was elucidated as (2S, 3R, 4R, 2’R)-2-(2’-hydroxy-9’Z-ene-tetracosanoylamino)-octadecane-1, 3, 4-triol (**70**) by spectral and chemical methods.[75]

The ceramide fractions were isolated from the fruiting bodies of Tuber indicum and separated into three kinds of molecular species **71**, **72**, and **73** by normal and reverse phase silica gel-column chromatography. By means of NMR spectroscopy, FAB-MS, and chemical degradation experiment, their component sphingoid base for **71** and **72** was uniformly (2S, 3S, 4R)-2-amino-1, 3, 4-octadecantriol, while the sphingoid of **73** was D-*erythro*-sphingosine, and their structures have been determined unequivocally to be (2S, 2’R, 3S, 4R)-2-(2’-D-hydroxyalkanoylamino) octadecane-1, 3, 4-triol, the fatty acid composition of which consists of 2-hydroxydocosanoic, 2-hydroxytetracosanoic, and 2-hydroxytricosanoic acids; (2S, 3S, 4R)-2-(alkanoyl-amino) octadecane-1, 3, 4-triol, the fatty acid composition of which is unusual and consists of docosanoic, hexadecanoic, tricosanoic, octadecanoic and nonadecanoic acids; and (2S, 3R, 4E)-2-(alkanoylamino)-4-octadecene-1, 3-diol, the component fatty acids of which were hexadecanoic (predominant) and octadecanoic acids, respectively.[76] The new phytosphingosine-type ceramide **74**, named paxillamide, was isolated from the fruiting bodies of the basidiomycete *Paxillus panuoides*.[77]

From the fruiting bodies of ascomycete *Tuber indicum*, a new steroidal glucoside with polyhydrxy ergosterol nucleus, tuberoside (**75**), has been isolated. This is the first example of isolation of a polyhydroxylated ergosterol glucoside from higher fungi in nature.[78] Two new oleate esters of polyhydroxylated ergostane-type nucleus, 3β, 5α -dihydroxy-(22E,24R)-ergosta-7,22-dien-6β -oleate (**76**) and 3β, 5α -dihydroxy-(22E,24R)-ergosta-22-en-7-one-6β -oleate (**77**), were isolated from the fruiting bodies of the basidiomycete Tricholomopsis rutilans along with three known sterols.[79] A new cytotoxic lanostane triterpenoid (**78**) was isolated from the basidiomycete *Hebeloma versipelle*.[80] **78** exhibited to possess cytotoxic activities against tumor cell lines, HL60, A549, SGC-7900 and Bel-7402, with IC_{50} values, 11.2, 20.9, 22.6, and 25.0 µg/ml, respectively. A new ergostane-type glycoside, named tylopiloside (**79**), was isolated from the fruiting bodies of the basidiomycete *Tylopilus virens*. Its structure was elucidated as (22E, 24R)-ergosta-7, 22-dien-5α , 6β -diol-3β -O-[3-(3-phenylpropanoyloxy)]- β -D-glucopyranoside.[81]

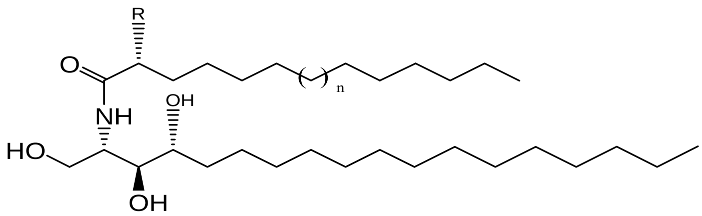


67 n=9, **68** n=8, **69** n=7

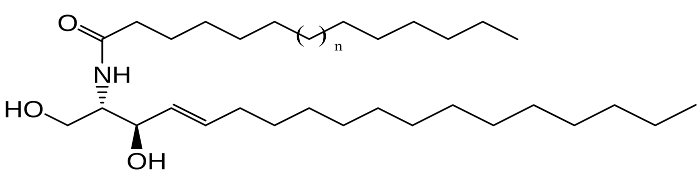


70 n=11, m=4

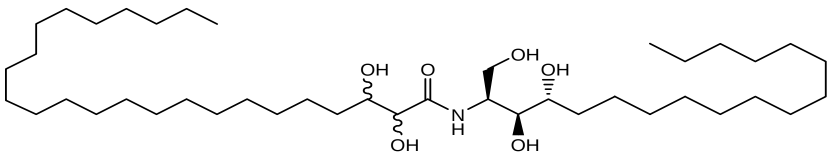
Figure 67 - 70: described chemical compounds



71 R=H (n=10, 11, 12)
72 R=H (n=4, 6, 7, 10, 11)



73 n=4, 6



74

Figure 71 - 74: described chemical compounds

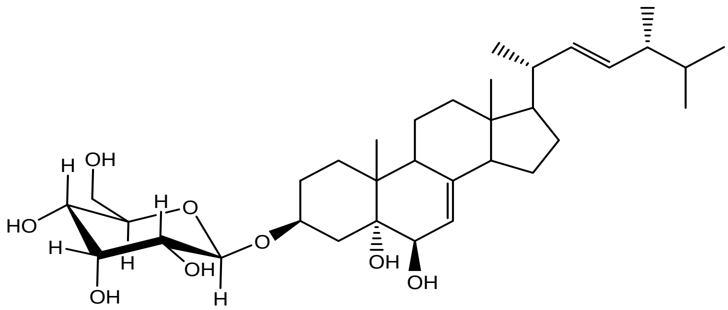


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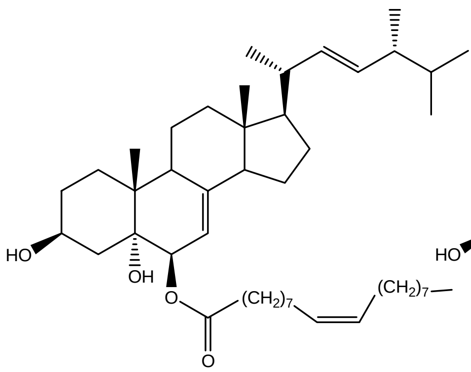
Figure 75: described chemical compound



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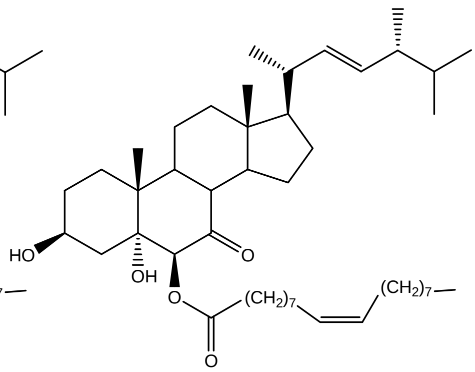

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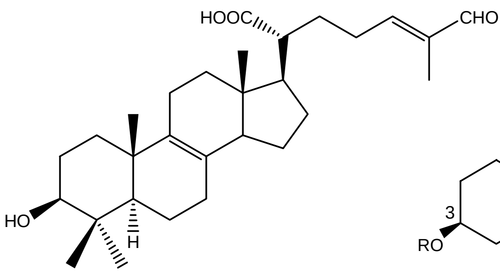

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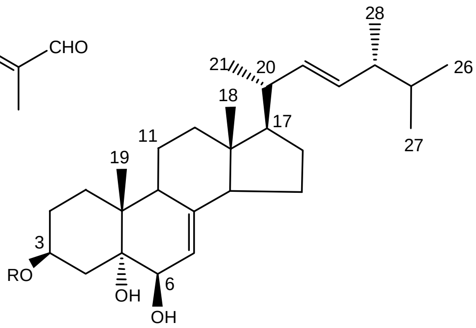

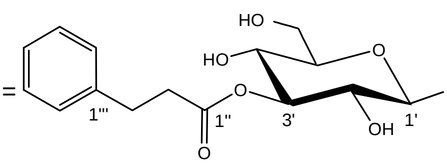

79 R =

Figure 76 - 79: described chemical compounds

The fungus *Bondarzewia berkeleyi* (Fr.) Bond. et Singer of the family Bondarzewiaceae (Basidiomycota) grows at the base or roots of *Abies* and other conifers of the family

Fagaceae. There are no any reports on its chemical constituents in literature. Steglich and Anke reported a cytotoxic metabolite, montadial A, isolated from the polypore *B. montana*.[82] They pointed that treatment of these mycelial roots with aqueous KOH causes an intense yellow color. Taxonomically the genus *Bondarzewia* has been placed in the order Russulales, which is supported by the occurrence of stearoyl-velutinal, the chemotaxonomic marker compound for this order.[82]

9 SUMMARY

Higher fungi, among the many diverse organisms, are a major source of biologically active natural products. They have often been found to contain biologically active compounds, and they provide a rich variety of active secondary metabolites. There are potentially many compounds still to be discovered in higher fungi since until now only a relatively small number of higher fungi have been chemically investigated, and many of the remaining species are involved in interesting biological phenomena. These as yet unstudied species hold the promise of providing new natural products. That these fungi are often involved in interesting biological processes indicates not only that the new metabolites involved will be chemically interesting but also that the new metabolites may be biologically interesting and significant. The large biodiversity of higher fungi provides a huge resource for extending the chemodiversity of natural products and for finding new lead structures for medicinal chemistry.

10 REFERENCES

1 J. K. Liu, Chem. Rev. 2005, 105, 2723.
2 J. K. Liu, Heterocycles 2002, 57: 157-186.
3 E. De Clercq, Chemotherapy of Human Immunodeficiency Virus (HIV) Infection, 2000, 323.
4 X. D. Qin, Z. J. Dong, J. K. Liu, L. M. Yang, R. R. Wang, Y. T. Zheng, Y. Lu, Y. S. Wu, and Q. T. Zheng, Helv. Chim. Acta 2006, 89, 127 (WO 2005037841).
5 X. D. Qin, and J. K. Liu, Helv. Chim. Aata 2004, 87, 2022.
6 F. Wang, and J. K. Liu, Helv. Chim. Acta 2004, 87, 2131.
7 L. E. Gray, H. W. Gardner, D. Weisleder, and M. Lieb, Phytochemistry 1999, 50, 1337.
8 M. Igarashi, Y. Tetsuka, Y. Mimura, A. Takahashi, T. Tamamura, and K. Sato, J. Antibiot. 1993, 46, 1843.
9 X. D. Qin, and J. K. Liu, J. Nat. Prod. 2004, 67, 2133.
10 X. D. Qin, Z. J. Dong, and J. K. Liu, Helv. Chim. Acta 2006, 89, 450.
11 M. Ye, J. K. Liu, Z. X. Lu, Y. Zhao, S. F. Liu, L. L. Li, M. Tan, X. X. Weng, W. Li, and Y. Cao, FEBS Letters 2005, 579, 3437.
12 D. Q. Luo□ H. J. Shao□ H. J. Zhu□and J. K. Liu□ Z. Naturforsch. 2005, 60c, 50.
13 V. Hellwig, R. Nopper, F. Mauler, J. Freitag, J. K. Liu, Z. H. Ding, and M. Stadler, Arch. Pharm. Pharm. Med. Chem. 2003, 2, 119.
14 C. Qing, M. H. Liu, W. M. Yang, Y. L. Zhang, L. Wang, and J. K. Liu, Planta Med. 2004, 70, 792.
15 W. M. Yang, J. K. Liu, C. Qing, Y. D. Liu, Z. H. Ding, Z. Q. Shen, and Z. H. Chen, Planta Medica 2003, 69, 715.
16 W. M. Yang, J. K. Liu, Z. H. Ding, Y. Shi, W. L. Wu, and Z. H. Chen, Chin. J. Trad. West. Med. 2004, 5, 1864.
17 F. Wang, D. Q. Luo, J. K. Liu, J. Antibiot. 2005, 58, 412.

18 C. L. Baldwin, L. C. Weaver, R. M. Brooker, T. N. Jacobsen, C. E. Osborne, Jr., and H. A. Nash, Lloydia 1964, 27, 88.
19 M. D. Osselton, H. Baum, and R. B. Beechey, Biochem. Soc. Trans 1974, 200.
20 L. J. Mulheirn, R. B. Beechey, D. P. Leworthy, and M. D. Osselton, J. Chem. Soc. Chem. Commun. 1974, 874.
21 P. E. Linnett, and R. B. Beechey, Methods Enzymol. 1979, 55, 472.
22 J. K. Liu, L. Hu, Z. J. Dong, and Q. Hu, Chemistry & Biodiversity 2004, 1, 601.
23 B. J. Ma, Q. Hu, and J. K. Liu, J. Basic Microbial. 2006, 46, 239.
24 B. J. Ma, and J. K. Liu, Z. Naturforsch. 2005, 60b, 565.
25 J. K. Liu, Chem. Rev. 2006, 106, 2209.
26 O. Sterner, R. Bergman, J. Kihlberg, and B. Wickberg, J. Nat. Prod. 1985, 48, 279.
27 W. R. Abraham, Cur. Med. Chem. 2001, 8, 583.
28 G. Vidari, and P. Vita-Finzi, Atta-ur-rahman Ed., Elsevier, Amsterdam, 1995, pp. 153.
29 W. A. Ayer, and L. M. Browne, Tetrahedron 1989, 37, 2199.
30 W. M. Daniewski, P. A. Grieco, J. C. Huffman, A. Rymikewicz, and A. Wawrzum, Phytochemistry 1981, 20, 2733.
31 D. Q. Luo, F. Wang, X. Y. Bian, and J. K. Liu, J. Antibiot. 2005, 58, 456.
32 L. Hu, and J. K. Liu, Z. Naturforsch. 2002, 57c, 571.
33 D. Q. Luo, Y. Gao, F. Wang, J. M. Gao, X. L. Yang, and J. K. Liu, J. Nat. Prod. 2006, 69, 1354.
34 X. L. Yang, D. Q. Luo, Z. J. Dong, and J. K. Liu, Helv. Chim. Acta 2006, 89, 988.
35 L. Z. Fang, H. J. Shao, W. Q. Yang, and J. K. Liu Helv. Chim. Acta 2006, 89, 1463.
36 X. N. Wang, F. Wang, J. C. Du, H. M. Ge, R. X. Tan, and J. K. Liu, Z. Naturforsch. 2005, 60b, 1065.
37 F. Kavanagh, A. Hervey, and W. J. Robbins, Proc. Natl. Acad. Sci. USA 1949, 35, 343.
38 J. J. Dugan, P. de Mayo, M. Nisbet, J. R. Robbins, and M. Anchel, J. Am. Chem. Soc. 1966, 88, 2838.
39 H. Anke, E. Hillen-Maske, and W. Steglich, Z. Naturforsch. 1989, 44c, 1.
40 J. Favre-Bonvin, K. Gluchoff-Fiasson, and J. Bernillon, Tetrahedron Lett. 1982, 1907.
41 M. Clericuzio, and O. Sterner, Phytochemistry 1997, 45, 1569.
42 T. Hasson, and O. Sterner, Tetrahedron Lett. 1991, 2541.
43 J. Heim, T. Anke, U. Mocek, B. Steffan, and W. Steglich, J. Antibiot. 1988, 41, 1752.
44 R. H. Witthaker, Science 1969, 163, 150.
45 G. Vidari, Z. Che, and L. Garlaschelli, Tetrahedron Lett. 1998, 39, 6073.
46 J. W. Tan, Z. J. Dong, and J. K. Liu, Helv. Chim. Acta 2000, 83, 3191.
47 J. W. Tan, Z. J. Dong, and J. K. Liu, Acta Bot. Sin. 2001, 43, 329.
48 J. W. Tan, Z. J. Dong, Z. H. Ding, and J. K. Liu, Z. Naturforsch. 2002, 57c, 963.
49 J. W. Tan, Z. J. Dong, L. Hu, and J. K. Liu, Helv. Chim. Acta 2003, 86, 307.
50 J. W. Tan, J. B. Xu, Z. J. Dong, and J. K. Liu, Helv. Chim. Acta 2004, 87, 1025.
51 Y. M. Xu, J. Z. Deng, J. Ma, and S. N. Chen, Bioorg. Med. Chem. 2003, 11, 1593.
52 S. T. Talcott, and J. H. Lee, J. Agric. Food Chem. 2002, 50, 3186.
53 H. Uchida, Y. Nakakita, N. Enoki, N. Abe, T. Nakamura, and M. Munekata, J. Antibiot. 1993, 46, 1611.
54 F. M. Hauser, and D. W. Combs, J. Org. Chem. 1980, 45, 4071.
55 K. Sugawara, M. Tsunakawa, M. Konishi, and H. Kawaguchi, J. Org. Chem. 1987, 52, 996.
56 L. Zhang, F. Wang, Z. J. Dong, W. Steglich, and J. K. Liu, Heterocycles 2006, 68, 1455.
57 X. N. Wang, R. X. Tan, and J. K. Liu, J. Antibiot. 2005, 58, 268.

58 X. N. Wang, R. X. Tan, F. Wang, W. Steglich, and J. K. Liu, Z. Naturforsch. 2005, 60b, 333.
59 B. J. Ma, and J. K. Liu, J. Basic Microbial. 2005, 45, 328.
60 B. J. Ma, H. J. Zhu, and J. K. Liu, Helv. Chim. Acta 2004, 87, 2877.
61 H. Shibata, T. Tokunaga, D. Karaswa, A. Hirota, M. Nakayma, H. Nozaki, and T. Tada, Agric. Biol. Chem. 1989, 53, 3373.
62 T. Ohta, N. Kita, N. Kobayashi, Y. Obara, N. Nakahata, Y. Ohizumi, Y. Takaya, and Y. Oshima, Tetrahedron Lett. 1998, 39, 6229.
63 T. Kita, Y. Takaya, and Y. Oshima, Tetrahedron 1998, 54, 11877.
64 X. N. Wang, J. C. Du, R. X. Tan, J. K. Liu, Chinese Traditional and Herbal Drugs, 2005, 36, 1126.
65 F. Wang, J. W. Tan, and J. K. Liu, Helv. Chim. Acta 2004, 87, 1912.
66 J. K. Liu, J. W. Tan, Z. J. Dong, Z. H. Ding, X. H. Wang, and P. G. Liu, Helv. Chim. Acta 2002, 85, 1439.
67 L. Hu, and J. K. Liu, Z. Naturforsch. 2003, 58c, 452.
68 L. Hu, J. W. Tan, and J. K. Liu, Z. Naturforsch. 2003, 58c, 659.
69 L. Z. Fang, H. J. Shao, Z. J. Dong, F. Wang, W. Q. Yang, and J. K. Liu, J. Antibiot. 2006, 59, 351.
70 H. Wu, X. F. Lao, Q. W. Wang, and R. R. Lu, J. Nat. Prod. 1989, 52, 948.
71 T. Kishi, S. Tahara, N. Taniguchi, M. Tsuda, C. Tanaka, and S. takahashi, Planta Med. 1991, 57, 376.
72 H. K. Wang, J. X. Xie, J. J. Chang, K. M. Hwang, S. Y. Liu, M. B. Lawrence, J. B. Jing, and K. H. Lee, J. Med. Chem. 1992, 35, 2721.
73 W. Q. Yang, X. D. Qin, Z. H. Ding, H. J. Shao, L. Z. Fang, and J. K. Liu, J. Basic Microbial.2006, submitted.
74 J. W. Tan, Z. J. Dong, and J. K. Liu, Lipids 2003, 38, 81.
75 Y. Qu, H. B. Zhang, and J. K. Liu, Z. Naturforsch. 2004, 59b, 241.
76 J. M. Gao, A. L. Zhang, H. Chen, J. K. Liu, Chem. Phys. Lipids, 2004, 131, 205.
77 J. M. Gao, A. L. Zhang, C. L. Zhang, and J. K. Liu, Helv. Chim. Acta 2004, 87, 1483.
78 J. M. Gao, L. Hu, and J. K. Liu, Steroids 2001, 66, 771.
79 F. Wang, and J. K. Liu, Steroids 2005, 70, 127.
80 H. J. Shao, C. Qin, F. Wang, Y. L. Zhang, D. Q. Luo, and J. K. Liu, J. Antibiot. 2005, 58, 828.
81 F. Wang, and J. K. Liu, Acta Bot. Yun. 2006, 28, 315.
82 S. Bernd, A. Norbert, W. Steglich, and T. Anke, J. Nat. Prod. 1999, 62, 1425.

MANAGEMENT OF MATSUTAKE IN NW-YUNNAN AND KEY ISSUES FOR ITS SUSTAINABLE UTILIZATION

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ABSTRACT

Matsutake is a group of economically important wild mushrooms. It contributes greatly to local economy and livelihoods in many places of the world. The management and sustainable use of this resource is gaining increasing attention in NW-Yunnan, one of the most productive areas for Matsutake in the world. In the paper, we provide an overview to the value, nature of matsutake and its distribution, collection, and current management in NW-Yunnan. We also identify key issues and challenges to for the sustainable utilization of this valuable resource.

Keywords: matsutake mushroom, management, Northwest Yunnan

1 INTRODUCTION

1.1 SOCIAL AND COMMERCIAL VALUE OF MATSUTAKE MUSHROOM

Matsutake mushroom is an autumn delicacy favored by Japanese since ancient times. Autumn is season of harvesting (*minori no aki*) and hearty appetites (*shokuyoku no aki*) in Japan. Several foods are associated closely with autumn in Japanese tradition: new rice (*Shinmai*), mushrooms (*Kinoko*) including Matsutake and Shimeji, wild vegetable (*Yasai*), fish (*Sakana*) and fruit (*Kudamono*) including grape, pears, chestnuts, persimmons. Amongst of which, matsutake is prized as the "King of mushroom". Matsutake gathered in groves of *akamatsu* or red pine in Japan are considered the finest in flavor and fragrance and command such a high price that most people can only afford to eat once a year, if at all. The subtle flavor of this delicacy is often enjoyed by cooking a single *matsutake*, sliced into small pieces, with rice (*matsutake gohan*) (Anonym, 1999). More than seasonal delicacy, matsutake also symbolize fertility, and by extension, good fortune and happiness (Hosford *et al*., 1997). In ancient, Matsutake is mainly used by nobles and priests; now it becomes a public consumable (Hosford *et al*., 1997).

Matsutake have become a commercially important wild mushroom. Depending upon the quality, the wholesale price in Japan varies from US$ 27 to US$ 560 per kilogram (Wang *et al*., 1997). Consumption in Japan is approximately 3000 tonnes per year, of which Japan produces 1000 tonnes in a good year (Van On, 1993). The remainder is imported mainly from Korea, China, and North America. Matsutake collection can generate significant income, for example, in Canada, the British Columbia wild mushroom industry harvests 250-400 tonnes per year, with a value of US$ 25-45 million (Wills and Lipsey, 1999). Collection of Matsutake has recently become more and more important in northwest

Yunnan, China as other income streams (e.g. timber extraction) are lost. In Shangri-La County, up to 80% of local revenue used to be generated from logging, but a commercial logging ban was imposed in 1998 in an attempt to conserve watershed integrity (Yeh, 2000).

1.2 NATURE OF MATSUTAKE MUSHROOM

"Matsu-take" translates literally as "pine-mushroom" from the Japanese. Originally, matsutake referred to *Tricholoma matsutake*, but subsequently the name refers to a group of similar mushrooms related to *T. matsutake* (Hosford et al., 1997). There are about 15 species (and one variety) distributed worldwide (Zang, 1990; Liu et al., 1999). They occur in Asia (mainly *T. matsutake*), North America (mainly *T. magnivelare*, also known as American matsutake), Europe (mainly *T. caligatum*, also known as European matsutake) and Oceania (Wang *et al*., 1997). In China, five species (and one variety) were found in at least eight provinces (Liu *et al*., 1999), of which *T. matsutake* is the most valuable and intensively exploited. Matsutake mushrooms are soil-borne and perennial mycorrhizal fungi. They develop a symbiotic association with the roots of specific trees (Ogawa, 1976; James, 1998). In NW Yunnan, these trees are mainly *Pinus spp*. and *Qucuer spp*.

1.3 NORTHWEST YUNNAN

Located in the southern mountain region (Hengduan Mountains) of the Eastern Himalayas, northwest Yunnan is in a transitional zone between the Qinghai-Tibet and Yunnan-Guizhou Plateaus. Three major rivers, the Lancang (Mekong), Jinsha (upper reaches of the Yangtze) and the Nu (Salween), run parallel in a southerly direction. High mountains and deep gorges dominate the regional landscape, with the elevation ranging from 6740m at the summit of Kawagebo to about 500m in the lower parts of the Nujiang valley. The variation of topography and latitude results in a high diversity of microclimates. Consequently, northwest Yunnan contains 40% of the province's 15,000 plant species and is recognized as a global biodiversity hotspot (Myers *et al*., 2002).

1.4 MATSUTAKE DISTRIBUTION, PRODUCTION & TRADE IN YUNNAN

As noted in Table 1, Japan annually imports 2300-3500 metric tonnes of matsutake (Gong and Wang, 2004), 1/3 to nearly 2/3's of which comes from China. Southwest China (mainly northwest Yunnan and southwest Sichuan provinces) accounts for almost 80% of the Chinese total; the second most productive area for matsutake in China is the Northeast (Heilongjiang and Jilin provinces).

Table 1. Matsutake importat of Japan (in tonnes), adopted from (Gong and Wang, 2004)

	1995	1996	1997	1998	1999	2001
Total Importation	3515	2703	3059	3248	2935	2394
From South Korea	633	170	249	355	515	181
From North Korea	1141	541	615	1086	307	210
From China	1191	1152	1076	1313	1292	1531
Percentage from China	33.88	42.62	35.17	40.42	44.02	63.95

In Yunnan, the income from matsutake ranks number one among all exported agricultural products and NTFPs. In 2005, more than U.S. $44 million was generated by the export of Matsutake. The distribution and abundance of matsutake in Yunnan is shown in Fig 1. The most productive areas of Yunnan are located in the northwestern and western parts. For example, in 2005 the total exportation from Yunnan was around 1300 metric tonnes. Diqing Prefecture (which includes Shangri-la, formerly known as Zhongdian) accounted for 47% of Yunnan's matsutake exports, while Dali, Chuxiong and Lijiang prefectures accounted for 21%, 18% and 12% respectively (Fig 2).

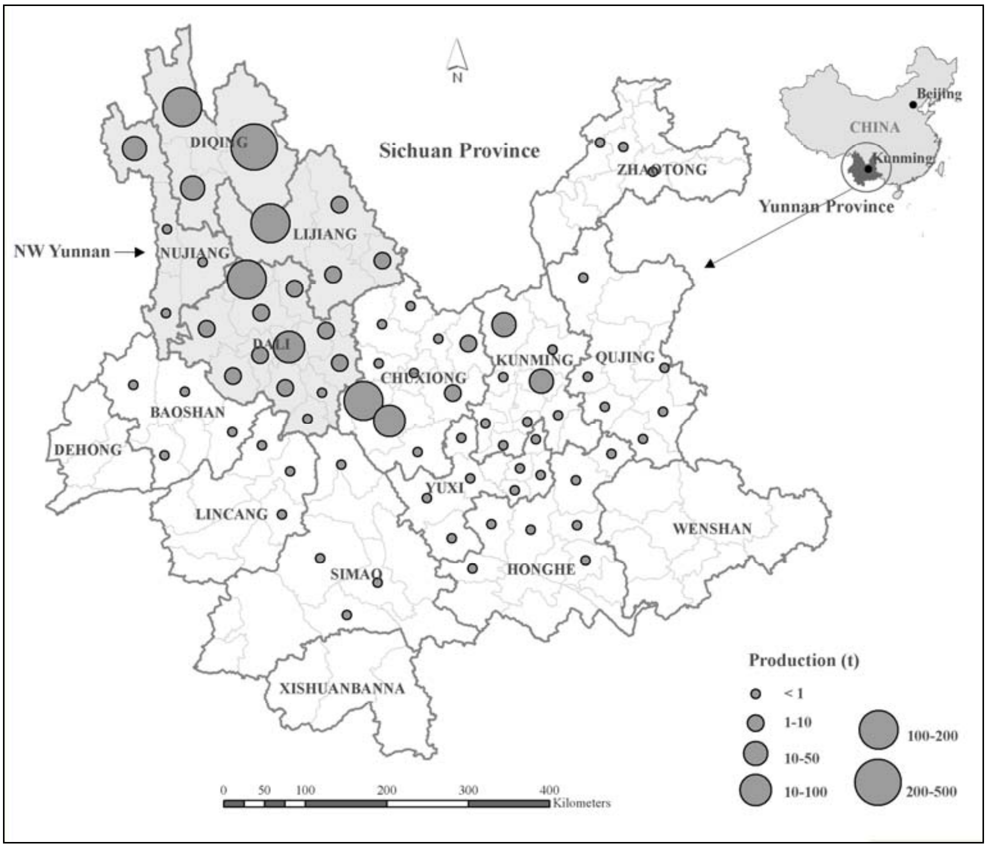

Figure 1 Distribution of Matsutake Production in Yunnan (Data based on year 2005)

The trend of matsutake production in Yunnan is difficult to evaluate in the limited time frame for which data is available. Data for Shangri-La County between 1998 and 2005 is shown in Fig 3. As can be seen, there are great year-to-year differences in amounts of matsutake harvested. The factors determining this fluctuation are weather (especially temperature and precipitation), price, and possibly the impact of previous harvests though this has not been substantiated. It is generally agreed upon by local mushroom pickers, traders and researchers that weather is the most significant factor contributing to crop fluctuations. While methods of harvest and habitat management are also considered important, it is difficult to quantify their impacts, if any, with the information available. Continued monitoring over the long term is necessary before a trend can be established.

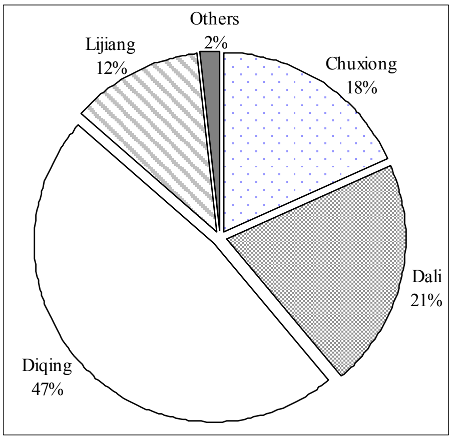

Figure 2. Matsutake Production in Yunnan Province in 2005 with a total production of 1300 metric tons.

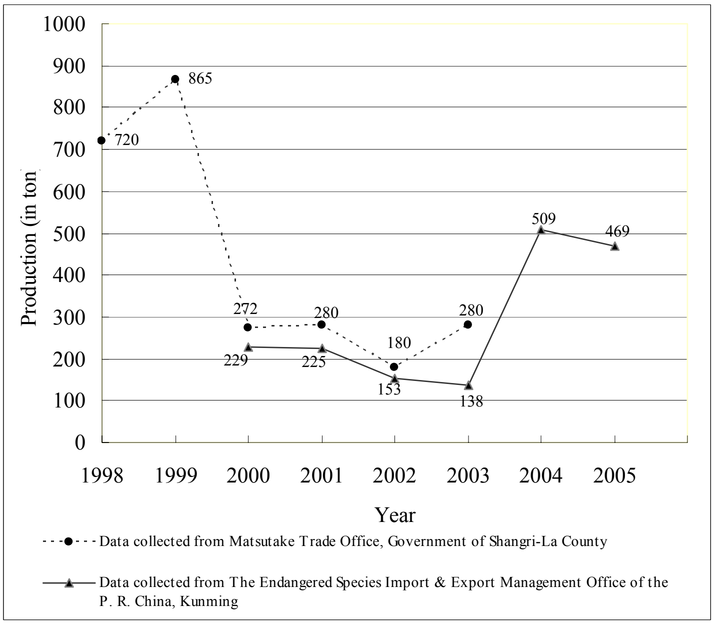

Figure 3. Matsutake production of Shangri-La (formerly Zhongdian) County. The data collected from the CITES-Kunming is slightly lower than that from Shangri-La Matsutake Office of the same year. The difference could be due to two reasons: 1, domestic consumptions and 2, export via Sichuan Province (e.g. preserved products). Moreover, the total amount of Matsutake trade in Shangri-La city mainly from Diqing Prefecture (mainly Shangri-La and Deqin Counties), part from Gangzi Prefecture of Sichuan Province and part from Changdu Prefecture of TAR (Tibetan Autonomous Region).

2 MANAGEMENT OF MATSUTAKE IN YUNNAN

2.1 POLICY ENVIRONMENT AT THREE LEVELS

In year 1999, the State Council enlisted *T. matsutake* as a protected wild plant - National Grade II. Based on the *Regulation of Wild Animal and Plant Protection*, the CITES Chinese office is authorized and started to implement a management system to control the matstuake export in 2000 by issuing the permit for exportation. This system is firstly executed in Yunnan and Sichuan Provinces and then extended to all the production area. With this system, it predefines the upper limit of total export of a year at national level; mandates the provincial forest authorities to administrate the registration of Matsutake Export Company and to allocate the export quota; and mandates the CITES local offices to issue the export permit. The custom processes the export procedure based on this permit.

At provincial level, the Forestry Department implements the administrative duties as mandated by the state. At prefecture or county level, three different governmental authorities tax the matsutake: *Special Agro-Forestry Products Taxation, Business Administration Taxation and Plant Quarantine Taxation*.

At local level, the local communities establish regulation, so called *Xiangguiminyue* to define the resource boundary, allocated resource user right and regulate harvesting methods or patterns.

2.2 RESOURCE TENURE AND ACCESS

Generally the tenure system for non-timber forest products is vague. In Yunnan, forestland tenure is broadly divided into three categories: state forest, collective forest and household or freehold forest in 1981 (Xu and Ribot, 2004). Although NTFPs are considered an attached attribute of the forestland tenure, there is no particularly tenure arrangement for specific forest products. However the right to harvest NTFPs can be negotiated based on customary institution and statutory forestland tenure arrangement among traditional users.

In customary practices, NTFPs had been harvested across administrative and forest tenure boundaries in northwest Yunnan either as open access resources or common property when they were consumed locally with small amount. With increasing marketing value and large-scale commercialization of NTFPs, such as the matsutake, conflicts occurred. New regulations are formed at community or township level to solve the inter-and-intra-village conflict, in which boundaries for matsutake harvest are demarcated, usually corresponding to administrative boundaries and customary access i.e. (*Xiangguimingyue*). Within each community, all villagers have equal access rights. In places of rich production, outsiders also can buy the harvesting permit for matsutake from local community authorities.

Harvesting practices various from village to village. For instance, in many villages of Deqin County, it is up to each individual where he or she wants to harvest each day, while in A'dong village a "rest day" is declared at least once a week during which no harvesting is allowed. But in Jidi village in Shangri-la County, a system of harvest rotation has been developed whereby matsutake production areas are divided into sections and villagers are divided into groups. Each group harvests one section in a day and then moves on to another section the next day, and so on. Where there is a great deal of variation in productivity from one part of the forest to the next, this rotation system ensures that each villager can access the most productive areas equally (but not every day) while mitigating pressure on the most productive areas by controlling the number of harvesters per day.

2.3 MARKET ARRANGEMENT AND ACTORS

Four levels of matsutake markets (see Table 2) can be recognized in Yunnan based on their size (number of buyers and total amount of matsutake exchanged), location, function, transportation infrastructure, and their degree of regulation and information flow. Actors in the market chain include mushroom pickers, local community authorities, middle-men, trading companies, exporting companies, and government authorities. As one move up the chain of markets from the small scale (town or village) markets to intermediate and regional scale markets, there is better transportation and information flow, and more regulation. However, the involvement of local people is becoming less.

In northwest Yunnan, mushroom pickers are mainly Tibetan, as well as Yi, Naxi, Lisu and Bai. Middlemen, or those who buy matsutake directly from the pickers, are comprised of small, usually local independent buyer-sellers as well as local agents and representatives of larger trading companies. The small buyer-sellers typically buy up matsutake from a small area. A primary grading of the matsutake usually takes place during the initial sale; the matsutake are then sold to bigger buyers or directly to the domestic market. During harvesting season, trading companies normally send their agents to village level and small scale markets as well as to intermediate scale markets in commercial centers. These company agents are usually Han Chinese from outside the area, but in most cases local villagers are employed to act as translators and for the purpose of gaining local trust.

In the largely Tibetan Diqing Prefecture, which accounts for nearly half of all the matsutake production in Yunnan (Fig 2), there are around 150 trading companies set up at the intermediate scale Matsutake Market of Shangri-La County. Exporting companies (50-60) with the legal right to export are generally based in Kunming. Each of the big trading companies has its own matsutake exportation quota determined by the CITES-Kunming office.

3 CHALLENGES IN SUSTAINABLE UTILIZATION OF MATSUTAKE

3.1 LACK OF HABITAT MANAGEMENT AND PRODUCTION MONITORING

That habitat is important to matsutake existence and production is well acknowledged. In the local village, in order to protect the forest hence to keep the production, some activities are not allowed such as timber extraction and grazing. However, there is a lack of habitat management in the real sense - for instance to purposely manage the forest density, age structure and species composition, soil characteristics, light condition and liter depth and coverage etc. - that is to optimize the environment for Matsutake production. Nevertheless, we cannot expect the local villagers to understand the ecology of the mushroom with a scientific manner and develop a systematic habitat forest management system. This needs the efforts of the government and the researchers. Indeed, many such researches have been carried out in Japan, Korea North America and China (Hosford et al., 1997; Amaranthus *et al.*, 1998; James, 1998; Gong *et al.*, 2000; Eberhart *et al.*, unknown), some of the knowledge and management experiences can be further tested and adopted locally.

Table 2. Market categories and characteristics in NW Yunnan

	Location and Activities	Function of the market	Number of Buyers	Daily Exchange	Transportation infrastructure	Information flow	Market Regulation
Village level sporadic primary market	Usually a remote village near the origin of the matsutake; buyer often mobile	exchange	1-3	<200kg	Poor, footpaths	Poor	Poor
Small scale market	Village road side, village market, or local established market for matsutake	Primary grading, exchange,	3-10	200-1000kg	Country road connect to outside market	Okay	Primary
Intermediate scale (regional) Market	Regional economic center of the production area, normally the capital of prefecture or county , e.g. Shangri-La Matsutake Market	Simple grading, exchange, preparing trading document, storage, transportation	Several dozen to hundreds, e.g. 150 in Shangri-La	1000-20000kg	Good networks connect with large scale market	Good	Good
Large scale Market	Normally capital city of province or strategic exporting point, in this case, Kunming	Fine grading, packing , process, storage , export	50-60 (20-30 have exportation right)	>20000kg	Large airport	Good	Good

As matsutake is a protected as well as highly commercialized mushroom. It's critical to understand the resource dynamics. However, we cannot clearly show how the resource has changed over time since lack of data. Started from 2000, CITES started to record the annual amount exported at county level, which forms as a fundamental base for matsutake monitoring. However, this data are generally not accessible by public. An open, systematic and finer monitoring mechanism should be in place for managing important NTFPs.

3.2 COLLECTING IMMATURE AND OVER-MATURE FRUITING BODY – FROM THE POPULATION ECOLOGY AND ECONOMIC POINT VIEW

We frequently found restrictions on collecting immature fruiting bodies in many of the local regulations, and it is involuntarily related with protection of the mushroom. Collecting of immature fruiting bodies is nothing related with resource protection but indeed economic important. However, the prohibition of over matured mushroom collection makes sense to conserve the resources. From the population ecology point view, collection should not influence the reproduction of the matsutake. There are mainly two ways for matsutake mushroom reproduction: vegetative growth of hypha and dispersal of spores produced by sexual reproduction cycle. Murata *et al.* (2005) showed that sexually reproduction through spores is very important in the propagation and distribution of *T. matsutake*. This implies that excessive collection or collection without leaving matured fruiting bodies to disperse the spores will impair the reproduction ability and eventually threat to the population itself.

However, at what extent this influence works and at which percentage of population should be collected are kept unknown.

From the economic point view, collecting baby matsutake is non-economic practice. As we know the price of matsutake varies greatly with grades which are determined by size, odor, degree of openness, status of bug-affected. For immature pieces (normally shorter than 5cm), it only cost USD 38/kg (based on whole sale export price of China in 2000). One kilogram requires 58-60 pieces of this size. While for matured ones (7-14cm, not fully open and damaged) the price is USD 58-80/kg and one kilogram only requires 6-34 pieces. Theoretically, if we only collect matured ones, the total income should at least double. Similarly, the price of over matured fruiting bodies is also relatively low. It should be left for regeneration.

3.3 FROM "QUANTITY" TO "QUALITY"

Obviously, China especially Yunnan is the major supplier of matsutake in terms of quantity. Presently, the increasing gain of the income is based on the increasing exploiting of the resource. This is somehow dangerous to the sustainable utilization of the resource. Though the quantity is big, the price for Chinese matsutake is generally low (See Table 3). The price can be determined by many reasons, such as freshness, odor, openness, and status of damage and bug-eaten. Although to some extent, Chinese matsutake cannot fully compete with Japanese and Korea matsutake, since latter countries have an advantage in transportation time, but they also have a superior product because of the greater care taken in harvesting and transporting the mushrooms. However, there are still many options for adding up the value of Chinese matsutake, for instance, focus on providing high quality products instead of providing everything, good packing, shorten the transport time and natural food certification.

Table 3. Average Wholesale Price (per kg) of Matsutake in Japan from Different Countries Modified from (Gong and Wang, 2004) Exchange rate was taken as 1USD= 118.94 Japanese Yuan

	From China	From South Korea	From North Korea	From Canada
In Japanese Yuan	7459	17074	7935	4914
In USD	62.71	144	67	41

3.4 KNOWLEDGE AND POLICY GAP

Although there is a body of knowledge available of matsutake, many still are kept unknown. These knowledge gaps impede the wise use of this resource. It includes artificial cultivation, the relationship with host plant, the impact of harvesting methods, population dynamic and ecology of the mushroom. Moreover, the gaps also exist between the knowledge itself and practice. For instance, very few management plans incorporate existing scientific and indigenous knowledge on matsutake ecology. Hence, more action researches are needed to bridge the existed knowledge with the management practice.

We introduced the policies related with matsutake at three levels. The legal policies mainly focus on the control of export while the customary regulations regulate the resource allocation, access and method of harvest. Policy is lack to clearly define the tenure and harvesting of the matsutake (and generally NTFPs). Although, the local regulations perform as a supplementary instrument to manage the resource, it is poorly implemented. For instance, most of the regulations prohibit the harvesting of matsutake shorter than 5 cm; but it is rarely controlled.

4 SUMMARY

It is well known that Yunnan is one of the most important areas for matsutake production in the world. The free market system and customary institutions are in place that has developed works well in many respects but some problems persist. There are many local regulations on harvesting, but there has been little attempt to restore the degraded habitats after logging, protect current matsutake habitat or to enhance matsutake reproduction. From the market point view, the collection and sale of baby fruiting bodies is also poorly controlled. There is also a lack of strategy plan improving the quality of matsutake exports. Aside from taxation and quota control, the government should play more importance roles on supplementing relevance policies of NTFPs management, monitoring the resource dynamics and develop and advocate a "quality" based exportation strategy. More researches and management approaches also should be in place to support the sound management of matsutake. In a word, to properly manage matsutake is a holistic approach that needs to take policy, research, market trade and local practice into account.

REFERENCES

Amaranthus, M. P., Weigand, J. F., and Abbott, R. 1998. Managing high-elevation forests to produce American matsutake (Tricholoma magnivelare), high-quality timber, and nontimber forest products. Western Journal of Applied Forestry, 13(4), 120-128.

Anonym. 1999. A day in the life. The Japanese Forum. Retrieved May 25, 2006, from World Wide Web: http://www.tjf.or.jp/newsletter/pdf_en/Nl14_ADIL.pdf

Eberhart, J., Luoma, D., Pilz, D., Amaranthus, M., Abbott, R., Segotta, D., and Moore, A. unknown. Effect of Harvest Techniques on American Matsutake (Tricholoma magnalivelare) Production [Online source]. Matsiman.com. Retrieved 16th Dec., 2003, from World Wide Web: http://www.matsiman.com/formalpubs/harvestmethodposter/harmethposter.htm

Gong, M.-q., and Wang, F.-z. 2004. The countermeasures of China to present market status of Tricholoma matsutake (in Chinese). Territory & Natural Resources Study(2), 88-89.

Gong, M.-q., Wang, F.-z., Chen, Y., Chen, Y.-l., Cao, J.-x., and Su, L.-j. 2000. Protecting the Eco-environment of Tricholoma matsutake and Improving Its Sustainable Developement (in Chinese). Forest Research, 13(5), 562-567.

Hosford, D., Pilz, D., Molina, R., and Amaranthus, M. 1997. Ecology and Management of the Commercially Harvested American Matsutake Mushroom (PNW-GTR-412): United States Department of Agriculture Ecology and Management of Forest Service Pacific Northwest Research Station.

James, F. W. 1998. Management Experiments for High-Elevation Agroforestry Systems Jointly Producing Matsutake Mushrooms and High-Quality Timber in the Cascade Range of Southern Oregon (General Technical Report PNW-GTR-424). Portland: U.S. Department of Agriculture, Pacific Northwest Research Station.

Liu, P.-g., Yan, M.-s., Wang, X.-h., Sun, P.-q., and Yang, X. 1999. Notes on the resources of Matsutake-Group and their reasonable utilization as well as effective conservation in China (in Chinese). Journal of Natural Resources, 14(3), 245-252.

Murata, H., Ohta, A., Yamada, A., Narimatsu, M., and Futamura, N. 2005. Genetic mosaics in the massive persisting rhizosphere colony "shiro" of the ectomycorrhizal basidiomycete Tricholoma matsutake. Mycorrhiza, 15(7), 505-512.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., Faseca, G. A. B. d., and Kent, J. 2002. Biodiversity hotspots for conservation priorities. Nature, 403, 853-858.

Ogawa, M. 1976. Microbial ecology of mycorrhizal fungus-Tricholoma matsutake(Ito et Imai) Sing. in pine forest III, funal florae in Shiro soil and on the mycorrhiza (293). Tokyo, Japan: The government forest experiment station.

Van On, T. 1993, June 1993. Tricholoma matsutake - matsutake [on line source]. New Zealand Institute for Crop & Food Research Ltd. Retrieved 10th, July, 2003, from World Wide Web: http://www.crop.cri.nz/psp/broadshe/matsutak.htm

Wang, Y., Hall, I. R., and Evans, L. A. 1997. Ectomycorrhizal fungi with edible fruiting bodies .1. Tricholoma matsutake and related fungi. Economic Botany, 51(3), 311-327.

Wills, R. M., and Lipsey, R. G. 1999. An economic strategy to develop non-timber forest products and services in British Columbia (Forest Renewal BC Project No. PA 97538-ORE). Bowen Island: Cognetics International Research Inc.

Xu, J.-c., and Ribot, J. 2004. Decentralization and accountability in forest management case from Yunnan, southwest China. The European Journal of Developement Research, 14(1), 153-173.

Yeh, E. T. 2000. Forest claims, conflicts and commodification: The political ecology of Tibetan mushroom-harvesting villages in Yunnan province, China. China Quarterly(161), 264-278.

Zang, M. 1990. A taxonomic and geogrphic study on the Song Rong (matsutake) group and its allied species (in Chinese). Acta Mycologica Sinica, 9(2), 113-127.

WILD EDIBLE FUNGI OF THE HENGDUAN MOUNTAINS, SOUTHWESTERN CHINA

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ABSTRACT

The Hengduan Mountains make up the core region of the "Mountains of Southwestern China", one of the World's 34 Biodiversity Hotspots. This region is extraordinarily rich in fungi. Significant progress has been made in field investigations and the studies of the mycobiota in this area in the last thirty years. Over 4,000 species of fungi have been identified in this region, representing about 40% of China's known fungal taxa. Among them, about 600 species belonging to about 120 genera are wild edible fungi. These fungi are an important natural product providing food, traditional Chinese medicine, and other goods for the local people. In this paper, the use and value of some common wild fungi of the Hengduan Mountains region are summarized. Our recent work shows that many fungi in the region (including some edible and medicinal fungi) are still very poorly known and need to be documented.

Keywords: natural resources; food; medicinal fungi; non-timber forest products; sustainable utilization

1. INTRODUCTION

The Hengduan Mountains are located in southwestern China. The region of the Hengduan Mountains, in the broad sense, extends from the western edge of the Sichuan Basin to eastern Xizang (Tibet) including the southern slope of southeastern Tibet, and southeastern Qinghai. The northern boundary reaches southern Gansu. The southern boundary reaches down to the Yunnan plateau (Fig. 1).

There are a series of parallel mountain ranges and rivers from running north to south in this region. For example, the famous Three Parallel Rivers of Yunnan Protected Areas lie in this region. The highest mountain reaches 7,756 meters above sea level, while the elevation in some hot-dry valleys is only about 1500 meters. The average altitude of the Hengduan Mountains is around 3,000 meters above sea level.

Due to the complicated topography, geography, diverse environments and many other ecological, geographical and geological conditions, the Hengduan Mountains make up the core of the "Mountains of Southwestern China", one of the World's 34 Biodiversity Hotspots (Boufford & van Dijk 2000; Myers et al. 2000; Conservation International 2005; Yang 2005).

Visitors travelling in the region during the mushroom season from June to October are impressed by the variety and the delicacy of fungi available in markets and restaurants (Schmid 2002; Yang & Piepenbring 2004). However, scientific knowledge of the diversity of the wild edible and medicinal fungi in the region is still scanty. A detailed and systematic survey needs to be conducted.

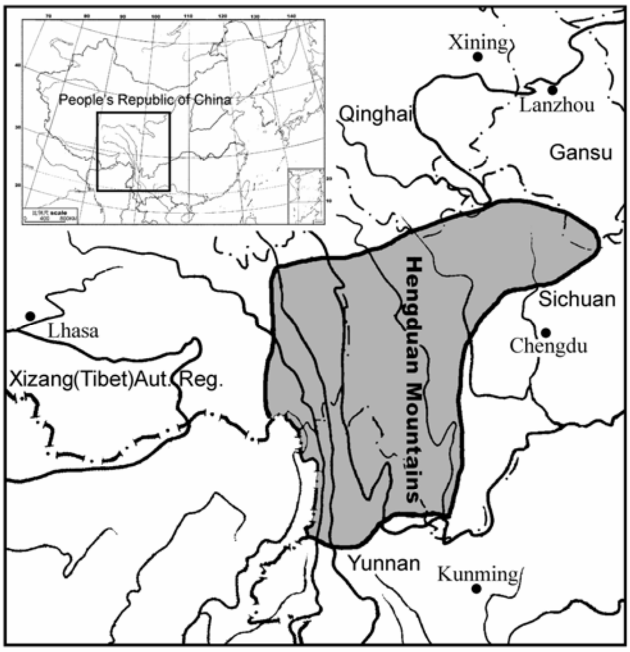

Figure 1. Location of the Hengduan Mountains, the core region of the "mountains of southwestern China", one of the world's 34 biodiversity hotspots

2. MATERIALS AND METHODS

Academic taxonomic reports on fungi from the region, especially on wild edible mushrooms, were collected and analyzed. Whenever possible, doubtful identifications were checked through re-examination of relevant original specimens. In order to expand the inventory of fungi in the region of study, several field trips were conducted. Fresh fungal materials were collected, annotated, and photographed, or otherwise illustrated. Possible ectomycorrhizal hosts were recorded at the time each collection was made. Fresh materials were dried using an electric or a kerosene mushroom drier. To learn more of the traditional uses of wild mushrooms, local people were interviewed. Examination and identification of the collections was conducted in the laboratory. Anatomical studies of fruit bodies were conducted using light microscopy (Yang 1997, Yang et al. 2004).

3. RESULTS

In the last thirty years, several important field investigations and significant progress in the study of fungal resources of the Hengduan Mountains region have been made. According to our research, over 4,000 species of fungi have been identified in this region (Teng 1963; Tai 1979; Wang et al. 1983; Mao et al. 1993; Dai & Li 1994; Ying 1994; Ying & Zang 1994; Yuan & Sun 1995; Teng 1996; Zang 1996; Wang et al. 2004; Yang 2005). Among them, nearly 600 species belonging to about 120 genera are wild edible fungi.

Some wild edible mushrooms, such as *Boletus griseus*, *B. reticuloceps*, *Cortinarius emodensis*, *Floccularia luteovirens*, and *Leccinum aurantiacum*, are quite common during the rainy season. Some of them, like *Aureoboletus thibetanus*, *Gomphus orientalis*, *Pisolithus tinctorius* and *Suillus pinetorum*, are rare, not commonly used as food, and not sold in markets. While most of the wild edible fungi are collected from July to October, *Cordyceps sinensis*, *Lentinula edodes*, and species of the genus *Morchella* can usually be found earlier in the year (during April to June). Fruit bodies of *Tuber indicum* and a few other species of the genus do not become mature until October to the February of the year following the beginning of fruiting body development (Yang & Piepenbring 2004). The most common and economically important wild edible and medicinal fungi in the region are listed in Table 1.

Table 1 The most common wild edible and medicinal fungi of the Hengduan Mountains

Scientific name	Utility
Amanita chepangiana Tulloss & Bhandary	Food
Amanita hemibapha var. *ochracea* Zhu L. Yang	Food, medicine
Amanita manginiana sensu W. F. Chiu	Food
Amanita pseudoporphyria Hongo	Food
Amanita sinensis Zhu L. Yang	Food
Auricularia auricula (L.) Underw.	Food, medicine
Boletus aereus Bull.: Fr.	Food
Boletus brunneissimus W. F. Chiu	Food
Boletus edulis sensu W. F. Chiu	Food, medicine
Boletus griseus Frost	Food
Boletus magnificus W. F. Chiu	Food
Boletus reticuloceps (M. Zang et al.) Q. B. Wang & Y. J. Yao	Food
Boletus speciosus Frost	Food, medicine
Cantharellus cibarius Fr.	Food, medicine
Cantharellus minor Peck	Food, medicine
Catathelasma ventricosum (Peck) Singer	Food
Cordyceps sinensis (Berk.) Sacc.	Medicine
Cortinarius emodensis Berk.	Food
Cortinarius tenuipes Hongo	Food
Engleromyces goetzii Henn.	Medicine
Floccularia luteovirens (Alb. & Schwein.) Pouzar	Food
Ganoderma lucidum (Fr.) P. Karst.	Medicine
Hericium erinaceus (Bull.) Pers.	Food, medicine
Hygrophorus russula (Schaeff. : Fr.) Quél.	Food
Laccaria laccata (Scop.: Fr.) Berk. & Broome	Food
Laccaria vinaceoavellanea Hongo	Food
Lactarius akahatsu Tanaka	Food
Lactarius deliciosus (L.: Fr.) Gray	Food
Lactarius hatsudake Tanaka	Food, medicine
Lactarius volemus (Fr.) Fr.	Food, medicine
Leccinum aurantiacum (Bull.) Gray	Food
Leccinum extremiorientale (Lar. N. Vassiljeva) Singer	Food
Lentinula edodes (Berk.) Pegler	Food, medicine
Lyophyllum decastes (Fr. : Fr.) Singer	Food
Lyophyllum fumosum (Pers.: Fr.) P. D. Orton	Food
Lyophyllum shimeji (Kawam.) Hongo	Food
Morchella conica Pers.	Food, medicine
Morchella elata Fr.	Food, medicine

Table 1 *continued*

Morchella esculenta (L.) Pers.	Food, medicine
Morchella smithiana Cooke	Food, medicine
Oudemansiella furfuracea s. l.	Food, medicine
Polyozellus multiplex (Underw.) Murrill	Food
Ramaria asiatica (R. H. Petersen & M. Zang) R. H. Petersen	Food
Ramaria hemirubella R. H. Petersen & M. Zang	Food
Ramaria linearis R. H. Petersen & M. Zang	Food
Ramaria sanguinipes R. H. Petersen & M. Zang	Food
Russula cyanoxantha (Schaeff.) Fr.	Food, medicine
Russula nigricans (Bull.) Fr.	Food, medicine
Russula virescens (Schaeff.) Fr.	Food, medicine
Sarcodon aspratus (Berk.) S. Ito.	Food, medicine
Schizophyllum commune Fr.	Food, medicine
Scleroderma citrinum Pers.	Food
Termitomyces bulborhizus T. Z. Wei *et al.*	Food
Termitomyces eurrhizus (Berk.) R. Heim	Food, medicine
Termitomyces striatus (Beeli) R. Heim	Food
Thelephora ganbajun M. Zang	Food
Thelephora vialis Schewein.	Food, medicine
Tremella aurantialba Bandoni & M. Zang	Food, medicine
Tricholoma bakamatsutake Hongo	Food
Tricholoma matsutake (S.Ito & S. Imai) Singer	Food, medicine
Tricholoma saponaceum (Fr.) P. Kumm.	Food
Tuber indicum Cooke & Massee	Food
Tylopilus eximius (Peck) Singer	Food
Wolfiporia cocos (F.A. Wolf.) Ryvarden & Gilb.	Medicine

4. DISCUSSION

4.1 DIVERSITY OF WILD EDIBLE FUNGI

The Hengduan Mountains region is extraordinarily rich in fungi. Over 4,000 species of fungi have been identified in this region, representing about 40% China’s known fungal taxa (Teng 1963; Tai 1979; Ying et al. 1982; Wang et al. 1983; Ying et al. 1987; Mao et al. 1993; Dai & Li 1994; Ying 1994; Ying & Zang 1994; Yuan & Sun 1995; Teng 1996; Zang 1996; Wang et al. 2004; Yang 2005). Among them, nearly 600 species belonging to about 120 genera are wild edible or medicinal fungi. These species account for about 75% of the total species of edible and medicinal fungi in China as a whole. The Hengduan Mountains may be the richest center of biodiversity for edible fungal species in China.

Most of the wild edible or medicinal fungi in the Hengduan Mountains belong to the *basidiomycota*, while a few belong to the *ascomycota* (Table 1). About 50 species are probably endemic to the region of study and adjacent regions. For example, both *Boletus reticuloceps* and *Cortinarius emodensis* are popular edible mushrooms and are usually found in the subalpine to alpine regions at 3000 - 4700 meters altitude in ectomycorrhizal association with *Abies* and *Picea*. *Engleromyces goetzii*, a well-known medicinal fungus that parasitizes alpine bamboos, occurs in eastern Africa (Uganda, Kenya, Tanzania and

Malawi) and Asia (Nepal and southwestern China). This fungus is most likely a relict of mycobiota that existed at least as long ago as the Tertiary.

4.2 FUNGI AS FOOD AND MEDICINE

As in other regions of China, wild fungi have been widely collected and used as food and medicine by the people of the Hengduan Mountains region. Wild edible fungi are one of the important natural resources on which the local people of all nationalities rely heavily, and these mushrooms certainly play a role in improving the food nutrition (Yang 2002). Species of the genus *Boletus*, such as *B. edulis, B. griseus* and *B. magnificus* and species of *Termitomyces* like *T. bulborhizus*, *T. eurrhizus* and *T. Striatus*, are sold in most of the local markets.

The Chinese caterpillar fungus, *Cordyceps sinensis*, is perhaps the most popular medicinal fungus in the region, and can only be found in the subalpine to alpine regions at 3000 - 4700 meters altitude. It is a very famous traditional medicine in China due to its well-known healing properties (Liu 1984; Ying *et al* 1987). In the mid-1990s, one fruit body of the caterpillar fungus could be bought for 1-2 Chinese Yuan. However, the price has sharply risen to 15-20 Chinese Yuan in the last four years. Apparently demand is outstripping supply, and the question of sustainable management of this fungus may rise. Other important medicinal fungi to be mentioned are *Ganoderma lucidum*, *Hericium erinaceus* and *Wolfiporia cocos* (Liu 1984; Ying *et al* 1987). These fungi are not uncommon in the region of Hengduan Mountains, and are often collected and sold in traditional Chinese medicine markets.

4.3 EXPORT OF WILD EDIBLE FUNGI

Both wild and cultivated edible fungi have been exported as food and for medicinal use from China to Europe (e.g. Italy, France, and Switzerland), North America (USA), East Asia (Japan and Korea), Southeast Asia (e.g. Singapore, Malaysia, Indonesia, and Thailand) and many other countries where the fungi are used as food and for medicinal purposes. Today, China is the most important country for the export of both wild and cultivated mushrooms (e.g. Schmid 2002; Wang & Liu 2002; Yang 2002). Among the exported fungi, perhaps the most prominent is matsutake or pine mushroom, *Tricholoma matsutake*. In the last 10 years, over 1000 tons annually of fresh fruit bodies of matsutake have been exported from this area (Fig. 2).

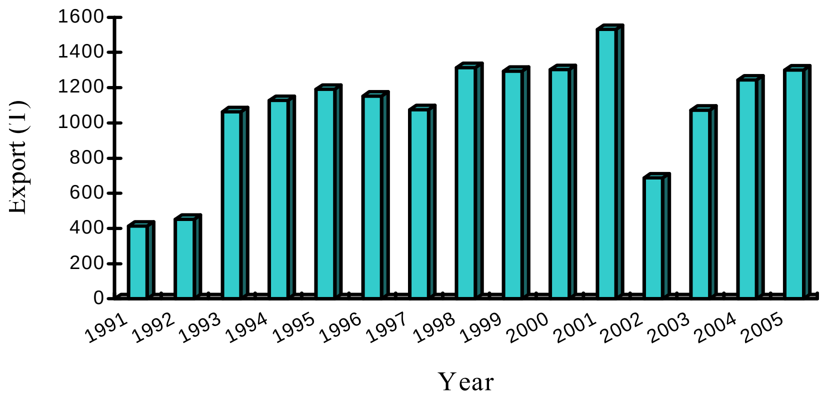

Figure 2 Annual export of fresh goods of *Tricholoma matsutake* from Yunnan, southwestern China to Japan

The foreign exchange income produced from this exportation is over 100 million US dollars every year. *Tricholoma matsutake*, and a few additional species, such as *Cordyceps sinensis, Tuber indicum,* and *Boletus edulis*, have become so important in local economic development in the last 10 years that the local governments have paid much attention to the marketing of them. Since the economic and transport conditions of many communities in the region of the Hengduan Mountains are still relatively underdeveloped, marketing of wild edible and medicinal fungi has significantly improved the local economy in the last few years.

5. CONCLUDING REMARKS

Wild edible fungi play important roles not only in the local ecosystems in terms of decomposition of organic material and formation of ectomycorrhizae with forest trees, but also in social systems as non-timber product from forests in the region of study. Wild edible fungi are an important natural product supporting local economies of the region. Most of the species, such as *Tricholoma matsutake, Boletus spp., Termitomyces spp.,* and *Tuber spp.* have developed a symbiotic relationship with plants or animals during their evolution and still cannot be cultivated under artificial conditions. These fungi can only be collected from natural environments. This is one of the dominant factors controlling the rising price of regional fungi in both local and overseas markets.

The commercial harvest of fungi in forests can damage forest habitat through the effects of repeated entry of mushroom collectors and compacting of the soil by their travel. Over-harvest may lead to gradual degradation and even loss of the mushroom resources. For example, the natural production of *Tricholoma matsutake* has decreased dramatically in the last 10 years in central Yunnan. In the early 1990s, matsutake was usually collected in the areas surrounding Kunming, the capital city of Yunnan Province, and then exported to Japan. However, by the mid-1990s merchants had to move westwards to Chuxiong in order to purchase fresh matsutake for export. By the early 2000s, a few major merchants moved farther to Shangri-la, in northwestern Yunnan, in order to get enough fresh stock of this delicacy.

With the development of the regional mushroom industry, it is becoming more and more clear that sustainable utilization and effective conservation of fungal resources will require regulation and management of future harvests on public or state-owned lands. A key to wise management of edible mushroom resources is a common understanding among resource managers, mushroom collectors, mushroom buying merchants, and the concerned public with regard to these key areas: (1) the biology of the region's unique forest organisms, (2) the ecological importance of mushrooms in forest ecosystems, (3) the effects of forest disturbance on the survival of fungi, and (4) the need to establish best practices for sustainable harvest (Molina et al. 1993).

Local governments can play vital roles in the areas of education, development of management practices, and deployment of these practices. In some mountain villages, local regulations created and implemented by the local governments have succeeded in helping create sustainable production and harvest methods for these communities.

On the other hand, our recent collections and studies indicate that many fungi of the region, including edible and medicinal species, are still very poorly known. For example, *Chroogomphus pseudotomentosus*, *Simocybe centunculus*, *Leucopaxillus rhodoleucus*, and others are widely distributed in the region. However, they have not been previously recorded from the region. Furthermore, some species are new to science, and their values to human life and commerce are still unknown. Such fungi need to be documented in the near future before we are left in ignorance their potential when they become extinct.

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REFERENCES

Boufford D.E., van Dijk P.P. 2000. South-Central China. In: Mittermeier R.A., Myers N., Mittermeier C.G. (eds.). Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Mexico City: CEMEX. Pp. 338-351.

Conservation International. 2005. Biodiversity Hotspots. http://www.biodiversityhotspots.org/xp/Hotspots/china.

Dai X.C., Li T.H. 1994. "Fungal Flora of Ganzi Prefecture, Sichuan Province". Chengdu: Sichuan Science & Technology Press.

Liu B. 1984. "Medicinal Fungi in China". Taiyuan: Shanxi People's Publishing House.

Mao X.L., Jiang C.P., Ouzhu CW. 1993. "Economic Macrofungi of Tibet". Beijing: Beijing Science & Technology Press.

Molina R., O'Dell T., Luoma D., et al. 1993. Biology, ecology, and social aspects of wild edible mushrooms in the forests of the Pacific Northwest: a preface to managing commercial harvest. Portland: U.S. Department of Agriculture.

Myers N., Mittermeier R.A., Mittermeier C.G., et al. 2000. Biodiversity hotspots for conservation priorities. Nature 403: 853-858.

Schmid X. 2002. Eine aussergewöhnliche Pilzexkursion nach China. Schweizerische Zeitschrift fuer Pilzkunde 80: 24-29.

Tai F.L. 1979. "Sylloge Fungorum Sinicorum". Beijing: Science Press.

Teng S.C. 1963. "Fungi of China". Beijing: Science Press.

Teng S.C. 1996. Fungi of China. Ithaca: Mycotaxon Ltd.

Wang X.H., Liu P.G. 2002. "Resources investigation and studies on the wild commercial fungi in Yunnan". Biodiversity Science 10: 318-325.

Wang X.H., Liu P.G., Yu F.Q. 2004. "Color atlas of wild commercial mushrooms in Yunnan". Kunming: Yunnan Science and Technology Press.

Wang Y.C., M. Zang, Ma Q.M., et al. 1983. "Fungi of Xizang (Tibet)". Beijing: Science Press.

Yang Z.L. 1997. Die *Amanita*-Arten von Südwestchina. Bibliotheca Mycologica 170: 1-240.

Yang Z.L. 2002. "On wild mushroom resources and their utilization in Yunnan Province, Southwestern China". Journal of Natural Resources 17: 464-469.

Yang Z.L. 2005. Chapter 2. Diversity and Biogeography of Higher Fungi in China. In: Xu J.P. (ed.). Evolutionary Genetics of Fungi. Norfolk (UK): Horizon Bioscience. Pp. 35-62.

Yang Z.L., Piepenbring M. 2004: Wild edible fungi in Yunnan Province, southwestern China. In: Agerer R., Piepenbring M., Blanz P. (eds.). Frontiers in Basidiomycote Mycology. Eching: IHW-Verlag. Pp. 419-426.

Yang Z.L., Weiß M., Oberwinkler F. 2004. New species of *Amanita* from the eastern Himalaya and adjacent regions. Mycologia 96: 636-646.

Ying J.Z. (ed.) 1994. “The Economic Macromycetes from Western Sichuan”. Beijing: Science Press.
Ying J.Z., Mao X.L., Ma Q.M., et al. 1987. “Icones of Medicinal Fungi from China”. Beijing: Science Press.
Ying J.Z., Zang M. (eds.) 1994. “Economic Macrofungi from Southwestern China”. Beijing: Science Press.
Ying J.Z., Zhao J.D., Mao X.L., et al. 1982. “Edible Mushrooms”. Beijing: Science Press.
Yuan M.S., Sun P.Q. 1995. “Sichuan Mushroom”. Chengdu: Sichuan Science and Technology Press.
Zang M. (ed.) 1996. “Fungi of the Hengduan Mountains”. Beijing: Science Press.

PROSPECTIVE STRATEGIES ON BIODIVERSITY CONSERVATION IN BAMBOO-BASED FOREST ECOSYSTEMS IN TROPICAL AND SUBTROPICAL CHINA

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ABSTRACT

To address current problems on increasingly degrading biodiversity in bamboo-based forest ecosystems in China, it is recommended that the strategies on policy development and integration, training and capacity building, and on-site demonstrations on sustainable management of biodiversity of the forest ecosystems in tropical and subtropical China should be taken as priorities in development of policies and technologies for sustainable forest management in China as follows:

1. Sectoral policy development in partnership to build the linkages between bamboo development for local economic benefits and biodiversity conservation at different levels of the government; 2. On-site demonstration on eliminating threatening impacts on biodiversity and ecosystem stability caused by shifting natural mixed bamboo forests into monocultured bamboo forests; 3. On-site demonstration on rehabilitation of the degraded biodiversity in monocultured bamboo forests in subtropical moso bamboo forests; 4. Biodiversity conservation of indigenous endangered Chinese bamboo species; 5. Development of a national network and partnership of biodiversity monitoring by incorporating this in existing forest ecosystem monitoring management systems; 6. Demonstration on livelihood development through bamboo resource utilization to benefit biodiversity conservation; 7. Application and documentation of the impact of participatory and co-management approaches to community level biodiversity conservation activities and incentive mechanisms in the project area for replication, upscaling and policy integration.

Keywords: bamboo-based forest ecosystem, biodiversity conservation, policy, awareness raising, capacity building, strategy

1. INTRODUCTION

Bamboo is a perennial species, and when annually harvested on a selective harvesting scheme, maintains a perennially green canopy. It is a pioneer plant for afforestation and vegetation recovery. It is a multipurpose resources and income generator, growing in remote mountains and rural poor areas where severe poverty exists, in China as well as in developing countries elsewhere in the world. There is plenty of indigenous knowledge on traditional bamboo stand management, as well as modern technology available for bamboo industry development in rural areas (Fu, Xiao and Lou, 2000). A rapid developing bamboo industry demands and consumes huge amount of bamboo materials from both plantations and natural bamboo forests. In many areas, the rate of harvesting bamboo is bigger than the growth rate of the bamboo forests because of the huge marketing demanding to the resources and people depending on the resources.

As a result, natural bamboo has been intensively harvested and over-exploited in past two decades because of its advantages as the best means for quality products to substitute timbers and for poor farmers to generate income from local resources. For short-term financial return, more than four million hectares of the natural mixed bamboo and broad-leaved or coniferous evergreen forests were cleaned up by removing all trees, shrubs and even underground vegetations to achieve maximum short-term bamboo productivity according to long-term productivity monitoring (Lou, 1998). Despite of increase in bamboo productivity, this practice has also resulted in serious degradation of ecosystem functions and biodiversity in bamboo-based forest ecosystems in tropical and subtropical China (Lou and Sheng, 1999). Furthermore, the danger of extinction of animal-inhabiting bamboo forests due to habitat destruction and massive bamboo flowering also poses great threats on not only the giant panda and the red panda, but also for example the endangered golden takin (*Budorcas taxicolor bedfordi*) and *Rhizomys sinensis*, the Chinese bamboo rat, who are mainly relying on bamboo for their foods in tropical and subtropical zones. Some endangered bamboo species, e. g. *Qiongzhuea tumidinoda* in Yunnan and Sichuan provinces listed in China Plant Red Data Book and Red List of IUCN, have been seriously over-exploited and destroyed for their commercially valuable culms and edible shoots. Evidence shows that intensive harvesting and use of commercially valuable bamboo forests are causing biodiversity lose in tropical and subtropical China (Lou, 1998). Besides the significant negative impacts on biodiversity on the forest ecosystems, all management practices currently applied for high-yielding pure bamboo forest through central government approved high-yielding standard such as cleaning up trees and shrub, loosening soil, pesticide and chemical fertilizer application, over-harvesting has also seriously resulted in soil erosion and declining of site and bamboo productivity in the managed monocultured bamboo forests, without any considerations on biodiversity conservation and ecosystem management for maintaining long-term site productivity.

Within this context, conservation of bamboo-based forest ecosystems is one of the keys to the effective conservation of the tropical and subtropical terrestrial ecosystem biodiversity in China. Should conservation of forest ecosystem biodiversity be achieved in a sustainable manner, it is imperative and critical to reconcile biodiversity conservation and economic benefits from bamboo-based natural forests in tropical and subtropical China, particularly in recognizing the fact that bamboo has become a major income source for huge rural population and a local core industry in more than 30 counties and much more townships and villages in rural and mountainous areas of tropics and subtropics. Actions are needed to protect the bamboo-based forests for biodiversity conservation and long-term productivity and the habitats for the many animals living in and on bamboos, and also to secure livelihoods of local farmers dependent on bamboos.

2. MAIN ISSUES ON DECREASING BIODIVERSITY OF BAMBOO-BASED FOREST ECOSYSTEMS IN CHINA

Over the past decades, China's tropical and subtropical forests have severely deteriorated in productivity, ecosystem functions, and biodiversity. This is largely due to a lack of knowledge and capacity at the national, provincial, and local legal infrastructure to safeguard biodiversity in forest management.

China possesses 7.2 million hectares of bamboo-based forests which comprise no less than 10% of the country's tropical and subtropical forests. The country's bamboo ecosystems symbolize a distinctive national resource and provide for the livelihoods of the local rural population. A forest is categorized as a bamboo forest if bamboo plants are dominant in number among the upper canopy species. Typically, natural bamboo-based forests in China contain a rich diversity of flora and fauna (Ma, Zhang and Lou, 1996). However, bamboo's fast growth and versatile use has led to over-exploitation of the resource and loss and fragmentation of habitats for the other plants and animals in bamboo based ecosystems. The most serious threats to the loss of biodiversity in bamboo based forests are described below.

The fragmentation and extinction of bamboo forests which provide food and shelter to the giant panda is a wide known threat to biodiversity. At present, numerous projects in nature reserves exist to protect the last remnants of these forests and animals.

However, the threat of mono-culture bamboo forests resulting from pressures at the local level to prioritize short term economic and production targets is largely misunderstood and mistaken. Over 4.2 million out of a total of 7.2 million hectares of natural mixed bamboo and broad-leaved or coniferous evergreen forests have been exploited and turned into monoculture forests (Jiang, 2003). In these forests, all trees, shrubs, and underground vegetations are removed to achieve maximum bamboo productivity.

As a result, short term economic returns have occurred at the cost of ecosystem long term biodiversity conservation and loss of long term site productivity. INBAR and its partners demonstrated the negative repercussions of monoculture forests in Anji of Zhejiang Province and Jianyang of Fujian province. In this study, an 11 year old monoculture bamboo forest declined in productivity by 25% and diversity of shrub and grass species was reduced from 58 to 31 species. Moreover, the number of bacilli and fungi in the soil declined by as much as 45% and 90%, respectively. Nitrogen fixation in the monoculture forest was less than 10% compared to mixed bamboo forests. This research illustrates how bamboo monoculture significantly and negatively affects the biodiversity of bamboo ecosystems, as well as, the long term sustainability of production (Lou, Ph. Dissertation, Chinese Academy of Forestry, 2001).

Furthermore, the possible extinction of native Chinese bamboo species also constitutes a considerable threat to the biodiversity of bamboo based forests in China, e. g. *Qiongzhuea tumidinoda* in Yunnan and Sichuan provinces (Dong, 2006). These species are listed in the China Plant Red Data Book and the Red List of IUCN. The Qiongzhuea species have been seriously overexploited because of their commercially valuable culms and edible shoots. The conservation of Qiongzhuea bamboo species is integral for biodiversity conservation in rich forest ecosystems.

3. GOALS OF STRATEGIC TECHNOLOGY AND POLICY DEVELOPMENT TO MINIMIZE LOSE OF BIODIVERSITY

The goal of strategic technology and policy development to minimize lose of biodiversity should well fall under the China National Biodiversity Action Plan (NBAP) of 1994 to prioritize the protection of forests ecosystems in tropical and subtropical regions in China, in particular Objective 5 (*In Situ* Biodiversity Conservation outside Reserves) –*"Adopting Forest Management to be Propitious to Biodiversity Conservation"*. (China State Environmental Administration, 1994). Moreover, the project falls under the policies set forth by the national and institutional framework of the 11^{th} fifth year National Plan, for example under paragraph 3 in chapter 20, which call for *The protection of ecological functions and biodiversity of forests and genetic resources of rare and endangered plants and animals in Yunnan and Sichuan provinces"* and the 12th Special Focus in Chapter 23 on *'Protection and rehabilitation of natural ecology by key engineering projects of* *ecological protection in the upper reach of the Yangtze River'*. These close and strong linkages show that this project has very well addressed some national priorities environmental protection in the national economic development plan and biodiversity conservation action plan (Chinese State Environmental Administration, 2002).

The designed national projects on strategic technology and policy development to minimize declining of biodiversity should focuses on direct and indirect threats taking place outside nature reserves. Specifically, the project concentrates on the effects of over management and over exploitation of bamboo-based forest ecosystems in sub-tropical and tropical forest of China. In the past, biodiversity conservation policies have not been developed nor incorporated in any national, provincial, and local forestry management plans to address these issues. In China, few research and demonstration projects on forest biodiversity conservation have been used as a basis for policy and technology development in the forestry sector. Thus, there is an imperative need to build capacity of government institutions and local farmers to implement biodiversity policies as part of management practices for bamboo bamboo-based forest ecosystems.

The main goals on strategic technology and policy development to minimize declining of biodiversity should be: to determine and show the optimal reconciliation between biodiversity conservation and economic return; to adequately strengthen the capacity of local, provincial, and national governments and farmers to create government policies and awareness; and to develop a strategy to up scale appropriate policies and experiences beyond the pilot project areas, as well as integrate policy in national initiatives on sustainable forest biodiversity management.

4. RECOMMENDATION ON STRATEGIC APPROACHES TO HANDLE THE BIODIVERSITY DECLINING IN BAMBOO-BASED FOREST ECOSYSTEMS

To address the current problems, policy development and integration, training and capacity building, and on-site demonstrations on sustainable management and conservation of bamboo ecosystem biodiversity in tropical and subtropical China are taken as priorities in strategic research and policy development of sustainable bamboo-based forest management described as follows:

4.1 SECTORAL POLICY DEVELOPMENT IN PARTNERSHIP TO BUILD THE LINKAGES BETWEEN BAMBOO DEVELOPMENT FOR LOCAL ECONOMIC BENEFITS AND BIODIVERSITY CONSERVATION AT DIFFERENT LEVELS OF THE GOVERNMENT

In many cases, local governments see bamboo resource development as a major means for local economic development without consideration of bamboo forest biodiversity. To sustainably use bamboo resources for local farmers' livelihoods by maintaining biodiversity of bamboo forests for long-term benefits, significant efforts to be made are:

1. To assess, demonstrate and assemble an adequate information base as a foundation for policy development and management decisions affecting bamboos biodiversity and to ensure the richness of biodiversity;
2. To work with the government at national, provincial, county, and township levels to formulate bamboo development policies that reconcile biodiversity conservation and income generation by incorporating relevant policies into their overall economic development and land use plan to mainstream the biodiversity conservation policies;

3. To develop and incorporate integrated, coherent and systematic policies for bamboo resource management, industrial development and product trade which is dispersed in different government agencies at different levels, to promote integration of bamboo biodiversity concerns into local development processes.
4. To conduct training and demonstrations to build the capacity of stakeholders at different levels to implement economic and land use policies with biodiversity concerns.

4.2 ON-SITE DEMONSTRATION ON ELIMINATING THREATENING IMPACTS ON BIODIVERSITY AND ECOSYSTEM STABILITY CAUSED BY SHIFTING NATURAL MIXED BAMBOO FORESTS INTO PURE BAMBOO FOREST.

Bamboos are used traditionally by many Chinese nationalities for example Han, Yi and Miao nationalities. The economic advantages for industrial utilization have also led to overexploitation of bamboo resources in many areas of China. To explore high bamboo productivity with short-term high profits, intensive management, over-harvesting, tree and shrub clearance, and pesticide and fertilizer application in natural bamboo forests and traditional bamboo plantations have occurred. This has very significant and negative impacts on maintenance of the biodiversity richness and ecosystem stability of mixed bamboo forests with other species. The following efforts should be taken to address the problems.

1. To improve the technological elements in traditional bamboo use practices and other cultural characteristics of rural people and minorities on bamboo resource in terms of biodiversity conservation in Yunnan and Sichuan provinces.
2. To develop appropriate sustainable and economically viable bamboo management technologies, which are certified as a national standard and with criteria for technology approved by the SFA. Current criteria in China that provide economic incentives for bamboo production should be adapted for sustainable management technologies that address bamboo biodiversity concerns in the China National High-Yielding Standard.
3. To demonstrate bamboo forest biodiversity conservation approaches in species selection and plantation plans in large scale bamboo afforestation and plantation programmes such as in Land Conversion Programme and the resource base for bamboo pulping projects in Guizhou, Yunnan and Sichuan provinces to promote biodiversity conservation in presently biodiversity unfriendly projects.
4. To build demonstration sites for the application of sustainable bamboo management technologies for natural mixed bamboo forests.
5. To conduct training and technology dissemination on policies for different stakeholders for capacity building on sustainable management of bamboo forests in terms of biodiversity concerns.
6. To disseminate the lessons learned and experiences from Sichuan and Yunnan to other areas with bamboo forests in China.

4.3 ON-SITE DEMONSTRATION ON REHABILITATION OF THE DEGRADED BIODIVERSITY IN PURE BAMBOO FORESTS IN SUBTROPICAL MOSO BAMBOO FORESTS.

1. To evaluate and document the impacts of the practices on biodiversity and site productivity.
2. To set up project sites to demonstrate the management practices to rehabilitate degraded biodiversity and site productivity of managed pure bamboo forests.

4.4 BIODIVERSITY CONSERVATION OF INDIGENOUS ENDANGERED CHINESE BAMBOO SPECIES

Not only the biodiversity of the bamboo forest ecosystems, but also the diversity of Chinese bamboo species is coming under serious threat. Although China is very rich in species, most of the bamboo research and conservation activities have been concentrated on collection and *ex-situ* conservation of the subtropical bamboo species which are widely used in industry such as Moso. However, preliminary data show that several important other subtropical and tropical species are under threat of extinction due to deforestation and/or overexploitation, and it is likely that other species are also endangered, but no data are available as yet. Examples of threatened species are *Qiongzhuea tumidinoda*, *Chimonobambusa granditolia, Brachystachyum densiflorum* and *Fargesia acaduca* in Yunnan and *Bambusa multiplex* cv. *Alphonse-Karr* on Hainan, etc. These species are important for the livelihoods of local people, often ethnic minorities, and also provide important habitat for rare and endangered animals (Dong, 2006). Future efforts should include:

1. To establish demonstration areas for *in situ* conservation of indigenous endangered tropical bamboo species *Qiongzhuea tumidinoda* in mountainous areas in the Yunnan and Sichuan provinces and to develop management technologies for the sustainable use of the bamboo resources as a reliable source of off-farm income for local communities where they traditionally use the endangered bamboo as a livelihood means.
2. To develop methodology, including the criteria for endangered species, and manuals for the collection and in-situ and if needed also ex-situ conservation of endangered bamboo species and establishment and maintenance of the reserve for endangered bamboo species.
3. To develop appropriate methods for assessing bamboo resources and the pressures on them and incorporating these methods into NTFP elements of national forest inventories.

4.5 TO DEVELOP A NATIONAL NETWORK AND PARTNERSHIP OF BIODIVERSITY MONITORING BY INCORPORATING THIS IN EXISTING FOREST ECOSYSTEM MONITORING SYSTEMS.

A national biodiversity monitoring network and partnership will greatly help maintain biodiversity in bamboo forests in the long run. So far, forest ecosystem monitoring in China includes neither bamboo ecosystems nor bamboo forest biodiversity. Thus the following steps should be taken:

1. To develop the monitoring technology for bamboo forest biodiversity evaluation and monitoring in China.
2. To develop national networks for evaluating and monitoring bamboo forest biodiversity.
3. To promote and incorporate bamboo forest biodiversity monitoring systems with the existing forest ecosystem monitoring system in south and southwest China.

4.6 TO DEMONSTRATE LIVELIHOODS DEVELOPMENT THROUGH BAMBOO RESOURCE UTILIZATION TO BENEFIT BIODIVERSITY CONSERVATION

Not only can these bamboo forests perform very well in biodiversity conservation and environmental protection for high rainfall catchment areas since they are perennially green and have a continuous canopy cover but well-managed bamboo forests can also continually generate income for farmers. Since bamboo is the fastest growing plant in the world and rapidly renews itself with versatility of utilization at a low cost investment for rural industry, bamboo has specific advantages in income generation for rural farmers. The efforts to demonstrate livelihoods development through bamboo resource utilization in terms of biodiversity conservation should be as follows:

1. To develop demonstration project sites on livelihood sustainability through bamboo development by training and capacity building on bamboo resource management, utilization and marketing bamboo products in relation to biodiversity conservation.
2. To conduct a series of trainings to disseminate livelihood development technologies that take into account biodiversity concerns.

4.7 APPLICATION AND DOCUMENTATION OF THE IMPACT OF PARTICIPATORY AND CO-MANAGEMENT APPROACHES TO COMMUNITY LEVEL BIODIVERSITY CONSERVATION ACTIVITIES AND INCENTIVE MECHANISMS IN THE PROJECT AREA FOR REPLICATION, UPSCALING AND POLICY INTEGRATION

Bamboo grows widely in more than ten provinces such as Yunnan, Sichuan, Guangxi, Hunan, Jiangxi, Guizhou, Chongqing, Henan, Hubei, Anhui, Zhejiang, Jiangxi, Fujian, Guangdong, and Tibet. Although they are the richest in bamboo forest resources and biodiversity in species, genetic and ecosystem levels, most of the provinces are also among the least developed and most disadvantaged areas. Any projects shall aim to employ and document the application of the participatory and co-management approaches during project implementation for future replication at different levels. For this purpose, the project should

1. To collect the best practices in participatory and co-management of natural resources, particularly with biodiversity conservation components and apply at the community level during project implementation.
2. To conduct trainings to disseminate the bamboo biodiversity conservation policies and technologies as well as best practices for alternative livelihoods at the community level to benefit biodiversity conservation through participatory and co-management approaches.
3. To promote and upscale the findings and policy recommendations to be included in national and local policy frameworks and forestry programmes and plans.
4. To promote policy integration to national initiatives on sustainable management of forest biodiversity

5. PROSPECTIVE OUTCOMES ON BIODIVERSITY CONSERVATION FOR BAMBOO-BASED FOREST ECOSYSTEMS IN CHINA

The guiding principle on strategic technology and policy development to minimize declining of biodiversity is to ensure lasting results in the biodiversity conservation of bamboo forests ecosystems. The goal of the project is to provide local, provincial, and national actors with a sustainable development approach to guide economic, land use and biodiversity planning in the various provinces.

It is recommended that tentative projects should be designed to have two main outcomes. Through the use of pilot projects, the first expected outcome should be to increase capacity building and raise conservation awareness among local government and citizens. The second outcome should bring local government and business actors together to adopt, integrate, and implement economic and land policies compatible to biodiversity conservation. In turn, these policies will help instigate regional and national level policies.

The expected outcomes will be based on following research outputs.

- ***Output 1***. On-site community level demonstration in mixed bamboo forests and strategies to halt the biodiversity decline, environmental degradation, and productivity instability resulting from a shift to monoculture forests.
- ***Output 2***. On-site community level demonstration on monoculture bamboo strategies to rehabilitate degraded biodiversity and restore ecosystem productivity.
- ***Output 3***. On-site community level demonstration on biodiversity conservation of indigenous endangered native bamboo species in Chinese forests.
- ***Output 4.*** Based on outputs from the pilot sites, a portfolio of current and new policies and strategies to combine biodiversity conservation in bamboo forests will be created. The portfolio will include short and long-term economic benefits, as well as, incentive systems for biodiversity conservation, e. g. payments for environmental services and certification scheme.
- ***Output 5.*** A national partnership network to monitor and promote biodiversity conservation in bamboo forests will be established. The goal of the network will be to monitor and incorporate knowledge from pilot sites into existing forest ecosystem management systems.
- ***Output 6***. Government officials and farmers will be trained in participatory approach to community level biodiversity conservation inside and outside project sites.

Any projects' pilot sites, training workshops, and partnerships should demonstrate that biodiversity conservation provides greater economic and social returns in the long-term. Awareness of the long-term threats to bamboo forest productivity will give local government and farmers higher incentives to conserve and utilize biodiversity for sustainable development. This, in turn, will strengthen local land and economic policies. Capacity building, public awareness, and government policies on biodiversity conservation will guarantee that new policies and technologies be implemented after the completion of the project. The national partnership network will significantly extend output results to other regions in China under prospective national initiatives on sustainable management of forest biodiversity in the country.

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REFERENCES:

China State Environmental Administration, 1994. China National Biodiversity Conservation Action Plan.

Dong Wenyuan, Xiao Jianghua, Fu Jiansheng, Xiong Zhuang, and Zheng Jinxuan, 2006.The Impacts of Human's Disturbances on the Degradation of Clonal Population of

Qiongzhuea tumidinoda Bamboo Forests. Proceedings of INBAR International Bamboo Workshop, Wuyishan., China, 21-23 October 2006.

Fu Maoyi and Lou Yiping, Prospects on research of sustainable management techniques of bamboo forests in China. Proceedings of Forestry Towards the 21st Century, China Agriculture Scien-tech Press, 1998: 100~108.

Fu Maoyi, Xiao Jianghua & Lou Yiping, (eds.), Bamboo Cultivation and Utilization. Beijing: China Forestry Publishing Press, 2000.

Jiang Zehui, Bamboo and Rattan in the World, Liaoning S & T Publishing, 2003.

Lou Yiping and Sheng Weitong, Study of Long-term Site Productivity of Managed Moso Bamboo Forests in China – Review and Prospects, Forest Research. 1999, 12 (2): 172-178.

Lou Yiping, Concept, Background, Current Status and Research Strategies of Long-term Site Productivity of Managed Forests. World Forestry Research, 1998, 11(5): 18~25.

Lou Yiping, Evaluation and prediction of long-term site productivity of managed moso bamboo forests - A review. Journal of Bamboo Research, 1998, 17(4): 31~35.

Ma Naixun, Zhang Wenyan, Lou Yiping, The High-yielding Techniques on Bamboo Forests. Beijing: China Forestry Publishing Press, 1996.

BARRIERS AND SUCCESS FACTORS FOR IMPLEMENTING MECHANISMS FOR THE SUSTAINABLE USE OF BIODIVERSITY

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1 INTRODUCTION

Biodiversity faces many types of threats to its ecological integrity and cultural significance. Although many factors are responsible for the ongoing decline in biodiversity, its root causes are invariably some forms of human activities, such as habitat destruction and fragmentation, over-harvesting or pollution, linked with the absence or failure of management and governance structures and processes to deal with these developments (Brooks et al. 2002; Myers 1993; Myers and Knoll 2001; Novacek and Cleland 2001; Pimm and Raven 2000: Singh 2002). This paper presents results from the interdisciplinary research project GoBi (Governance of Biodiversity), which evaluates the success or failure factors of biodiversity management, especially in protected areas. Its main hypothesis is that the ecological outcome of biodiversity management in protected areas including sustainable use mechanisms depends on the appropriateness of the selected governance and management systems with regard to the local context, and on broader economic and political issues.

Protected areas are one of the principal options to establish alternative resource use regimes or to restrict human activity altogether in the aim to stop - at least locally - biodiversity loss. The UN 2003 List of Protected Areas counts more than 102.100 protected areas world wide, covering about 18,8 mio km2, or close to 10% of the earth‘s terrestrial surface. This constitutes a sharp increase from the 48.388 protected areas counted in 1992, covering about 12,8 mio km2. Unfortunately, many of them do not meet their stated objectives of protecting biodiversity (Oates 1999; Terborgh 1999). Putting land under special legal protection might be a precondition for its effective conservation, but it is not sufficient. Pressures rise on forest products, arable land and drinking water, to name just the most prominent examples. At the same time global spending pungently mismatches the costs of conservation in terms of protected area budget and staff (James, Green et al. 1999; Balmford, Gaston et al. 2003). Consequently, the effective implementation of functioning management systems in already existing protected areas will be the foremost challenge for in situ conservation and also for sustainable use in their buffer zones in the years to come. The linkages between biodiversity conservation and the sustainabe use through local livelihoods are diverse and their framing at policy level ranges from separation to competition to symbiosis between the two issues (Adams et al. 2004). We observe an increase in the establishment of combined approaches.

To include the need for sustainable human livelihoods into conservation planning is widely recognised as a requirement for protected area management in general. Biosphere reserves are one such approach; the biosphere reserve concept combines a zoning scheme and participatory management requirements with a research-oriented world network (Batisse 1997; Chape et al. 2003). Biosphere reserves constitute a set of trans-sectional natural landscapes and ecosystems, many closely intertwined with human settlements and forms of use. Biosphere reserves are experimental places and vanguards for sustainable development‘, as declared in the Seville Strategy of UNESCO in 1995. This ambitious claim is nonetheless difficult to put into practice. As with ‘paper parks’ [1] , many biosphere reserve authorities, neither have the capacity nor the resources to meet this mandate.

2 BARRIERS AND SUCCESS FACTORS FOR IMPLEMENTING MECHANISMS FOR THE SUSTAINABLE USE OF BIODIVERSITY

Setting aside areas for conservation and sustainable use is favoured as a feasible and relatively fast strategy to slow down biodiversity loss. But this reasoning is only as valid as protected areas are actually capable of maintaining biodiversity. In other papers of the GoBi Research Group it has been explained how in particular conservation success of a protected area in the sense of fulfilling conservation functions can be assessed (Stoll-Kleemann & Bertzky 2005a-b).

Protected area management seeks to intervene in a complex social-ecological system to achieve conservation and sustainable resource use. The success of a protected area is hence determined by the impacts of this system and by the adequacy of the management intervention to mitigate these impacts. The probability of successful biodiversity protection and sustainable use is much higher if sound protected area management meets enabling governance conditions at local and regional levels.

Governance aspects affecting successful sustainable use of biodiversity in protected areas can be divided into the dimensions of “political embedding, institutional structures and related conflicts” (Stoll-Kleemann et al. 2006).

Political Embedding

Protected areas and their management differ substantially in their dependency on the political environment. Protected area management is subject of political interests and has to adapt to changing conditions in a highly politicised environment. Generally, an enabling political environment is required. Important factors are the financial situation, supporting (political) actors, effective networking, prestige, conflicting interests (pipelines, mines, etc), the national conservation discourse, the constellation of actors and the general political situation (*ibid*).

Furthermore, in many cases, the political arena for protected areas is closely connected to other issues such as indigenous politics, rural development programmes or industrial exploitation of natural resources (e.g. wood, minerals). Together they make up a complex and dynamic web of concurring and opposing interests (ibid).

Institutional Structures

To date, inadequate attention has been paid to the importance of institutions and analysis is required of the compatibility of conservation policies with the institutional setting within which they operate. Incorporating institutions increases the chance that policies once implemented will have the intended consequences of promoting conservation and sustainable use (Stoll-Kleemann 2005b). Research on common property institutions and sustainable governance of resources specifies the conditions under which groups of users will self-organise and sustainably govern resources upon which they depend (Agrawal 2001, Ostrom 1990). Agrawal (2001) provides a useful list: resource system characteristics, group characteristics, institutional arrangements, and external environment. This approach can be taken further: Institutions govern the relationships between the resource system, the user group and contextual factors. They are therefore highly responsible, as a proximate cause, of the sustainability of these relationships (Wood et al. 2000).

Conflicts

In order to avoid unsustainable exploitation of resources in or around protected areas the management has to determine and enforce rules and use restrictions up to zonation of the area with 'no-go' or 'no-take' zones. This often implies conflicts. But the closer these restrictions are to the traditionally practised forms of resource use in that area, the less the risk of conflict. Nevertheless, traditional use regimes are challenged by in-migration of people and new forms of resource use like commercial exploitation or access to new markets outside the area. The increased competition for resources enforces further potential for conflict.

Biodiversity conflicts can either focus on different preferences, values and objectives of actors, on the options and instruments they choose for action, or on a combination of both (Scheffran and Stoll-Kleemann 2003). Conflicts can be found in a variety of actor relationships and in the pattern of linkages between managing institutions, e.g. conflicts among the local population (access and use of resources, use and property rights, tourism, ethnic groups); conflicts between local population and protected area management or state authorities (conservation against resource use activities like agriculture, poaching, logging, fishing or collection of medicinal plants), and conflicts about the legal status and financial compensations. In many cases biodiversity governance and management policies have failed to solve these kind of conflicts and therefore to establish efficient protection or real sustainable use of biodiversity (*ibid*).

Protected Area Management

Protected area management consists of different responsibilities and fields of work. Protected area managers regularly have to deal with divergent requirements such as ecological and development needs. They often face contradicting interests (e.g. individual vs. common), and need to handle uncertainty of developments (Stoll-Kleemann 2005b).

Protected area management needs the support of the local and neighbouring population (Stoll-Kleemann and O'Riordan 2002 a-b). "Sharing Power", a recent guide to co-management of natural resources, identifies the synergetic character of collaborative natural resource management arrangements: Traditional management systems, instead of vanishing at the advent of modern resource use forms, evolve into 'hybrid' forms of management drawing on the strengths of the different (i.e. local and non-local, modern and traditional) actors (Borrini-Feyerabend et al. 2004). However, this requires a strong recognition of the diversity of views and interests involved and a disposition to follow the much more dynamic and hence less predictable road of collaborative management. This kind of integrative approach emphasizes the social and political implications of protected area politics: Wilshusen et al. (2002) point out that biodiversity conservation is essentially a political issue of distributing costs and benefits. Conservation should not happen on the backs of the already poor rural populations that have little economic alternatives to the use of natural resources for their living.

Therefore, it is important not only to have people participating in management processes but also to respond to their livelihood needs. Stable livelihoods around a protected area are the best pre-condition for acceptance of use-restrictions inside the park. The development of alternative sources of income can take very diverse forms, e.g. new cultivation techniques, better access to nearby markets but also tourism related services. They are certainly preferred to compensation payment schemes which promote dependence, conflict and corruption. Promoting or securing stable local livelihoods is a long-term task which requires considerable capacity and resources (Stoll-Kleemann 2005b).

A further main challenge to protected areas is the lack of financial sustainability (e.g. de la Harpe et al. 2004). In general, lack of resources strongly inhibits protected areas activities. Poor infrastructure, unpaid staff and missing outreach cannot be compensated by political support. High financial insecurity makes planning obsolete and causes serious conflicts in itself: For inhabitants of protected areas it can be more than disappointing to see their hopes smashed, which had prior been generated by protected area officers (Stoll-Kleemann and O'Riordan 2002a).

Earmarked funding is a further difficulty: Though conditions linked to money may have a steering function, protected areas are often in a situation where they have to respond first to the requirements of their various governmental and non-governmental donors, and only in second place to their acute needs. Of course, cases can be found in which some protected areas are managed to function well even without money while others fail to reach their conservation goals despite important funding, due to adverse circumstances (e.g. corruption) or weak management (Stoll-Kleemann et al. 2006).

Empirical Results

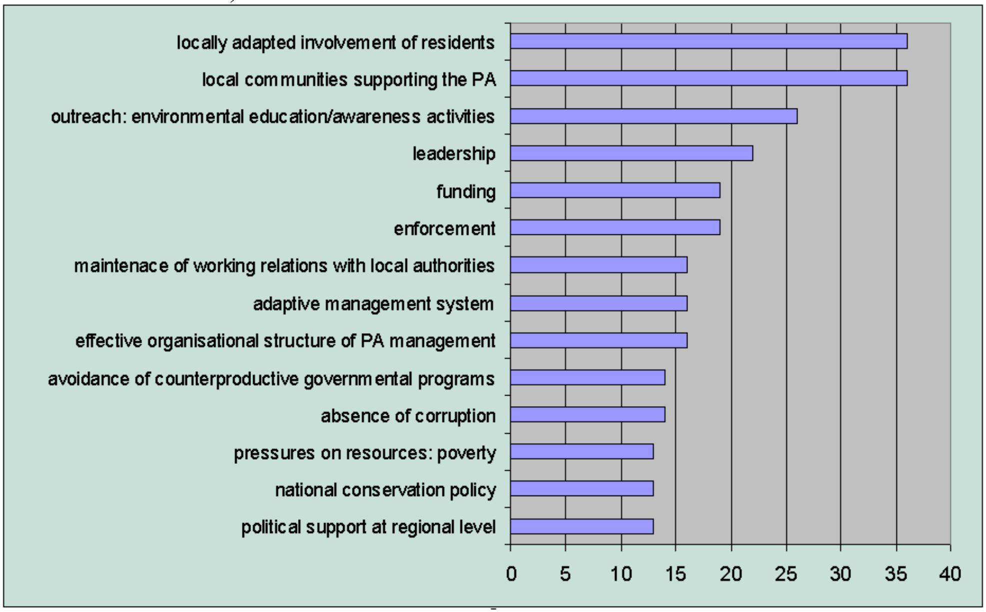
The results of the GoBi Factor Ranking Survey (Stoll-Kleemann et al. 2006) show what experts consider particularly relevant for successful protected area management. More than 160 persons have been asked to rank 41 factors with regard to their importance for the overall protected area success. Professional positions ranged from conservation professionals, government officials, and scientists to representatives of indigenous groups; most respondents had a university degree.

To differentiate among varying conceptions, we asked respondents to first give their definition of a successful protected area. Then they could choose among four ranks to describe each factor with regard to its relevance for protected area success (from relevance "very high" to "no relevance at all"). Respondents were asked to state whether their evaluation was in reference of a specific protected area, country, region or whether it was general in outlook. Finally we asked them to identify the top three factors according to their experience. While going through the ranking sheet, we commented on the different factors clarifying our understanding of them and asking the experts to name further aspects that deemed important to them.

Table 1 shows part of the top three factors selection. The results are surprising: The two factors attracting the highest score refer to the necessity of good relations between the protected area management and the local population as described above. Almost 20% of the respondents chose them; this is especially interesting because the distribution of chosen factors is quite large with many factors receiving between 10 and 15 votes. The issues of funding and of enforcement, typically emphasized in literature, do rank high but attract less than 20 votes each, whereas participation and local support attract more than 35 votes each. Leadership and environmental awareness raising also rank high, again emphasizing a people-oriented approach (Stoll-Kleemann 2005b, Stoll-Kleemann et al 2006).

The results are even more surprising if we consider the strong presence of people with ecological (and not anthropological) backgrounds, and if we take into account the diverse understandings of what is a successful protected area. Definitions range from 'conservation first', via 'reconciliation between preservation and use' of resources, to 'pro-people' concepts – notwithstanding these differences, the necessity of working closely and in trust with the local population is recognized as central to conservation efforts.

Table 1: Top factors influencing protected area success. 163 experts selected among 41 factors their top three. The table presents only the 14 factors with the highest scores (Stoll-Kleemann et al. 2006)



3 CONCLUSIONS

The results show that typical imperfections of governance and management institutions such as enforcement problems, insufficient political support, lack of stakeholder involvement, corruption, lack of capacity and leadership play an important role in determining success or failure of protected areas including implementing mechanisms for the sustainable use of biodiversity. The empirical material raised shows correlations between singular success and failure factors and allows deriving reasons for the continuance of governance and management failures. Adaptable institutional arrangements including responsive leadership and capacity building are necessary to manage biodiversity and ecosystems that have complex social, political, cultural and ecological dimensions.

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REFERENCES

Adams, W. M., R. Aveling, Brockington, D., Dickson, B., Elliott, J., Hutton, J., Roe, D., Vira, B. and W. Wolmer 2004. Biodiversity Conservation and the Eradication of Poverty. Science 306: 1146-1149.

Agrawal, A. 2001. Common Property Institutions and Sustainable Governance of Resources. World Development 29: 1649-1672.
Balmford, A., Gaston K.J., Blyth, S., James and A., V. Kapos 2003, Global variation in terrestrial conservation costs, conservation benefits, and unmet conservation needs. PNAS 100(3): 1046-1050.
Batisse, M. 1997. Biosphere Reserves. A challenge for Biodiversity Conservation and Regional Development. Environment 39: 7-33.
Borrini-Feyerabend, G., Pimbert, M., Farvar, M.T., Kothari, A. and Y. Renard (eds.), 2004. Sharing Power. Learning by doing in co-management of natural resources throughout the world. Tehran, IIED and IUCN/ CEESP/ CMWG, Cenesta.
Brooks, T.M., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Rylands, A.B., Konstant, W.R., Flick, P., Pilgrim, J., Oldfield, S., Magin, G. and C. Hilton-Taylor 2002. Habitat loss and extinction in the hotspots of biodiversity. Conservation Biology 16: 909-923.
Chape, S., Blyth, S., Fish, L., Fox, P. and M. Spalding 2003. 2003 United Nations List of Protected Areas. IUCN and UNEP WCMC, Gland, Switzerland and Cambridge, UK (IUCN) and Cambridge, UK (UNEP-WCMC).
de la Harpe, D., Fearnhead, P., Hughes, G., Davies, R., Spenceley, A., Barnes, J., Cooper J. and B. Child 2004. Does ‘Commercialization’ of Protected Areas Threaten Their Conservation goals? In Child, B., 2004. Parks in Transition. Earthscan London, 189-216.
Dudley, N. and S. Stolton 1999. Conversion of Paper Parks to Effective Management: Developing a Target. Report to the WWF-World Bank Alliance from the IUCN/WWF Forest Innovation Project.
James, A.N., Green, M.J.B. and J.R. Paine 1999. A Global Review of Protected Area Budgets and Staff. WCMC Biodiversity Series No.10. Cambridge U.K., World Conservation Monitoring Centre.
Myers, N. 1993. Questions of Mass Extinction. Biodiversity and Conservation 2: 2-17.
Myers, N. and A.H. Knoll 2001. The biotic crisis and the future of evolution. Proceedings of the National Academy of Sciences of the United States of America 98: 5389-5392.
Novacek, M. J. and E. E. Cleland 2001. The current biodiversity extinction event: Scenarios for mitigation and recovery. Proceedings of the National Academy of Sciences of the United States of America 98: 5466-5470.
Oates, J. 1999. Myth and reality in the rain forest: How conservation strategies are failing in West Africa. Berkeley, University of California Press.
O`Riordan, T. and S. Stoll-Kleemann 2002 (eds.) Biodiversity, Sustainability and Human Communities. Protecting Beyond the Protected. Cambridge: Cambridge University Press.
Ostrom, E. 1990. Governing the commons: The evolution of institutions for collective action. Cambridge University Press, Cambridge.
Pimm, S.L. and P. Raven 2000. Biodiversity - Extinction by numbers. Nature 403: 843-845.
Scheffran, J. and S. Stoll-Kleemann 2003. Participatory Governance in Environmental Conflict Resolution: Developing a Framework of Sustainable Action and Interaction. Deb, K., Srivastava, L. (eds.). Transitions Towards Sustainable Development in South Asia. New Delhi, India: The Energy and Resources Institute, 307-327.
Singh, J.S. 2002. The biodiversity crisis: A multifaceted review. Current Science 82: 638-647.
Stoll-Kleemann, S. and T. O’Riordan 2002a. From participation to partnership in biodiversity protection: experience from Germany and South Africa. Society and Natural Resources 15: 157-173.

Stoll-Kleemann, S. and T. O'Riordan 2002b. Enhancing Biodiversity and Humanity. O'Riordan, T. and S. Stoll-Kleemann. (eds.) Biodiversity, Sustainability and Human Communities. Protecting Beyond the Protected. Cambridge: Cambridge University Press, 295-310.

Stoll-Kleemann, S. and T. O'Riordan 2004. Global biodiversity and conflict resolution. The possible role of public private partnerships. IHDP Newsletter 3: 6-8.

Stoll-Kleemann, S. 2005a. Indicators and evaluation of sustainable natural resource management and governance in biosphere reserves In: Global Change Impacts in Mountain Biosphere Reserves, Paris: UNESCO, 2005, 237-245.

Stoll-Kleemann, S. 2005b. Voices for Biodiversity Management in the 21st Century. Environment 47 (10), 24-36.

Stoll-Kleemann, S. and M. Bertzky 2005a. Biodiversity Management and Monitoring in Protected Areas – State of the Art and Current Trends. Sonak, S. (eds.). Multiple Dimensions of Global Environmental Change. New Delhi, India: TERI Press 143-169.

Stoll-Kleemann, S. and M. Bertzky 2005b. Monitoring the Success of Biosphere Reserves. An Interdisciplinary Endeavor. Lass, W., Reusswig, F. (eds.) 2005. A Practical Guide to Social Monitoring in Biosphere Reserves. MAB UNESCO BRIM Series 2, Paris: 100-110.

Stoll-Kleemann, S., Bender, S., Berghöfer, A., Bertzky, M., Fritz-Vietta, N., Schliep, R. and B. Thierfelder 2006. Linking Governance and Management Perspectives with Conservation Success in Protected Areas and Biosphere Reserves. GoBi Discussion Paper Series No.1, Humboldt University of Berlin, Berlin.

Terborgh, J. 1999. Requiem for Nature. New York: Island Press.

Wilshusen, P., Brechin, S.R., Fortwangler, C. and P.C. West 2002. Reinventing a Square Wheel: Critique of a Resurgent "Protection Paradigm" in International Biodiversity Conservation. Society and Natural Resources 15: 17-40.

Wood, A., Stedman-Edwards, P. and J. Mang 2000. The Root Causes of Biodiversity Loss. London: Earthscan.

DEVELOPMENT OF PLANNING SYSTEM OF CLOSE-TO-NATURE FOREST MANAGEMENT FOR MULTIPLE BENEFITS ECOLOGICAL FORESTRY IN CHINA

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ABSTRACT

The recent forestry development in China has tended to shift emphasis from timber production to ecological rehabilitation and environmentally sustainable services. The planning system of forest management is therefore facing challenges of adjusting development goals, updating guide theory, and modifying planning methods for the multiple beneficial objectives of sustainable forestry. The concept of close-to-nature forest management is a possible way to meet the needs of multi-benefit sustainable forestry. Under the principles of close-to-nature forest management, a variety of technical elements and tools can be developed for localized implementation. This paper introduces a preliminary study of a close-to-nature forest management planning system which aimed to meet the needs of these new development trends. The main improved technical elements of this planning system include four formatted techniques: inventory and identifying of the basic management units characterized with biotope mapping, goal analyzing and designing with the support of the so called Target Forest Development Type concept, stand operation shifting from a timber volume oriented system to a target tree oriented operation, silvicultural planning changed from a rotating scheme to natural succession and a vertical structure oriented temporal flexible form. With experimental examples from different forest types, the new planning scheme and techniques characterized by the Close-to-Nature concept are implemented in several model areas in China for transforming plantations into near-natural forests. The first results and the future application for Chinese ecological rehabilitation are discussed.

Key words: Close-to-nature forest management, Biotope mapping, target forest development type, target tree operation, silvicultural planning.

1 INTRODUCTION

Sustainable Development is an urgent issue of modern forestry, and the basic questions of sustainability are: (1) What should really be sustainably developed? and (2) How can we perform this in practice? The first question is about the target, and the second concerns the implementation methods and application techniques (Aplet et al. 1993). The answer to the first question is clearly that the forest as an ecosystem should be sustainable and a close-to-nature forest is a sustainable forest ecosystem. For the second question it is clear that techniques and supporting tools of close-to-nature forest management will help to realize the goal of sustainable development.

Since the 1950s, the Dauerwald-movement and the attempt to introduce close to nature forestry by law led to a large set back for close to nature forestry in Germany. Arbeitsgemeinschaft Naturgemässe Waldwirtschaft (ANW) was founded first with only 46 foresters as a working group for close to nature forestry (Wobst 1979). The concept and implementation of Close-to-nature forestry techniques are accepted and further developed in European forestry (Ammon 1937; Assmann 1950a, 1950b; Gayler 1975; Lamprecht 1977; Hatzfeldt 1994; Knock & Plusczyk 2001). From the 1980s the ANW membership has been rising continually. The principles of close to nature forestry, as defined by ANW, have also been adopted by the Chinese State Forest Administration and we have applied them to our research project as technical support to the Natural Forest Protection Program since 2003.

Generally, close-to-nature forest means that the forest is of uneven age, is mixed with local tree species, and has a multilayer structure (Höfle 2000; Lu et al. 2004). Close-to-nature forest management is then a management model which is based on the natural stability mechanisms of the ecosystem, is supported with biological diversity, and includes economic requirements and ecological feasibility to realize the various beneficial objectives of sustainable development.

With the emphasis of forestry strategy shifting from timber production to ecological rehabilitation in China, forest management is facing the challenge of adjusting development goals, updating guide theory, and modifying planning methods to meet the needs of ecosystem construction (Lu & Zhang 2002). The planning system of forest management should represent the principles of sustainable and multifunctional ecological forestry, and develop a relevant planning model, operation technique and implementation procedure to ensure the goal of multifunctional forestry sustainability (Lu & Gan 2002). After years of study we reach an elementary planning system to implement close-to-nature forest management in China. In comparison with a timber harvesting oriented plantation model, the close-to-nature based planning system is improved in the following aspects: (1) inventory and identification of the basic management units characterized with biotope mapping, (2) management goal analysis and design with the support of the so called Forest Development Type concept, (3) shifting stand operation from a timber volume oriented system to a target tree oriented operation, and (4) changing management planning from a rotating scheme to a natural succession based and vertical structure oriented temporal flexible form. These four technical elements have been experimented in several demonstration areas (as shown in figure 1) and will be further implemented in the next 5 year research phase.

2 EXPERIMENT AREAS AND DATA

As shown in figure 1, our study on close-to-nature management has been conducted since 2003 and has been demonstrated in different forest types from the tropical province of Hainan, subtropical Yunnan and Sichuan to temperate regions in the Shanxi province and Beijing. For a simple and coherent description we use the data from the Beijing region, with some Chinese pine stands (*Pinus tabulaeformis*) as an example in this paper.

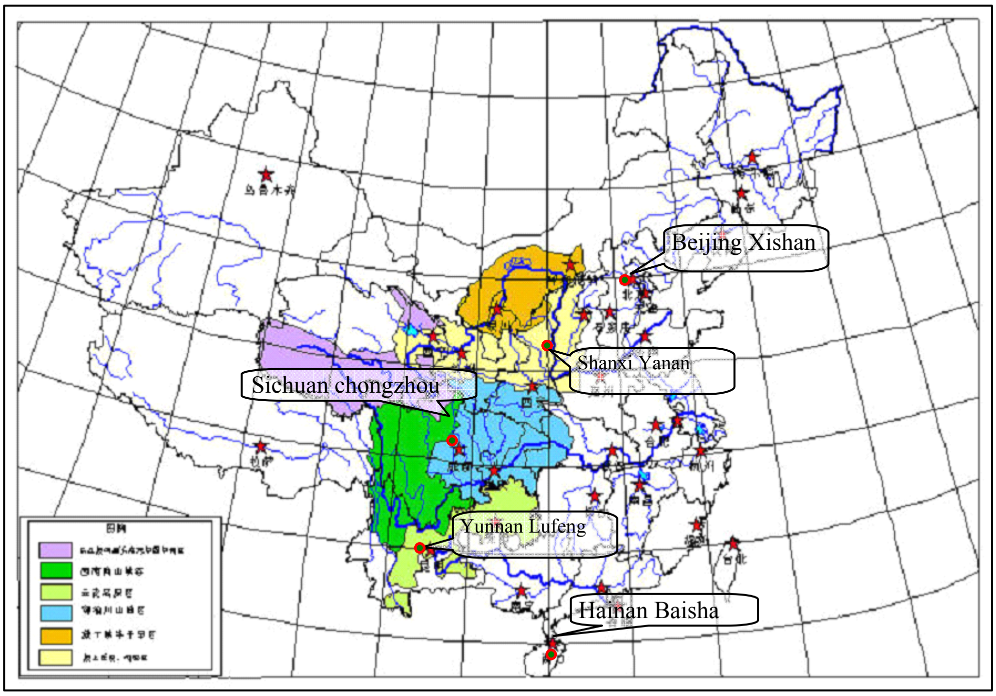


Figure 1. Study areas on close to nature management

Our investigation consists of 3 parts: forest site and environment condition, vegetation situation and soil, and stand structure and growth. Site conditions are expressed by a code system, consisting in elevation (4 levels in the Beijing region), soil nutrition (6 levels), topographical and physiognomic state (8 classes) and soil thickness with organic contents (4 classes). Each component of these parameters indicates a different site condition which should be considered in forest management planning. Results of site surveys will be presented mainly with different biotope maps and related data tables. Vegetation survey studies on the current vegetation composition should estimate present and future dominant species compositions. Investigation of stand structure and growth is conducted with different survey plots and the resulting stand parameters are shown in Table 1, including growth data for diameter, height and volume.

Table 1 shows the stand parameters out of 6 plots of 54 years old pine plantation in the Beijing region. With its average stand volume of 72 m3/ha and 9.2 m mean height after the 54-year growing period, the even aged needle tree plantation shows a clear degradation of growth and a transformation towards a close-to-natural stand is urgently needed.

Table 1. Stand parameters of a pine plantation (Pinus tabulaeformis) of Xishan forest farm in the region of Beijing.

Sample No.	(N/ha) Stems	(m2/ha) Basal area	(m3/ha) Standing volume	Mean DBH (cm)	Mean height (m)	Number of tree species	Number of family
1	400	12.11	65.71	19.64	10.85	2	2
2	1680	18.23	69.91	11.76	7.67	1	1
3	1800	17.06	60.93	10.99	7.14	1	1
4	720	17.63	105.78	17.66	12.00	1	1
5	1000	17.12	81.15	14.77	9.48	1	1
6	1440	15.76	63.18	11.81	8.02	1	1
Average	1173	15.68	72.09	13.05	9.19	1	1

3 IMPROVED PLANNING SYSTEM FOR CLOSE-TO-NATURAL FORESTRY

According to the principles of close-to-natural forestry, we understand that the first step for forest management is to understand the present situation and natural potentials of the site, and then to see what is an optimal combination on the site for human interests and the natural possibilities. This is necessary to set goals for proper management. After setting goals we should operate in the stand according to the relationship of the trees to obtain improvements or harvest with lower costs for people and fewer disturbances to nature. In the long term forest development process it is necessary to have a schedule of different operations aimed at the management goals. These are the things we need to do in management planning and they are formulated into four technical elements in an integrated planning system.

3.1 IMPROVED INVESTIGATION

The goal of investigation is to understand the present situation and its natural potential. The improvements for this step are: (1) an expansion to include the parameters of forest environment and site condition, stand structure, and tree growing data; (2) a quantitative code system to express the site condition; and (3) expressing most results in a set of professional maps by using biotope mapping.

A biotope can be understood as a typical ecosystem unit in the spatial and temporal state (Anonymous 1980). It has to be the base of a forest management plan referring to securing the ecosystem dynamics in the forest, while nature conservation in most cases refers to the conservation and advancement of biotopes and endangered species (Schulte et al. 2003; Sturm & Hanstein1986; Sturm 1989).

As shown by Figure 2, Biotope mapping means classifying the comprehensive impacts of different natural elements and indicators. With the help of coding and mapping, the site conditions can be organized into biotype classes which are elementary units with similar natural attributes for proper forest management.

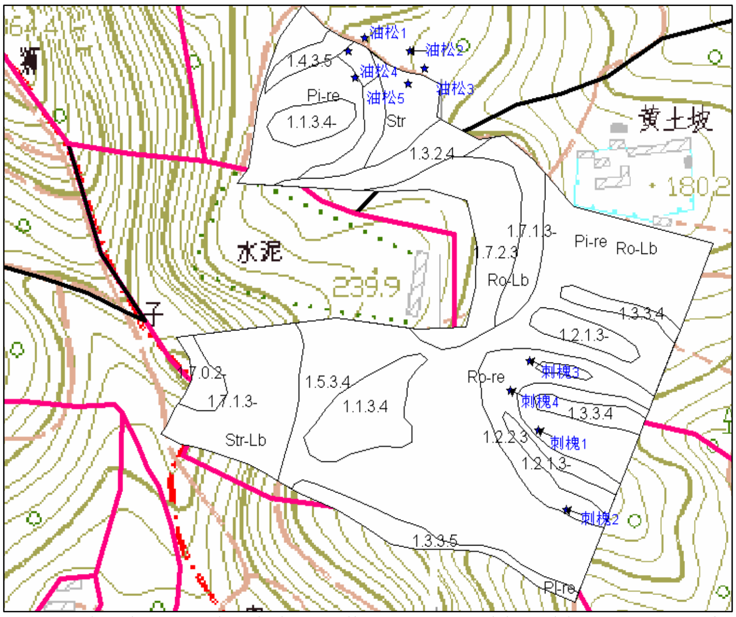


Figure 2. Investigation result of site coding presented in a biotope map of an experimental area in Beijing.

3.2 GOAL ANALYZING AND THE DESIGN OF FOREST DEVELOPMENT TYPES

Analyzing the management goal is a combination of the needs of people with the possibilities of the nature. As the Xishan experimental pine plantation is located on the joint part of an urban and suburban region in the western part of Beijing, the overall management objective is to provide recreation and landscape service functions before timber production. As this is hardly reachable with the present even-aged pure needle species plantation, it is necessary then to transform it into a close-to-nature forest with a diverse structure to meet the needs of sustainable environmental and cultural needs.

There are several ways to express management objectives; the traditional method in China is the so called Target Stand Design (TSD). Generally, TSD is usually used for new afforestation areas, it defines tree species or composition, it targets stand volume and rotation or cutting circle based on site indicators and growth parameters of tree species. Another one of the objective expression methods is Forest Development Type (FDT, or WET in German). FDT was originally developed in the LOEWE program of Niedersachsen, Germany (Anonymous 1991; Otto 1994) and it is figured with a dynamic controlling of forest and some concrete parameters such as target harvesting diameter and vertical structure.

The integration of TSD and FDT improved our management goal analysis and expression. In our experiment, areas of Target Forest Development Type (TFDT) are used to present the main characters of a close-to-natural forest in the future. TFDT is composed of a description of Forest condition, development target, service and conservation functions, ability of timber production, target diameter, mixture type, tree species composition, and regeneration possibilities as its main parts. But for optimal management planning we feel a quantitative and visualizing supporting tool for design of TFDT is still absent.

3.3 TENDING OPERATION ORIENTED BY TARGET TREES

A fundamental difference between close-to-nature forestry and plantation forestry is the decision parameters of how to cut trees in a stand, with or without the target tree design as a key element in between. A practical target tree oriented operation starts by classifying all trees in stand into four classes labeled as target trees, ecologically valuable trees, disturbing trees, and other normal trees. Classification must be done according to the biological and ecological relationships between single trees such as vigor, stem quality, and biodiversity. The second step is the felling of disturbing trees with consideration for the protection of natural regeneration.

Figure 3 shows a Pinus tabulaeformis stand which is located in a western suburb of Beijing. The management goal is defined as maintaining landscape and recreation services in combination with timber production. Based on the analysis of biotopes and the design of a Target Forest Development Type, the transformation task of this pine plantation is concluded as the following three aspects: (1) stopping the tendency of tree growth degradation; (2) improving the diameter structure to possibly a sustainable reverse J shape distribution; and (3) increase the proportion of broadleaved trees. With its single tree relationship based advantages, target tree operation will help to improve these points over and over, aimed to an unequally distributed close-to-natural forest.

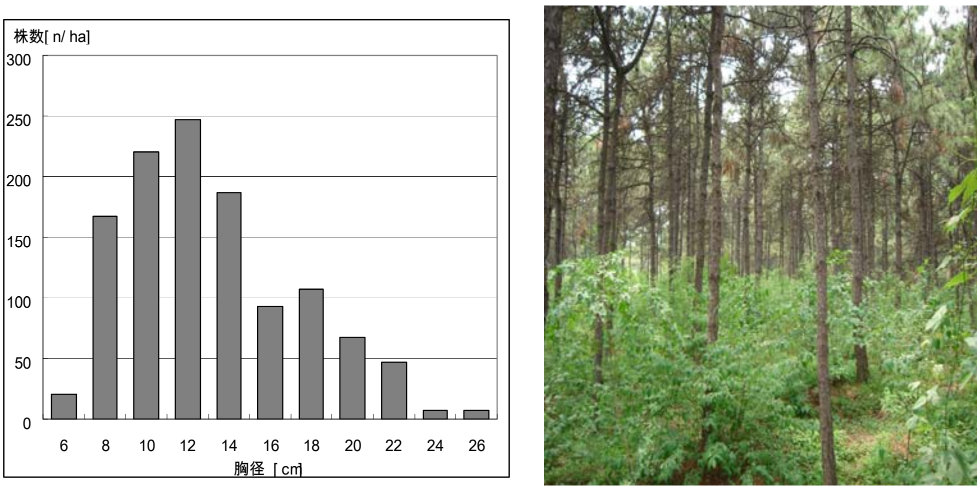
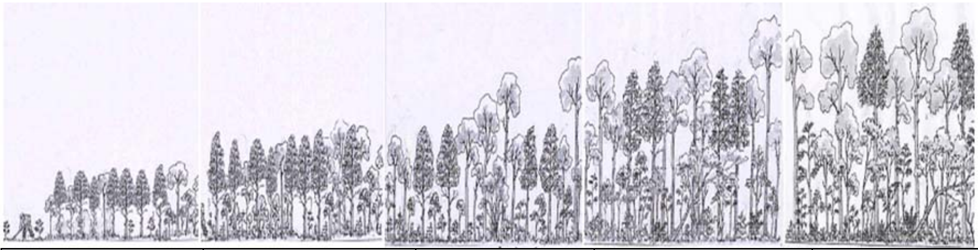


Figure 3 Diameter class distribution and forest condition in Chinese pine plantation.

3.4 OUTLINE OF SILVICULTURAL PLAN ON THE CLEW OF NATURAL SUCCESSION

A traditional silvicultural plan uses rotation-based sequences to control the process of forest growth towards economic production. In our study, this is changed to a design of silvicultural operation planning based on the natural progress of succession. The natural succession can be classified into 4, 5 or 6 phases with different ecological indicators to meet the need of understanding and management (Spurr & Barnes 1980; Whittaker 1975; Horn H S 1981). In our study, this progress is divided into 5 stages with clear differences of the structural and operational parameters, as shown in Figure 4. An operational planning table with ecological indicators and forestry parameters from forest establishment, competition differentiation, selection stage, close-to-nature (pre-mature) stage, and natural permanent forest stage are given for silvicultural measurements in the stands which aim to be close-to-natural forests.



I．establishment	II. competition differentiation	III. selection stage	IV. close-to-nature (pre-mature) stage	V. natural permanent forest stage
Afforestation	protection	Select and tending the TT	Checking TT	Partly harvest TT in main canopy
Promoting the natural regeneration	Special TT* selection in needle stand	Cutting disturbing trees	Cutting disturbing trees	Tending TT in under canopy
tending	Special operation for degraded stand	Protecting natural seedling	Select TT in the second generation	Promotion gap regeneration

Figure 4. Classification of forest succession procedures and planning main silvicultural operation for each stage.

For an implementation outline of silvicultural operation, information on ecological indicators such as competition, species composition, canopy development, and soil development needs to be collected, and forest development parameters should be analysed to support developing a reasonable operational planning table. This table will serve as a guideline for the operational measurement at each stage of stand devolopement for vertical structure orientation and temporal flexible forms in practice.

In relation to a concrete stand, the time sequencing of each stage varies, depending on the growth rates of the tree species, the site conditions, and the different stages. It means that the period from forest establishment to a permanent, self-sustaining forest will be estimated to last from 50 to 120 years in case of the Beijing region.

4 CONCLUSION AND DISCUSSION

The planning system of close-to-nature forestry, taking demonstrative data from Beijing, is developed out of our primary study on multi-functional ecological forest management in China for different experimental areas from the tropical area of Hainan, subtropical Yunnan and Sichuan, to the temperate regions in the Shanxi province and the Beijing region. Due to the long-term process of forest ecosystem development, evaluation of influences with concrete field data is still a task for us in the future. However, the concept of Close-to-Natural Forestry is realized in China due to the efforts of the last years, and further study and implementation will continually be conducted and extended to other regions in the next five years of the national research program. We hope that this integrated planning system with its four concrete technical elements will serve as a tool for sustainable forest management strategies in China and make its contribution to biodiversity conservation and ecological rehabilitation in the future.

REFERENCES

Ammon, W. 1937. Das Plenterprinzip in der schweizerischen Forstwirtschaft. Büchler, Bern & Leipzig. 108 pp.

Anonymous 1980. Forstliche Standortsaufnahme: Begreffe, Deffinitionen, Einteilungen, Kennzeichnungen, Erlaeuterungen (Vierte Auflage). Landwirtschaftsverlag, Muenster-Hiltrup, Germany. 1980,1~188.

Anonymous 1991. Niedersaechsisches Programm zur Langfristige Oekologischen Waldentwicklung in den Landesforsten. Niedersaechsische Landsregierung, Hannover. 1991,1~49.

Aplet G H, Johsen H, Olson J T, Sample V A 1993. Defining Sustainable Forestry. Island Press, Washington. 1993, 1~480.

Assmann, E. 1950a. Naturgemässer Wirtschaftswald (Close to nature production forest). Allgemeine Forstzeitschrift 5, 141-143.

Assmann, E. 1950b. Noch einmal: Naturgemässer Wirtschaftswald? (Once more: Close to nature production forest?) Allgemeine Forstzeitschrift 5, 315-316.

Gayler, W. 1975. 25 Jahre Naturgemässer Waldwirtschaft– eine Bilanz. Allgemeine Forstzeitschrift 30, 351-352.

Hatzfeldt, Hermann Graf 1994. Ökologische Waldwirtschaft – Grundlagen-Aspekte-Beispiele: Alternative Konzepte. Stiftung Ökologie & Landbau Verlag C.F. Müller GmbH, Heidelberg.306 pp.

Höfle H H. 2000. Waldbau, Naturschutz und Betriebswirtschaft am Beispiel des Niedersächsischen Forstamts Bovenden. Forst und Holz, 2000, 55:218~220.

Horn H S 1981. Some Cases of Variety in Patterns of Secondary Succession. In: West D C, Shugart H H, Botkin D B (eds.). Forest Succession: Concepts and Application. Berlin & New York, Springer, 1981,pp 24~35.

Knock, Thomas; Plusczyk, Niels 2001. On economic consequences of transformation of a spruce (Picea abies (L.) Karst.) dominated stand from regular into irregular age structure. Forest Ecology and Management ,151: 163 – 179.

Lamprecht, H. 1977. Naturgemässe Waldwirtschaft - standortsgerechter Waldbau in Theorie und Praxis (Close to nature silviculture - site-adapted forestry in theory and practice). Forst und Holzwirt 32, 325-329.

Lu, Yuanchang; Knut Sturm; Gang Jin; Lei Xiangdong; Guo Hong. 2004. Close-to-Natural Forest Management in the Practice of Plantation Thinning in Beijing Region. Transactions of China Pulp and Paper, Vol.19, Supp. 285-289. (in Chinese with English abstract)

Lu, yuanchang; Zhang, Shougong 2002: Imperative technical problems to be solved and strategies recommended in regions of the protection program of Chinese natural forests. Speech paper in the 2002 year's conference of the Chinese Scientific Association, 4-9, Sept. 2002, Chengdu, China. (in Chinese with English abstract).

Otto Hans-Jürgen 1994. Ökologische Waldwirtschaft in Niedersachsen. In: Hatzfeldt H G (ed), Ökologische Waldwirtschaft – Grundlagen-Aspekte-Beispiele: Alternative Konzepte. Stiftung Ökologie & Landbau Verlag C.F. Müller GmbH, Heidelberg. 1994,1~259.

Schulte, Wolfgang; Sukopp, Herbert; Li, Jianxin 2003. Biotope mapping in cities, towns and villages--a national program in Germany. ACTA ECOLOGICA SINICA, Vol.23 No.3 P.588-597.

Spurr S H, Barnes B V 1980. Forest Ecology. 3rd edition. New York, Wiley & Sons. 1980.

Sturm K, Hanstein U. 1986. Waldbiotopkartierung im Forstamt Sellhorn - Naturschutzgebiet Lüneburger Heide. - Aus dem Walde, H. 40, Hannover, 1986, 1~204.

Sturm K. 1989. Was bringt die naturgemäße Waldwirtschaft für den Naturschutz.- NNA Berichte Niedersachsen - Naturgemäße Waldwirtschaft und Naturschutz, 2. Jg., H. 3/89, S. 1989, 154 ~158

Whittaker R H. 1975. Functional aspects of succession in deciduous forests. In: Wolfgang S (eds), Sukzessionsforschong. Berichte der Internationalen Symposien der Internationalen Vereinigung für Vegetationskunde. A. R. Gantner Verlag, Vaduz, Germany. 1975, 377~405

Wobst, H. 1979. Geschichtliche Entwicklung und gedankliche Grundlagen naturgemässer Waldwirtschaft. Forstarchiv 50, 22-27.

COLLECTIVE ACTION FOR PROMOTING COMMUNITIES' MARKETING CAPACITY: SUSTAINABLE NTFP MANAGEMENT IN THE CONTEXT OF THE COMMUNITY-BASED NATURAL RESOURCE MANAGEMENT (CBNRM) MECHANISM

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1 BACKGROUND

1.1 UNCLEAR LEGISLATIVE ARRANGEMENT FOR NTFP OWNERSHIP

The Forest Law of P. R. China regulates that "all forest resources (including NTFPs) belong to all citizens except those parts belonging to collective entities as regulated by law" (Article 2). That means that there are two kinds of ownership for forest resources: one is state-owned and the other is collective-owned in rural areas.

However the past reforms on forest resources after the establishment of P. R. China paid much attention to the legal arrangement of forestland. The basic principle is to separate use right of forest land from ownership, which means to keep the collective-owned and allow individual households and users groups to have use rights over forest land and then to authorize the ownership for forests and timber (including bamboo and fruit trees). This implies that there is no clear legal arrangement for NTFPs.

Traditionally, NTFP is an open access to all collective members within the village and even outside the village which resulted in (1) over-harvesting and non-management for NTFP itself; (2) conflicts among different users; and (3) poor management for forest resources, including NTFP.

1.2 NTFP BECOMES AN IMPORTANT SOURCE FOR MANY RURAL HOUSEHOLDS IN YUNNAN

Yunnan has most abundant fauna and flora resources in P. R. China. Let's take eatable wild mushroom as an example, there are more than 720 species in China and 600 species in Yunnan, takes 86.7%[1]. Traditionally rural people collected NTFP for family consumption so that NTFP contributed very much for improving rural households' food sources and nutrient structure.

In the recent more than 10 years, with the improvement of economic situation for most Chinese people, more and more people paid much attention to the quality and structure of food, green food becomes the first priority for many urban residents, so that NTFP also becomes an important cash income source for many rural households.

The unclear legislative arrangement and bigger and bigger market demand resulted in poor management and over utilization for many NTFPs, especially wild mushrooms, eatable wild vegetables and many species of herbal medicinal plants. This situation also is paid attention by both governments and local communities. The former issued and implemented many policies to manage the NTFP, and the later initiated different approaches to manage the NTFP resources based upon local situation. Xiaoshao Village, Yiliang County is one good example.

Xiaoshao Administrative Village consists of 8 natural villages comprising a total of 380 households and 1,382 residents. It belongs to Goujie Township in Yiliang County, Kunming Municipality. The village is 85 km away from Kunming. The village has a total land area of over 50,000 mu (over 3,000 hectares). Its arable land area is only approximately 3,000 mu, with 700 mu of paddy land and the remainder dry land. Forestland occupies the remaining approximately 47,000 mu of village land. The net income was about 2500 RMB yuan (300 USD) of which NTFP accounted for 2/5.

2 INTRODUCTION TO XIAOSHAO VILLAGE'S TENURE SYSTEM OVER FOREST

2.1 YILIANG COUNTY

According to briefings with county agriculture and forest bureau officials, Yiliang County allocated forest land to households under the "Two-Hill" Policy in 1983. By 1987, however, severe over-cutting had occurred in many parts of Yiliang. In response, the county adopted a policy that all land that had not been reforested by households would be returned to collective management at the natural or administrative village level. Land that had been reforested by households would remain under household management under the principle that "he who plants the trees shall have rights to the land." Currently, approximately two-thirds of Yiliang's forest land is operated under collective management, with the remaining land managed by households.

County officials pointed to several reasons for the over-cutting that followed allocation of forestland to households. First, many households found forest land difficult to manage. In comparison to arable land, forestland tracts are large and often difficult to access, meaning that greater investments of time and labor are required for effective management. Second, frequent changes in forest policies made farmers feel insecure, and increased their desire to cash in on the economic benefits of the forestland they had been allocated before the next change in policy. However, county officials also recognized that in some instances, households had been able to effectively manage the forestland that had been allocated to them. These successful examples of household management were based on several factors, including: allocation of forestland in a manner that made forestland easily accessible by farm households, a secure perception among farmers that they would be able to reap the benefits of any investments they made on their forestland, and access to the capital required for such investments. On the whole, county officials felt strongly that collective forest management had been more effective than household management in protecting forest resources.

2.2 XIAOSHAO VILLAGE

Collective Forestland Management.

Village cadres in Xiaoshao reported that allocation of forestland under the Two-Hill policy in 1982 resulted in progressively severe harvesting by households. Cadres estimated that within the first two years of the Two-Hill policy, approximately 40% of village trees had been harvested, and that by 1985 village tree cover had declined to 40% of 1982 levels. Tree harvesting was pervasive throughout all of the villager small groups within the administrative village, and was primarily attributed to the desire to build new houses and to reap economic benefits from the forests while households possessed management rights. In 1988, the village decided that it would close the forests to farmers because, in their words, "the forests were bare, the water sources were dry, and the people were poor." Village cadres attributed instances of erosion, seasonal flooding, and decrease in grazing areas, all of which were prevalent between 1983-1990, to the lack of tree cover. In 1990, all forestland was formally taken back under village collective management. Cadres estimated that current tree cover in Xiaoshao had returned to approximately the same levels as existed in 1982.

Contracted Hill Policy

Xiaoshao village also provided an example of local innovation to realize the economic potential of forestland without harvesting trees. This method, called the "Contracted Hill" policy, capitalizes on the presence of a particular type of edible mushrooms that grows in village Hills. Under the policy, rights to manage specific parcels of Hill land during a designated mushroom harvesting season are auctioned to the highest bidder, who receives a contract specifying his rights and obligations on the land. Successful bidders receive the right to harvest mushrooms on the contracted land during the designated season (May 31 – October 31) and to retain any income from the sale of mushrooms. Contractors are also permitted to charge admission fees to individuals who are interested in picking mushrooms on the land. Contractors are required to pay all contracting fees, determined by auction, at the time of contracting, and are required to protect the forestland to which they have won rights. Neither tree cutting nor grazing is permitted on the contracted land during mushroom season.

Management of forestland is also contracted out during the non-mushroom season (November – May), but the contracting method is reversed. An auction process is opened to village households, with the household providing the lowest bid (that is, willing to manage an area of forestland during those months in return for that payment) earning the position in return for payment of the contracted amount by the administrative village.

The Contracted Hill policy was first introduced on an experimental basis in Da Gou Li villager small group in 1992. At that time, approximately 800 mu of forestland was contracted out for a total of 3,400 RMB. In 1993 and 1994, other villager small groups introduced the policy, but the contracted land areas remained small and collective income was minimal. During these initial years of the policy, contracting was limited to village households only.

In 1995, the village adopted a different approach to the Contracted Hill policy. The area of land to be contracted was expanded greatly, and for the first time, non-villagers were allowed to contract the land. As a result, collective revenues from contracting increased dramatically to approximately 360,000 RMB. Income, aside from a small fee retained by the administrative village, was allocated among the villager small groups occurs based on each small group's share of total village population[2]. Village policy required that contracting fees be used to cover each villager small group's annual operating expenses, including cadre salaries and any public works projects. The increased contracting revenues allowed small groups to cancel all other collective contributions, taxes, and fees that had been imposed on farmers, with additional profits distributed among all village small group members on a per capita basis. Village cadres reported that a public accounting of expenditures and profit distributions is made to farmers every year.

The policy of allowing non-villager to participate in the auction process was maintained between 1995 and 2000, with contracting revenues increasing each year to a high point of 630,000 RMB in 2000. In each year, revenues were sufficient to cover all public works costs and to distribute profits to villagers. The amount of annual profits distributed varied among villager small groups, and depended on the extent of public works that were required in any given year. Cadres told us that many villages had used the revenue to undertake basic agricultural infrastructure improvements such as improving village reservoirs.

Beginning in 2001, however, the village reversed its policy of contracting to outsiders, once again allowing only village residents to participate in the auction process. This decision was motivated by two considerations. First, village cadres reported that non-villagers presented difficulties in managing and enforcing contracting arrangements. Second, village cadres and farmers felt that the benefits from village resources should be accrued by villagers themselves, rather than outsiders. This shift in contracting led to a reduction in contracting revenue from 630,000 RMB in 2000 to 580,000 RMB in 2001, but cadres we interviewed expressed unanimous support for the decision in spite of this lost revenue.

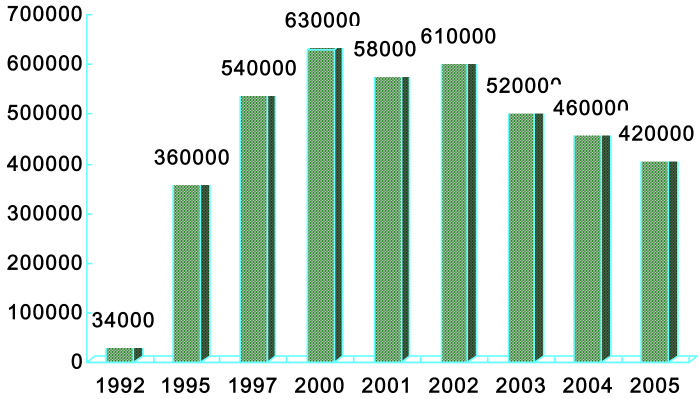

Figure 1. Shift in contracting revenue.

Following our interview with village cadres, we interviewed two groups of farmers that included three current contractors and several non-contractors of the Contract Hill land from different villager groups. All of the farmers participating in the group interviews, regardless of whether they were contractors or non-contractors, strongly supported the Contracted Hill policy. When we asked whether farmers would favor allocation of the forestland to households, they universally expressed opposition to this possibility. Non-contractors replied that they were happy to receive a profit distribution each year “without doing anything,” and reported that the profit distribution in their villager small group the previous year had been 300 RMB per capita. Contractors pointed out that management by a small number of contracting households, who lived on the contracted land during the mushroom season was more efficient and ensured better forest protection while simultaneously providing the opportunity for individual profit.

They also expressed support for the policy limiting contracting to villagers, stressing that villagers should have the opportunity to reap the economic benefits from village resources. They noted that when management was contracted to non-villagers, a considerable amount of poaching of mushrooms had been done by villagers, but that poaching has declined since contracting to villagers was undertaken due to social pressure.

All three forestland contractors told us that they had obtained contracts through a competitive auction. Auction participants were required to pay 1,000-2,000 RMB for the right to bid on the land to be contracted, depending on the decision made by each villager group. For unsuccessful bidders, this deposit was returned in full. For successful bidders, it served as a down payment on the contracting fees.

One of the contractors, Mr. Zhao, had obtained rights to a parcel of 350 mu of forestland for a contracting fee totaling 38,500 RMB. Though this was the most expensive parcel of Contracted Hill land in the village, competition was intense, with nearly 20 people submitting bids for that parcel. The opening bid for the parcel was 28,000 RMB. Mr. Zhao was able to pay the contracting fee through a combination of personal savings and loans. He borrowed approximately 25,000 RMB from the township credit cooperative, and the remainder from friends and relatives. To secure the loan from the credit cooperative, the village cadre provided documentation of rights to the contracted land. Mr. Zhao reported that it is very difficult for farmers to get loans from the credit cooperative for typical agricultural purposes, but they are willing to make substantial loans to those farmers who have contracted forestland under the Contracted Hill policy. The interest rate on the loan is 0.72% monthly (8.64% annually). Mr. Zhao has already made payments to the credit cooperative totaling 27,000 RMB.

A second contractor who had successfully won the bid for three consecutive years between 1999 and 2001 also reported that the competition was keen. In 2001, for a tract of 350 mu of forestland, his winning bid was 28,950 RMB, well above the starting bid of 15,000 RMB. Seventeen farmers participated in the bidding process for that parcel. The profit was also impressive. His cash income from contracted Hill of 400 mu in 1999 was 30,000 RMB, while the contract fees were just 15,100 RMB. In 2000, he was able to make more than 40,000 RMB from half of his 800 mu of contracted Hill (the revenue collected from the other half was kept by his son) although his winning bid for all of 800 mu was only 53,000 RMB. By the time of our interview, he had almost recouped all of the contract fees he paid, and still had nearly two months to collect revenues from mushrooms before his contract expired.

3 OUTCOMES AND IMPACTS

First, existing forest resources are effectively protected. All bidders are required to submit a bidder's fee of 1,000 Yuan prior to the auction. Upon any successful bid, the contracting party is also required to pay between 100-1,000 Yuan depending on the area of forestland contracted to cover the costs of closing the forests to outsiders and forest fire prevention. In addition, the contractee also must pay a lump sum of the contracting fee for the current year. After the signing of contract with the village committee, the contractee is permitted to take over the mountain. Parcels are auctioned off once per year, but contractees may bid for management rights to the same parcel in consecutive years. Parcels are typically auctioned, and management contracts signed, every April, and the contract period ends on October 31. Upon expiration of the contract, an inspection team consisting of village leaders and residents conducts an examination of the contracted land. If no forest fires have occurred, and the forests have not been degraded through tree-harvesting or other develop, the deposit will be returned. Some village small groups even incorporate forest management and oversight into contracting terms. As a result, Xiaoshao village has not had forest fires or forest degradation crimes for the past 14 years. Villager small groups and farm households have voluntarily returned cultivated land into forests. Forest resources have been effective protected, and the mushroom production has continually increased.

Second, fees and taxes imposed on farmers have been reduced while the collective economy has been developed. Among the 8 villager small groups, 5 groups have abolished all collective contributions, and two groups have not only abolished collective contributions but also allocated a portion of the contracting fees to villagers as a distribution of profits. The Dagouhei group's average annual distribution amounts to 500 Yuan per capita. The village committee receives a management fee amounting to 3% of the collected contracting fees, equaling nearly 20,000 Yuan per year. The villager small groups no longer rely on collecting fees from the farmers to carry out public works projects. During the period of the "Ninth Five Year Plan", Xiaoshao Village Committee invested 5.1 million Yuan to establish four land parcels for tobacco cultivation construct 7 small reservoirs provide drinking water for 6 villager small groups, establishing chestnut-drying centers in 3 villager small groups, and complete electrification programs in 4 villager small groups.

Third, is the creation of mutuality between resources and the economy and a positive cycle between the environment and economic development. Since Xiaoshao began contracting out forestland for mushroom picking, not only has the economy been developed, but also forest resources were protected. It is said that nowadays in Xiaoshao, "there are forests on mountains, there are mushrooms in the forests, there are reservoirs in the semi-mountainous areas, there are grains in the valley and there is money in the home." Moreover the output of mushrooms increased by more than 1.5 times since (1) contracting households may control products and ensure harvesting undertook with the best timing; (2) mushrooms'root and production environment could be protected well. Meanwhile, the price increased by more than 15% from both good market season and mushroom quality. All these contributed to the increase of villagers'income since households who could not acquire collection rights may share benefit from distribution of profits.

Fourth, the practice has explored a new avenue for forest management and oversight. Turnover of personnel has increased and speeded the process of reform and development through open-mindedness. Influenced by Xiaoshao Village, state-owned tree farms also initiated this method of contracting out forest land this year. During the months of mushroom season, office workers from departments in Kunming and Yiliang City make the trip to Xiaoshao to breathe our fresh air and pick mushrooms – about 20 carloads on an average weekend. This has increased word-of-mouth advertising, further opening up farmers' minds to the economic opportunities. In the meantime, extensive market research by villagers has expanded visions for economic development and market expansion.

REFERENCES

Lai Qingkui, et al, Case Studies for Community Forestry, Yunnan Scientific and Technical Pressing House, 2002, P.127.

Prior to 1999, 100% of receipts were allocated to villager small groups. Starting in 1999, the administrative village imposed a 3% service charge to cover the costs of contracting, leaving the remaining 97% for allocation to villager small groups.

CERTIFICATION OF NON-TIMBER FOREST PRODUCTS: POTENTIAL PATHWAY TOWARD BALANCING ECONOMIC AND ENVIRONMENTAL GOALS IN SOUTHWEST CHINA

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ABSTRACT

Non-timber forest products, or NTFPs, have attracted considerable interest as a component of sustainable development initiatives in recent years due to their ability to support and improve rural livelihoods while contributing to environmental objectives, including biodiversity conservation. However, systematic understanding of the role and potential of NTFPs in conservation and development remains weak and it has been realized that the utilization of NTFPs requires certain measures of planning and control to be sustainable. While domestication is one way to reduce pressure on the natural resource, certification may provide another option to ensure that wild collection is maintained at a sustainable level. Certification can offer collectors higher prices to compensate for lower harvest levels and help them to secure user rights. This paper discusses in detail the potential and challenges of organic, ecological and Fairtrade certification schemes toward balancing poverty reduction and biodiversity conservation goals in China's Southwestern mountain regions.

Keywords: biodiversity, certification, China, Fairtrade, Forest Stewardship Council, non-timber forest products, Yunnan.

1 INTRODUCTION

Products from natural and planted forests play an important role in the household economy, especially in the more remote mountain areas of Southwest China that lack other business opportunities. With the enforcement of a strict logging ban in 2000 on all natural forests and the gradual conversion of land above 25 degrees of slope from annual into tree crops under the *Sloping Land Conversion Program*, many upland communities have lost a significant income source (from timber). Many upland households have substituted this loss by intensifying the collection of NTFPs from natural and planted forests which has lead to a severe decline of some products and, thus, poses an increasing threat to biodiversity. As most collectors of NTFPs lack basic market knowledge and rely on traders to buy their produce, they only earn a small income from NTFPs.

Domestication of NTFPs can be a way to intensify production (through higher yields, improved and/or more consistent quality, and control over timing of harvest), secure producer rights and reduce pressure on wild resources. Its risk are that domestication of products originally harvested from the wild can lead to genetic homogenization, reduce the economic value of wild systems (up to the point where natural forest land is being cleared to grow domesticated NTFPs on a larger scale) and lead to transfer of benefits from one group of stakeholders to another (Belcher, 2003).

Another potential solution that could benefit and bridge economic and environmental goals is product certification under organic, Fairtrade or sustainable forest management schemes. NTFPs that can be dried, further processed and stored, such as nuts, medicinal plants and mushrooms for example, may be particularly suited since distance to markets poses a serious logistical challenge. At present, the relatively wealthier consumers of certified products are only found in the big cities in the East of the country or abroad.

The objectives of this paper are to present initial development initiatives conducted by the *Center for Mountain Ecosystem Studies* related to the natural resource “NTFP” in mountainous Southwest China. More specifically, the paper evaluates and discusses the potential and constraints of certification for the sustainable management of NTFPs and for improving incomes among some of the poorest upland communities in China.

2 TOWARD IMPROVED NTFP MANAGEMENT IN NORTHWEST YUNNAN

The *Kunming Institute of Botany* (KIB), China’s leading institution in the fields of biodiversity and ethno-botany in China, has recently intensified its applied research in partnership with the World Agroforestry Center (ICRAF) through its jointly managed *Center for Mountain Ecosystem Studies* (CMES). The two most important on-going research and development projects of CMES related to NTFP are presented and discussed below. These and the initiatives described in Section 3 represent promising opportunities to successfully address the need for improving rural incomes while maintaining the natural resource base in typical poor upland communities in Southwest China.

Domestication of non-timber forest products: reducing pressure on natural resources

One strategy to reduce pressure on NTFP resources in their natural environment and create more income opportunities for farmers is domesticating them, i.e. growing them on-farm. The *Center for Mountain Ecosystem Studies* has pursued this option together with the *Department of Forestry* in Baoshan prefecture, Northwest Yunnan. An initial participatory survey of potential NTFP in 2003 in the project site, in Yangliu township (Longyang District, 98o 50′ eastern longitudes, 25o15′ northern latitude; elevation range: 1500 – 2500 m above sea level) – one of the poorest villages in Yunnan - identified seven valuable medicinal plants species that local farmers were interested to try growing on their land, recently converted to tree crops under the *Sloping Land Conversion Program* (SLCP). Agricultural land converted in China under the SLCP to tree crops (mainly peach and walnut trees) are prohibited from being used for growing annual crops, even during the early establishment stage of the trees when there is ample space between them. To compensate for the income loss farmers receive payment for each hectare of land converted to trees, for up to 8 years. However, medicinal plants are not classified as annual crops and can thus be grown in-between the trees. It is commonly observed that trees in similar agroforestry system benefit from the more intensive land management (weeding, fertilizer application to crops) compared to leaving the land fallow (and simply slashing the weeds).

Starting from spring 2004, six farmer households (all living in the same village) participated in this action research and tried growing the medicinal plants on a total area of

2 ha. Since collection of medicinal plants from wild resource is the responsibility of women, also the action research was done by the female members of the participating households. They intercropped the medicinal plants with the existing young pear and walnut trees and applied mineral fertilizer. After 18 months most species were ready for harvesting.

Initial experience has shown that some medicinal plants have a high potential for domestication and that a major constraint is lack of knowledge among farmers in the management of growing medicinal plants on-farm. Only one species, *Dipsacus daliensis* whose root is commonly used in Chinese medicine, performed well. However, due to the exceptionally good growing conditions (no competition and fertile soil) roots were bigger than commonly found in the market and traders were concerned that these would not sell as well as average-sized roots since buyers might doubt the identity of the species.

As an outcome of the first 18 months of this action research, only three species (*Dipsacus daliensis, Foeniculi fructus* and *Pinellia ternata*) are now being tested on-farm by about 40 interested households in two villages (on about 5 ha of land) and the *Forestry Department* pays special attention to working with farmers on improving the management of the crop. Based on the findings from the first phase of the action research the time form planting to harvesting of *D. daliensis* for example, is now being reduced to one year. It is interesting to note that the male household members have also become involved in growing medicinal plants on-farm now, since it is turning out to become a more profitable farming enterprise than simply collecting plants from the wild.

The approach of this action research has also been extended to other parts of mountainous Yunnan. So has CMES started to cooperate with the extension staff of *Southwest Forestry College* in promoting the growing of medicinal plants on SLCP land more widely.

The domestication of wild plant resources requires an iterative process of action research and basic scientific studies. Now that the first medicinal plants have been ear-marked as performing well when grown on-farm, as a next step their active chemical ingredients need to be quantified and compared to those plant specimens growing in the wild. If this analysis confirms that the quality of the plants growing on-farm is satisfactory, production on farmers' fields can be confidently promoted. Conducting inventories of wild resources over time will be needed to confirm the claim that domestication is reducing pressure on the natural resource base and, thus, supports biodiversity conservation. Impact of domestication on market prices need to be examined as well.

However, since domestication of medicinal plants and other NTFP is not applicable for the majority of species, equal importance need to be placed on the development of sustainable wild collection systems. Certification of wild collection can be an option to provide incentives for conservation and sustainable use and can strengthen local economies. Yet, the rich diversity of NTFP species (among the group of medicinal plants alone) and complex ecological interactions, make certification of wild resources a far more challenging endeavor than the certification of agricultural crops (see also: http://www.floraweb.de/map-pro for more information on this aspect).

The base for improving market access: commodity chain analysis

While agricultural crops have been well researched and promoted by the Chinese government and international research organizations worldwide, non-timber forest products have not yet received the attention they deserve. A better understanding of their value in the household economy as well as in domestic and international markets (including regional cross-border trade) and is needed to demonstrate their importance for rural incomes and sustainable resource management. Under this premise a Master study is currently being conducted at CMES that focuses on commodity chain analysis of selected commercially important non-timber forest products collected and harvested in two townships in Baoshan prefecture, namely Yangliu and Shuizhai townships. Both townships represent typical upland situations in Southwest China: while the former has little forest area left and large parts of the sloping land has been converted to tree crops under the *Sloping Land Conversion Program*, the latter has a forest cover of more than 80 % in some of its mountain villages (some of which has been planted more than 30 years ago) and thus relatively rich non-timber forest resources.

Objectives of this research are to: (i) identify those NTFPs that are currently the most important commodities for farmers / collectors in Yangliu and Shuizhai or have a high potential to become important commodities in these communities; (ii) document details of the commodity chain from producer to customer for selected NTFPs; and (iii) identify opportunities and associated strategies for improving rural communities' benefits from NTFP management, harvest, processing and marketing while preventing an over-use of the resource base.

The underlying research hypothesis is that a thorough understanding of the commodity chain of NTFPs – from producer/collector, trader and processor up to retailer and consumer – is an essential base for strategic development interventions at the local level as well as a crucial source for sound policy recommendations. Findings of the research will feed into CMES' development efforts to place rural producers/collectors and village-based traders in a better market position and build the base for jointly developing sustainable collection/production methods with the communities. The study uses key informant interviews as the major tool. Target respondents are the main producers/collectors, traders/wholesalers, processors and retailers of the most important NTFPs from the study area, as well as local government staff. Interviews are complemented by the collection of secondary data from government offices, such as information on trade, export and relevant legislation.

Initial results have …

- **Confirmed the importance of non-timber forest products** in terms of cash income for the majority of smallholder households, as well as the steady market demand for all surveyed products.

  In the poorer villages (in Yangliu township), medicinal plants - mostly collected by women and commonly gathered far from the villages (up to four hours walk) - constitute a key income source for most households who can derive up to 75 % of their annual cash income from this activity. Walnuts and pine-nuts (most of which have been planted) are increasingly adding to household income as more of the planted trees start bearing fruits. A single large walnut tree (more than 20 years old) can provide as much as twice the annual average per capita income (of about 105 US $).

  A significant contribution to household income in the wealthier villages (in Shuizhai township) comes from the collection of high-value forest mushrooms, such as the Matsutake mushroom (Tricholoma matsutake) that is largely exported to Japan and truffle (Tuber sinensis) chiefly sold to Europe. A single household can earn up to ten times the average annual per capita income from collecting and selling Matsutake mushrooms. While most households have access to truffle growing areas (within and outside their own village boundaries), access to

Matsutake is restricted to a smaller number of households, those who have the use rights over the forest parcels where the mushroom can be found.

- **Identified over-harvesting as a threat to biodiversity conservation** and to the sustained supply of NTFPs as a source of cash income. Collectors and traders observed a steady decline for a range of medicinal plant species, resulting in their increased value on the market. While for medicinal plants and truffles it is a resource with free access to everyone (i.e. without any control of over-harvesting), the case is different for Matsutake mushroom. Communal forest areas are sub-dived and each household in the village has the use rights to a certain piece of the forest. In those forest parcels where the valuable Matsutake mushroom grows users guard the area well during harvesting time and do not collect the young mushrooms since they fetch a lower price from the trader. The high value of this particular NTFP has made it clear to users that a decline or complete loss of this resource would harm their household economy and an informal system of sustainable management has evolved (through privatized control over the resource).
- **Documented major constraints to maximizing income benefits from NTFP**. In general, producers and collectors do not have access to market knowledge (such as demand and price) and sell their produce individually to local (i.e. from within the village) or outside traders. At least, there are a number of traders for each product and individual households have a certain bargaining power, especially for high value products (such as Matsutake mushroom). The lack of a local production and marketing organization, however, also means that there is no processing (value adding) at the village level. Another issue is that the planting of tree crops, such as pear and walnut (resulting from heavy government promotion), is not based on well-founded knowledge of market development for the products. The large number of mature pear trees have in recent years already lead to an over-supply of fruits on local markets and a decline of prices, to the extend that fruits are not harvested. With the large number of walnut trees planted in recent years it remains to be seen whether an over-supply will result in drop-off in prices in six to eight years from now as well.
- **Pointed to some opportunities and needs for intervention, such as:** (i) building capacity among community members to access market knowledge and explore joint marketing and processing initiatives; (ii) investigating the potential benefits of group certification under organic, Fairtrade or sustainable forest management schemes to access alternative (so-called “niche”) markets and maintain valuable and ecologically important NTFP resources; (iii) building capacity within forestry extension services to promote the planting of a wider range of tree species (based on a thorough survey of market demand and prediction of future market developments) and sound management systems (including domestication of selected NTFP, such as medicinal plants); and (iv) making NTFPs more visible, i.e. draw government attention to the many important commodities that have not yet entered official statistics due to a lack of clear classification and challenges in conducting inventories and in monitoring home-use and informal trade; this would from the basis for improving legislation on sustainable management and the equitable share of revenues from NTFP resources.

Concurrently with the commodity chain analysis described above, CMES has starting working with government and NGO partners to build capacity among facilitators (extension staff and community development workers) and farmer leaders to engage communities in Southwest China in more professional marketing initiatives. Improved quality management and group certification (for organic and Fairtrade labeling) have been key topics in related training activities and workshops (see Section 3 below).

As the applied research and development initiatives initiated by CMES and presented above have identified certification as a potential option for improving upland economies and contributing to sustainable natural resource use, the Center has taken up this topic and is currently exploring this option jointly with other institutions in China. The following Section discusses these initiatives and the associated benefits and challenges in more detail.

3 CERTIFICATION INITIATIVES IN SOUTHWEST CHINA TARGETING SMALLHOLDER FARMERS: POTENTIAL AND CHALLENGES

Certified organic agricultural production began in China around 1990, after the *Rural Ecosystems Division of the Nanjing Institute of Environmental Sciences* (now the *Organic Food Development Center of China* [OFDC] under the *State Environmental Protection Administration*) became China's first member of the *International Federation of International Agricultural Movements* (IFOAM) in late 1988. Since then, organic food production in China has grown rapidly, mainly driven by demand from overseas markets in Europe, Japan and the USA. In recent years demand for organic products on the domestic market is increasing, as the wealthy middle class in China is rapidly growing (mainly in the big cities in the East of the country) and consumers are increasingly becoming aware of the health benefits of eating organic food. China's first supermarket for organic products has opened in 2005 in Shanghai.

Aside from the Chinese certification agencies, namely the Organic Food Development Center of China (OFDC; under the State Environmental Protection Administration) and the China Organic Food Certification Center (COFCC; under the Ministry of Agriculture), a number of international certifiers are now present in China (such OCIA, ECOCERT, BCS, IMO, JONA and OMIC). The certification of farms growing crops for the overseas organic market by international certifiers has started in 1995.

Unlike in many other countries, where farmers were the drivers behind organic agriculture movements (at least during the early development stage), organic food production initiatives in China were originally organized and managed by the government (state firms). While the government has moved away from direct ownership and private firms have taken over now, smaller companies and smallholder farmers in poorer and remote areas - such as those in mountainous Southwest China - will need more government support to overcome constraints to participation in the growing organic food market in China and abroad. Even today, farmers are not the primary force behind the growth in organic production, but trading companies. These typically initiate, provide technical advice, organize needed input supply, and take care of processing and marketing. This mode of operation also prevails in poorer regions and in wild collection areas. Most of the certified organic wild collection of food and medicinal plant resources is managed / controlled by a few large companies that typically also are engaged in managing a number of organic farms.

The following sections report of three on-going innovative strategies that specifically address the needs related to certification of smallholder producers and collectors of non-timber forest products and that have a direct bearing on biodiversity conservation. These few examples draw a clear picture of the scale of the challenge that most mountain farmers and the supporters of such smallholder initiatives are currently facing.

Creating more opportunities for smallholder producers of organic food products

In 2005, CMES, the *BioFach China Project* and the *Organic Food Development Center of China* (OFDC) have started their cooperation based on the assumption that the development of domestic marketing and distribution business of organic agricultural and non-timber forest products contributes to the improvement of the socio-economic situation of smallholder mountain farmers in Southwest China. Joint capacity building initiatives have specifically targeted smallholder producers and collectors of wild resources and have supported building capacity among communities and development organizations to strengthen related local initiatives, as well as raising awareness among Chinese consumers regarding the benefits of organic food production and Fairtrade.

The *BioFach China Project* is a public-private partnership project coordinated by the *Nuernberg Global Fairs* with support from and in coordination with the *Deutsche Investitions- und Entwicklungsgesellschaft* (DEG, under the KfW banking group) and accompanied by the *International Federation of Organic Agriculture Movements* (IFOAM) as the patron of *BioFach Fair*, the leading annual international product fair for certified organic products. The *BioFach China Project* aims to contribute to the domestic market development for organic and natural products in China. It does this through policy advice, establishing networks for dialogue and exchange, trainings for all actors in the commodity chain, market development, and raising public awareness. *BioFach China* offers an educational program, including a number of training seminars with agricultural producers, private companies and organizations as well as information seminars with consumers. *BioFach China* will also connect the Chinese organic sector with the international markets using the other *BioFach* events in Germany, Japan, United States and Brazil to promote the Chinese organic industry. The first *BioFach-China* conference will be conducted in December 2006 and a yearly annual *BioFach-China* product fair from mid 2007.

Two training seminars for smallholder groups and supporting organizations have been jointly realized by CMES, *BioFach-China* and OFDC, and a third one is under preparation for early 2007.

The first seminar & workshop provided a platform for people form various fields and professions (i.e. research/academe, government, business, NGO sectors) currently involved in promoting or doing organic farming and Fairtrade to exchange views and ideas on opportunities and key challenges in Southwest China. It is obvious from the facts presented and discussed that organic farming and Fairtrade have a great potential in China. Key challenges, especially in the Southwest of China where mountain farmers cultivated remote hilly lands of relatively low productivity (compared to the lowland areas in the middle and east of the country) are: (i) access to knowledge (e.g. in production technology, processing and marketing), (ii) access to markets, and (iii) cost of certification (including those associated with complying to certification requirements). The seminar-workshop also confirmed that organic food production by smallholder farmers (in contrast to large-scale farm enterprises and state-owned farms in the middle and eastern part of the country that largely produce for the export market), and more so Fairtrade, is still a relatively new concept in China. This is especially true for provinces in the southwestern part of the country.

The focus of the second training was based on the conclusion from the first seminar: community facilitators, extension workers and local community/farmer group leaders need more knowledge on the specific requirements rural producer groups need to follow and the skills they need to attain to engage more professionally in the production and marketing of their farm or non-timber forest produce. Quality awareness, internal control systems and smallholder group certification were key topics during the training. Participants were staff members of government agencies, non-governmental organizations, research institutions, certification agencies and the private business sector directly involved in supporting or collaborating with rural communities.

The IFOAM manual for setting up internal control systems, or ICS, in the context of smallholder group certification has been translated to Chinese language and used for the seminars. In addition the topic "Poverty alleviation and organic agriculture" has been presented during several events in 2005/2006. In December 2006, the topic will be presented during the first *BioFach China* Conference in Shanghai jointly by CMES and OFDC in order to create more awareness and to bring interested companies in contact with small farmer initiatives. One of the core experiences is that no functioning and successful organic smallholder project is existing in China right now. The third training may, therefore, target a small number of facilitators from government extension offices, NGO staff, as well as staff of certifying agencies who are directly responsible and committed to supporting smallholder groups successfully produce and market their products.

While certification under national and international organic labeling schemes has been the major focus of this joint initiative, also alternative ways of marketing agricultural and non-timber forest products on the Chinese market will be explored in the future. Alternative modes to market organic products could be those that forego the need to obtain the label of an accredited certifier (and thus, reduce cost and probably time) by building consumer trust, i.e. develop localized direct-marketing schemes and promote products under a unique brand name. This may build on successful examples in other parts of China, such as Hongkong, and abroad (e.g. Thailand).

Emerging Fairtrade initiatives in China

Unlike certified organic production, Fairtrade certification is a relatively recent concept that contributes to sustainable development by supporting better trading conditions for small-scale farmers in the developing world. Higher prices paid by consumers (mainly) in developed countries for a product that has been produced according to Fairtrade standards means more income for producers and development support for their entire community.

Fairtrade Labelling Organizations International (FLO) is the leading Fairtrade standard setting and certification body. FLO was established in 1997 and is an association of 20 Labelling Initiatives worldwide that promote and market the Fairtrade label in their countries. FLO members currently operate in 15 European countries as well as Australia and New Zealand, Canada, Japan, Mexico and the United States. At present, FLO regularly inspects and certifies about 508 producer organizations in more than 50 countries in Africa, Asia and Latin America. The major strategic intent of FLO is (i) to deliberately work with marginalized producers and workers in order to help them move from a position of vulnerability to security and economic self-sufficiency; (ii) to empower producers and workers as stakeholders in their own organizations; and (iii) to actively play a wider role in the global arena to achieve greater equity in international trade. (URL: www.fairtrade.net)

In China, only two pilot Fairtrade projects exist so far, but many more producer groups have approached FLO to participate in the scheme. Discussions are currently underway at FLO how to best deals with the growing interest from China. Concerns are that FLO may need to work with and train an established certifier (for organic products for example) that has been accredited by the China National Certification and Accreditation Administration and whether all parts of the standards, especially for hired labor in plantations, could be fulfilled in China.

As with organic certification, the motivation to start a Fairtrade producer group has come from a company interested to explore this market niche for Chinese tea. There is no awareness at farmers' level about the existence of a market for Fairtrade products. The export company assisted producers to form an association and develop more technical, managerial and organizational skills. Through the annual inspections and resulting recommendations for improvement given by FLO the tea associations has made great progress in terms of embracing and applying all principles of Fairtrade and their communities have benefited greatly from the extra money (Premium) received from the sale of their FLO-certified tea overseas.

As the two tea associations have been FLO certified since 2002 and have made great progress and demonstrated that the Premium money can have a big positive impact on community development, it may be time for scaling up the concept in China. This will need initiative from FLO to communicate with the Chinese government or an accredited certification agency in the country to increase the scope of operation, as well as support for raising awareness among producers and consumers about the principles and benefits of Fairtrade.

The first seminar organized by CMES, *BioFach-China* and OFDC has already raised considerable interest among NGO groups in Southwest China to know more about the concept and discuss it with the communities they work with. Recently CMES has also been approached by the *Western Academy of Beijing*, an International School, to jointly promote Fairtrade in China's capital.

Sustainable forest and NTFP management: Forest Stewardship Council certification

The Forest Stewardship Council (FSC) is an international network whose mission is to promote environmentally appropriate, socially beneficial, and economically viable management of the world's forest. It provides a system for different stakeholders interested in forest issues to work towards responsible forest management. Through the FSC system, the forest owners, managers, forest product manufacturers, local communities, non-governmental organizations and other interest groups are given equal access and voice. In short: "*FSC brings people together to find solutions to the problems created by bad forestry practices and to reward good forest management*". (URL: www.fsc.org)

In 2001, WWF-China helped establish the *National Working Group on Forest Certification* with 28 representatives from the government, NGOs, enterprises, media, research institutions and trade organizations. The main task of the *FSC Working Group* is to put forward strategies for forest certification development in China. A draft version of *Chinese Forest Certification Standard* has since been completed, and a review is in process to ensure it satisfies the requirements of national laws, regulations and policies, while also meeting *Forest Stewardship Council* requirements. (URL: http://www.forestandtradeasia.org/ guidance/China/English/7/20/). The *FSC China National Initiative* was launched in March 2006.

FSC certification can include non-timber forest resources as well (the most widely-know is Brazil nut). All NTFPs that bear the FSC logo must come from fully FSC certified forests and the management system must be evaluated for each NTFP. However, even though the *NTFP Working Group* of FSC has been attempting to put NTFP certification into practice since 1996, experience with the certification of NTFPs is still relatively small. Ecological, economic and social impacts related to controlled harvesting of the large variety of plant species in complex eco-systems and to adding value to these natural (formerly in most cases free-for-all) resource is still not well-understood. In many countries, land tenure or long-term land use rights complicate the issue. That FSC-certified NTFPs command a price premium in the market is also not yet proven for the majority of products.

The *Center for Mountain Ecosystem Studies* is currently discussing with *WWF-China* and FSC to start a pilot project on community-managed forest and NTFPs in Southwest China. So far, only forest plantations have been granted FSC certification in the country. Presumably the Matsutake mushroom that is harvested by the community from the community-owned pine forest may fetch higher prices in Japan, once it bears the FSC label. This, and the opportunities for other products (such a walnut, truffle, medicinal plants, etc.) to increase in value through FSC or any other certification, will need to be confirmed through further research.

The new initiatives started in Southwest China, as presented above (Section 2 and 3), are hoped for providing directions and alternative working models for engaging smallholder farmers and collectors more genuinely in the production and marketing business in line with organic, Fairtrade and FSC standards. Outside facilitators, such as non-governmental organizations (NGOs; especially those with solid experience in the field; possibly building on experience in other countries), can play a decisive role in moving such initiatives forward by helping communities attain the needed technical, organizational and managerial skills. Successful examples could be extrapolated and implemented with the lead of local governments and extension staff. Findings can also be shared through national and international networks which will enhance mutual learning among all involved in promoting organic agriculture and Fairtrade. Drafting of policy recommendations and discussion papers – based on thorough evaluation of initial successful cases and approaches - can enhance discussion and exchange, and scale up impact.

4 SUMMARY DISCUSSION AND CONCLUSIONS: THE CHALLENGES OF MARKET ACCESS IN MOUNTAINOUS SOUTHWEST CHINA

Non-timber forest products are an important source of household supply and cash income for the majority of smallholder mountain farmers in Southwest China. Sustainable management is possible – as the case of Matsutake mushroom shows – but it does not normally exist for the majority of non-timber forest resources, such as medicinal plants, truffle and pine-nut for example. The incentive for communities to develop a mechanism to regulate the access to natural resources does only exist when producers or collectors understand and can enjoy the economic and environmental benefits from such intervention. While resource privatization can lead to sustainable management of NTFPs - as observed with Matustake mushroom growing in Baoshan prefecture, Northwest Yunnan - it can also create or enlarge disparity in income levels within the community, as only a fraction of all households (in this concrete case: about one third) benefits from the valuable resource. Government regulation, such as taxation of the mushroom trade, could help improve the existing system so that every community member will benefit.

Domestication of NTFP is one way to reduce pressure on natural resources, it is, however, only applicable for plants that can be easily grown on-farm, such as some medicinal plants for example. Besides, if plants that demand a good price in the market can be easily domesticated, more people will grow them or even companies might start production on a much larger scale. This may cause fierce competition and is likely to change market prices.

Certification may be another option to balance income needs and biodiversity conservation goals. Certification systems relevant for NTFPs include organic agriculture, sustainable forest management (FSC) and Fairtrade. While FSC certification may be the most “natural” scheme for a forest product, it is also the most difficult certification to obtain, in terms of the evaluation process and cost. In addition FSC-certified NTFPs may initially not sell as well as products that bear a well-recognized organic certification label, since most consumers may have never heard about FSC-certified non-wood products.

Recent discussions regarding combining certification schemes (see also URL: http://www.isealalliance.org/ for more information) to reduce time and cost, have not been held in China yet since only organic certification is more widely known in the country. Combining certification schemes, i.e. organic, Fairtrade and sustainable forest management certifications, makes progressively more sense as all are moving towards holistic approaches, i.e. incorporating ecological, social and economic aspects in their respective standards. Therefore, the overlap between standards of all three major certification schemes is increasing. NTFPs have played a key role in this discussion since they can be certified under any of the three major certification schemes.

While certification has become more affordable for smallholder farmers in the developing world since group certification became available and IFOAM published a guidance manual for producer organizations applying for smallholder group certification in 2004, the challenges for smallholders in China’s mountainous Southwestern provinces are still more profound. Right now, no functioning and successful organic smallholder project exists in China. The government-promoted “*Farmers plus Company Model*” has worked well and without major conflicts where it has been applied in the past. Traders and processing businesses have contributed their skills, financial resources/investments (e.g. in storage and processing facilities) and have made use of their established business connections (all of which rural communities usually do not have). This is also how the Fairtrade pilot projects were initiated (i.e. through the initiative of the export company) and is still functioning today, with a notable increase in empowerment of the producer association over time, however. In any such case, there is no fast way for communities to take over the role that the company has played and not many have the desire to do this - as it requires commitment, time and patience at the start – and, hence, are satisfied with the *status quo*.

Many NGOs, especially in the Southwest of China, are working with poor communities where no such company & farmer scheme exists to develop or advance local business models that integrate economic, social and ecological benefits. They build capacity among producers of agricultural or handicraft products or collectors of NTFP to work together and jointly market their produce to enlarge incomes. However, improved market access is the major goal, certification just one of several potential pathways. Trainings that have been initiated by the *BioFach-China* Project in cooperation with CMES and OFDC support building the knowledge base needed by community development facilitators, local leaders and certifiers to develop capacity among communities to set up and run a market-oriented association. It needs to start from the basics of organizational management, including understanding the requirements for quality assurance and internal control systems in smallholder groups. A producer and marketing group will need this fundamental knowledge, whether the group likes to pursue certification or just wants to improve its marketing power. Easily overlooked is the fact that volume matters, i.e. the market commonly demands a constant supply of consistently high quality which can be a challenge for a small producer group and needs to be thought of early during the planning phase.

Aiming for certification may not always be the best option, as the domestic market for certified NTFP may be very limited and the challenges to export beyond solution for many smallholders, and with Fairtrade still in its infant stage in China. Alternative pathways need to be explored with equal vigor. Developing a brand name for community products from sustainably-managed farm and forest land, linking with consumers and building trust are steps that need to be explored. Groups and facilitators need to learn from outside experience, such as the successful government-supported promotion of upland village products in Thailand for example.

The demand for certified products from well-managed forests and agroforestry landscapes is on the rise. That smallholder producers and collectors can benefit from this has been observed in various parts of the world. Poor communities in China' mountainous Southwest are surely going to participate in this trend. However, more needs to be done than just supporting capacity building and pursuing certification or alternative marketing schemes. NTFPs need to be duly recognized and monitored like any other commodity by the government, and use rights need to be improved. Research organizations have to support more research to understand the ecology, reproductive capacity over time and sustainable management of NTFPs. Moreover, consumer awareness need to be raised, and innovative partnerships sought with the business sector (e.g. looking at effective public private partnerships and corporate social responsibility).

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REFERENCES

Belcher, B.M. (2003): Comment: What is an NTFP? International Forestry Review 5 (2): 161-168.

SILVICULTURE FOR WOOD AND NTFP PRODUCTION IN TROPICAL RAIN FORESTS: CONTRADICTION OR CHANCE? EXAMPLES FROM THE SOUTH PACIFIC ISLANDS

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ABSTRACT

In tropical rainforests the production of wood and – at the same time - NTFP is often seen as a contradiction: conventional logging creates severe changes to the structure and biodiversity of the forest, with the result that the growing conditions for most NTFP species are heavily disturbed. A sustainable production of the full set of naturally occurring NTFP seems to be impossible under conventional logging systems.

On a number of South Pacific Islands a sound silvicultural management system for indigenous tropical rainforests is applied, that maintains both the forest structure and its biodiversity to a large degree. This is demonstrated by the results of a simulation based on the pre-harvest inventory data from a 6000 ha management unit from the Fiji Islands. Furthermore it becomes obvious that a negative impact on NTFP tree species is, overall, very limited. Nevertheless, more specific investigations and research are still needed to further refine and improve the system, whereby in particular more detailed aspects of the ecology of different NTFP species need more attention.

1. INTRODUCTION

In tropical rainforests the production of wood and - at the same time - NTFP is often seen as a contradiction: conventional logging creates severe changes to the forest ecosystem. The **forest structure** is heavily disturbed through the removal of much of the upper canopy. In addition the remaining stand and the regeneration are damaged due to uncontrolled felling and improper skidding operations. Excessive road, skid track and landing construction leads to fragmentation and loss of forest area. Using heavy machinery results in soil compaction. Furthermore blocking of watercourses through insufficient or badly constructed water crossings and, on slopes, soil erosion is leading to negative impacts on the forest growth or even to the dying of stands.

Besides the forest structure the **biodiversity** (flora, but closely depending on this also fauna) of the forest is heavily affected: Directly through excessive removal of only few commercial species (mostly of the upper canopy species) with very low cutting limits so that the regeneration of these species is hardly possible. Furthermore the biodiversity is indirectly affected through changes in forest structure.

The abiotic and biotic ecological factors such as light, water, nutrients, wind, and competition differ before and after logging. In consequence logging leads to changed forests which results in changed growing or living conditions for flora and fauna including the NTFP species.

The following paper shall show that both sustainable wood production and NTFP production is possible in the same forest and at the same time. In this context, NTFP production is not necessarily understood as widening the scope for commercial forest use, but at least as preservation of the natural variety of NTFP needed for the subsistence of the local population. The management system used as example was developed for different South Pacific countries with main focus on the Fiji Islands.

2. MATERIAL AND METHODS

2.1 THE REGION

The countries involved are all situated in the south western Pacific Ocean. The most important applied research was carried out at Nakavu/SE Viti Levu, the largest and Drawa/central Vanua Levu, the second largest island of the Fiji Islands. But also experiences from Vanuatu, Samoa and Niue have contributed to the development of the management system.

The climate in the investigated areas is tropical with average annual temperatures of approx. 20 to 25°C and an annual precipitation of approx. 3000 to 4000 mm. A distinctive dry season is absent.

The Fiji Islands still have a forest cover of approx. 55 %. The tropical lowland rain forests are located mostly in the south eastern parts of the bigger islands. Approximately 300 tree species are found within the natural forest which has, in comparison to other tropical regions, a rather poor tree species diversity.

2.2 THE PROJECT

The natural forest management pilot project (NFMPP) was established as part of the (then) Fiji-German Forestry Project in 1989, which was supported by GTZ (DE VLETTER 1995). Later on it was extended as Pacific-German Regional Forestry Project to other countries of the region (supported by GTZ/SPC).

The goal of the natural forest management project was to enable local forest owners to manage their forest resources independently and in a sustainable way (community forestry approach). For that purpose research was carried out in a 300 ha research area at Nakavu and in a 6000 ha management unit, the so called Drawa Block. The main activities were:

Involvement of the local resource owners in all relevant steps of sustainable natural forest management.

Carrying out of reduced impact logging (RIL: pre-harvest inventory; pre-harvest planning of roads, skid trails and landings; directional felling; winching of logs; post-harvest assessment) according to international standards.

Development of a silvicultural system which makes use of sets of species-specific felling limits for three different logging intensities (Table 1) and carrying out selection and marking of trees for harvesting according to the defined limits.

In 2005 the project was selected by the FAO/APFC initiative *In search of excellence: exemplary forest management in Asia and the Pacific* (FAO/APFC 2005).

Table 1: Summarized Diameter Limit Table (acc. to MUSSONG 1992, SPC/GTZ 2003)

Logging Intensity 1 „light“ (removal of 20% of standing volume >= 35 cm dbh)		**Logging Intensity 2 „medium” (removal of 30% of standing volume >= 35 cm dbh)**		**Logging Intensity 3 „heavy“ (removal of 40% of standing volume >= 35 cm dbh)**	
DBH >=	**No. of species**	**DBH >=**	**No. of species**	**DBH >=**	**No. of species**
110	**2**	**105**	**2**	**100**	**2**
80	**24**	**75**	**24**		
65	**25**			**65**	**24**
50	**15**	**50**	**40**	**45**	**38**
40	**all others**	**40**	**all others**	**35**	**all others**

NOT qualified for logging: - All **unknown** species/trees
- 53 species **unsuitable for timber** production (i.e.: mature trees too small, ficus spec. with no real trunk)
- 11 species with important **non timber use** (**NTFP)**

2.3 THE ASPECT OF NTFP

For indigenous forest areas in Fiji 183 NTFP species where described from which 94 are tree species (SIWATIBAU 1992). Taking into account that approx. 300 tree species are growing in Fiji, every third tree species has to be classified as a multi purpose tree. In the management plan of the Drawa Block in total 24 species are listed as relevant NTFP species according to an ethno botanical study (KOROVULAVULA AND TUIWAWA 1999). From this 24 species there are two animal species (fresh water prawns, wild pigs) and another two palm species that will be not attractive for any logging operation. Nine other tree species are excluded from logging due to their classification in the diameter limit table as species with important non timber value. The remaining eleven species have a high wood value but are important NTFP species as well. As a compromise this species are allowed to be cut (if also the local forest owners agree) for wood production, but with relatively high cutting limits only (dbh 50 to 105 cm) so that they can fulfill their NTFP function as well.

2.4 THE SIMULATION

To test how strong a logging operation would affect the NTFP tree species population, several simulations were carried out. In the first simulation it is tested how precise the tree selection according to the diameter limit tables will work. In a second simulation it is investigated how the forest structure changes after logging. The third simulation focuses on the change of the NTFP tree species diversity.

In the first simulation all three logging intensities (light, medium, heavy logging; cf. Table 1) were tested for the Drawa Bock pre-harvest inventory data. In all further simulations the medium logging intensity (removal of approx 30 % of standing volume of all trees 35 cm and above) was chosen only. A systematic strip sampling method with plot sizes of 20 x 10 m characterizes the used inventory design. The total number of established plots is 18067.

For the second simulation, sequences of five connected plots were chosen by a systematic sampling (every 500th plot sequence) after a random start. The required information was species name of the inventoried trees, their dhb and the usable log length (about total tree height and crown diameter there were not sufficient or no data available in the inventory files). All chosen plot sequences were plotted next to each other to simulate the forest structure before logging. Subsequently, all trees which were selected according to the diameter limit table were highlighted for removal. In this way the possible change of forest structure could be made visible and underlined with the descriptiva of structure relevant stand characteristics (like number of trees, basal area and volume per hectare, average dbh and stem height, number of plots without trees >= 35 cm dbh, area of closed canopy with at least 1 tree >= 35 cm dbh/plot).

In the third simulation the impact on the tree species diversity was investigated: how many NTFP tree and tree species will disappear after a logging operation. All simulations are focusing on trees of 35 cm dbh and above. Smaller trees and regeneration is not subject of this investigation.

3. RESULTS

3.1 PRECISENESS OF THE DIAMETER LIMIT TABLES

In the first simulation the diameter limit tables are tested for tree selection in a simulated 4 ha stand. The results show very clearly that the diameter limits work quite precisely, not only on a large scale like tested before on different inventory data sets (NFMPP area (300 ha), Drawa Block (6000 ha), National Forest Inventory (250000 ha) but also on a very small scale like the simulated 4 ha stand. The target removal of 20 % standing volume for a light logging, 30 % of a medium logging and 40 % of a heavy logging are not fully reached (Figure 1) but the deviation from the targets is acceptable, taking into consideration the very small area.

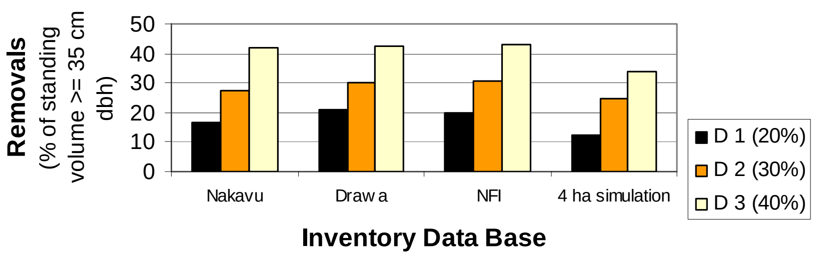

Figure 1. Simulated removals according to the Drawa diameter limit table (DE VLETTER AND MUSSONG 2001, changed)

3.2 CHANGE OF FOREST STRUCTURE

The results of the simulations show the typical unsystematic tree distribution pattern for undisturbed tropical rain forests (Figure 2). Densely stocked as well as more open parts occur, small trees grow next to big trees, sometimes also a single big or small trees without any close neighboring tree are found. In some cases plots are “empty” which means that they have no trees >= 35 cm dbh (probably smaller trees and regeneration are found in such plots).

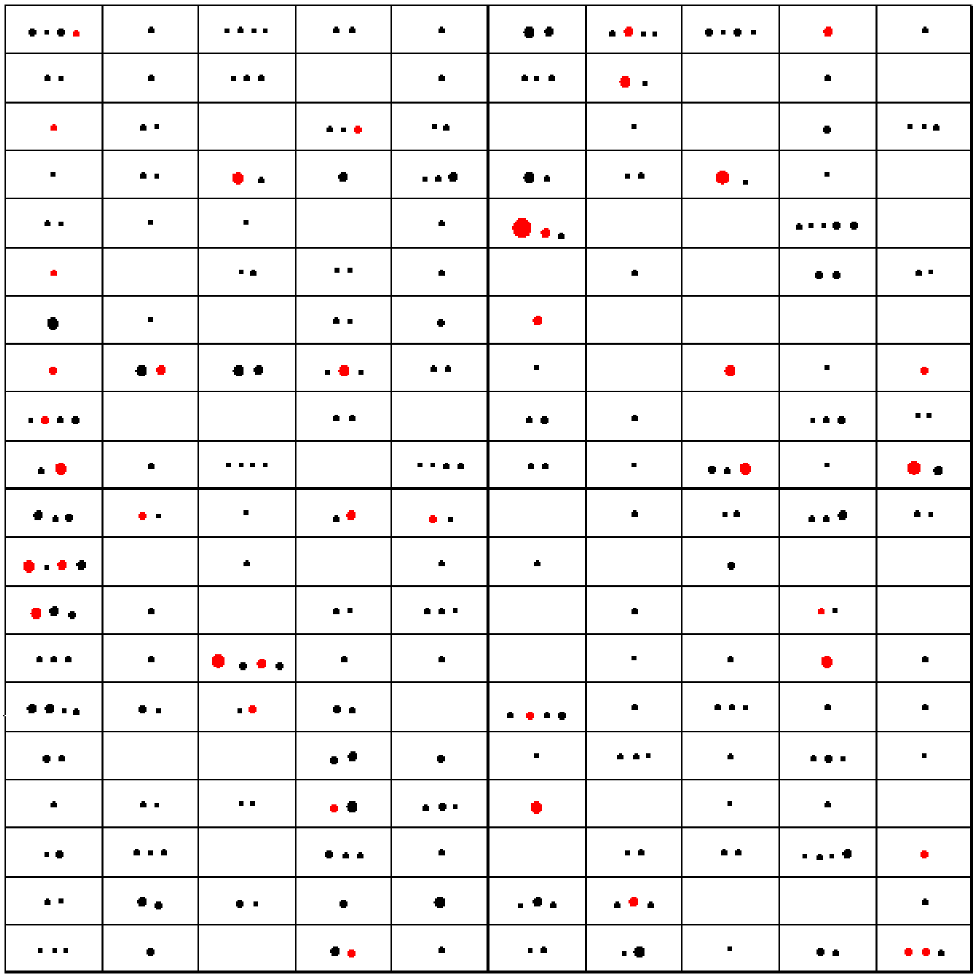

Figure 2: Simulated 4 ha stand (each indicated plot measures 20 x 10 m); each dot represents an inventoried tree; red dots are trees to be removed during logging operation; dot size proportional to dbh (35 to 130 cm)

In the second simulation step an unbiased tree selection is carried out strictly according to the diameter limit table. It becomes visible that the trees to be removed have an unsystematic distribution as well (Figure 2). In some cases a tree within a group of several trees is removed, in other cases the only tree >= 35 cm dbh in a plot will be cut. Sometimes very dense structures remain untouched whereas in other cases several trees are removed. In addition, not only the trees with large diameters are selected, but medium and small sized trees as well.

The descriptiva of forest structure related stand parameters before and after simulated logging show that both, the volume and the basal area of all trees >= 35 cm dbh is reduced after logging by approx. 27 %, whereas the number of trees after logging is only 14 % less (Table 2). The average dbh after logging is reduced with approx. 7 % only. The average stem height is almost not affected through logging. After logging, the average usable log length is reduced only by 5 cm or 0.5 %. On the other hand, the number of gaps (plots with no tree >= 35 cm dbh) is significantly increasing (by 22 %) whereas the “closed” canopy (plots with at least one tree >= 35 cm dbh) is decreasing by 6 % only.

Table 2. Descriptiva of forest structure related stand parameters before and after simulated logging (logging intensity "medium” with target removal of 30% of the standing volume of all trees >= 35 cm dbh); all figures for trees >= 35 cm dbh

	before logging	after logging	%
number of trees (n/ha)	73.50	63.25	86.1
basal area (m^2/ha)	14.10	10.40	73.8
volume (m^3/ha)	95.00	69.28	72.9
arithmetic (squared) dbh (cm)	47.7(49.4)	44.8(45.8)	93.9(92.6)
average stem height (m)	9.38	9.33	99.5
number of „gaps“/ha (>= 10x20 m without trees >= 35 cm dbh)	11.25	13.75	122.2
area of „closed“ canopy (m^2/ha covered with trees >=35 cm dbh)	7750	7250	93.5

3.3CHANGE OF BIODIVERSITY AND DIVERSITY OF NTFP TREE SPECIES

The change of biodiversity is estimated according to the change of tree species richness after logging. Remarkable is the fact that in the Drawa Block only approx. 11 % of the tree species have relevant NTFP value according to the ethno botanical survey (Table 3). This share also applies to the number of NTFP trees per ha.

Table 3: Number of tree species and number of trees per ha and share of NTFP within the Drawa Block; all figures for trees >= 35 cm dbh

	total	NTFP	%
tree species (n)	168+4?	18	10.6
inventoried trees (n/ha)	64.0	7.4	11.6

In order to estimate the loss of NTFP tree species diversity due to logging activities a simulation was carried out for the entire Drawa Block. The results show that the number of NTFP trees per ha is reduced by approx. 13 % (0.9 trees/ha), whereas the number of NTFP tree species is decreasing after logging by approx. 6 % (one NTFP tree species) (Table 4). But it has to be taken into consideration that the simulation used trees of 35 cm dbh and above so that it is very likely that this species is still occurring in the stand although with smaller diameters.

A last simulation intends to show the number and distribution of NTFP tree species in the stand and which NTFP trees will be logged according to the diameter limit table. For this purpose in the simulated 4 ha stand (cf. Figure 2) all NTFP trees are indicated (Figure 3).

Table 4. Simulated change of NTFP species richness and reduction of NTFP trees per ha after logging in the Drawa Block; all figures for trees >= 35 cm dbh

	before logging	**after logging**	**%**
NTFP tree species (n)	18	17	94.4
NTFP trees (n/ha)	7.4	6.5	87.1

It becomes visible that only 2 out of 16 existing NTFP trees will be logged. All other NTFP trees remain untouched. Both removed trees have high to very high timber value. The NTFP values (resin, latex) have less importance for the local population.

4 DISCUSSION

The chosen method of different relatively simple simulations on a huge data base (18067 plots; 23144 trees) seems to work well for an applied research approach. To reach statically reliable results in further investigations, the number of replication should be increased.

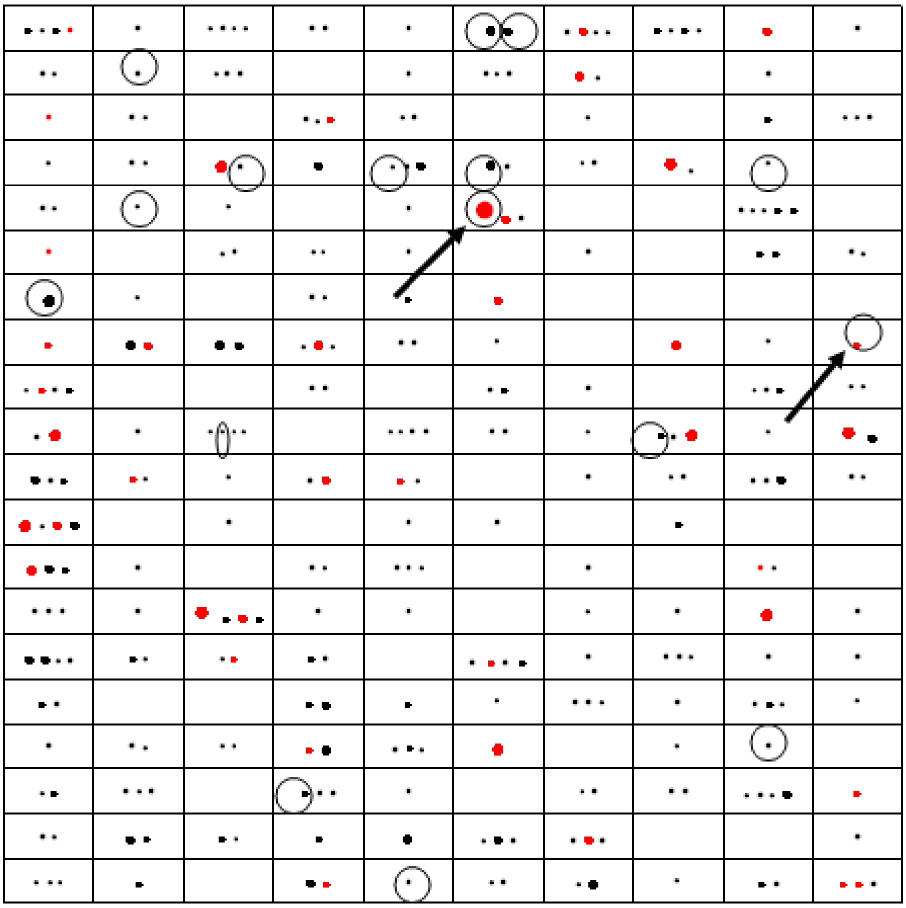

Figure 3: Simulated 4 ha stand (each indicated plot 20 x 10 m); each dot represents an inventoried tree; red dots are trees to be removed during logging operation; rings indicate NTFP trees; dot size proportional to dbh (35 to 130 cm)

The diameter limit tables were already developed and tested before, using different inventor data sets (DE VLETTER AND MUSSONG 2001). The simulation of the tree selection on a small stand (4 ha) shows that the system could work not only on a large scale but also on small scale with acceptable results. The deviation from the target removals for all logging intensities is within a tolerable range, whereas it is obvious that the smaller the area is, the bigger the expected deviations are and vice versa.

The simulation of the changes of the vertical forest structure after logging shows that, in spite of a removal of almost 30 % of the basal area and standing volume of all trees 35 cm dbh and above, the average diameter and the average stem (tree) height of the remaining stand are barely affected. Also the opening of the upper canopy is increasing by 6.5 % only. Looking at the changes in the horizontal structure, it is shown that the removal of the trees lead neither to an equal distribution nor to a concentration of removals in certain parts of the simulated stand. Combined with the fact that not only big, but also medium sized and small trees are removed, close-to-nature patterns arise which resemble unsystematic natural mortality patterns (Schroeder 1992, ULBIG 2005)

It can be concluded that if the forest structure is conserved, the growing/living conditions for other species, the biodiversity, will be conserved as well. In addition, the integration of almost all upper canopy tree species in the tree selection system (but with relatively high species-specific cutting limits) reduces the risk to loose certain tree species due to logging activities considerably.

The same holds true for NTFP species. If the changes in the forest structure through the described selective logging system are comparable to close-to-nature processes, their growing/living potential is not basically endangered. Even the possibility given by the diameter limit tables to cut a few NTFP tree species (with relatively high cutting limits) with a high timber value for wood production, apparently does not causea risk for the NTFP potential. In the simulation only 2 NTFP tree out of 40 trees (5 %) were cut. The other 14 NTFP trees remain untouched. The "loss" of one NTFP tree species in the simulation does not necessarily mean that this species does not occur any more. The simulation works only with the inventories minimum diameter of 35 cm dbh and above. If a species is not found any more in the upper canopy after logging, it is very likely that it still occurs with a dbh < 35 cm.

This investigation can not completely exclude, that logging may have a negative impact on a small number of NTFP species with very specific growing/living requirements. Information about the ecological requirements of such species is still lacking. Page: 9

The tested silvicultural management will conserve the environment required by most NTFP species, so that the sustainable production of wood and NTFP in combination seems to be possible.

5 CONCLUSIONS

- Sustainable production of wood and NTFP in the same stand and at the same time is not necessarily a contradiction but a chance for people and environment
- With a sound silvicultural system it is possible to manage tropical rainforests in such a way that the sustainable production of both wood and NTFP is feasible
- Condition is that the structure as well the biodiversity of the forest is maintained through „close-to-nature“ interventions
- The developed „diameter limit table“ is a suitable tool for such an approach

- The system can not necessarily serve to increase the NTFP production but will secure the present production
- For the further development of the system and especially the promotion of specific NFTP species, more investigations are needed.

REFERENCES

FAO/APFC 2005: In search of excellence: exemplary forest management in Asia and the Pacific. Bangkok.

KOROVULAVULA, I. AND TUIWAWA, M. 1999: Ethnobotanical Study Report Drawa Block Vanua Levu 2000. University of the South Pacific. SPC/GTZ – Pacific German Regional Forestry Project

DE VLETTER, J. 1995: Natural Forest Management Pilot Project Final report, . Fiji Forestry Department/Pacific-German Regional Forestry Project, Technical Report No.27.

DE VLETTER, J AND MUSSONG, M. 2001: Evaluation of Forest Inventory Data Collected in the Drawa Block. Fiji Forestry Department/Pacific-German Regional Forestry Project.

MUSSONG, M. 1992: Fijian Landowner Tree Selection System (FTS). Fiji Forestry Department/Fiji-German Forestry Project, Technical Report No. 15.

SCHROEDER, J.M. 1992: Strcuture and increment conditions in the evergreen moist forest of the Fiji Islands. Fiji-German Forestry Project, Technical Report No. 17

SIWATIBAU, S. 1992: Other forest products in Fiji. Fiji-German Forestry Project, Technical Report No. 14.

SPC/GTZ 2003: The Drawa Block Sustainable Indigenous Forest Management Plan (2003-2012). SPC/GTZ, Suva, Fiji Islands.

ULBIG, CH. 2005: Tree Mortality in Fiji's Tropical Forests. Thesis for the Degree of Bachelor of Science. FH Eberswalde.

STRENGTHENING FARMERS ACCESS TO FORESTS FOR SUSTAINABLE USE OF NON TIMBER FOREST PRODUCTS: LESSONS BASED ON COMMUNITY MANAGED MATSUTAKE MUSHROOM AND BAMBOO SHOOT COLLECTION IN YUNNAN PROVINCE, SOUTHWEST CHINA

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ABSTRACT

In the past decade, there has been increasing recognition that the collection of NTFP (Non Timber Forest Products) plays a significant role in reducing poverty and maintaining forests as part of the global trend of sustainable development. Simultaneously, the development of a market economy also provides opportunities for forest-depended communities to commercialize NTFP collection.

Without good management, commercial NTFP collection may lead to resource depletion and socio-economic differentiation. This goes to the fundamental problems of the "tragedy of open-access". Through the lessons learned from the management, harvesting and trading of Matsutake mushrooms and bamboo shoots in Yunnan, Southwest China, this paper attempts to explore how NTFP conservation could be enhanced through local collective action of NTFP management. It is argued that local collective action can play a crucial role to change the negative impact of "open access" by utilizing the strength and power of communities. The changes are to lead to a sustainable and commonly managed resource, withstanding and coping with the pressure of the new market economy, by strengthening farmers' access to forest and resulting in a better resource management of the environment and forests.

Keywords: Access to Resource, Commons, NTFP, Collectives and Collective Action, Southwest China

1 INTRODUCTION

Non-timber Forest Products refer to "all renewable products in the forest or on any land with similar functions (He, 2000). Compared to timber production and logging, sustainable extraction of Non-Timber Forest Products (NTFP) generally does not damage and impact on the overall functions and structure of natural and regenerated forest (He, 2002). NTFP thus often become the most economic valuable products extracted by local people and could potentially become the basis of a development strategy that reconciles the economic, cultural, and ecological values of the ecosystem (Nepstad and Schwartzman, 1992). In the past decade, there has been increasing recognition that the collection of NTFP plays a significant role in reducing poverty and maintaining forests as part of the global trend of sustainable development. Simultaneously, the development of a market economy also provides opportunities for forest-depended dwellers to commercialize NTFP collection.

However, the impact of increasing commercialization and conservation of resources are not clear and similarly, how the local communities will respond in the longer term; how existing forest and land management policies might impact and newly developed ones being adopted on the sustainable use of NTFP? In particular, given the rapid growth of the NTFP market, the problem of overuse and unsustainable harvesting practice becomes more challenging (e.g. Fox, 1995; Wollengerg and Ingles, 1998; Rijsoot and He, 2001, He and He, 2003). Without good management, commercial NTFP collection can be observed in many areas to lead to resource depletion and socio-economic differentiation and gap-widening in formerly more homogeneous societies. This often relates to and is attached to the fundamental problems of the "tragedy of open-access". Using case studies and research based on Matsutake mushroom and bamboo shoot collection, this paper attempts to explore how NTFP collection and forest conservation could be enhanced by utilizing local collective action for NTFP management and harvesting. It is argued that local collective action can play a crucial role to change from "open access" to a system where NTFP become common property and be better managed under present increasing pressure of the new market economy, and also be able to strengthen farmers' rights and access to forests. It is expected to lead to more sustainability, equity and justice, better wealth distribution and overall better management of the use of resources and forests.

2. NTFP DEVELOPMENT IN YUNNAN

Yunnan province is of great importance in Southwest China for its upland agriculture and its relatively well preserved, rare, and valuable forest resources. However, from 1949 until 1957, timber extraction to meet the demands for the development of industry and construction of the national infrastructure were the most important focuses of the government, leaving little room for long-term forest management and leading to overuse and unsustainable extraction (Su, 2001). As major forest region of China, the province plays a significant role as timber supplier. Meanwhile, the NTFP use and its market significance had been generally ignored during that time and only played a role at the local markets and often as a fall-back strategy for communities in times of hardship.

Recently, along with implementation of Natural Forest Protection Program (widely referred to as the "logging ban") and access to new markets, the role of NTFP for community development also has been recognized as an additional source of income. Limited research has been conducted on single species of NTFP as they are mostly being lumped into a broad category under 'additional family income'. Nevertheless, the significance of NTFP in improving local livelihoods and possible reduction and pressure through heavy timber logging had been widely acknowledged. In Yunnan, as one of the major areas for the implementation of the Natural Forest Protection Program and other environmental conservation programs (e.g. the establishment of National Parks or Nature Reserves), commercialized NFTP extraction become more and more important for rural community development. Especially, were they provide one of the few sources of cash income, i.e. for forest-depended communities in the proximity of conservation areas (He, 2002). Consequently, sustainable use and sometimes even the expansion of NTFPs extraction as an alternative forest management strategy is advocated by many scholars and more forward thinking foresters, as well as policy-makers at the State Forest Administration.

In economic terms, even so lacking long-term official statistics and village level data, NTFP contribute to the economy, and often play a significant role in cash income generation. Edible mushroom, for instance, have been exported at the level of more that 23,000 m.t. to Japan, Europe and the US in the past 3 years, and generated more than 193 million USD only for Yunnan Province (see table I). Besides mushrooms, other products likes resin, bamboo shoots, herbal medicine, etc. are also important NTFP extracted from forest and sold either locally, at the national or international markets.

Table 1. Exported Edible Mushroom in Yunnan

Year	Quantities (tons)	USD (million)
2002	6678	43.17
2003	9563	65.76
2004	7744	84.37
Total	23985	193.3

Source: Kunming Custom Statistics.

The forest sector at provincial and national level is now much more aware of the potential of NYFP and realizes that with proper environmental conservation and protection the value of trade could increase, and also that the subsistence value of NTFP is very important to local people living in mountainous forests, since they are often the only products that can provide the daily life needs and cash income (Rijsoort and He 2001). Moreover, at the national and regional level, as Rijsoort and He (2001) highlighted, NTFPs also play a significant role in the international trade and as an export commodity. In other words, development of NTFP not only can improve local people or forest depending communities standard of live, but also increase employment opportunity in rural and semi-urban areas, through domestication, local processing and improved cottage industry. In some cases, people recognized that some NTFP are even more valuable than timber production and extraction, i.e. Matsutake mushroom collection. Initiatives with a focus on the development of sustainable NTFP management and harvesting carried out under associated poverty alleviation and community development programs have now been widely implemented in rural areas with positive impact for livelihoods and environment.

However, with economic success, incentives for over-use of NTFP exist (He, 2002). Over-extraction often takes place where NTFP are not well-managed or local institutional arrangement are weak or good community leadership is lacking. Over-extraction of NTFP may also destroy the structure and function of forest and ultimately may lead to the depletion of the forest recourse (see also Rijsoot & He, 2001) Given the lack of thorough understanding of their requirements and often symbiotic relationships and dependence on their micro-climate sometimes leads to extinction of a species and certainly requires more in-depth research before management strategies can be implemented. In those cases, instead of providing an alternative way to sustainable forest management, collection of NTFP may have a heavy negative impact on the biodiversity and the sustainable forestry management leading to over-harvesting and sometimes extinction.

3. FOREST TENURE AND NTFP MANAGEMENT

Among many reasons for over-harvesting in scientific exchange and analysis of NTFP, people believe forest tenure is the critical aspect to address. Strengthening of forest tenure and user rights is seen as the key to improve long-term sustainable management and harvesting schemes. From a formal legal standpoint, the forest tenure system has been radically transformed from collectivization to de-collectivization over the past four decades in China. This transformation was officially recognized with the “Opening and Reforming Policy” in 1978. Initially, the de-collectivization policy was implemented only in agricultural lands via the establishment of “Household Responsibility System”, which allocated collective lands to individual households. The success of this system in stimulating agricultural production led to the application of the model of agricultural land reform in forestry management by the so-called “Three Fix” policy and the “Two Mountain System” (*lianshang sandiang*) in 1981.

The “Three Fix” policy attempted to clarify the tenure and status of forest lands by (1) delineating the boundaries between state forest, collective forests, and nature reserves; (2) allocating and securing freehold forest to farmers, and; (3) clarifying the responsibilities, rights and benefits associated with forestry for both households and villages (Zuo, 1995). Thus, after the reform, the forestry sector in China depended on the distinction between state forests (*guoyoulin*), collective forests (*jintilin*) and, increasingly, household forests. State forests can be subordinate to central, provincial, prefecture and county level government, whereas collective forests are managed by townships, administrative villages or natural villages. Villages have both use and ownership rights over collective forests whereas the various levels of government own the state forests. However, logging in collectively owned forest is still subject to state quotas and control, and income is taxed, often without clear and transparent assessments.

The tenure system is more complicated for the household forests. Governance of these forests is based on the “Two Mountain System” consisting of “Freehold Forest Land” and “Responsibility Forest Land”. The former refers to what are generally poorly forested or un-forested (barren or waste-lands) lands relatively close to a village. The purpose of allocating this land was to allow farmers to plant trees to meet subsistence needs – thus it could be put to any purpose other than clearing (Zuo, 1997). On the other hand, “Responsibility Forest Land” is collective forest that is supposed to be leased to individual households in the form of contracting villages and individuals. This allocation aimed to provide incentives for forest protection and reforestation.

Nevertheless, the “Two Mountain System” policy was not uniformly implemented in Yunnan province. While some villages demarcated forests and implemented household responsibility lands, most villages did not redistribute collective forest to household level. Instead, they maintained a single tract of collective forest for the use of all residents. In other cases, the situation was more complicated and under constant change with the distribution moving back and forth between de-collectivization and re-collectivization. In other areas, some parts of collective forest were leased out to individual households, and the remaining area stayed under the control of a collective of remaining households. With no clear guidelines and long-term experience of farmers to changing policy and taxation environments, sustainable NTFP management could hardly develop under insecure ownership. Henceforth, often it resulted in over-harvesting and short term opportunistic extraction and marketing. The critical issue to address in this environment is not who owns the forest or its products but who can have legal and documented access and rights to harvest and therefore control over the products. With the realization of the potential and value of NTFP and the transition from timber production to NTFP (especially under the present restricted logging rights), it created further pressure on the resource and increased the urgency to clarify resource property rights (He, 2006). Without a clear legal framework and property relations (no de jure rights), NTFP remain in many areas as an “open access” resources, and this inevitably leads to resource competition, and eventually resource degradation and social problems.

4. COLLECTIVE ACTION FOR NTFP MANAGEMENT IN YUNNAN

The collective action refers to "action taken by a group (either directly or on its behalf through an organization) in pursuit of members' perceived shared interests" (Marshall, 1998, as cited from Knox McCulloch et.al. 1998). Collective action in natural resource management include rules on using (or refraining from using) a resource, as well as implementing a process of monitoring, sanctioning, and dispute resolution (Ostrom, 1990). On the other hand, property rights can be defined as "the capacity to call upon the collective to stand behind one's claim to a benefit stream (Meinze-Dick and Knox, 1999). Thus property rights involve a relationship between the right holder, others and an institution to back up the claim (ibid.). Property rights and collective action are interrelated, especially in natural resource management.

In natural resource management, the structure of property rights and collective action shape the efficiency, equity and environmental sustainability. They set up a range of institutional arrangement from a centralized management regime to more devolved institution. A number of success stories such as Community-based Natural Resource Management (CBNRM), co-management, joint forest management, local self-governance and self-organization are now considered good practice to enhance local participation in controlling natural resource. This section examines the case of Matsutake mushroom and bamboo shoot for its local collective action for natural resource management.

THE CASE OF THE MATSUTAKE MUSHROOM COLLECTION

In the Tibetan Area of Northwest Yunnan, especially in the county Shangri-la (formerly Zhongdian), Matsutake Mushroom (*Tricholoma matstutake*) started to play a significant role in income generation and improved local development after the implementation of the partial logging ban and increased demand from traders to export Matsutake, especially to Japan. At present, tax levied from Matsutake trading account for 30% of county revenues, and cash income increased from 50% to 80% at household level due to intensified mushroom collection (He, 2004). This created not only higher pressure on the resource itself, but unclear property rights on Matsutake Mushroom harvesting combined with mass commercialization and processing inevitably imposed a heavy impact on the sustainability of the resource utilization practices. As a result, production of Matsutake declined from 530 metric tons in 1995 to 272 m.t. in 2000 (He, 2003). Rapid resource degradation called for a great attention from both government and local communities. On the one side, the government launched a number of regulations and strategies (e.g. privatization) to govern the collection and market. However, due to poor enforcement and extensive transaction cost they don't necessarily result in better management and sustainable use. On the other side, local communities also initiated different adaptive local actions in a collective way for self-governing the sustainability of Matsutake collection with positive outcomes. The local collective action became a good starting point for resource management.

The majority of Matsutake collection activities occur mostly in the collective forests, since they are closer to the villages. Under the policy of the "Two Mountain System", except for a small number of communities, most villagers have a strong understanding of their access rights to collective forest and apply this now to Matsutake management (whereas the term 'management' mainly relates to the management and protection of the oak/pine forests) and harvesting . Also, they have created several strict rules on how to harvest and market Matsutake and enforce their property rights through both, the formal legal system as well as informal practices.

In Jidia village, for instance, the regulations set up in terms of harvesting timing and hence access to the forest, and zoning are summarized as follows: 1) all extractors are restricted to harvest in village owned collective forests rather than indiscriminately, and outsiders are denied access to the resource. 2) If "outsiders" would like to access, an access fee is charged. But, outsiders are classified as villagers who originate from the village, and might have, out of various reasons (often due to marriage) out-migrated. Rules prohibit access to 'real' outsiders with no family connection to the village forests. 3) The standard of the access fees paid by "outsiders" are RMB 400/year for male and RMB 500/year for female collectors. The reason for this difference between the sexes is because male members are required to participate in forest patrols. 4) The harvesting size or length of the mushroom must be more than 6cm if it is to be collected. 5) For harvesting, access is restricted to every three days for collection, or to more explicit, the common practice and experience calls for 3 days for collection and 3 days for management and protection. 6) The activities of picking the mushroom can be only conducted by traditional oak-stick rather than other tools, and only a small hole can be dug for extraction. 7) After picking the mushroom, the hole should be covered again by soil, leaves and other organic matter to enrich the soil and to allow for mushroom regeneration.

To enforce those regulations, several associated practices are conducted. During the 3 days with no collection of Matsutake, all male should take on the responsibility of patrolling so as to see if anybody breaks the harvesting rules. The rules are explicit and state that there need to be at least 5 males from different households to be assigned and responsible for this task. This task is allocated in a rotation scheme and furthermore, between collection days, all villagers are required to come together three times each day at 9:00 AM, 1:00 PM and 4:00 PM. This is a basic, but well functioning system to make sure whether all villagers are following the regulation. In the 3 days of gathering time, villagers are also required to come together at every morning at 6:00 AM to guarantee equal access rights and time-share to the resource for all members. Besides, people are grouped in 3-4 person teams so that they can mutually monitor each others harvest activities. There are also "village council teams" responsible to both monitor the villagers harvest practice and deal with cases when rules have been broken. After the mushroom season, this village council team continuously takes on the responsibility of sustainable forest management to maintain the forest resource and environment. At the end of the year, a village meeting will be called in to discuss possible improvements, amendments and general discussions on the enforcement of those regulations.

To summarize, the local collective action was instrumental to develop and shape institutional arrangements and practical guide lines to regulate and manage peoples access to a valuable resource, both spatially and in access time, but also setting up arrangements on how local adaptive rules and regulation schemes can be developed and enforced, amended and monitored and can actually be a future guideline for policy makers. It changes and improves the "open access" into a commons scheme with a sound institutional setting and arrangement, which then leads to better sustainable practice of resource utilization and provides conflict resolution in cases where there are disputes.

A CASE RELATED TO THE MANAGEMENT AND HARVESTING OF BAMBOO SHOOT

Bamboo shoots were commercialized after the market reform, however, without much notice by government officials. This case is based on an empirical study of the Nuozhadu Nature Reserve in Yunnan. As in many similar cases in China, the establishment of nature reserve has caused conflicts between the government and local forest depending communities as it limits access to a traditional income source. In 1999, the local government together with the Sino-Dutch project supported the establishment of joint management committees to support conflict resolution and sustainable use of resources in nine nature reserves of Yunnan. By doing this, joint resource management is not limited to bamboo shoots, it rather tries to address the whole ecosystem on which communities depended and its sustainable resource utilization.

With the establishment of nature reserves, the tradition of bamboo shoots collection and its former management was broken down and bamboo shoots *de facto* became an open access commodity after the market reform. This situation has led to severe bamboo forest degradation. The establishment of the joint management committee is seen as a starting point to focus on sustainable bamboo shoot harvesting and management as well as to address other NTFP harvesting within the nature reserves. It is also seen as a way to establish local organizations and institutionalization of conventional joint management schemes and practice. In order to achieve this, project management and communities set up joint management committees consisting of 7-10 people in different villages. These committees are joint by 1-2 government officials and 6-9 elected villagers. Male and female are to be equally represented and each is assigned with his/her own responsibilities. This management required a monitoring system that aims to check not only on the villagers forest use, but also to help develop and institutionalize functioning village based organizations to achieve commonly derived goals in a given community.

With the support of these organizations, and based upon multi-stakeholders discussion, improved bamboo shoot managerial arrangement was also meant to reduce bamboo forest degradation as follows: 1) Develop spatially fixed tenure systems to restore traditional zoning activities for allocating bamboo forest to communities including freehold forests, collective and state forest. With this, particularly inter-communities boundaries are to be clarified and secured. 2) Allocate proper harvesting times and access by limiting harvest to July to August; extraction of bamboo shoots in any other months is prohibited. 3) Development of harvesting schemes by prohibiting clear cutting, and more specifically, at least one shoot must be left within a bamboo cluster.

Through those formalized and regulated institutions, bamboo forest could recover and increase production of bamboo shoots. Monitoring and organizational support by the committee helped to reduce past damages on the bamboo forest resource. Related positive results are to be found in the reduction of conflicts among communities by restoring and improving a formerly functioning system and this especially is very welcomed by all villagers and communities and receives additional support which again has a positive impact on the overall adaptation of the management scheme. Concerning the second rule, bamboo shoots in Yunnan mainly grow from July to August and naturally a stricter limitation to harvesting time helps to concentrate everyone's focus on bamboo for a limited time and secures the regeneration period. Also merchants only come to the village during that time. Consequently this regulation can be easily implemented and enforced. For the third regulation, villagers are apt to leave the bamboo shoots which grow deeper in the forest, because it is too difficult and time consuming to go deep into dense bamboo forest far away form villages for gathering.

In short, those institutional and management changes can be well implemented in bamboo shoot extracting. Besides, there are also forest guards and members from the committee, who are obligated to monitor harvest practice, and to enforce regulations. Moreover, any rule breaker will be fined. The fines will be used for the committees' operation costs, which contribute to the sustainability of the institution.

In Chinese, those regulations are called "*xianghui mingyue*" (local regulations or village code). "*xianghui*" refer to township regulations; "*minyue*" represent a vernacular mutual agreement. The implications are that those institutions combine official and vernacular regulations, which demonstrate the long history of joint management in China. "*Xianghui minyue*" is the main institutional arrangement of joint management committees in the Nuozhadu Nature Reserve. The committees also formulate other NTFP management "*xiangui minyue*" to guide any NTFP collection.

In turn, the establishment of committees ensures the durability of management schemes and its impact is not limited to NTFP management, rather the committees have a wider positive impact on all village affairs.

In summarizing, local institutions of bamboo shoots were formulated in response to market intervention. An institutional arrangement supported and facilitated the development, in this case the Sino-Dutch development project. Local adaptive strategies as collective actions associated with external support played a key role to sustain resource use and to promote local economic development. Under those circumstances, participatory management institution are formalized and institutionalized based upon multi-stakeholders discussion, with local villagers and government officials participating in decision-making. Joint management institutions can play a crucial role in promoting efficient and sustainable resource use; eventually contributing to the improvement of local livelihoods. A ositive side effect is the improvement of relations between communites and government officials.

5. CONCLUDING REMARK

The challenge of protecting diminishing forest resources combined with the provision of income for communities by letting them access and harvest NTFP can be overcome by promoting sound and regulated economic development and harvesting schemes. With adaptive practice involving all stakeholders, maintaining and even increasing production while simultaneously maintaining or improving ecological conditions is possible (Neumann and Hirsch, 2000). The discussion of sound forest management, therefore, encompasses a wide range of social, economic, political and ecological questions. Clearly, State's regulations and tenure on forest caused unclear property rights of NTFP resource utilization. As a result, tenure system of NTFP is *de facto* open access. Owing to unclear tenure system of NTFP, over-harvesting is common practice, which often not only depletes the NTFP resource, but also leads to forest degradation. Free market interventions associated with poor policy applications often threatens the local environmental sustainability and has a negative impact on communities by widening income gaps.

Local collective action can perform either as a self-governance or joint management practice and can adjust resource overuse. It enables not only more sustainable use of resource, but also inclusive management of resources with its related protection. The local collective action overcomes the weakness of *de jure* forest tenure system, by setting up the local adaptive and situated institution. It decentralizes usufruct rights to a resource to local communities and henceforth creates incentives for economic development and efficient resource extraction. In addition, the institution initiates an improved tenure system to prevent overuse of resource. Rules, regulations and institutions need to be locally derived (and are often based on traditions), adaptive, accountable, and amendable as well as dynamic and open to adjustment.

Thus, strengthening local access to and control over forest is a critical approach within a collective action for achieving rural sustainable development and livelihood improvement. Inclusive and participatory management can meet the needs of a large variety of rural communities and user groups and help to improve social, cultural and economic conditions. In particular, developing and institutionalizing several types of NTFP management regimes and including spatial and temporal dimensions, can be seen as a more effective way to manage NTFP. Also, local institutions and clearly defined access arrangement can reduce negative impact of globalization and commercialization. Therefore, with the recognition of local tradition and participatory approach, joint management and local institutions are critical for governments to include when developing and implementing resource management strategies and policies regulating access and property rights.

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REFERENCE

Agrawal, Arun and Elinor Ostrom (1999) “Collective Action, Property Rights, and Devolution of Forest and Protected Area Management”. Paper presented at the Policy Workshop on “Collective Action, Property Rights, and Devolution of Natural Resource Management”. in Philippines. June. 21-25, 1999.

Fox, Jefferson (ed. 1995) Society and Non-timber Forest Products in Tropical Asia; East-west Center Occasional Papers Environment Series No.19, August 1995; East-West Center.

He, Pikun, (2000) “Development and Utilization of the Non-timber Forest Products in China”; Paper presented in International Symposium II on Montane Main Land Southeast Asia (MMSEA) “Governance in the Natural and Cultural Landscape”; Chiang Mai, Thailand July 1-5, 2000.

He, Pikun and He Jun (2003) Tropical Social Forestry. Kunming: Yunnan Technology Press.(in Chinese)

He, Jun (2002) Local Institutional Responses to Commodity Chain of Non-timber Forest Products: A Case Study in Nuozhadu Nature Reserve, Yunnan Province, P.R. China, unpublished Master Thesis in Sustainable Development, Chiang Mai University, Thailand.2002

He, Jun. (2003) “Cross-scale Institutional Linkages of Commercial Matsutake Mushroom Management and Marketing: a Preliminary Study of an NTFP in Zhongdian County, Yunnan, China”, in Xu Jianchu and Stephen Mikesell edited Landscapes of Diversity. Kunming: Yunnan Science and Technology Press. pp. 193-197.

He, Jun (2004) Globalized Forest-Products: Commodification of Matsutake Mushroom in Tibetan Village Yunnan Province, Southwest China. paper presented in 10th biennial conference of the International Association of The Study of Common Property in Oaxaca, Mexico from 7- 15 August.

He, Jun (2006) Political Economy of Recreation of Commons: Matsutake Mushroom Management in Tibetan Region of Yunnan, China. in Lebel, Louis, Xu Jianchu and Antonio Contreras eds. Institutional Dynamics and Stasis: How Crises alter the way common pool resources are perceived, used and governed. Chiang Mai: Regional Centre for Social Science and Sustainable Development (RCSD).

Knox McCulloch, Anna, Ruth Meinzen-Dick and Perter Hazell (1998) “Property Rights, Collective Action and Technologies for Natural Resource management: A conceptual

Framework". Working Paper of CGIAR System-wide program on Property Rights and Collective Action.

Meinze-Dick, Ruth and Anna Knox McCulloch (1999) "Collective Action, Property Rights, and Devolution of Natural Resource management: A Conceptual Framework". Paper present in Policy Workshop on "Collective Action, Property Rights, and Devolution of Natural Resource Management". in Philippines. June. 21-25, 1999.

Nepstad, Daniel C. and Stephan Schwartzman (eds. 1992) Non-Timber Products From Tropical Forests Evaluation of a Conservation and Development Strategy; Bronx, N.Y.: New York Botanical Garden, 1992.

Ostrom, Elinor. (1990) Governing the Commons: The evolution of institutions foor collective action. Cambridge University Press.

Rijsoot, Jeanette Van and He Pikun (eds. 2001) The International Seminar On Non-timber Forest Product: China Yunnan, Laos, Vietnam, Yunnan University Press.

Su, Yufang (2001) Building Collective Tenure for Sustainable forest management in a Multi-ethnic Community: A Case Study in Taohua Administrative Village of

Lijiang, Yunnan, P.R. China; Unpublished, Master Thesis in Sustainable Development, Chiang Mai University, Thailand.

Wollengerg, Eva & Andrew Ingles (eds. 1998) Incomes From The Forest: Methods For the Development and Conservation of forest Products for Local Communities; Bogor: Center for International Forestry Research; World Conservation Union.

Zuo, Ting (1995) "Forestry Liangshan Daohu Policy and Its Impacts on Land Resource Management in 1980s, Yunnan, China"; Benjavan Rerkasem (ed.) Montane Agriculture in Mainland southeast Asia. Proceedings of a Conference at Chiang Mai University.

INTERRELATIONSHIP BETWEEN THE ONTOGENETIC TYPE OF PINE TREES AND THE RESIN PRODUCTION POTENTIAL

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1 PROBLEM IDENTIFICATION

Resins of trees are substances extensively used in various industries. China produces about half of the world's resin consumption of altogether over 1 million tons per year. The resin preferably comes from natural pine forests in the Southern belt of the country. Like other renewable resources the pine forests are limited in size and their dynamic characteristics determine the resin production capacity. The resin is synthesised and stored in endogenous, interconnected horizontal and vertical canals of both xylem and phloem of the pine trees. Anatomical knowledge about the resin canal system, the resin biosynthesis and the resin flow are essential to understand the biological fundamentals of resin production and to develop effective resin tapping technologies, too. There is some evidence that resin composition and yield is a function of time, environment, and genetic constitution of the trees. The resin tapping operation affects the tree growth and development behaviour (COPPEN, HONE 1995).

Despite the increasing number of studies concerning the secretory structures in conifers, less is known about differences in the structures, their development, the response to wounding and the variations between species of a certain genus (LANGENHEIM 2003). We have become acquainted with the problem of how pines exude and store resin. However, in order to raise the resin yield capacity of a forest stand on a sustainable basis it is desirable to exhaust all the technological and silvicultural options at hand. To this end, potential crop tree selection and systematic elimination of the serious competitors of each potential crop tree appear to be a necessary investments in stands that grow up nearly uniformly (SMITH ET AL. 1997). Derived from that the critical research question is, whether resin production depends on different ontogenetic types of pine trees.

In this paper results of an investigation on the resin secretory structure and resin flow after wounding of the tropical pine species of *Pinus massoniana* Lamb. and *Pinus merkusii* Jungh. et de Vriese will be referred to. Furthermore, recent research concerning morphologically distinguishable growth types in pine stands of *Pinus sylvestris* L. in central Europe shall be exploited to suggest potential treatment options for tropical pine stands geared to resin tapping. This shall serve as a basis to advance forest stand management research for resin production in pine forests, which have not yet undergone objective-oriented silvicultural interventions.

2 CHARACTERISTICS OF RESIN FLOW AND RESIN REFORMATION AT TWO TROPICAL PINE SPECIES

Comparative studies of 30 to 40-year old trees from Pinus massoniana and Pinus merkusii in Quang Ninh province, Vietnam, have been conducted with regard to their suitability for resin tapping (STEPHAN 1976). The so-called fish-bone technique with the V-shape and a tapping angle of 40° was employed for wounding. The resin flow duration was calculated based on the assumption that the amount of resin outflow (R) per unit of time (t) expressed in per cent of the total amount of resin outflow (T = 100 %) will be proportional to the difference between the total amount of resin outflow (T) and the amount of resin outflow per defined unit of time (t) as follows:

$$dR : dt = k \times (T - R). \quad (1)$$

After integration and considering that for t = 0 and R = 0 the integration constant results in C = T, the equation changes to

$$R = T \bullet (1 - e^{-kt}). \quad (2)$$

In this non-linear equation (2) the parameter k indicates the effectiveness of the epithelial cells of resin canals (extension due to water absorption) for the resin flow duration. In case of *Pinus massoniana* the mean value $k_{ma} = 0.1645$ was calculated, and for *Pinus merkusii* $k_{me} = 0.0421$, respectively. This reflects clear differences between both of the pine species examined (Table 1).

Table 1. Observations on the physiological behaviour of Pinus massoniana Lamb. and Pinus merkusii Jungh. et de Vries

Attribute	***Pinus massoniana***	***Pinus merkusii***
Resin flow duration	1 day	3 – 4 days
Resin reformation speed	8 – 9 days	4 – 5 days
Stimulation with yeast extract solution	30 % resin yield surplus	no resin yield surplus
Resin crystallisation	during 1 day	during several days

(adapted from STEPHAN 1976)

While the resin flow of *Pinus massoniana* came to end up after one day, it kept flowing for three to four days at *Pinus merkusii*. Measurements of resin reformation speed to compensate the losses indicated considerable differences as well. According to the observations *Pinus merkusii* needs about four to five days to refill the resin canals, whereas *Pinus massoniana* seems to use eight to nine days respectively. It becomes obvious that important differences between both of the pine species concerning the process of resin biosynthesis and the effectiveness of the epithelial cells of the resin canals must be taken into account for tapping operations.

RAPID RESIN FLOW

The amount of resin pouring out from the canal per unit of time depends on the pressure of the epithelial cells, the viscosity of the exudation and the diameter of the resin canal system.

Pressure of the epithelial cells: After wounding the tree, resin will start to pour out immediately. The epithelial cells begin to suck in water from the surrounding sapwood through osmosis and enlarge their volume. This is to initiate the process of pressing out resin from the canal system. During this event the secretory system has already started to provide the resin canals with new resin until they are completely filled and a balanced pressure situation is achieved. However, the crystallisation of resin interrupts the resin flow from the tapped tree.

Viscosity: The content of turpentine is important for the viscosity of the resin. The higher the turpentine concentration is, the better the resin flow will be. High air temperatures are closely correlated to internal tree temperatures, which reduce the viscosity of resin (Stephan, 1973; Kaminski, 1986). Although higher temperatures improve the resin flow, this correlation is less pronounced in case of accelerated transpiration of the needle biomass. Under this situation the epithelial cells suffer from reduced water supply and cannot generate sufficient pressure for the resin flow. In contrast, increased resin exudation results from high temperature combined with high atmospheric humidity.

Diameter of the resin canal system: Both horizontal and vertical resin canals occur in the xylem, with the vertical canals connected by the horizontal ones. The horizontal resin canals of Pinus sylvestris reach, e. g., a diameter of 0.03 mm to 0.05 mm, and the vertical ones 0.08 mm on average with a length of 0.5 to 1.00 m (Stephan 1967). In examining the diameter of resin canals at representatives of high-productive pine trees Verma (1968) found out that their diameter was almost 50 % larger then those of low-productive pine trees. Indeed, the density of resin canals per unit of area has not been proved being crucial in any investigation.

RAPID REFORMATION SPEED

Resin-synthesizing epithelial cells of pine species are concentrated nearby the resin canals, although their number seems to be much higher around the vertical canals as compared to the horizontal canals (MCREYNOLDS ET AL. 1989). Terpenoid resin formation needs at first mono- and sesquiterpenes being generally volatile. GLEIZES ET AL. (1980, 1983) showed the involvement of plastids in monoterpene biosynthesis, and reported evidence that sesquiterpenes of pines are formed in the endoplasmic reticulum. The locations of nonvolatile terpenes formation in conifers are not well explored up to now. Molecular genetic will improve the understanding of resin biosynthesis in future (BERENBAUM 2002; LANGENHEIM 2003). After resin biosynthesis the metabolic compound is being transported into the lumen of the canals where it is being stored. However, resin components are derived from photosynthetically produced carbohydrates broken down to separate simpler compounds for new substance formation. Therefore, an active primary carbon metabolism and a sound internal resin biosynthesis affects resin tapping operations in a crucial manner.

Stimulation: Chemical application to stimulate and maintain resin flow after tapping operation is extensively used. For a long period of time application of sulphuric acids has been given preference over other compounds in order to open up a large number of the horizontal resin canals and counteract the rapid blocking of the resin canals after wounding the tree. This application results in a prolonged resin flow solely (Coppen and Hone 1995). More recent research was focussed on substances modifying the function of the epithelial cells, the resin canals or the resin biosynthesis for higher yield production. In this sense, yeast extract solutions (Saccharomyces cerevisiae) has been tested and applied successfully to Pinus sylvestris in Germany with a yield increase of between 30 to 60 % (Figure 1).

In the course of further development the plant growth regulator "Ethephon" as 2-chloroethylphosphonic acid ($C_2H_6ClO_3P$) has been added to the yeast extract solutions at a ratio of one to six showing a further increase in resin yield (Stephan 1986). It is believed that the phytohormone ethylene is directly responsible for the resin biosynthesis (Wolter 1977). Most probably Ethephon is acting as an effective promoter of endogenous ethylene production in living plant cells. Though clear evidence exists for enhanced yields of latex in rubber tapping through this ethylene-releasing compound, the long-term benefits of its application in tapping pine trees must still be demonstrated (Coppen and Hone 1995).

Figure 1. Demonstrated reisin tapping technique

3 ONTOGENETIC TYPE OF PINE TREES AND RESIN YIELD

It is well-known that the individuals of any population differ from each other in their genotype (genetic constitution), and in many cases, also in their phenotype (behavioural, physiological and morphological characteristics). Greater fitness of genotypes means a better adaptation to their physical and biotic environment resulting in higher survival and reproduction rates within the population (KIMMINS 1997). Concerning the different ontogenetic types of Scotch pine (Pinus sylvestris) in Germany profound investigations have been conducted in the northeastern lowlands (ERTELD 1955, 1958; ERTELD, KRÄUTER 1957; KRÄUTER 1957, 1964, 1968). At least three ontogenetic types had been identified within the pine populations (Figure 2 and Table 2).

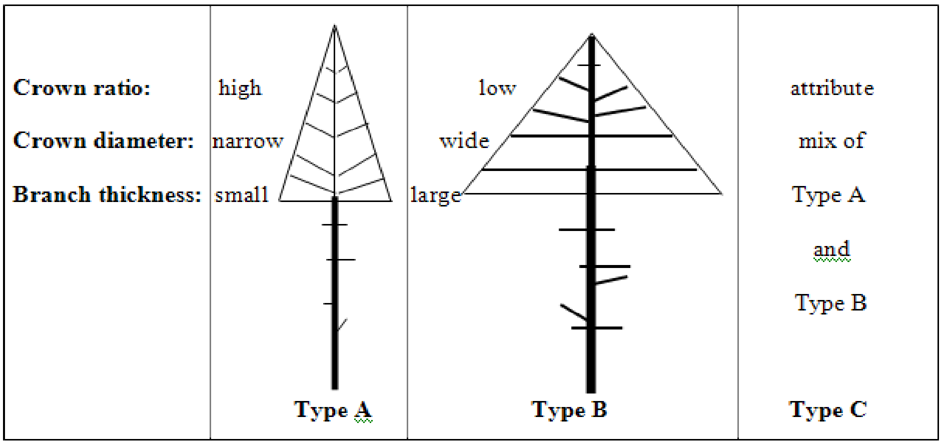


Figure 2. Essential attributes to distinguish ontogenetic types of Pinus sylvestris L. in the northeastern lowlands of Germany (after ERTELD, KRÄUTER 1957).

The attributes identified for the assessment (Table 2) must be recognised as mean values of trees with almost identical diameters in a homogenous stand.

Table 2. Ontogenetic types of Pinus sylvestris L. in the northeastern lowlands of Germany.

Attribute	Ontogenetic type		
	A	B	C
Juvenile growth	slow	Fast	Trees with not
Mature growth	continuous	falling off	clearly identifiable growth prediction
Current height increment	culmination relatively late and low, but high growth values in maturity phase	culmination relatively early and high, but low growth values in maturity phase	concerning the culmination of current height
Crown shape	narrow, good ratio of crown length to crown diameter, fully shaped	wide, poor ratio of crown length to crown diameter, limited shaped	increment and growth values
Juvenile shoot length	short	long	Attributes of both
Branch thickness	small	large	Type A and
Branch angle	wide on trunk, narrow in crown	narrow on trunk, wide in crown	Type B

(after ERTELD, KRÄUTER 1957)

POHFAHL, LOCKOW, KRÄUTER (1979) have carefully tested the existence of the proposed ontogenetic types A and B applying the morphological attributes proposed by ERTELD AND KRÄUTER (1957) on the basis of the multidimensional variance analysis. This examination has revealed that the ontogenetic types differ from each other significantly in terms of both the morphological characteristics and the growth behaviour. Thus, it has been suggested to use the characteristics *crown length to crown diameter* (crown ratio), *branch thickness* and *crown diameter* (branch length) for a reliable diagnosis of the ontogenetic type (Figure 3).

KOHLSTOCK (1982) investigated the proportion of these ontogenetic types in selected permanent research plots. During the 1990s research has specifically been directed to the exploration of the distinct growth behaviour of the different ontogenetic types, and the relationships between molecular genetic markers and characteristics of pine trees in the northeastern lowlands of Germany. A concise reflection on findings relevant for further research on pine resin production is compiled in Table 3.

(a) (b) (c)

Figure 3. (a) naturally regenerated Pinus khasya stand composed mainly of Type A and C trees; (b) planted Pinus khasya stand thinned in favour of Type A trees, Lam Dong, Vietnam; (c) Naturally regenerated Pinus caribaea with varying crown shape in Pinar del Rio, Cuba (Photos: H. Uibrig(a,b); H. Pohris (c))

According to the "Guidelines of Silviculture, 2004" for Scotch pine (*Pinus sylvestris* L.) of the forest administration of Brandenburg federal state the promotion of vigorous, high-graded single trees is the main objective for timber production. As many as 150 potential crop trees should be selected in the well-established pine stand during the phase of between 7 to 12 m top height. They normally fit the Type A and partly the Type C. Experience has shown that a minimum harvestable diameter at breast height of 45 cm to 50 cm is advisable for final felling under different site conditions. However, looking at the results of around 50 years of research work regarding the ontogenetic types of Scotch pine in Germany, the Type B generally leads to noteworthy characteristics as well:

1. The genetically determined outstanding vitality of Type B trees during their juvenile and immature phase favours a fast crown formation with early and high culmination of the current annual increment on productive sites.
2. After stand tending operations that give preferential treatment to Type B trees by liberation, the diameter increment will be encouraged additionally. This allows to achieve the target diameter for resin tapping much sooner than that of the Type A. Furthermore, a site stabilising undergrowth will naturally develop even if the crown closure is only slightly interrupted.
3. Vigorous Scotch pines also produce a biologically active root system with almost 90 % of the total root biomass (ENDTMANN ET AL. 1991).

Taking into account the yield of single trees after resin tapping it has clearly been shown that those trees have yielded most, which had demonstrated an outstanding growth behaviour during the small pole stage. An early selection and preferential treatment of such relatively fast-growing trees may lead to a higher number of "Potential Resin Crop Trees (PRTs)" in a pine stand. As a consequence, it is recommended to use the diameter growth behaviour of pine trees during the small pole stage as an indicator (STEPHAN 1973, 1986).

Table 3. Findings from research on ontogenetic types of *Pinus sylvestris* L. in the northeastern lowlands of Germany (1992 – 2000) relevant for resin production

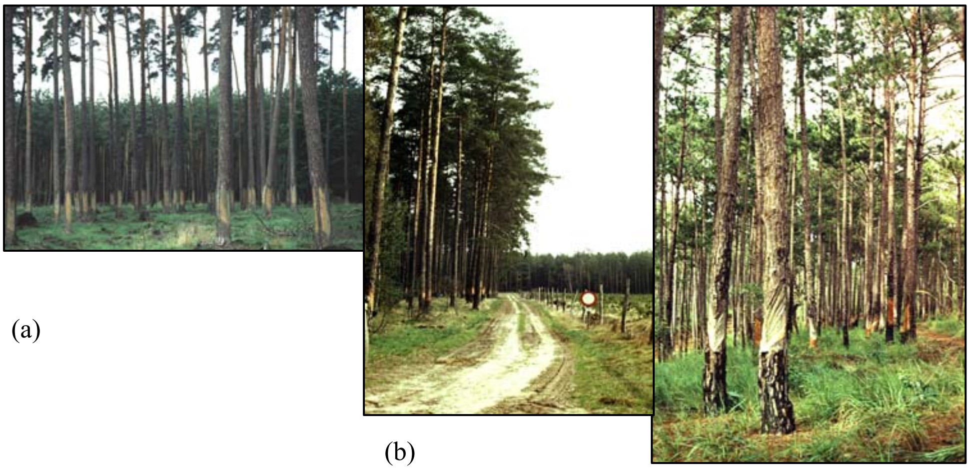
Serial No.	**Growth behaviour**
1	Trees of the Type A and Type B demonstrate a different level of the diameter growth curve under equal site, age and stand treatment conditions.
2	Trees of the Type B develop trunks with larger diameters as trees of the Type A in even-aged pure stands.
3	Trees of the Type A do not surpass the diameter of the trees of the Type B during the development of even-aged pure stands.
4	The superiority in diameter growth of the trees of the Type B results from the larger crown and, consequently, the growing space.
5	Trees of the Type B still indicate a lower growing space economy (annual diameter increment related to crown surface area [mm · m-2]).
6	Trees of the Type A produce higher-graded stem quality after Potential Crop Tree selection and liberation.
7	Data sets from permanent sample plots (PSPs) allow to describe and mathematically predict the growth behaviour (diameter growth curves) of trees from the Type A and trees from the Type B as well.
	Genetic constitution
1	Trees of the Type A and Type B differ with regard to their morphology, as well as in terms of their genetic constitution.
2	Trees of the Type A have shown a higher genetic variation and most likely dispose of alleles serving for a major potential of adaptation to changing environmental conditions (needle analysis).
3	Trees of the Type B have predominantly alleles serving for control of the growth rate (needle analysis).

(adapted from LOCKOW 1992, 1993, 1998, 2000; LOCKOW, POFAHL 1994; HERTEL, KOHLSTOCK 1994; HERTEL, KOHLSTOCK, LOCKOW 1998; KOHLSTOCK, HERTEL, SCHNECK 1993)

4 OUTLOOK

Three fundamental questions arise instantly from the reflections made (Fig. 4):

1. Is it possible to harvest higher resin yield per unit of time from deliberately selected and actively promoted pine trees of the Type B or Type C on productive sites?
2. Do the described ontogenetic types identified for Scotch pine also occur in populations of tropical or subtropical pine species?
3. Which silvicultural treatment allows to obtain highly productive trees for resin tapping within a comparatively short period of time?



(a) (b) (c)

Figure 4. Resin tapping requires an objective oriented management of the pine stands based on scientific knowledge (a, b) *Pinus sylvestris* in Mecklenburg, Germany; (c) *Pinus khasya* in Lam Dong, Vietnam (Photos: H. Uibrig)

Although it can be assumed that the silvicultural guidelines for Scotch pine in Germany do not focus exclusively on the improvement of resin production there is some evidence for the validity of the hypothesis linked with the first question from former resin research plots.

Periodicity and pattern in growth of individual trees of tropical pine populations are well known, but investigations about existing ontogenetic types have not been pointed out expressly (EVANS, TURNBULL 2004). In a 10-year-old stand of *Pinus caribaea* var. caribaea Morelet (II. site class) in the Pinar del Rio province (Cuba), GONZÁLES (1986) found out the Type A and Type B with a mean crown ratio of 1.96 and 1.26, a mean branch thickness of 1.38 cm and 2.11 cm, a crown diameter of 2.10 m and 3.40 m as well as an average diameter at breast height (DBH) of 10.7 cm and 13.8 cm for the first time. STEPHAN AND BETANCOURT (1981) had observed a moderate trend to higher resin yield per unit of measurement [gram per cut and face-metre] with increasing DBH (20 – 30 cm) of *Pinus caribaea var. caribaea* in this region, but without a special classification into ontogenetic types. An objective assessment referring to the second question has to combine both of the observations.

Recently, ROBERDS ET AL. (2003) have published some research results about the genetic and phenotypic variability for constitutive oleoresin flow in Loblolly Pine (*Pinus taeda* L.) in Florida (USA). The 10-year-old trees had a mean height of 12.10 m and mean DBH of 17.7 cm. Genetic components of variance made up a significant portion of the phenotypic variance observed in both the resin flow and growth trials. The estimates of individual tree heritabilities were $h^2 = 0.44$ for spring resin flow and $h^2 = 0.59$ for summer resin flow. For the growth variables they analysed $h^2 = 0.48$ for height, $h^2 = 0.49$ for DBH and $h^2 = 0.53$ for volume. They suggest a directional selection from the pine population to improve resin flow, which concerns the third question mentioned above.

There is a set of silvicultural treatment measures available to improve of the stand growth behaviour of pines (POHRIS 2004). Clonal plantation establishment with tropical pines appears to be difficult due to considerable rooting problems with cuttings from older trees and the time-consuming procedure to prepare plants by grafting. Generative propagation by seeds from high-productive trees may serve as the first step to increase resin yield from pine stands. A subsequent selection and liberation of Potential Resin Crop Trees (PRTs) can contribute to their fast growth and early reaching of the threshold diameter for resin tapping, which should be more than 20 cm. A study concerning the constraints towards sustainable resin production in pine forests (*Pinus massoniana*) of Guangxi province in China by WANG LIFENG (1998) has shed light on the pressure on pine stands of diameters at breast height below 20 cm in practice. Extensive research works have been conducted on various silvicultural, technological, and economic issues; on management planning and implementation of operational plans in natural and planted pine forests combining timber and resin production following participatory approaches in a number of tropical countries (POHRIS, STEPHAN, UHLIG, UIBRIG 1992). They provide valuable reference for future research.

REFERENCES

Beerenbaum, M.R. 2002. Postgenic chemical ecology: from genetic code to ecological interactions. Journal of Chemical Ecology 28, 873-896.

Berg, H.A.; Bilke, G.; Heduschka, L.; Hendtke, H.; Lockow, K.-W.; Ness, T.; Schmidt, S.; Stähr, F.; Thielemann, T. 2004. Kiefern – Naturverjüngung, Pflege und Nutzung. Ministerium für Landwirtschaft, Umweltschutz und Raumordnung des Landes Brandenburg, Abteilung Forst, Landesforstverwaltung Brandenburg, Waldbau-Richtlinie 2004, 1-14.

Coppen, J.J.W.; Hone, G.A. 1995. Gum naval stores: turpentine and rosin from pine resin. Natural Resources Institute. FAO, Rome.

Endtmann, K.J.; Mai, D.H.; Lange, E. 1991. Die Kiefer (Pinus sylvestris) Artmerkmale, Taxonomie, Entwicklung der Art, Natürliche Verbreitung. Berichte aus Forschung und Entwicklung, Forschungsanstalt für Forst- und Holzwirtschaft Eberswalde, 24, 4-38.

Erteld, W. 1955. Der Zuwachs der Kiefer als Folge innerer Veranlagung und als Ausdruck erkennbarer Merkmale. Archiv für Forstwesen 4,5/6, 511-522.

Erteld, W. 1958. Wachstumsabläufe und Baummerkmale bei der Kiefer. Forst und Jagd 8,1, 35-40.

Erteld, W.; Kräuter, G. 1957. Untersuchungen über die Erkennbarkeit guter und schlechter Zuwachsträger bei der Kiefer. Archiv für Forstwesen, Berlin 6, 5/6, 361-420.

Evans, J.; Turnbull, J.W. 2004. Plantation forestry in the tropics. The role, silviculture, and use of planted forests for industrial, social, environmental, and agroforestry purposes. Third edition, Oxford University Press, Oxford, 467 pp.

Gleizes, M.; Carde, J.P.; Pauly, G.; Bernard-Dagan, C. 1980. In vivo formation of sesquiterpene hydrocarbons in the endoplasmic reticulum of pine. Plant Sciences Letters 20, 79-90.

Gleizes, M.; Pauly, G.; Carde, J.P.; Marpeau, A.; Bernard-Dagan, C. 1983. Monoterpene hydrocarbon biosynthesis by isolated leucoplasts of Citrofortunella mitis. Planta 159, 373-381.

Gonzáles, I.E. 1986. Beitrag zur Durchforstung von Pinus caribaea var. caribaea in Kuba. Dissertation, Technische Universität Dresden, Sektion Forstwirtschaft Tharandt, 139 S.

Hertel, H.; Kohlstock, N. 1994. Different genetic structures of two morphological types of Scotch Pine (Pinus sylvestris L.). Silvae Genetica 43, 268-271.

Hertel, H.; Kohlstock, N.; Lockow, K.-W. 1998. Genetische Untersuchungen an Kiefern. AFZ/Der Wald 18, 928-930.

Kaminski, E. 1986. Untersuchungen zur Temperatur im Holz geharzter Bäume. Agrarwissenschaftliche Gesellschaft der DDR u. a., 3. Wissenschaftliche Tagung Harzgewinnung vom 6. – 9. Mai 1986 in Fürstenwalde, 23-26.

Kimmins, J.P. 1997. Forest ecology. A foundation for sustainable management. Prentice-Hall, Inc., Second edition, 596 pp.

Kohlstock, N. 1982. Neue Erkenntnisse in der Kiefern-Jungwuchspflege. Beiträge für die Forstwirtschaft 4, 155-159.

Kohlstock, N.; Hertel, H.; Schneck, H. 1993. Zur Genetik von a- und b-Typen bei Kiefer. Beiträge für Forstwirtschaft und Landschaftsökologie 27, 174-177.

Kräuter, G. 1957. Wachstumsuntersuchungen an Einzelstämmen aus Kiefernbeständen. Forst und Jagd 7, 565-571.

Kräuter, G. 1964. Ein Beitrag zur Rationalisierung der Pflegearbeiten in Kiefernjungbestockungen. Soz. Forstwirtschaft 14, 7, 203-205.

Kräuter, G. 1968. Kiefernjungbestandspflege, aber wie? Soz. Forstwirtschaft, Berlin 18, 4, 113-116.

Langenheim, J.H. 2003. Plant resins. Chemistry, evolution, ecology, and ethnobotany. Timber Press Portland, Cambridge, 586 pp.

Lockow, K.-W. 1992. Zum Wachstumsablauf und zur Wuchsdynamik der Kiefer mit einigen Schlussfolgerungen für die Bestandesbehandlung. Der Wald 42, 5, 170-173.

Lockow, K.-W. 1993. Zur Quantifizierung der Wuchsdynamik der Kiefer und Schlussfolgerungen für die Bestandespflege. Forst und Holz 48, 357-360.

Lockow, K.-W. 1998. Der Kiefern-Durchforstungsversuch Chorin 97 – Ziele und Ergebnisse für die Praxis. Beiträge für Forstwirtschaft und Landschaftsökologie 32, 1, 15-23.

Lockow, K.-W. 2000. Durchforstungsweise und Bestandesentwicklungsdynamik bei Kiefer. AFZ/Der Wald 20, 1084-1086.

Lockow, K.-W.; Pofahl, U. 1994. Neue Erkenntnisse über Gesetzmäßigkeiten des Einzelbaumwachstums der Kiefer. Beiträge für Forstwirtschaft und Landschaftsökologie 28, 2, 83-86.

Mcreynolds, R.D.; Kossoth, S.V.; Clements, R.W. 1989. Gum naval stores methodology. In: Zinkel, D.E.; Russell, J. (eds.) Naval Stores: Production-Chemistry-Utilization, 83-122, Pulp Chemicals Association, New York.

Pofahl, U.; Lockow, K.-W.; Kräuter, H. 1979. Zur Lösung von Klassifizierungsproblemen mit Hilfe der mehrdimensionalen Varianzanalyse. Beiträge für die Forstwirtschaft 13, 2, 41-48.

Pohris, H. 2004. Some emerging research issues in high-intensity forest plantation management of tropical and subtropical regions. German-CIFOR Workshop on Rethinking Tropical Plantations. CIFOR, Bogor, December 7-10, 2004, 14 pp.

Pohris, H.; Stephan, G.; Uhlig, S.K.; Uibrig, H. (1992) Tharandter Beiträge zur Bewirtschaftung tropischer Kiefern. Mitteilungen der Bundesforschungsanstalt für Forst- und Holzwirtschaft Hamburg, Nr. 170, 60 – 67.

Smith, D.M.; Larson, B.C.; Kelty, M.J.; Ashton, P.M.S. 1997. The practice of silviculture: Applied forest ecology. Ninth edition, John Wiley & Sons, Inc., New York, 537 pp.

Roberds, J.H.; Strom, B.L.; Hain, F.P. 2003. Genetic and phenotypic variability for constitutive oleoresin flow in Loblolly Pine. In: McKinley, C.R. (ed.) Proceedings of the 27th Southern Forest Tree Improvement Conference, June 24-27, Stillwater, Oklahoma, 102-104.

Stephan, G. 1967. Untersuchungen über die Anzahl der Harzkanäle in Kiefern (Pinus sylvestris). Archiv für Forstwesen 16, 5.

Stephan, G. 1973. Die Gewinnung des Harzes der Kiefer (Pinus sylvestris). 2. Aufl. – Berlin: Hauptabteilung Forstwirtschaft beim Ministerium für Land-, Forst- und Nahrungsgüterwirtschaft der DDR, 203 S.

Stephan, G. 1976. Beobachtungen zum physiologischen Verhalten von Pinus merkusii Jungh. et de Vries und Pinus massoniana Lamb. Beiträge zur tropischen Landwirtschaft und Veterinärmedizin 14, 1, 71-78.

Stephan, G. 1986. Der Stand der Anwendung hochwirksamer Stimulationsmittel in der Harzgewinnung. Agrarwissenschaftliche Gesellschaft der DDR u. a., 3. Wissenschaftliche Tagung Harzgewinnung vom 6. – 9. Mai 1986 in Fürstenwalde, 23-26.

Stephan, G.; Betancourt, Y. 1981. Die Höhe der Harzerträge von Pinus caribaea var. caribaea Morelet und die Möglichkeit der Harzproduktion in Pflanzungsbeständen dieser Baumart. Wissenschaftliche Zeitschrift der Technischen Universität Dresden 30, 4, 247-250.

Verma, V.P.S. 1968. Beobachtungen an einigen ertragsbeeinflussenden Faktoren bei der Kiefernharzung. Archiv für Forstwesen 17, 10.

Wang Lifeng 1998. Historical survey of the system and assessment of constraints towards sustainable gum resin production in pine forests of Guangxi Province, China. Master thesis, Technische Universität Dresden, Institut für Internationale Forst- und Holzwirtschaft Tharandt, 99 pp.

Wolter, K.E. 1977. Ethylene-Potential Alternative to the Bipyridium Herbicides for Lightwood Induction. Proceedings of the Annual Meeting of the Lightwood Research Coordinating Council, January 18 and 19, 1977, Jacksonville, Florida.

NON WOOD FOREST PRODUCTS IN TIMBER PRODUCTION FOREST IN EAST KALIMANTAN, INDONESIA

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As reflected in relevant research publications as well as reports and proposals of international technical cooperation projects of the late 1990s non-wood forest products (NWFP) were frequently expected to have a high development potential. On the one hand it is hypothesized that the current contribution of NWFP to the income and subsistence of rural people living on the forest edge is underestimated. On the other hand, an intensified management of NWFP is anticipated to increase the income of these people (Tan, Ruiz Pérez & Ibach 1996, Sepp et al. 1996), as well as offer incentives for the conservation and sustainable management of natural forests in the form of managed natural production forests, especially in the tropics (Arnold & Ruiz Pérez 1996; BML 1997, BMZ 1997, CIFOR 1995, Falconer 1990, Falconer & Arnold 1989, FAO 1995, GTZ 1993, Nepstad & Schwarzman 1992, Redford & Padoch 1992, Sepp et al. 1996, Tan et al. 1996). Last not least it is propagated by certain interest groups that subsistence use and market oriented management of NWFP can be integrated into forest management schemes aimed primarily at timber production (Prebble et al. 1999).

At the same time voices are on the rise criticizing these expectations claiming that they are often either based on insufficiently tested hypotheses (Godoy & Bawa 1993) or on unilateral sectoral analyses (Godoy & Bawa 1993, Arnold & Ruiz Pérez 1996, Padoch & de Jong 1989). These sectoral approaches usually do not take into account either the technical aspects of forest management or the socio-economic aspects of the use and management of NWFP by the selected target groups. Based on this conclusion the following aims of the presented research project (Grossmann 2000) were formulated:

- Elaboration of a target group oriented and interdisciplinary research concept: a con¬tribution to the development of a transferable methodology for analyzing the role and development potential of NWFP in any area with natural forests.
- Answers to three fundamental questions relevant to the management of NWFP in a timber concession area in East Kalimantan, Indonesia:
  1. How large does the area of natural forest need to be to supply the local population with the types and amounts of NWFP currently used?
  2. How is the supply of NWFP from natural forests influenced by selective commercial logging?
  3. Do the inspected forest stands provide the potential for local people to intensify market oriented management of NWFP that will, at the same time, enhance forest conservation?

An individual working definition of NWFP was formulated for the study as no published definition was suitable to answer these research questions: “Non Wood Forest Products (NWFP) are tree products other than wood as well as other plants, animals and their products growing in natural forests.”

The concession area of the timber company Limbang Ganeca in central East Kalimantan was selected as the research area. Long Lalang and Ritan Baru, which border on the concession area, were selected as research villages. The selections took place in the context of the activities of the Indonesian-German Development Cooperation Project “Promotion of Sustainable Forest Management Systems in East Kalimantan”, which initiated and financed the study. The research area is covered with Lowland-Dipterocarp-Forest, including 30% primary and 70% logged-over forest. The research area is typical of East Kalimantan in its high socio-geographic diversity. In contrast to other studies with similar research objectives, research sites were not pre-selected due to their production of particular NWFP or their local economic importance.

An interdisciplinary research concept consisting of two consecutive phases was developed for the study. The focus of the first phase was the analysis of secondary data relevant to the region and the implementation of a pilot study in the research area. The pilot study took place in the two research villages utilizing a 'Participatory and Rapid Rural Appraisal' approach. The most important results of the pilot study were:

1. a list of all NWFP used in the research villages, including local names, properties, uses, harvesting techniques and scientific names,
2. clarification of differences concerning the understanding of terms such as 'forest' and 'NWFP',
3. a collection of locally important socio-economic household criteria and their indicators (primarily economic status and ethnic affiliation of the household members),
4. an impression of suitable social behavior during homestead visits and interviews, and
5. the realization that the interest of the local people concerning NWFP is ranked rather low in comparison to other topics relevant for subsistence as well as for income generation.

In the second phase, the main study, the two aspects most important for the analysis of the significance and the development potential of NWFP (technical and socio-economic aspects) were investigated using appropriate methods from forestry and the social sciences.

The forestry part of the study was composed of a sample inventory of 340 square sample plots (0.04 hectare each) distributed on a systematic grid in two different forest stands of the timber concession forest of the study area. In this inventory, the species and population densities of perennial plants producing NWFP were investigated. A stand of primary forest and a stand of logged-over forest were compared to analyze the influence of commercial logging on the supply of NWFP in timber production forests. In addition the site preferences of the NWFP-producing plant species were analyzed. Corresponding interdependencies were considered in the interpretation of the inventory results to eliminate site-induced differences in population densities on the two investigated forest stands.

Fifty-eight NWFP-producing tree species were identified in the investigated research stands. On average they were represented by 1.3 adult individuals per species per hectare. Groups of different species producing interchangeable NWFP collectively reached an average of 2.0 (maximum 7.8) adult individuals per hectare. Regeneration was assured for almost all NWFP-producing tree species.

Thirty-four NWFP producing rattan species were identified at an average population density of 2.0 (maximum 9.4) adult individuals per hectare. The density of ripe and interchangeably usable canes provided by different species was calculated to be between 6 and 72 canes per hectare. Regeneration was assured for five of six of these groups of interchangeable rattan species.

Population densities between 0.3 and 19.7 adult individuals per hectare were calculated for the 8 NWFP-producing palm species that grow in the form of trees or shrubs. None of these species showed a population structure indicating sufficient natural regeneration in the investigated forest stands.

The two NWFP-producing liana species that included more than 5 detected individuals in the study, reached population densities of 1.2 and 3.2 adult individuals per hectare. Regeneration did not seem sufficient for either species.

Selective logging had a significant impact on the populations of different NWFP-producing perennial plant species. Both negative and positive impacts were observed. No differences in population densities between primary forest and logged-over forest were observed for about half of the investigated species.

For most of the NWFP-producing tree species relevant to local people during the research period, it can be concluded that selective logging at best does not have a negative impact on their occurrence and population density. For those tree species (*Palaquium* and *Payena* spp.) that interchangeably produce Gutta Percha, a latex used for subsistence as well as income generation, a further reduction of originally low population densities due to logging was detected.

For most of the NWFP-producing rattans, tree palms, shrub-like palms, and lianas, changes in the structure of forest stand due to logging do not seem to threaten supply. In fact, the density of the respective NWFP-producing plant species actually tended to increase. Nonetheless, data suggested that some NWFP-producing rattan species (e.g. *Daemonorops critina, Plectocomiopsis geminiflorus*), are primary forest species negatively influenced by logging activities because they are shade tolerant and therefore sensitive to changes in the forest canopy.

Several NWFP-producing wildlife species, or their traces, were encountered in the primary forest stand as well as in the logged-over forest stand. Their occurrence was registered, but no quantitative data were collected.

The socio-economic aspects of the use of NWFP by local people in the two research villages were analyzed using methods from the social sciences.

A sample of 31 households provided quantitative data on the contribution of NWFP to their income and subsistence over the period of one year. In addition, information was collected on the natural properties of the NWFP used (such as the average yield per plant), on the harvesting techniques that were applied (destructive vs. non destructive), and on traditional or governmental rules and regulations concerning the harvest of NWFP (knowledge of and adherence to). The following main methods were applied: structured and semi-structured interviews, product counts, food diaries, and participatory observation.

The average monetary income of the local people was calculated at 2,500,000 Indonesian Rupiah (Rp.) per household per year. During the research period this amount was equivalent to about US$ 900. NWFP contri¬buted 124,000 Rp., or 5%, to this total income.

Over 80% of cash earned with NWFP was obtained on the basis of wildlife and wildlife products. Plants provided the remaining 20% of the income based on NWFP. Thirteen percent was derived at the village-level by sales of articles made of rattan. The remaining 7% was generated by sales of, and trade in, unprocessed vegetal NWFP beyond the village limits.

Individual households demonstrated broad variations of total income and of the respective contribution of NWFP to cash earnings. The share of NWFP based income ranged from 0 to 100%.

Associations between commercial use of NWFP and socio-economic characteristics of different households could be shown in context with economic status of the household. The nominal value, as well as the percentage of NWFP based earnings, decreases with rising total income. While poor households generated an average of 11.4% of their annual income on the basis of NWFP, it was only 1.7% for affluent households. In particular, the sale of game contributed disproportionately to the income of poor households, as could be demonstrated with a further subdivision of the analysis into NWFP product groups.

The contribution of NWFP to subsistence was resolved into two components. Firstly, the contribution of NWFP to nutrition and secondly, the contribution of NWFP to articles of daily use were demonstrated. Faunal NWFP were identified as the second most important source of protein in all households. Game was served with one quarter of all meals, surpassed only by river fish, served with 40% of all meals but not considered a NWFP in this study. Vegetative NWFP were served only with 5.2% of meals and then only in very small quantities, primarily as very bitter vegetables or spices and condiments. Their contribution to the diet as appetizers is valued higher than their probably low calorie and nutritive content.

All participating households owned articles and utensils made completely or partly of durable NWFP such as cutlass handles and sheaths, wickerwork and palm hats. The most important raw materials were rattan canes, used differently according to their natural properties and final purpose. They were followed by *Licuala* palm leaves and Gutta Percha, used as adhesive. Further household articles traditionally made of rattan were also made from agricultural products, especially cultivated bamboo canes and leaves of *Pandanus* palms, or plastic. Informants reported an increasing process of rattan substitution. None-the-less Rattan Sega (*Calamus caesius*) was considered indispensable.

The replacement value of all articles made of durable NWFP was used as a method to compare the contribution of NWFP to subsistence with the contribution of NWFP to monetary income. The total replacement value was calculated as the sum of the local market-price values for the average number of articles per household. The results demonstrate that the monetary value of these articles per household is about equivalent to one third of the average annual cash income of the households investigated. A comparison of the annual replacement value of articles made of NWFP for subsistence with the monetary income generated on the basis of NWFP in the same time frame derived the following figure: the replacement value of NWFP harvested and processed for personal use amounted to five fold the amount of money earned by market oriented use of NWFP. Therefore the contribution of vegetative NWFP to subsistence is valued much higher than the direct contribution of NWFP to local monetary income.

An area of 100,000 hectare of natural forest (including primary and logged-over forest) was calculated to be required to continuously supply the people of Long Lalang and Ritan Baru with all plant-derived NWFP at their current rate of consumption. This figure corresponds with the total management area of the timber concession company Limbang Ganeca and surpasses the usual area of forest related activities by the village people. In addition, the harvest of NWFP by inhabitants of the other 14 villages on the border of the concession area would have to be restricted to assure the current rates of consumption. To supply the need for most NWFP, but excluding the rare and sought for Rattan Sega and Gutta Percha, a total area of about 4,000 hectare of managed natural forest would probably suffice.

In the NWFP-inventory, 101 NWFP-producing plant species were identified, of which only 42 species (about 40%) were actually used by the informants of the participating households during the research period. Only 10 of these NWFP were marketed, either as raw material or as processed goods. *Agelaea trinervis* (Mekai), *Calamus javensis* (Rattan Pulut putih), *Daemonorops critina* (Rattan Pulut merah) and *Parkia speciosa* (Petai) were sold unprocessed; species that were processed and marketed included *Calamus caesius* (Rattan Sega), *Korthalsia echinometra* and *K. ferox* (Rattan Merah), *Daemonoros atra* and *D. longipes* (Rattan Murah/Seringan) as well as *Payena acuminata* (Gutta Percha). These

NWFP and articles made thereof were products that were needed for subsistence as well, except for two rattan species providing Rattan Pulut, which were sold exclusively at the village-level.

An underused market potential could be anticipated insofar as products provided by at least 25 of the recorded NWFP-producing species during the inventory were traded at the provincial level and/or in other regions of Borneo. The socio-economic component of the study found that 16 of these commercial NWFP were not marketed in the research villages. For the others, with the two exceptions mentioned above, trade beyond the immediate research area did not take place during the research period.

Several reasons were identified for why more than 50% of all theo¬retically usable NWFP were not used at all and why more than 60% of all NWFP with market prices were not sold commercially. For most of these species the reasons were low attractiveness or poor quality of their products. Immediately following were economic reasons, which can be traced back directly or indirectly to the scarce plant population densities in natural forest stands. Attempts to promote the marketing of NWFP in the research area would have to deal with these problems of supply and quality as well as limited means of control over vast areas of managed natural forest.

Because of these handicaps the development of more intensive management of NWFP in these natural forests by local people cannot be expected. Consequently, no significant incentives are bestowed for the con¬ser¬vation of natural forests.

A purely sectoral or solely NWFP-oriented approach to secure and/or increase the use of NWFP as a source of income (in monetary terms or for sub¬sis¬tence) by the local people into the future seems promising only through an increased integration of NWFP in traditional agroforestry cultivation systems, provided that these systems are further developed. A rise of income for the people in the research villages could presumably be achieved more easily by pro¬moting the cultivation and marketing of established agricultural products. Having the official right to harvest timber, the improvement of working con¬ditions in the forestry sector and/or a regular share of the profits from the timber industry, reaping local resources as well as regulated monetary benefits from the nationalized usufruct of *Collocalia*-breeding caves, would be more promising than a unilateral promotion of the management of (vegetative) NWFP.

Based on these conclusions, recommendations were formulated in the context of different development options in the research area. At first, several potential development objectives were described, in which the use and management of NWFP played varying roles. These development options and objectives are partly interwoven and partly mutually exclusive. Conscious decisions for specific development priorities are recommended, though a sectoral promotion of the management of NWFP in natural forests is not a focus in either of these options. None-the-less, the results of the study predict a rising demand for particular local NWFP that possess a certain management potential outside of closed natural forests.

The final if disillusioning conclusion of this study is that NWFP are a weak but not to be neglected argument for the necessity of natural forest conservation, more so for faunal than vegetal NWFP. An intensified market oriented management of NWFP will most probably not contribute to natural forest conservation in the survey area.

REFERENCES:

Arnold, J.E.M. & Ruiz Pérez, M. 1996: Framing the issues relating to non-timber forest products research. In: Current issues in non-timber forest products research. Hrsg. Ruiz Pérez, M. & Arnold, J.E.M., Bogor: CIFOR, S. 1-18.

BML 1997: Tropenwaldbericht der Bundesregierung. 5. Bericht, Bonn, 59 S.

BMZ; GTZ; KfW; DSE 1997: Tropenwalderhaltung und Entwicklungszusammenarbeit. 5 Jahre nach Rio. Erfahrungen, Leistungen Perspektiven. Bonn: BMZ, 105 S.

CIFOR 1995: Contribution of non-wood forest products to socioeconomic development and their potential role in forest management concepts. Application for a Restricted Core Project to BMZ, Jakarta: CIFOR, 34 S.

Falconer, J. 1990: The major significance of 'minor' forest products: The local use and value of forests in the West African humid forest zone. Community Forestry Note 6, Rome, FAO, 232 S.

Falconer, J. & Arnold, J.E.M. 1989: Household food security and forestry: An analysis of socio-economic issues. Community Forestry Note 1, Rome: FAO, 145 S.

FAO 1995: Non-wood forest products for rural income and sustainable forestry. Non-Wood Forest Products 7, 127 S.

Godoy, R.A. & Bawa, K. 1993: The economic value and sustainable harvest of plants and animals from the tropical forest: Assumptions, hypotheses, and methods. Economic Botany 47, S. 215-219

Grossmann, C.M. 2000: Nichtholz-Waldprodukte in Ost-Kalimantan, Indonesien: Analyse der waldwirtschaftlichen und sozio-ökonomischen Aspekte ihrer Bedeutung und ihres Entwicklungspotentials für die Lokalbevölkerung in einem Holzkonzessionsgebiet. (Dissertation, Univ. of Hamburg, Germany). In: Mitteilungen der Bundesforschungsanstalt für Forst- und Holzwirtschaft No. 199, Kommissionsverlag Max Wiedebusch, Hamburg, 300 p.

GTZ 1993: Fachgespräch über forstliche Nichtholzprodukte (NHP). Protokoll (unveröff.), 17 S.

Nepstad, D.C. & Schwartzman, S. (Eds.), 1992: Non-timber forest products from tropical forests. Evaluation of a conservation and development strategy. Advances in Botanical Economy 9, NY: New York Botanical Gardens, 147 S.

Padoch, C. & de Jong, W. 1989: Production and profit in agroforestry: An example from the Peru¬vian Amazon. In: Fragile lands of Latin America: Strategies for sustainable develop¬ment. Browder, J.G. (Hrsg.), Boulder CO: Westview Press, S. 102-112

Prebble, C.; Ella, A.; Subansenee, W. 1999: ITTO: Making the most of NWFP. In: ITTO Tropical Forest Update 1, S. 4-8

Redford, K. & Padoch, C. (Eds.) 1992: Conservation of neotropical forests: working from tradi¬tional resource use. NY: Columbia Univ. Press, 475 S.

Sepp, C.; Walter, S.; Werner, W. 1996: Grundlagen und Leitfragen zur Thematik Forstlicher Nicht-Holzprodukte (FNHP) im Rahmen der Technischen Zusammenarbeit. GTZ, Abt. 424 (Hrsg.). Wiesbaden: Universum Verlagsanstalt, 47 S.

Tan, L.C.; Ruiz Pérez, M.; Ibach, M. 1996: Non-timber forest product databases. Bogor: CIFOR, 94 S.

ASSESSMENT TOOLS FOR FORESTRY DECISION-MAKERS - EXPERIENCE FROM FOREST DEVOLUTION IN VIETNAM'S CENTRAL HIGHLANDS

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SUMMARY

How can decision-makers in China's forestry administration acquire the information they need for the design and implementation of forest policy? Effective policy implementation requires the development of mechanisms for monitoring, analyzing, and adapting forest policies in a timely and efficient manner. This paper discusses a tool developed in Vietnam for assessing local outcomes of devolution policy. The tool combined attention to the effects of devolution on forest conditions as well as local livelihoods. Results from its application in ten villages suggest that the tool provides an effective and feasible way for forest administrations to generate relevant information about local outcomes of forest devolution. Assessments such as the one analyzed in this paper can make important contributions to learning-oriented approaches to forest policy, i.e., approaches that bring together policy-makers and scientists in mutually beneficial communication processes.

INTRODUCTION

China's forest policy has transferred significant rights on forests to local people (Weyerhäuser *et a*l. 2006). The move towards devolution poses serious challenges to forest departments, as it radically transforms their dealings with local people. Devolution challenges forest departments not only because they have to cede direct control over valuable resources and territory. But forestry officials, in China as in many other parts of the world, are also not used to thinking of local people as responsible resource managers (Edmunds and Wollenberg 2003). In addition, they often lack mechanisms for monitoring and analyzing initial policy outcomes, mechanisms that would allow them to adapt devolution policies to local contexts (Borrini-Feyerabend *et al*. 2000).

Devolution requires significant learning on the side of forest departments. The learning begins with the formulation of devolution experiments, their implementation in the field, and evaluation (Mayers and Bass 1999). Forestry officials need to learn from the outcomes of initial policy experiments in a systematic and collaborative manner. Such a learning-oriented approach involves generating knowledge on critical outcomes of devolution (Fisher 1999, Ribot 2002). Equally important, the approach calls for new ways to give various types of local actors a voice in policy evaluation (Edmunds and Wollenberg 2002). Forest departments need to develop mechanisms that help them work with local people in monitoring, analyzing, and adapting devolution policies in a timely and efficient manner.

In this paper, we present a simple tool developed to support learning-oriented approaches to forest devolution. It is the product of a collaborative assessment of devolution outcomes undertaken with provincial and national decision-makers and a provincial forest department in Vietnam. The tool is intended to help forest departments derive lessons from initial experiences to inform the design of subsequent rounds of devolution. Its development took explicit consideration of three criteria that are vital for its potential to support learning (Edmunds and Wollenberg 2002): the tool was developed to be effective, in the sense that it generates accurate information about changes in critical devolution outcomes; feasible, in the sense that its resource requirements match with the level of human and financial resources typically available to forest departments; and relevant, in the sense that it generates information upon which forestry decision-makers can act.

The paper is structured as follows. Section 2 introduces the policy and geographical background in which the assessment tool was developed. Section 3 presents the social and analytical processes guiding tool development. Section 4 discusses important lessons learned in the development and application of the tool. Section 5 concludes with more general remarks about assessment tools in devolution programs.

POLICY AND GEOGRAPHICAL BACKGROUND

Just as in parts of China and other Southeast Asian countries, Vietnam's forests used to be under direct state management. Vietnam nationalized forests in 1955 and established a system of state enterprises to manage them in the north and, after reunification in 1975, also in the south. State enterprises and governmental forest departments employed a large number of technical staff to manage the forests in a 'scientific' manner. Forestry engineers trained at Vietnam's forestry colleges and technical schools joined forces with workers recruited among the local population to put scientific management into practice. This was the primary way how people participated in forest management.

In the early 1990s, Vietnam's forest administration embarked on a major reform. The reform aimed to give local people a more active role in forest management. The 1993 Land Law created a legal basis for allocating long-term use rights to forestry land to non-state units, including rural households. A subsequent decree allowed state enterprises to contract out forest protection to local people and made significant funds available to finance the contracts. The reforms expanded the role of local people in forest management. Yet forest departments appeared ill-prepared to accommodate the new role attributed to local people in the legal and policy framework. They granted long-term use rights to local people only for degraded forestry land. Natural forests remained under the direct control of state enterprises.

In 1998, the provincial government of Dak Lak decided to seek new ways to attain sustainable forest management. The decision came after a decade of rapid economic growth fuelled by high in-migration. Dak Lak's dipterocarp and bamboo forests had gotten under increasing pressure from agricultural expansion. The rapid pace of economic change and in-migration had produced deforestation, making forest cover shrink from 70 percent in 1975 to 51 percent in 1999. The rapid pace of economic and demographic changes had also made local livelihoods increasingly insecure. Dak Lak's ethnic minority population, in particular, had felt increasingly threatened by the migrants.

The provincial authorities reacted by endorsing a proposal of the Department for Agriculture and Rural Development (DARD) to devolve forests as a way to stop deforestation and improve livelihood security. 'Forest land allocation' (FLA), as the devolution program was coined, transferred significant authority over natural forests from state enterprises to local villagers (Tran et al. 2003). Allocation granted local people long-term use rights to natural forests, including the rights to harvest timber and non-timber forest products, convert part of the forests to cropland, exclude others from the allocated forest, and pass forest titles on to their children or exchange them among each other. Forest recipients, in return, had to take over the duties to monitor forest use and report illegal activities to the local authorities. As for governance structures, DARD expected local authorities and village communities to take over most of the tasks previously assumed by the state enterprises. Village communities received the mandate to resolve minor disputes and develop internal management regulations. Local governments were required to fine violators and pass the resolution of larger forest disputes on to district courts.

Dak Lak's initiative met strong reservations on the side of the Ministry of Agriculture and Rural Development. The allocation of natural forests in Dak Lak went far beyond the practice of allocating degraded forestry land to rural households in other parts of Vietnam. Moreover, forest recipients in Dak Lak receive the right to exploit timber, even for sale. The provincial initiative, therefore, provoked initial resistance by the central government. In 2000, however, the Ministry recognized the provincial initiative, according it an experimental status. The provincial authorities, in turn, paused the program, after having allocated 16,000 ha of forestry land to individual households, groups of households and village communities in 15 villages until 2002. The pressure was on DARD to prove the benefits of devolution or abandon its initiative.

DEVELOPMENT OF THE ASSESSMENT TOOL

DARD reacted by requesting the German Agency for Technical Cooperation (GTZ) to support an assessment of the initial experience with forest land allocation. Provincial decision-makers wanted to analyze the outcomes of the first round of allocation before initiating the next one. This section discusses the development of the tool applied for the assessment of local outcomes. It focuses on two critical elements that structured the learning process in Dak Lak: a social and an analytical process. The focus is on the two processes, and not the tool or the results of the assessment, because they are of broader relevance to other forest departments in Vietnam and beyond. The tool and the results, in contrast, are specific to Dak Lak, as they reflect the interests of Dak Lak decision-makers and local conditions (for a summary of the results, see Tran, Nguyen and Sikor 2003b; further in-depth analyses of devolution outcomes are Nguyen 2005, 2006; Tran 2006; and Tran and Sikor 2006).

THE SOCIAL PROCESS

The province and GTZ got the assessment underway by way of a planning workshop in April 2001. They hired two researchers (the two Vietnamese co-authors of this article) to facilitate the assessment, including one DARD official who had played a central role in the allocation program to that point. They formed an advisory team including three senior officials from the Ministry of Agriculture and Rural Development and three experienced researchers with backgrounds in economics, ethnology, and social forestry. They also invited Humboldt University Berlin to contribute scientific advice to the assessment and train the two researchers. GTZ subsequently confined itself to providing financial support. Project oversight rested largely in the hands of DARD.

The development of the assessment tool was carried out in three rounds (see Figure 1). The first round, from July 2001 to January 2003, served to prepare the assessment. The two researchers performed a review of the relevant literature at Humboldt University and conducted in-depth studies of two villages. They consulted decision-makers in the People's Committee and DARD about their interests in the assessment. The consultations indicated that Dak Lak decision-makers primarily wanted to know about the effects of devolution on forest conditions and the benefits of the forests to local people. These interests informed the development of a prototype tool by the researchers and Humboldt University, including a set of practical aids for the collection and analysis of data.

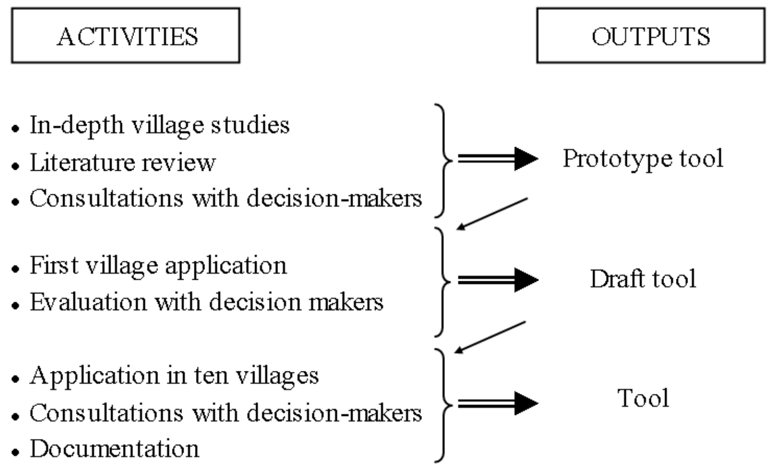

Figure 1. The social process of tool development

The second round, from February to April 2003, tested the prototype tool in the field. A team of three forest officers applied the tool in a village with assistance from the researchers. The two researchers, the advisory team, and Humboldt University evaluated the application and its results through joint fieldwork in the village. The researchers also presented the process and results of the village assessment to provincial leaders, seeking their comments and suggestions for modifications. They made necessary adjustments to the tool and documented the resulting draft tool in a manual.

The third round, from May to July 2003, centered on the application of the tool. Five teams of forest officers conducted assessments in ten villages, using the draft manual under supervision of the researchers (see also Text box 1). They documented their results in village reports and a database. The researchers synthesized the village results in an overview report and incorporated new insights into the manual. They presented the overview report and manual to decision-makers in Dak Lak and Hanoi. They finally had the report and manual printed in Vietnamese and English and distributed them among decision-makers and international development practitioners in Dak Lak, Hanoi, and other provinces (Tran, Nguyen and Sikor 2003a, 2003b).

Text box 1: The assessment tool

In Dak Lak, village assessments included the following activities:

Preparation (2 days): The team leader compiles secondary data about the village and forest, makes the necessary practical arrangements with villagers, the local authorities, and the State Forest Enterprise, and conducts wealth ranking for the selection of the household sample.

Fieldwork (5 days): The team leader and two enumerators collect data through household interviews; key informant interviews with the local forest officer, village leaders, expert villagers, and a person from a neighboring village; forest walks; and, focus groups with forest recipients and non-recipients in the village.

Data input (3 days): The team leader and enumerators put the collected data into a database.

Data analysis and report writing (4 days): The team leader analyzes the collected data and writes a report on the assessment results.

The tool is documented in a set of practical aids, including an operational work plan for a village assessment; data collection forms and instructions for all activities in the field; a database with users guide; instructions for data analysis; and, a template for the village report. The aids are available in Vietnamese from the authors on request.

THE ANALYTICAL PROCESS

The development of the assessment tool involved a social process involving various stakeholders. At the same time, the development followed an analytical process that helped translate the interests of DARD into concrete activities. The rationale helped the assessment team cast the interests of decision-makers into research questions, use analytical frameworks to define the needed variables, define concrete measures and data collection techniques for the variables, and employ analytical techniques in order to use the collected data for answering the research questions.

Research questions and analytical frameworks

Dak Lak decision-makers expected the assessment to produce insights into the effects of devolution on forest conditions and the benefits derived by villagers from the forest. These two primary interests motivated five concrete research questions. The questions, in turn, inspired the development of simple analytical frameworks as a way to identify relevant variables for the assessment.

Question 1: How have forest conditions changed after devolution?

Question 2: How have the benefits derived from forest changed after devolution?

The questions called for direct comparisons of the situation immediately before devolution with the situation at the time of assessment. The comparisons distinguished different kinds of forest resources and types of benefits. They also recognized that the benefits were likely to vary among households.

Question 3: What are potential causes of observed changes in forest conditions and benefits?

Question 3 was about the degree to which the observed changes in forest conditions and benefits probed by the first two questions were due to devolution. It prompted assessments to check the plausibility of a causal relationship between observed changes and devolution. Forest conditions and benefits typically change due to the simultaneous effects of multiple factors, especially in highly dynamic settings such as those prevalent in Dak Lak. Question 3 therefore proposed a simple check on the potential causes underlying observed changes. Its objective was not necessarily to identify to exact cause(s) producing observed changes, but to understand if there were other factors beyond devolution that may have contributed to the observed changes in forest conditions and benefits.

Question 4: What are potential changes in forest conditions in the future?

Question 4 expanded on Question 1 by exploring the possibility of further changes in forest conditions associated with devolution. The recent timing of forest land allocation motivated this question. Changes in forest protection and management were unlikely to have resulted in changed forest conditions at the time of application of the tool. In addition, changes in the local forest institutions in reaction to forest land allocation could be expected to happen gradually and take time.

The analytical framework associated with question 4 linked potential changes in forest conditions in the future to property rights and governance structures. The underlying assumption was that forest conditions improve if forest recipients have secure rights to the forest, if monitoring of forest use and sanctioning of violations exist, and if conflicts are minimized through appropriate mechanisms for conflict resolution. In this way, forest recipients have both the incentive and the means to manage forests in a more sustainable fashion.

Question 5: What are potential changes in benefits in the future?

Question 5 expanded on question 2 by examining changes in anticipated benefits derived from devolved forests. The reasons for this question were the same as those explained above for question 4. Just as in question 4, question 5 linked potential future changes in benefits to property rights. The assumption was that the higher the potential value of the forest itself, the more secure people's rights to the forest, the better their resources, and the more extensive their dependence on the forest, the more likely it is they will benefit from allocated forest in the future.

Measures, data collection techniques, and analytical techniques

The primary interests of decision-makers in the assessment yielded five concrete questions. The concrete questions inspired simple analytical frameworks, which, in turn, defined a series of variables. The variables could be grouped into six sets: (1) forest conditions and benefits from forest; (2) forest users and uses; (3) property rights on forest; (4) governance structures; (5) household attributes; and (6) potential causes of observed changes in forest use.

Measures served to identify concrete data to describe the abstract variables. The measures originated from the researchers' intimate knowledge of local conditions, as they had conducted two village studies to gain the required in-depth understanding of local conditions. The choice of measures was also informed by comparable assessments undertaken elsewhere, in particular the work of CIFOR on criteria and indicators (Prabhu et al. 1996). Each variable had at least one measure. The more important variables were measured by up to three measures.

The assessment incorporated multiple data collection techniques to obtain reliable data required for the measures. They included the collection of existing government statistics about the village and the allocated forest; forest walks to describe forest topographic conditions, accessibility, and changes in forest resources; focus groups with forest recipients and non-recipients on changes in forest resources, property rights, and governance structures; key informant interviews with village leaders, the local forest officer, and a person from a neighboring village on forest use, property rights and governance structures; and, household interviews on the use of forest, tenure rights, household resources, and main sources of income. The use of multiple techniques was intended to improve data quality through triangulation. Data required for the more important measures were collected from multiple informants and through the use of multiple techniques. For example, changes in forest conditions were described by direct observation, focus groups with villagers, and interviews with a local forest officer.

As a final step, the definition of analytical techniques helped to relate the collected data back to the research questions. The analytical techniques were simple, mostly relying on direct comparisons in tables and charts.

The analytical and social processes served as a basis for developing the assessment tool. The two processes helped the assessment team to translate the interests motivating the assessment into a set of practical aids and generate information on outcomes of forest land allocation. The development of the tool took three rounds of iterations, as discussed above. Each round was informed by new insights gained from the trial application of the tool, joint evaluations, consultations with Dak Lak decision-makers, and the eventual application of the tool in ten villages. In each round, the analytical process helped to structure the discussions involving the various stakeholders. It made sure that the assessment tool generated the information expected by decision-makers. It also helped the researchers to prioritize which data and activities were more important for the assessment and which less.

LESSONS LEARNED

The process described in the previous section generated a tool for the assessment of forest land allocation in Dak Lak. This section identifies important lessons learned in Dak Lak with respect to the development of effective, feasible and relevant tools in support of learning-oriented approaches to forest devolution.

Effectiveness

Application of the tool generated rich information about changes in benefits derived by local people from devolved forests, forest conditions, property rights, and governance structures. The assessment results also indicated villages where devolution was associated with improved forest conditions and increasing benefits and villages where it was not. The information was documented in the form of brief village reports and an overview report. It was also stored in a database for comparative use in future assessments.

The information presented in the village reports and overview report appeared reasonably accurate. We compared the assessment reports from three villages with the findings from our in-depth fieldwork in an adjacent village, finding no apparent contradictions. We believe that the background and training of team leaders and enumerators helped the accuracy. We selected as team leaders only those forest officers who had prior experience with participatory methods in forest management. We instructed them and the enumerators about the application of the tool not only in the office but also in the field. In addition, we closely supervised the first village application to provide practical advice to the assessment team in the field.

Despite the training, enumerators faced problems in inquiring about property rights, and team leaders had difficulty writing about them. The problems originated from five sources. First, property issues are complex, involving multiple actors, resources, and rights (Ribot 2002). Second, some terms used to describe property rights and governance structures in the international literature were not easy to translate into Vietnamese. Third, property relations were largely 'invisible' to villagers, because villagers were not used to thinking and talking about the use of and control over forests in these terms. Fourth, villagers were reluctant to talk about some property issues, as they referred to forest uses deemed illegal and prosecuted by the state. Fifth, the local effects of forest land allocation took time to develop, as they depended on negotiations and changes in material and symbolic practices that unfolded over time. As a result, the assessments team had a hard time describing property rights. We therefore decided to orient the assessment more towards concrete practices in forest management than abstract rights and obligations. This orientation also helped the assessment teams make the distinction between legal institutions and actual property relations.

Just as property rights take time to change, so do the benefits derived by local people and trends in forest conditions. An assessment of local outcomes undertaken a few years after legal devolution cannot be expected to indicate significant changes in benefits and forest conditions. Our experience demonstrated, however, that observed changes might be indicative, even if they are small. Observed instances of changing benefits and forest conditions indicated shifts in underlying trends that take more time to come to the fore. In addition, the general expectation that changes in outcomes would take time to develop helped us motivate the attention to property rights and governance structures. We justified the inclusion of property rights and governance structures by relating them to the primary interests of decision-makers through the construct of 'potential changes in the future'. 'Potential changes in the future' referred to changes in forest conditions and benefits that one may expect if the new regime of property rights, governance structures, and all other influences on forests remained the same. The underlying - and debatable - assumption was that benefits and forest conditions improve if appropriate property rights and governance structures are in place.

We also recognize several limitations to the assessment tool. First, the assumption of direct causal linkages between devolution and changes in benefits and forest conditions is problematic, particularly in dynamic settings such as Dak Lak. The assessment tool includes procedures that help check the plausibility of causal relations between devolution and observed changes. Nevertheless, inclusion of 'control villages', i.e., villages without devolution in similar conditions to those with devolution, would have improved the robustness of the analysis. Second, attention to equity effects proved to be another challenge for the assessment. The tool is 'blind' on intra-household dynamics and pays relatively minor attention to the claims of non-villagers on the devolved forest. Finally, the assessment defined the outcomes of forest land allocation in a rather narrow fashion. A more complete assessment would consider the effects of devolution on non-devolved forests and non-forest income.

Feasibility

DARD did not perceive the human and financial resources required for the village assessments as an obstacle. The department included sufficient staff members who could serve as team leaders and enumerators. They possessed the interviewing and computer skills required for enumerators as well as the organizational, analytical and writing skills demanded from team leaders. The simplicity of the tool and the user-friendly documentation clearly helped its application. The required number of labor days amounted to five percent of the labor required for the implementation of forest land allocation. As for financial costs, they amounted to between five and ten percent of the costs of allocation, depending on the size of the devolved forest.

We anticipate, however, that the overview assessment poses a significant challenge to the human resource capacity of forest departments. In Dak Lak, the two researchers performed the overview assessment with assistance by Humboldt University. In other cases, forest departments may not have the capacity to conduct the village comparison, which is less standardized than the village assessments. Some parts of the cross-village analysis require analytical skills that are rarely available in forest departments. Similarly, the overall interpretation of village results depends on a familiarity with socio-economic concepts that is scarce in a typical forest department. Without the necessary skills and knowledge, forest officers may easily draw wrong conclusions from the village results. This may mean that forest departments require guidance from external experts until they incorporate such skills and disciplines into their personnel and training.

The need for external guidance is even more true for the development of assessment tools suited to the interests of decision-makers and local conditions. Forest departments are unlikely to have the necessary social and analytical skills to translate the interests of decision-makers into concrete activities in the field. The danger is that, in the absence of these skills, well-intended efforts to learn from initial experiences of devolution may lead to blue-print application of assessment tools developed for other interests and conditions.

Relevance

The assessments generated information relevant to the needs of national and provincial forest departments. Much of the relevance derived from the fact that devolution is in its initial stages not only in Dak Lak but also in Vietnam as a whole. National and provincial decision-makers lacked relevant experience with devolution to guide the design of forest policy and programs. The assessment in Dak Lak provided much needed information about local outcomes of devolution to national and provincial decision-makers in a timely fashion. A report about the outcomes of forest land allocation commissioned by the Ministry in 2004 drew extensively on the results from Dak Lak. In Dak Lak, decision-makers decided on the basis of the assessment results to initiate further pilot projects before scaling the forest land allocation program up to the provincial level. They also recognized the need to strengthen the benefits derived by forest land allocation recipients by way of post-devolution support programs.

Decision-makers at both the national and provincial level consider the assessment tool as suitable for generating reliable information about the local outcomes of forest land allocation. The Ministry intends to include the tool in a ‘Forestry Manual’ summarizing best practices in Vietnamese forestry. The professional magazine published by the Ministry invited a feature article on the tool. More importantly, Son La province in northern Vietnam has started to adapt the tool to its own needs and conditions. The provincial forest department has applied the tool in one village on an experimental basis and is preparing o use it to evaluate the forest land allocation program implemented in Son La in 2001.

But the learning did not stop here. Evidence suggests that the tool development process contributed to learning among provincial and national decision-makers in other important, less tangible ways. The assessment results have served as an eye-opener for many decision-makers, bringing the drastic difference between the expected results and actual outcomes of forest land allocation to their attention. Decision-makers have increased awareness on the gap between legal rules and regulations, on the one hand, and de facto property relations and governance structures, on the other (cf. Fisher 1999). They now understand better why policy evaluations require systematic investigation in the field to examine how rules and regulations are mediated locally.

Another important effect is that the tool development has brought together national and provincial forestry officials. In 2000, the Dak Lak authorities and the central government were at loggerheads about devolution. Dak Lak's decision to allocate standing natural forest to villagers met strong reservations in Hanoi. Joint development of the assessment tool provided an important platform for national and provincial decision-makers to meet. Participation in tool development helped the provincial officials gain recognition for their policy innovation and encouraged national officials to assess the provincial initiative. Once they found the tool to be reliable and relevant, both sides recognized the information about local outcomes generated from its application.

CONCLUSIONS

In this paper we have discussed a tool developed in Vietnam that helps forest departments assess the local outcomes of devolution. In its application in Dak Lak, we found the tool to be effective, feasible and relevant. Although refinements are possible and desirable, the tool generated much-needed information about the local outcomes of initial devolution experiments in a timely fashion. In addition, the development of the assessment tool facilitated significant learning among provincial and national decision-makers. National forestry officials overcame their initial reservations against devolution. Provincial officials identified important lessons for subsequent rounds of devolution. At the same time, the Dak Lak forest department could not have developed the tool and performed the overview assessment without external assistance.

Assessments such as the one in Dak Lak can make important contributions to learning-oriented approaches to forest devolution (cf. Edmunds and Wollenberg 2002). Given appropriate assistance in participatory action research and socio-economic analysis, forest departments can develop effective, feasible, and relevant tools for assessing the outcomes of devolution. Such assessments not only generate important knowledge about local outcomes but they also give local people a voice in policy evaluation. They can serve as eye-openers for forestry decision-makers who have little experience dealing with local people and limited understanding of socio-economic dynamics in devolved forest management. They can also strengthen the confidence of forestry officials in the potentials of devolved forest management and help them identify ways to improve the design of devolution policies and programs. The low resource requirements of village assessments can even make those a suitable instrument for long-term monitoring.

Two elements appear crucial in the development of assessment tools. First, developing assessment tools is a social process involving a variety of actors (cf. Borrini-Feyerabend *et al.* 2000). The actors jointly develop the tool in iterative rounds of consultations, field application, and evaluation. Joint fieldwork may be especially conducive to overcome stereotypes, firmly-held beliefs and long-standing disagreements. Second, the development of assessment tools involves an analytical process that translates the interests of decision-makers into concrete activities in the field. The analytical process helps the involved actors to make sure that they collect all the data needed to generate the desired information in a timely manner. It also allows them to make best use of available human and financial resources. Focus on these two processes, and not the set of practical aids itself, makes the experience from Dak Lak relevant to other countries and contexts. It also makes the tool development process adaptable to other goals attributed to devolution, constellations of actors, interests motivating the assessment, and available human and financial resources.

Before we conclude, we want to emphasize the need for complementary tools and in-depth research. Short-term assessments cannot replace more rigorous research. That is why we combined the assessment process with two in-depth village studies. Assessments conducted by forest departments can also not replace monitoring and evaluation undertaken by local user groups (e.g., Springate-Baginski *et a*l. 2003) and people's organizations (e.g., Hartanto, Lorenzo and Frio 2002). Our concern is that forest departments need to improve their capacity because they are key players in devolution and post-devolution forest management. At the same time, they are often ill-prepared to take on the required new roles in forestry. Forest departments need to learn forest devolution.

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REFERENCES

BORRINI-FEYERABEND, G., FARVAR, M.T., NGUINGUIRI, J.C., NDANGANG V.A. 2000. Co-management of natural resources: Organising, negotiating and learning-by-doing. Kasparek Publishers, Heidelberg. 95 pp.

EDMUNDS, D. and WOLLENBERG, E. 2002. Historical perspectives on forest policy change in Asia: An introduction. Environmental History 6 (2): 190-212.

EDMUNDS, D. and WOLLENBERG, E. (eds.). 2003. Local forest management: The impacts of devolution policies. Earthscan Publications, London. 208 pp.

FISHER, R.C. 1999. Devolution and decentralization of forest management in Asia and the Pacific. Unasylva 50: 3-5.

HARTANTO, H., LORENZO, M.C.B. and FRIO, A.L. 2002. Collective action and learning in developing a local monitoring system. International Forestry Review 4 (3): 184-195.

MAYERS, J. and BASS, S. 1999. Policy that Works for Forests and People. Executive Summary of Series Overview. International Institute for Environment and Development, London. 350 pp.

MEINZEN-DICK, R. and KNOX, A. 2001. Collective action, property rights, and devolution of natural resource management: A conceptual framework. In: Meinzen-Dick, R., Knox, A. and Di Gregorio, M. (eds.). Collective action, property rights and devolution of natural resource management - Exchange of knowledge and implications for policy. Deutsche Stiftung für Internationale Entwicklung, Feldafing. 292 pp.

NGUYEN, Q.T. 2005. What Benefits and for Whom? Effects of Devolution of Forest Management in Dak Lak, Vietnam. Shaker Publishers, Aachen. 350 pp.

NGUYEN, Q.T. 2006. Forest devolution in Vietnam: Differentiation in benefits from forest among local households. Forest Policy and Economics 8: 409-420.

PRABHU, R., COLFER, C.J.P., VEKATESWARLU, P., TAN, L.C., SOEKMADI, R. and WOLLENBERG, E. 1996. Testing criteria and indicators for the sustainable management of forests: Phase 1 Final report. CIFOR, Bogor. 217 pp.

RIBOT, J. 2002. Democratic decentralization of natural resources: Institutionalizing popular participation. World Resources Institute, Washington, D.C. 35 pp.

SPRINGATE-BAGINSKI, O., YADAV, N., DEV, O.P. and SOUSSAN, J. 2003. Institutional development of forest user groups in Nepal: Processes and indicators. Journal of Forest and Livelihood 3 (1): 21-36.

TRAN, H.N., SIKOR, T., DANG, T.L., NGUYEN, V.D. and VU, V.M. 2003. Devolution of Forest Management: Six Years of Experience in Dak Lak. Department of Agriculture and Rural Development Dak Lak, Buon Ma Thuot (available at www.agrar.hu-berlin.de/wisola/ipw/plr). 27 pp.

TRAN, N.T. 2006. From legal acts to village institutions and forest use practices: Effects of devolution in the Central Highlands of Vietnam. Shaker Publishers, Aachen. 325 pp.

TRAN, N.T., NGUYEN, Q.T. and SIKOR, T. 2003a. Local impact assessment after forest land allocation: Manual. Department of Agriculture and Rural Development Dak Lak, Buon Ma Thuot (available at www.agrar.hu-berlin.de/wisola/ipw/plr). 24 pp.

TRAN, N.T., NGUYEN, Q.T. and SIKOR, T. 2003b. The local outcomes of forest land allocation: Evidence from Dak Lak. Department of Agriculture and Rural Development Dak Lak, Buon Ma Thuot (available at www.agrar.hu-berlin.de/wisola/ipw/plr). 34 pp.

TRAN, N.T. and SIKOR, T. 2006. From legal acts to actual powers: Devolution and property rights in the Central Highlands of Vietnam. Forest Policy and Economics 8: 397-408.

WEYERHÄUSER, H., KAHRL, F. and SU, Y. 2006. Ensuring a future for collective forestry in China's southwest: Adding human and social capital to policy reforms. Forest Policy and Economics 8: 375-385.

TRANSFER OF SCIENTIFIC EXPERTISE INTO SUCCESSFUL FOREST POLICY - CONCEPTS FOR THE EVALUATION AND MONITORING OF SUSTAINABLE FORESTRY IN CHINA

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1 INTRODUCTION

China runs the biggest forestry programs in the world. Improved use of these and the newly planted forests should provide multiple benefits for Chinese people. The success of this ambitious forest policy depends not only on the huge resources invested in it and on a strong political will but also on the expertise required in order to fulfil the task in the correct manner. Due to the complex system of multiple-use forestry it is a huge challenge to pinpoint the instruments which would deliver the desired impacts in an efficient manner. The transfer of scientific expertise into forest policy making is becoming one of the success factors of China's forestry development.

Examples from other parts of the world show that the science/policy interface is a very sensitive relation. (Forest-)scientists often produce unrequired knowledge and stake holders expect scientific answers which cannot be provided to them quickly. An additional common deficit is that stake holders believe in specific traditional or fashionable solutions which are scientifically incorrect. Finally, despite scientific activities, monitoring systems and evaluation reports, national and international stake holders often ignore science in favour of decisions guided by interests.

In the following chapters several factors to ensure a successful transfer of scientific expertise into policy practice will be discussed against the background of the evaluation and monitoring of sustainable forestry in China. The current monitoring and evaluation systems in China will first be described. Subsequently, problems and challenges presented by these systems will be identified. These problems will then be analysed against the background of political scientific theories of knowledge transfer in order to identify weaknesses and potential for improving the Chinese way of monitoring and evaluating. The conclusion will sum up the main results of this paper and will develop further questions for future research.

2 MONITORING AND EVALUATION SYSTEMS IN CHINA

2.1 SCIENTIFIC MONITORING SYSTEMS

Chinese Ecosystem Research Network (CERN)

The most important scientific forest monitoring system is CERN, managed by a selection of the Chinese Academy of Science's (CAS) research institutes and botanic research gardens, There are more than 36 research stations affiliated to CERN over the country, out of which nine are forest ecosystem research stations. These stations are under the auspices of the Ministry of Science and Technology.

The research stations are located in different types of forests, including humid temperate forests, sub-humid warm temperate forests, monsoon sub-tropical forests, high mountain warm temperate forests and humid tropical forests. All the stations engage in monitoring work, research, experimentation and demonstration.

Figure 1. Distribution of CERN stations (the second symbol stands for the forest stations)

- Changbai Mountain Forest Research Station
- Beijing Forest Ecosystem Research Station
- Dinghushan Forest Ecosystem Research Station
- Gonggashan Forest Ecosystem Research Station
- Xishuangbanna Tropical Rainforest Ecosystem Station:
- Ailaoshan Tropical Rainforest Ecosystem Station
- Maoxian Forest Ecosystem Research Station
- Huitong Forest Ecosystem Research Station
- Xiaoliang Tropical Forest Ecosystem Research Station

Chinese Forest Ecosystem Research Network (CFERN)

CFERN is a monitoring system specialized to forest ecosystems. It is financed by the State Forestry Administration and the Ministry of Science and Technology. The committee of CFERN is composed of officials from the State Forestry Administration and forest experts. The chairman of the committee is Jiang Youxu, senior scientist of the Chinese Academy of Forestry (CAF). Some stations are lead directly by CAF, the others are supervised by the forestry colleges and local forestry research institutes. The information from these stations is collected in CAF.

The CFERN was first established at the end of 1950s and the beginning of the 1960s. A total of 6 stations were established during that period. These research stations were based on concepts from Soviet Russia. The other 13 stations were established after the 1960s, and some concepts from the USA and European countries were adopted.

These stations are located in nearly every type of forest in China, including tropical forests, subtropical forests, temperate forests and cold temperate forests.

Figure 2: Distribution of CFERN stations

Table 1: List of forest stations

1. Binglashan Forest station, Laoning	11.Dagangshan Forest Station, Jiangxi
2.Capital Forest Station, Beijing	12.Wuyishan Forest Station, Fujian
3.Xiaolangdi Forest Station, Henan	13.Huitong Forest Station, Hunan
4.Pearl Delta Forest Station, Guangdong	14.Jianfengling Forest Station, Hainan
5.Daxing'anling Forest Station, Mongolia	15.Tianshan Forest Station, Xinjiang
6.Mao'eshan & Liangshui Forest Station, Heilongjiang	16.Qilainshan Forest Station, Gansu
7.Taiyue Forest Station, Shanxi	17.Wolong Forest Station, Sichuan
8.Qinling Forest Station, Shanxi	18.Lingzhi Forest Station, Tibet
9. Baotianman Forest Station, Henan	19.Karst Forest Station, Guizhou
10. Yangtse River Delta Forest Station, Jiangsu	

There are two important research fields. One is the relationship between forest and water resources, the other is forest carbon sequestration and carbon balance.

Main research tasks in the future

- To establish a forest environment monitoring system and forecasting system
- To establish a forest ecological benefit assessment system
- To establish a combination model on forest resources, forest environment, water resources, carbon cycle and social development
- To establish a publicly available database and website

Monitoring indexes system

- Interaction indexes of forest climate
- Physical and chemical indexes of forest soil
- Forest ecosystem health and sustainable development indexes
- Interaction indexes of forest hydrology
- Forest ecosystem community character indexes

2.2 POLICY MONITORING SYSTEMS

Economy Research Centre, State Forestry Administration (SFA)

The Economy Research Centre, a part of the SFA was established in 1994. The institution is responsible for providing an economic forestry consulting service for the SFA’s policy makers. Its main tasks include economic forestry consulting, forest policy monitoring and forestry strategy formulation. One of the most important projects of this institution is the so-called “Key public-benefit forest monitoring program at social and economic level” It represents the largest forest policy monitoring program. The program was initiated in 2002. Altogether 200 counties, 188 villages and 1200 farmers were selected to be monitored, and one part-time member of staff is responsible for collecting the information of that county. The data is collected and delivered to the Economy Research Centre annually. A report is published at the end of each year.

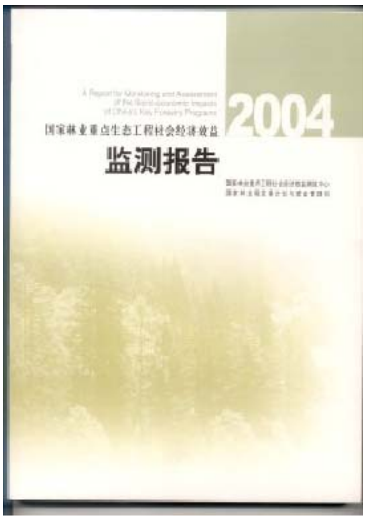

Figure 3 Social and economic Monitoring Report of the non-commercial forest programs

Research Institute of Forestry Policy and Information, CAF

The Research Institute of Forestry Policy and Information (RIFPI) was established in 1964. The institute is responsible for providing the SFA, the Chinese Academy of Forestry and other state general departments and administrative agencies with forestry policy consulting, information collection and data analysis services. The institute is also engaged in organizing thematic information studies according to the requirements of the upper administrative organizations and to the need for development dynamics regarding relevant topics. Its main tasks include forestry policy consulting, forestry policy monitoring, world forestry information consulting, forestry strategy making, forest product and market consulting. Key research fields include forestry policy and strategy, forest environmental economy, world forestry, the wood product industry and community forestry.

Centre of Chinese Agriculture Policy, CAS

One of this centre's important research fields is resource and environment policy, which includes

- Cost-benefit analysis of important forest programs
- Forest resource management system reformation and sustainable development
- Land resource protection and sustainable utilization

3 PROBLEMS AND DISADVANTAGES OF THE MONITORING AND EVALUATION SYSTEM CONCERNING FORESTRY POLICY IN CHINA

There are many forest ecosystem research stations and forest policy assessment institutions in China. However it would be wrong to say that forest ecosystem monitoring and policy assessment in China were optimal. There are many problems and disadvantages to these two systems.

1. **Separation of the ecosystem monitoring system from the policy monitoring system**: In China, the forest ecosystem monitoring system and policy monitoring system are distinctly separated from one another. They belong to different sectors. These two systems should be reconciled with each other in order to improve sustainable forest management in China (Xu Jintao, 2002).
2. **Data transparency:** In China, there are several forest monitoring systems which belong to different sectors. Their data is normally not available to other research institutions (Jin Fang, 2005).
3. **Short Monitoring period:** China's forest monitoring system was first established in the 1950s. Due to the fact that it has only been in place for about 50 to 60 years, the data obtained from the stations has not yet been able to provide sufficient information about the forest management cycle on which to base forest policy making (Xiao Jianmin, 2004; Chen Dongli, 2005).
4. **Veracity of information from local governments:** Data obtained from different levels of government is being used in policy monitoring and assessing. In some cases, this data is not reliable; especially when it is required for the analysis of sensitive forest policy issues (Xu Jintao, 2003).
5. **Fairness within policy monitoring and assessing institutions:** In China, policy monitoring and assessment institutions belong to different sectors. These institutions normally delegate the benefits of their sector, and there are some biases in their research results (Ran Yonghong, 2005).

6. **Lack of forestry and pollution research:** Pollution has, especially in recent years, become a very serious problem in China, and with rapid economic development the pollution can only become worse. Forests can to some degree contribute to the reduction of this pollution. This effect is an important factor for forest policy making. This effect has however not been sufficiently taken into consideration within the forest ecosystem and policy monitoring system, (Jin Fang, 2005).
7. **Limitation of international forestry issues:** As the biggest developing country with rapid economic development, China will play a more important role in international forestry issues. At present, China's chances of being able to participate in global forest monitoring and forest policy are poor. There are no specialised institutions currently focussing on this issue (Zhou Shengxian, 2002).

4 POLITICAL FACTORS FOR A SUCCESSFUL TRANSFER OF EXPERTISE

4.1 TRANSFER OF SCIENTIFIC EXPERTISE BETWEEN TECHNOCRACY AND THE "REAL POLITICAL WORLD"

In classic technocratic approaches knowledge flows from science to public policy-making and is applied and mediated from truth to power (Weingart 1999, 2003). In technocratic models policy making is constructed as an act of rational "problem-solving" and expert participation is seen as essential. Within this model, scientists are brought into policy processes to impart their unique knowledge and wisdom to policy-makers (Pregernig 2004). The role of science for policy-making is in such models that of "speaking truth to power" (Price 1981). Scientific advisors influence the policy process due to their superior knowledge, something through which they become powerful. Expertise plays the role of a neutral problem-solving resource for political actors. In principle there is no problem behind the transfer of scientific expertise into successful policy – it is just a question of the policy actors' demand for expertise. The identified problems of the Chinese monitoring and evaluation system for sustainable forestry show that political reality seems to be far away from technocratic dreams. It would be worthwhile to analyse these problems against the background of more recent results within scientific knowledge-transfer research. In contrast to naïve technocratic models, more recent literature has identified some important general problems of knowledge transfer which can be applied to the challenges presented by the Chinese monitoring and evaluation system.

1. Scientific expertise does not always deliver unbiased problem solutions., Experts or institutions can be driven by a variety of other interests such as obtaining funds or serving the interests of their financiers. Experts are not necessarily neutral and apolitical but are often forced to come to an "arrangement" with those groups that financially support them (Fischer 1990; Krott 1989). Decision makers try to use expertise for legitimising their interests and political programmes (Krott 1999) and, thus support those scientists who deliver the scientific results which conform to their expectations and beliefs (Schneider 1989). Political actors often choose the scientific concepts which most represent their political ideas or simply completely ignore scientific assumptions (Murswieck 1994, 105). In the Chinese policy monitoring and assessing system it can be observed that the institutions involved belong to specific sectors whose interests they serve. Their research results are therefore sometimes

biased. In addition to this, the data obtained by these different institutions is not made accessible to other research institutions, so there is no possibility for other experts or institutions to review this data in a critical manner.

2. The technocratic model argues that obtaining the expertise relevant to a specific policy problem does not present any difficulty. However when dealing with complex and novel problems, such as achieving sustainable development, an innovative re-organisation of the transfer of expertise is required even before solutions to such new and intersectoral and interdisciplinary problems can be delivered. Currently, in China, the ecosystem monitoring system is separated from the policy monitoring system and the important connection between sustainable development, forests, and pollution is not well investigated. In addition to this, the shortage of data from the forest monitoring systems and the non-reliability of data provided at different levels of government show that the currently available expertise does not seem to be applicable to sustainable forestry in China.

4.2 CONDITIONS FOR A SUCCESSFUL TRANSFER OF EXPERTISE

There are several conditions to ensure the effective transfer of scientific expertise into policy which should be discussed in order to provide an insight on how to organise the Chinese monitoring and evaluation system. These conditions should reflect the reality of the impossibility of a technocratic application of scientific knowledge. Pregernig (1999) argues that there are two main conditions which lead to the application of scientific expertise in political practice:

1. Research and its results have to be problem-oriented and
2. Expertise has to be perceived and accepted by practitioners and within their “contexts of application” which include power relations and the actors’ interests.

The first condition is self-evident and will not be further elaborated in this paper. The second condition refers to the perception of scientific expertise of the political actors and/or other practitioners who are to make use of it:. It also refers to the important point that *political actors have to accept scientific expertise before they make use of it.* Three main factors which positively influence the practitioner’s acceptance and/or utilization of expertise are discussed in the literature pertaining to this topic. These factors are: *Salience*, *credibility*, and *legitimacy.*

1. *Salience* refers to the relevance of information for an actor’s decision choices or for the choices that affect the given stakeholders (Cash et al 2002: 4). Some topics discussed by scientists may not be very relevant to political practice even though they are elaborated by scientists for an application in practice. Scientific expertise has to suit the interests of powerful policy actors since the selection or application of expertise is more dependent on power relations than simply on scientific rationality. If developed technologies are inappropriate for the special environmental context in which they should be used then the expertise can be deemed to be lacking in salience. If information on specific issues reaches the practitioners too early or too late, or if information is too broad or too narrow in scope, or if it is not at the right scale for decision makers, then the expertise can fail to influence action due to lack of salience (Kingdon 1995). Even if the expertise meets all of these criteria then the amount of influence the expertise has on the political process is still determined by power relations and by the interests of powerful actors.

2. *Credibility* refers to whether an actor perceives information as meeting standards of (scientific) plausibility and technical adequacy. Actors must deem sources of knowledge as trustworthy and/or believable, along with the facts, theories, and causal explanations invoked by these sources (Cash et al 2002: 4). One problem is that political actors are often not able to evaluate the scientific credibility of one source of expertise. The degree of the general credibility of scientific expertise therefore increases with the decrease in the level of scientific uncertainties and a scientific consensus concerning a special issue emerges. Another critical point regarding credibility is that, for professional reasons, actors often regard specific information sources as more credible than others. One source of expertise competes with another source of expertise to gain credibility among political actors. For example, the fact that an actor may have had positive experiences with a specific information source in the past could lead to the policy actor regarding this source as more credible than an information source with which he has not had any experience to date. A policy actor trusting a source of expertise of his own profession more than an outside information source (foresters might trust foresters as experts more than nature conservationists) is a further example of credibility.
3. *Legitimacy* refers to whether an actor and public groups perceive the process in a system as unbiased and meeting standards of political and procedural fairness. (Cash et al 2002: 5). The transfer of scientific expertise into policy may meet such standards by considering appropriate values, interests, concerns, and specific circumstances from multiple perspectives (Cash et al 2002: 5). The legitimacy of expertise increases if the flow of information is organised and communicated in a transparent manner which also incorporates the concerns and perspectives of the different actors involved in the policy process, the actors who have to apply scientific recipes, and the citizens who may be affected by the use of a specific knowledge source.

4.3 ASSESSMENT OF THE CHINESE MONITORING AND EVALUATION SYSTEM

The Chinese monitoring and evaluation system faces specific challenges against the background of these factors of knowledge-transfer:

1. Due to the dynamic change of use and protection of forests in China, keeping up a high standard of salience is becoming very difficult. The integration of new groups affected by forests and forest use into the monitoring process has to be facilitated. The old system of monitoring and use of information is becoming less and less adequate due to newly emerging information requirements. New groups requiring information are private enterprises, citizens who wish to establish their own opinion about the state of nature, national interest groups for environmental protection, international agencies and interest groups who deal with the heritage of our forests worldwide. The sectoral-oriented Chinese monitoring and evaluation system is more and more challenged by the need of intersectoral problem analyses and is not adequate against the background of new questions and information needs.
2. Since some monitoring and evaluations seem to be too biased and the different (especially new) actor groups do not have access to all relevant information or data, there is a lack of trust in the expertise which leads to a decrease of credibility. All in all, the understanding of the strengths and limits of scientific expertise is still small and the partial answers of the scientists are not fully accepted by the stakeholders.

3. The process of producing and using monitoring and evaluation information lacks transparency for the public. The important incorporation of international information processes is still to be worked out and could possibly connect the national monitoring and evaluation system with international discourses and regimes such as forest certification or international conventions.

Summed up, the organisation of the Chinese monitoring and evaluation system is currently not adequate when taking into consideration the outlined criteria for an optimal scientific knowledge transfer.

4.4 STRATEGIES FOR THE IMPROVEMENT OF THE TRANSFER OF EXPERTISE AND OPEN RESEARCH QUESTIONS

The following potential strategies may improve the transfer of expertise within Chinese monitoring and evaluation systems in order to promote sustainable forestry.

1. A better integration and linkage of ecological and social monitoring can substantially improve the usability of the monitoring systems for the needs of users at national and international level. Only the integration of social and political data leads to a rational selection of the correct ecological tasks which can be carried out against the background of social and political constraints.
2. Scientific expertise on forests would become much more relevant for many groups if they could obtain direct access to data production and data use. Herein lies a huge potential for scientific expertise to produce easy accessible data and to make it accessible to the public.
3. With regard to legitimacy it could be helpful to search for procedures which integrate different sources of knowledge into the monitoring and evaluation system. On the one hand such a strategy could aim at integrating international forest monitoring measures, on the other hand at integrating different kinds of knowledge, especially sources of tacit knowledge, such as older generations' disaster prevention knowledge or the experience-based knowledge of rural inhabitants. This strategy refers to newer approaches of how to produce legitimate systems of expertise-transfer in the political sciences (see Fischer 2002: 24 ff).
4. It could also be of strategic advantage to improve the interface between science and the media as well as between science and political institutions in order to achieve a higher dissemination of expert knowledge and a better integration of the public and political actors' interests into the production process of expertise (transparency).

REFERENCES

Cash, David W.; Clark, William C.; Alcock, Frank; Dickson, Nancy; Eckley, Noelle; Jäger, Jill (2002): Salience, Credibility, Legitimacy and Boundaries: Linking Research, Assessment and Decision Making. KSG Faculty Research Working Paper 02-046. Cambridge, MA: Kennedy School of Government, Harvard University. 25 pp.

Chen Dongli, Yu Xinxiao and Liao Banghong (2005): Analysis on the Function of Conservation Water of the Chinese Forest Ecosystem. World Forestry Research. 18(1):49-54

Fischer, Frank (1990): Technocracy and the Politics of Expertise. Newbury Park et al.: Sage. 387 pp.

Fischer, Frank (2004): Professional Expertise in a Deliberative Democracy: Facilitating Participatory Inquiry. The Good Society (Vol. 13 – No. 1). pp 21-27.

Jin Fang, Lu Shaowei and Yu Xinxiao (2005): Forest ecosystem service and its evaluation in China. Chinese Journal of Applied Ecology 16(8):1531-1536

Kingdon, John (1995): Agendas, Alternatives, and Public Policies. 2nd ed., New York: Harper Collins.

Krott, Max (1989): Policy-Analyse aus der Sicht eines Politikfeldes am Beispiel der Forstwirtschaft. Österreichische Zeitschrift für Politikwissenschaft (Vol. 18). pp. 21-34.

Krott, Max (1999): Musterlösungen als Instrumentarien wissenschaftlicher Politikberatung. Das Beispiel des Naturschutzes. Zeitschrift für Parlamentsfragen (No. 3/99). pp. 673-686.

Murswieck, Axel (1994): Wissenschaftliche Beratung im Regierungsprozess, in: Axel Murswieck (Ed): Regieren unPolitikberatung, Opladen: Leske & Budrich, pp 103-119.

Pregernig, Michael (1999): Die Akzeptanz wissenschaftlicher Erkenntnisse, Frankfurt: Peter Lang.

Pregernig, Michael (2004): Linking Knowledge and Action: The Role of Science in NFP Processes. In: Glück, Peter; Voitleithner, Johannes (eds): NFP Research: Its Retrospect and Outlook. Proceedings of the Seminar of COST Action E19 "National Forest Programmes in a European Context", September, 2003, Vienna. Publication Series of the Institute of Forest Sector Policy and Economics – Vol. 52. Vienna: Institute for Forest Sector Policy and Economics. pp. 195-215.

Price, Don K. (1981): The spectrum from truth to power. In: Kuehn, Thomas J.; Porter, Alan L. (eds): Science, technology, and national policy. Ithaca; London: Cornell University Press. pp. 95-131.

Ran Yonghong, Niu Dingwei and Liu Jinrong (2005): Farmer Participatory in Calculate of Beneficial Result in Study of Returning Some of Their Cultivated Lands to Forest: Take Huacha Valley, Gansu Province for Example. Green Economics. 5: 59-61

Schneider, Wolfgang L. (1989): Kooperation als strategischer Prozeß. Administrative Auftragsforschung im Spannungsfeld zwischen professionellem Interesse und politischer Instrumentalisierung. In: Beck, Ulrich; Bonß, Wolfgang (eds): Weder Sozialtechnologie noch Aufklärung? Analysen zur Verwendung sozialwissenschaftlichen Wissens. Franfurt am Main: Suhrkamp. pp. 302-331.

Weingart, Peter (1999): Scientific expertise and political accountability: paradoxes of science in politics. Science & Public Policy (Vol. 26 - No. 3). pp. 151-161.

Weingart, Peter (2003): Paradox of Scientific Advising. In: Bechmann, Gotthard; Hronszky, Imre (eds): Expertise and Its Interfaces: The Tense Relationship of Science and Politics. Berlin: edition sigma. pp. 53-89.

Xiao Jianmin, Ma Lnyi and Wang Xiaoping (2004): Economic Benefit Dynamics of Carbon Sequestration by F0rest trees in Miyun Watershed Journal of Beijing Forestry University. 26(4):20-24

Xu Jintao, Cao Yiying (2002): Sustainable Development Issues of Land Conversion from Crop to Forest. International Economy Comment.2:56-60

Xu Jintao, Yu Ying and Xie Chen (2003): Effects to Community Forest & Community Economy by Natural Forest Protection Program. Forest Economics.6:28-32

Zhang Lei, Zou Hong (2003): Evaluation on Forestry Policy of Implementing the West Development Strategy. Journal of Northwest Forestry University. 18(1):59-62

Zhou Shengxian, Jiang Zehui and Lei Jiafu (2002): Chinese Forestry Sustainable Development Strategy. Chinese Forestry Press. Beijing, China. pp.374-377

SOIL CONSERVATION POLICIES IN CHINA: CAPACITIES FOR SUSTAINABLE RESOURCE USE

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1 INTRODUCTION

China pursues active environmental policy nationally and at the international level. It has a "relatively well-developed regulatory system with more then 2000 laws issued in the area of environmental protection" (OECD 2005: 13) and plays an active and dynamic role in international environmental conventions (e.g. SEI/UNDP 2002: 64). Still, environmental problems are pressing and it is often pointed to implementation difficulties (OECD 2005, World Bank 2001).

Soil protection has a long tradition in China and several reforestation programs have been implemented since the 1950s (CCICCD 2002). More recently, China has been active in the frameworks of the United Nations Conference to Combat Desertification. The immense losses of human life and property in the 1998 Yangtze flood made policy makers aware of the direct consequences deforestation in the river's upper catchments may have and led to enforced protection measures in the 10th Five-Year-Plan (World Bank 2001). However, soil degradation is a major problem. More than 180 million ha out of a total land area of 926 million ha are affected by water erosion, 150 million ha by wind erosion and more than 70 million ha are affected by chemical deterioration (van Lynden and Oldeman 1997).

Soil conservation is a very distinct and difficult field of environmental policy. Soil conservation has an unfavourable underlying "problem structure" due to low visibility of the problem and complex causes among other things (Jänicke 1999). Therefore worldwide, "only few countries have national soil policies, and only a fraction of those countries effectively implement, monitor and finetune policies" (Hurni and Meyer 2002: 7, for a typology of legal frameworks compare Hannam and Boer 2002). In addition, international activities – a driving force of environmental policy in many other policy fields – are limited.

Against this background this paper presents an analysis of policies and capacities in the field of soil conservation in China. Capacity was defined by the OECD Task Force on Capacity Development: "Capacity in environment relates to the abilities of a society to identify environmental problems and solve them, capacity development in environment relates to the 'process' by which those abilities are developed" (OECD 1994: 9). Further specified by Jänicke (1997) capacities can be described as the strength, competence, and configuration of proponents of environmental protection as well as cognitive-informational, political-institutional, and economic-technological framework conditions. In addition, situative factors (e.g. natural disasters) and the kind of problem (the problem structure) are crucial factors for institutionalization of environmental policies. In the case of developing countries, international influences from development aid or international conventions are rather strong. Therefore, this work extends the framework to incorporate these influences.

The present study is based on a review of primary documents, literature, and web-based information that are available in English (or German, but not Chinese). A wealth of German and English literature on environmental protection in China is available. Detailed documentations and analyses of Chinese environmental legislation were published by Lee (1999) and Heuser and Graf (2001). Overviews on Chinese environmental policy are found in Mao (1996), Cheung (1998), Betke (2000), World Bank (2001), Stockholm Environment Institute and UNDP China (SEI/UNDP 2002), and OECD (2005). More specifically on soil conservation issues compare Küchler and Straub (2002), and documents published as part of the "Capacity Building to Combat Land Degradation Project" led by the Asian Development Bank (ADB 2004). In addition, policy documents by the Chinese Government document soil conservation efforts (especially CCICCD 2002).

The paper starts from a review of soil conservation policies and legislation in an international perspective highlighting the general difficulties in regulating this particular environmental problem. Secondly, the state of policies for soil conservation at the national level is presented and, thirdly, determinants of this development are assessed. Finally, a brief discussion concludes.

2 SOIL PROTECTION – AN INTERNATIONAL PERSPECTIVE

Soil conservation policy and legislation have a long history. The first soil conservation laws were introduced in the first half of the 19th century primarily to control erosion by wind and water (Hannam and Boer 2002: 27). In the 1930ies a system of government programmes to combat soil erosion was introduced in the United States. However, a review of 200 individual national soil legislations suggests that "existing national soil legislations are inadequate" and, generally, "national legislation for soil has received less attention than that for other ecosystem components (e.g. water, vegetation, wetland)" (Hurni and Meyer 2002). This same study (ibid: 28) cites recent reforms in Chinese soil legislation as one of few positive examples. Other than in many policy fields, very different types of legislative regimes for soil conservation evolved. Hannam and Boer (2002) differentiate eight types of soil conservation legislation. This might be a consequence of country-specific requirements, but in parts also reflects how difficult this particular environmental issue is. In addition, most countries approach soil in a fragmented way.

International activities are similarly less developed than for other environmental problems: There is only "soft" law on soil in the international context ("World Soil Charter" and "World Soils Policy"). In three binding international agreements (United Nations Convention to Combat Desertification (UNCCD), United Nations Convention on Biological Diversity (UNCBD), and the United Nations Framework Convention on Climate Change (UNFCCC)), however, soil is addressed, but not the central issue. In sum, concerning external factors limited international coordination and diffusion is observed. An international soil instrument could potentially contribute to raising awareness and improve funding. Another important international activity on soils would be to prepare guidelines for individual nations to improve national soil laws (Hurni and Meyer 2002: 26).

Recently land degradation has become a focal area of the GEF (Global Environmental Facility) that so far was only funding biodiversity conservation. Thus, the international funding activities will increase, and one example is the so-called "Capacity Building to Combat Land Degradation Project" in China, with a considerable budget.

3 SOIL PROTECTION POLICIES

Policy output in the field of soil protection embraces a broad range of activities. Legislation on soils is to be mentioned first. Provisions relevant for soil protection are also found in additional legislation, especially in forest legislation, land use planning and land administration legislation. Apart from legislation, strategies, policies, and plans as well as specific programmes and projects for soil conservation are of crucial importance for soil conservation. Finally, attempts of "greening" other sector and resource use policies, thus, policy-integration, can strengthen soil conservation.

China has an embracing and differentiating environmental legislation and soil specific legislation (Bückmann and Lee 2000: 30). Soil conservation is treated in a specialised law as well as in neighbouring laws and in a general environmental law. Soil legislation suffers from a lack of protection of non-agricultural land and regulating pollution aspects (ibid: 75). In addition, agriculture as a cause of soil conservation is not treated (Küchler and Straub 2002: 75).

A specialised "Soil and Water Conservation Law" was passed in 1991, which replaced the "Soil and Water Conservation Regulations" of 1982 (Bückmann and Lee 2000: 71). As early as 1957 "Soil and Water Conservation Provisional Outlines" were introduced (ibid: 72). Thus China has a fairly long tradition of soil conservation legislation. The law has a strongly preventive character (Küchler and Straub 2002: 75). A second specialised law on soil conservation is the „Law on Combating Desertification" of 2001, which is the first of its kind worldwide (CCICCD 2002: 12). This law was directly related to China's activities as part of the UNCCD. The "Land Administration Law" of 1986, revised in 1998, regulates use of land and states the general objective of protecting land resources and special obligations related to the use of land. This law is especially relevant to soil conservation since it sets the framework for land use in terms of duration of contracts and conditions of use of different types of land. A range of additional laws include provisions on soils. Of special importance for soil conservation are the "Grassland Law" of 1985 and the "Forestry Law" of 1986, revised in 1998 with its objective of protecting forest functions and incentives for reforestation (Heuser and Graf 2001: 28).

Apart from legislation, China's soil conservation programmes especially trough afforestation and water management are impressive and have been acknowledged internationally (Betke 2000: 343). Recent policies and development plans with the aim of controlling land degradation include the "Western Development Strategy" launched in 1999, with one main objective of ensuring sustainable natural resources management, "National Plan for Ecological Environment Construction", "Natural Forest Protection Program", "National Land Conversion Program", "Small Watershed Program of the Ministry of Water Resources", "Desertification Prevention and Control Programs", and the "National Action Program to Combat Desertification".

In Chinese environmental policy, SEI/UNDP (2002: 79) observes three different approaches: (1) a "campaign approach", the earliest government approach starting in the 1960s, (2) an approach based on "legislative and regulatory frameworks" starting with the beginning of the reform period, and (3), most recently, the use of "market-based instruments". Especially in natural resource management, the report (ibid) finds continuation of the first approach: "In the wake of the devastating floods in the summer of 1998, the Chinese government renewed its attention to the conservation of natural resources by issuing new directives to restrict logging and calling for wetland preservation along the middle reaches of the Yangtze River. […] These important administrative measures have been backed up by large investments. Some investments are similar to past methods used in the 1980s to reforest or re-grass land." However, there are also examples of the use of market-based approaches in natural resource management, especially the "Sloping Land Conversion Program" which provides incentives (a combination of food and cash subsidies over a period of eight years) for farmers to convert steep lands that are presently cultivated or barren, into forest, shrub, or grassland cover (ADB 2004: 6). Also, the new desertification law has some provisions to stimulate community and private sector involvement through the use of fiscal and other incentives (ibid.).

Overall, strong commitment by the Chinese government in soil conservation is observed. Shortcomings are "overlapping roles, conflicts, and inconsistencies" in the legal framework, (ibid: 5). Concerning land tenure reforms the same study reports that "in many areas there is still uncertainty among farmers as to the security of their user rights, particularly with regard to basic farmland suitable for grain production. This discourages them from making long-term land management improvements". Several issues of coherence and coordination in land degradation measures are currently addressed in the above mentioned "Capacity Building to Combat Land Degradation Project" that aims at "improving policies, laws, and regulations for land degradation control" and includes key stakeholders in this field.

4 CAPACITIES FOR SOIL CONSERVATION

4.1 STRUCTURAL CONTEXT FACTORS: ECONOMIC CONTEXT FACTORS

In the last 20 years China experienced rapid economic growth (average economic growth rates between 1990 and 2001 were 10% (World Bank 2003)). The socialist development project was accompanied by the series of environmental problems that other countries experienced in a far longer time span. In the last decades great achievements in poverty reduction were made especially in rural areas (Fan 2000), but still poverty is strongly a problem of rural areas. Especially the western areas and southern mountain areas are the poorest areas. Two thirds of the so called „National Designated Poor Counties" are located in ecologically fragile areas (World Bank 2001: 69) and soil degradation was found to be linked partly to poverty (Künkel 2005).

4.2 POLITICAL-INSTITUTIONAL FACTORS

Institutionalizing environmental issues as a policy field at the national level began in1974 with the Environmental Protection Office (EPO) which was upgraded in the 1980s to an agency with a "bureaucratic rank slightly below a ministry" (World Bank 2001), the National Environmental Protection Agency (NEPA). An important coordinating role was played by the State Environmental Protection Commission (SEPC) (established in 1984), consisting of key persons from ministries, commissions and representatives of large enterprises and media. Today the environmental administration at the national level is lead by the State Environmental Protection Agency (SEPA) (since 1998) uniting the competences of both bodies. The dismantling of the SEPC is regarded as a "step which weakened the possibilities for proper co-ordination of environmental measures within the State Council" (OECD 2005: 10). SEPA was upgraded to a (non-cabinet) ministry and is the agency with overall responsibility for environmental management and protection (World Bank 2001). SEPA has extensive competences concerning policy development, legislative functions, development of environmental standards, coordination of subordinate departments and the implementation of environmental norms (Betke 2000: 351). However, SEPA is still "far less powerful than some other key ministries or bodies" (OECD 2005: 10). Thus, the institutionalisation of environmental management has already undergone several reforms and adjustments.

Implementation is organised by SEPA for those projects undertaken by the sectoral bodies at the national level, or activities that are of national significance, whereas the Environmental Protection Bureaus (EPBs) at lower levels implement regulations (OECD 2005: 11).

Below the national level, the provincial level has own competences in environmental policy. Apart from implementation, at the provincial level national legislation can be further specified and complemented. Provincial environmental protection bureaus exist in all provinces and are independent agencies (World Bank 2001: 100). The cooperation and division of competences between the levels is characterised by the "horizontal-vertical" issue (World Bank 2001: 99), meaning that "lower-level EPB's report to higher-level EPBs and ultimately SEPA, but receive their budgetary resources from the local government" (ibid). This often leads to conflicting demands, e.g. in the case of polluting industry, on which the local government depends.

Participatory elements have been introduced only recently, e.g. in the Agenda 21 and the in the "Law on the Prevention and Control of Water Pollution" (1996, amended 2000) and are slowly gaining importance. The idea of environmental education was already introduced early with the Environment Act in 1978, and is increasingly practiced.

The role of the courts is not yet very active in adjudicating environmental disputes (World Bank 2001). Thus, enforcement of environmental law is rather weak and is cited as a major weakness of Chinese environmental policy (Jänicke at el 1999). Mao (1996: 242) characterises it as being "without teeth". A recent approach to strengthen implementation was stricter measures in criminal law (Troost 2000).

4.3 ACTORS AND PROPONENTS OF SOIL CONSERVATION

So far, in China relevant actors of environmental protection are almost exclusively on the part of the government (Heuser and Graf 2001: 35).

Within the higher levels of the administration, Mao (1996: 243) observes a high priority for environmental protection since the 1980s. Whereas in early environmental legislation environmental protection was stated to be subordinate to socialist modernisation, in 1981 the state council announced it to be equal in rank with economic development (Heuser and Graf 2001: 24). In the national Agenda 21, introduced by China in 1994 as the first country, the concept of sustainable development is announced as guiding principle of economic development. A "turning point" in the reform of environmental policies was marked by the 1996 Fourth National Conference on Environmental Protection (OECD 2005: 9). It defined, for the fist time, "explicit environmental objectives, duties and plans for the end of the 1990s and the next century" (ibid.). The following ninth, and especially the 10th Five-year-plans were much more sensitive to environmental issues, and the latter contained a specific Five-Year Plan for Environmental Protection (ibid.).

However, economic growth still ranges high as an objective in the administration and among cadres at the national and local level. Cheung (1998: 162) states this "pro-growth bias" as a major obstacle to the implementation of environmental protection. More important, however, are conflicts of interest between the local level and the national level. Priorities for environmental protection at the local level are rather low, especially where they directly contradict growth interests of the local industries, the “town and village enterprises” (ibid: 163).

The focus in environmental protection was up to the late 1990s clearly on controlling industrial pollution and managing urban environment, whereas rural environmental protection “wasn’t a major government priority until the late 1990s” (World Bank 2001: 108). This can be seen for example in the staff resources dedicated to the two fields: of the staff of NEPA in the first half of the 1990s only 10% were allocated to natural resource protection (Mao 1996: 247). Financial and staff resources attributed to soil conservation were low up to the 90ies, thus contributing to neglecting the issue (Küchler/Straub 2002: 74). However, in the late 1990ies a shift of priorities was observed. Already in the ninth Five-Year-Plan, decided in 1995 Lee (1997: 83) observes a strong commitment to soil conservation both concerning soil pollution and soil erosion. He regards soil as having advanced to a generally important subject of protection in this plan. But especially the 1998 Yangtze flood is often cited as a turning point in environmental policies, which was followed by increased conservation efforts of forests and combating land degradation. In addition, as part of UNCCD activities, efforts to combat desertification were intensified and existing measures were revised. But even concerning earlier periods, China’s long tradition in soil conservation must not be overlooked when describing priorities in Chinese natural resource management. As in other countries, environmental policy is a rather young policy field, whereas resource policies date earlier.

Concerning soil conservation, the above mentioned general structure of the environmental administration deserves a closer description. As in most countries, responsibilities for land and soil conservation are fragmented. Responsibility for soil conservation is shared between different ministries: the Ministry of Water Resources (MWR) and the State Forestry Administration (SFA), but also SEPA, the Ministry of Land and Resources, and the Ministry of Agriculture (MOA) among other entities. Responsibilities for soil erosion depend especially on “whether it is water-induced (MWR) or wind-induced (SFA)” (ADB 2004: 12). In addition, resource management and resource protection are not under one responsibility, e.g. “the agency responsible for desertification (SFA) is not responsible for the management of grasslands (MOA), despite grassland degradation being the major cause of desertification.” A body specialized on soil conservation programs and extension like a “soil conservation service” does not exist in China, as World Bank (2001: 109) notes.

Nongovernmental actors have very little influence on environmental policy (ibid), however, Mao (1997) points to an emerging active role of local actors. OECD (2005: 31) provides a typology of key non-governmental actors and characterises the 1996 “State Council Decision Concerning Certain Environmental Issues” as having “signalled a turning point by strongly encouraging both media and citizens to expose illegal actions that caused environmental damage”.

4.4 SITUATIVE CONTEXT FACTORS

As mentioned above, the Yangtze flood of 1998 is often cited as an important incident that raised awareness for natural resource conservation at the national level. It initiated discussions on causes of the flooding and deforestation in the upper reaches of the great rivers became an issue. In reaction to these discussions, the Government announced increased efforts, and changes in land-use policy to stabilize the upper reaches of rivers through afforestation. Much earlier (i.e. 15 years beforehand), a report of a Government Commission on dangers of deforestation in the upper reaches of rivers is cited by Weggel

(1998: 725) to have led, among other factors, to the huge afforestation project "Great Green Wall".

4.5 EXTERNAL FACTORS

International soil conservation activities are not a strong "push-factor" for national soil conservation policies, but in general, Chinese environmental policy is rather open.

In general, the "modern" idea of environmental protection is regarded as an "imported idea" (Mao 1996: 252). Betke (2000: 347) states that the introduction of environmental policies in China was not a reaction to obvious environmental problems, but was initiated, as in most developing countries, by external developments. The starting point is marked by the Chinese participation in the 1972 United Nations Conference on the Human Environment (OECD 2005: 8) in which China took a speaker's position for developing countries. In later international conferences China consolidated its leading role among developing countries, and put developing countries' issues on the agenda, among them desertification and natural resource problems (Lee 1997: 83), but also the need for international cooperation in solving global and developing countries' environmental problems. Several scholars (Mao 1996: 252, Kruse 2001: 30) regard China's active environmental diplomacy as a driving force of domestic environmental policy development. Furthermore, China actively engages in international cooperation and demands support, e.g. with the "China Council for International Cooperation on Environment and Development" established in 1992 (Bechert 1995: 102). Thus, China has evolved to be internationally active and open concerning international cooperation on environmental issues. Among its Asian neighbours, China can be classified as a pioneer (Ludwig 2000: 14).

CONCLUSIONS

China is rather a „pioneer“ than a „laggard“ when looking at the policy output in soil conservation. A long tradition in soil conservation and a rather high priority for environmental issues in the national administration may explain this development. Input from the international level is actively demanded. Also, soil conservation has been a dynamic field in recent years. Shortcomings to more effective soil conservation lie in compartmentalized and sectorally fragmented approaches, weak capacity at local level and unproper land tenure arrangements and land use rights, as well as undeveloped participatory approaches (ADB 2004).

REFERENCES

1. Asian Development Bank (ADB) (2004/2002): Framework Brief for the PRC-GEF Partnership on Land Degradation in Dryland Ecosystems,
2. Bechert, Stephanie (1995): Die Volksrepublik China in internationalen Umweltregimen. Mitgliedschaft und Mitverantwortung in regional und global arbeitenden Organisationen der Vereinten Nationen, Münster.
3. Betke, Dirk, (2000): Umweltkrise und Umweltpolitik, in: Hermann-Pillath, Carsten, Lackner, Michael (Eds.): Länderbericht China. Politik, Wirtschaft und Gesellschaft im chinesischen Kulturraum, 2. edition, Berlin, pp. 325-357.

4. Bückmann, Walter (Eds.) (1991), Probleme eines Bodenschutzgesetzes im internationalen Vergleich, Technische Universität Berlin, FAGUS Schriften No. 1, Berlin.
5. Bückmann, Walter, Lee, Yeoung Huei (Eds.) (2000): Verhaltenssteuerung zum Bodenschutz – Probleme eines Konzepttransfers zwischen Deutschland und Ostasien, Technische Universität Berlin, FAGUS Schriften No. 10, Berlin.
6. Chen, Chang-Chin (1997): Beijing`s Environmental Diplomacy, in: Issues and Studies, Vol. 33, pp. 68-89.
7. China National Committee for the Implementation of the UN Convention to Combat Desertification (CCICCD) (2002): China National Report to Implement the United Nation`s Convention to Combat Desertification (UNCCD), Beijing, (http://www.unccd.int/cop/reports/asia/national/2002/china-eng.pdf, 24.05.03).
8. Fan, S., Zhang, L. (2000): Growth, Inequality, and Poverty in Rural China: The Role of Public Investments, International Food Policy Research Institute, IFPRI Research Report 125, Washington.
9. Heuser, Robert, Graf, Jan de (Eds.) (2001): Umweltschutzrecht in der VR China. Gesetze und Analysen, Hamburg.
10. Hurni, H., Meyer, K. (Eds.) (2002): A world soils agenda. Discussing International Activities for the Sustainable Use of Soils, Prepared with support of an international group of specialists of the IASUS Working Group of the International Únion of Soil Sciences (IUSS), Centre of Development and Environment, Bern.
11. Jänicke, Martin, Kunig, Philip, Stitzel, Michael (1999): Umweltpolitik. Lern- und Arbeitsbuch, Bonn.
12. Jänicke, Martin, Weidner, Helmut (unter Mitarbeit von Helge Jörgens) (Eds.) (1997): National Environmental Policies: A Comparative Study of Capacity-Building, Berlin.
13. Kruse, Claudia (2001): Umweltbildung und Umweltkommunikation in der VR China, in: ASIEN, VOL. 78, pp. 25-49.
14. Küchler, Johannes, Straub, Wolfgang (2002): Wasser- und Bodenschutz als Baustein einer Strategie zur Überwindung der ländlichen Armut: Erfahrungen aus einem deutsch-chinesischen Projekt in Shandong, in: Zerbe, Stefan, Küchler, Johannes, Hamann, Bettina (Eds.): Ökoligische und sozio-ökonomische Grundlagen und angewandte Aspekte des Natur- und Umweltschutzes in Nord-China und Südkorea, TU Berlin Schriftenreihe der Fakultät Architektur Umwelt Gesellschaft, Berlin, pp. 74-85.
15. Künkel, Nana (2005): Sozioökonomische Ursachen von Bodendegradation in Asien – eine
16. räumliche, statistische Analyse auf der Grundlage von Agrarentwicklungsmustern,
17. Agrarwirtschaft Special Issue No. 181, Ph.D. Dissertation Humboldt-University of Berlin, Frankfurt.
18. Lee, Yeoung Huei (1999): Umweltschutz in China. Umweltpolitik, Umweltplanung, Umweltrecht und Rahmenbedingungen in der Volksrepublik China, FAGUS Schriften der Technischen Universität Berlin, No. 9, Berlin.
19. Liu, Shouying, Carter, Michael, Yao, Yang 1998: Dimension of Property Rigths in Rural China: Dilemmas on the Road to Further Reform, in: World Development, Vol. 26, pp. 1789-1806.
20. Ludwig, Jutta 2000: Die Wasserwirtschaft im Rahmen der Umweltpolitik in der Volksrepublik China, in: ASIEN, Vol. 74, pp. 2-26.
21. Mao, Y. 1997, China, in: Jänicke, Martin Weidner, Helmut (Eds.): National Environmental Policies, Berlin, pp. 237-255.

22. Oldeman, L.R. van Lynden, D. 1997: Assessment of the Status of Human Induced Soil Degradation in South and Southeast Asia, International Soil Reference and Information Centre (ISRIC), Wageningen.
23. Troost, Georg 2000: Recent Trends in Chinese Environmental Law, in: ASIEN Vol. 74, pp. 27-39.
24. SEI/UNDP (2002): Stockholm Environment Institute/United Nations Development Programme (UNDP) China (2002): China Human Development Report 2002. Making Green Development a Choice, New York.
25. Weggel, Oskar 1998: Naturkatastrophen und Archetypen – Variationen zum Thema „Yangzi-Fluten", in: CHINA aktuell 7/98: pp. 718-730.
26. Weidner, H., (2002): Capacity Building for Ecological Modernization. Lessons From Cross-National Research, AMERICAN BEHAVIORAL SCIENTIST, Vol. 45 No. 9, May 2002 1340-1368
27. Weidner, Helmut, Jänicke, Martin, (Eds.) (2002): Capacity Building in National Environmental Policy. A Comparative Study of 17 Countries. Berlin u.a..
28. World Bank (2001): China. Air Land and Water. Policies for a new millenium, Washington.
29. Zieschank, Roland, Jänicke, Martin, Tietz, Wolfgang (1999): Wesentliche Problembereiche aus der Sicht der Policy-Analyse. In: Bückmann, Walter, Jänicke, Martin, Lee, Yeong Heui, Tietz, Wolfgang, Wolff, Julian, Zieschank, Roland: Steuerungsfunktionen von Recht, Politik, Planung und Information am Beispiel des Bodenschutzes, Technische Universität Berlin, FAGUS-Schriften, Band 8, Berlin, pp. 11-70.

CERTIFICATION ISSUES IN RESPONSIBLE UTILIZATION OF RENEWABLE NATURAL RESOURCES

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INTRODUCTION

The mention of certification evokes passionate responses from many people concerned about the environment and working conditions. Certification is seen by some as the panacea that will bring about much needed reform in natural resources sectors, while others are vehemently opposed to this form of voluntary regulation as an unnecessary barrier to trade. Whatever the opinion, certification has become the hot topic in many natural resource sectors.

The following shall serve as background information for the discussions on the existing certification schemes relevant for NTFP and on the benefits, challenges, and constraints of certification for the people involved, with a special focus on forest management certification.

1. CERTIFICATION

Certification is the process of evaluating and labeling products against accepted standards of good management. To ensure the objectivity of certification, a reputable independent third party conducts the evaluation against defined standards. Once certified, a business may promote their business and products as certified, which is often done by using the distinctive logo of the standard-setting organization.

FSC defines non-timber forest products (NTFP) as: "All forest products except timber, including other materials obtained from trees such as resins and leaves, as well as any other plant and animal products." (1).

NTFP can play important economic, social and environmental roles: some provide income for the poorest people and are at the same time incentives to maintain natural forests, others like oil palm or coffee are intensively managed at a large scale, with significant contribution to a country's income. Under specific conditions NTFP extraction can provide a reasonable income for forest dwellers and can take place with causing only minimal damage to the forest structure. Many NTFP are exploited unsustainably (for the source of the NTFP or for other parts of the eco-system, where the NTFP is coming from), but there is a growing market for responsibly-produced NTFP, guaranteed by a certificate. NTFP may then be certified based on standards for fair trade, organic production, and/or forest stewardship. Different organizations have developed standards for certification that may be applicable for NTFP:

- Forest Stewardship Council (FSC): Forest Stewardship is the process of managing forests to protect their ecological values while creating responsible economic and social benefits. Biodiversity, water quality, employment, cultural values and the rights of first nations are among the issues addressed by forest stewardship certification. The FSC is an international network organization promoting well-managed forests through the application of criteria addressing these issues. (2).

- The International Federation of Organic Agriculture Movements (IFOAM) is the equivalent world body for organic agriculture, and has criteria for wild-harvested products as well as specific criteria for some NTFP like maple syrup and honey. (3).
- Fairtrade Labelling Organizations (FLO) International places an emphasis on the social components of production, ensuring the well-being of the producer, and currently certifies a limited number of agro-forestry products.(4).

Through the FSC system, the forest owners, managers, forest product manufacturers, local communities, non-governmental organizations and other interest groups are given equal access, voice and vote to a mechanism that is democratic, inclusive and transparent. FSC provides a system to develop standards with criteria and indicators to certify forest management, and only in some case dedicated standards for the responsible management of one or of a group of NTFP.

The primary goal of certification of forest management including NTFP management is to bring about positive environmental and social change in resource stewardship. Certification criteria can be used by producers and harvesters everywhere as a model for best practices.

2. SCOPE OF NTFP AND CHALLENGES FOR CERTIFICATION OF NTFP

While the certification of forest management (and also of organic agriculture) is, even though on management unit basis and therefore based on individual cases, already a kind of routine, the development of certification standards for NTFP is still challenging for several reasons.

One reason is that the NTFP cover a *wide range of products* from plants and from animals, products for food, medicine, for construction and more. This includes for example major crops, such as oil palm or coffee, venison (from extensively-managed species such as reindeer or from wild species), honey from wild bees, exudates like rubber and resin, livestock fodder, or materials for construction. Looking only at edible NTFP from trees, these can be roots, barks, leaves, exudates, fruits, sprouts, etc. Certification requires the development of standards, which are appropriate for the products addressed. So far there is no general standard for NTFP that can cover all these products (or their harvesting time, quantities, qualities, e.g.) sufficiently.

Also the *management types* of the resources are quite different: Some are collected from the wild, others semi-managed and are collected extensively, while another group can be quite intensively cultivated. Many are minor products from an economic point of view, while a few can be large scale (oil palm plantations). Certified organic foods often come from agricultural/cultural landscapes. Although many NTFP are essentially available freely, often providing income for the poorest people on subsistence level, their collection is labor-intensive with low-income return.

The ownership of, *tenure rights* and/or the rights to harvest and utilize NTFP differ equally: Some of the certified management units for NTFP may occur on state-owned forests/lands, communal lands or private lands especially for organic certification. This may have some implications on small producers and subsistence users including their need to prove or formalize customary tenure and access rights as well as the potential to lose their subsistence use rights due to increased market demands.

As a positive example, many of the European state-owned, communal or also private forests are operated primarily for timber production, but members of the public have, as part of "everyman's" policies, access rights to the forests (including the right to walk and camp), some countries' public have even the rights to collect fire wood, for hunting and fishing. This can lead for example to commercial collecting of forest products such as berries, even by people migrating in from other countries. However, to carry out the inspections necessary for the certification of operators involved in picking, buying, and processing of the berries, many different levels of stakeholders are involved. (If going towards organic certification, the organized collectors will be provided with information and training about the rules of the relevant certification scheme, they sign an agreement to follow harvesting instructions, which is then the contract with a registered organic buyer.)

Related to other forestry activities, NTFP can also be harvested under FSC group certification schemes: a group manager (an individual or a legal entity) develops the group scheme. Individual forest managers can then join the scheme and their forestry activity can be certified as part of the overall group. The collection of pine nuts (e.g. from Pinus cembra sibirica) in Russia Far East and Mongolia may demonstrate that responsible harvest of the NTFP is possible, when it is following some technical and legal regulations: The harvest is usually done by hitting the tree with big sticks until the cones with the seeds fall from the tree. If the cones are close to their natural ripeness, this can be done without high energy input, and without much damage to the tree's stem and bark. The competition of harvesting requests that legal regulations define the earliest time for the start of the harvest – and this needs control over the resources, and consequences for infringements of regulations. If the collectors of the cones start their business late in the year, they might have to face he situation that other people already collected the cones. The collectors need to act in an organized and monitored way.

There are different types of *knowledge* about NTFP: The lack of ecological knowledge about individual species, including baseline data, sustainable harvesting levels and resiliency levels is probably one of the reasons for the low acceptance of NTFP on major markets. This knowledge is often only relevant to specific ecological niches and is held in part by local harvesters. If the product has a high economic importance (coffee, berries in Scandinavia, hunting in Europe, ...), it is usually subject to intensive research and much is known about sustainable management. If the product is only traditionally used locally and for subsistence, there may exist a long tradition of oral information for sustainable management practices, but for certification the documentation of quantities harvested, mapping of resources, management plans and other information is prerequisite. Apart from this, in many case studies a gendered knowledge about NTFP can be observed (with the general trend, that women are more experts in the field of edible NTFP and for subsistence use, compared to men, who are more often dealing with NTFP when it come to cash crops (5, 6). This needs to be reflected (but is often ignored) when certification standards are in the process of development or when stakeholder consultations are made during certification processes.

To be able to manage a natural renewable resource responsibly, the characteristics of the resource must be known. This can be critical if there is a recent growing international market demand for such forest products that have had a long traditional local importance without any information documentation on their characteristics and management. Certification of forest management and of organic products requires that the manager of the resource has control over the information as described above, the management regulations (legally required or described in his own management plan), the legal framework and impacts on social issues. Basic questions are what and how much is where and when available. Certification requires that the information is gathered, documented and monitored. The wide array of NTFP does not allow an easy access to general, uniform and standardized information. At the same time the Certification Body needs to be knowledgeable about these issues, to be able to raise the appropriate questions.

The threat to sustainable harvesting comes when a market value is attached to the individual species and harvesting rates increase. There are still and will be in future difficulties in creating market benefits from certified NTFP. Markets for certified products are not well developed and tend to occupy niche markets for high quality products. Often quality control measures in NTFP harvesting and processing need to be developed. Additionally, it has yet to be shown whether certified NTFP are able to command a higher price in the marketplace.

Nevertheless there is a growing demand for sustainably-produced and certified NTFP, especially for those with a demand growing towards international markets. Currently, they are certified by organic and forest certification bodies, and in some cases additionally by Fair Trade schemes. There are already products jointly certified according to IFOAM and to FSC regulations. The underlying principles of the certification schemes have many complementarities with respect to NTFP, but also some differences. Joint inspections offer a range of potential advantages: reduced costs for the certification process, joint promotion from different certification schemes for the same product, easier market access, less competing messages to consumers. The differences are potentially in the area of requirements regarding the use of pesticides and genetically modified organisms, occupational health and environmental issues, and different methods relating to chain of custody inspection – and the lack of experiences with the NTFP. One of the early examples is the certified chewing gum "Jungle Gum" (the "chicle" species Manilkara zapota). The Mexican operation received organic (Wild Things ®) and FairTrade e.V.® certificates as well as the first FSC approved NTFP certification(7).

While FSC is most closely associated with NTFP, it is also the most complex certification program to implement with regard to standard development and stakeholder consultation, as FSC takes into account the requirement of directly and indirectly involved constituencies and their social, economical and ecological interests. In addition, the FSC system is difficult to apply to the vast majority of informal community-based NTFP operations that constitute the bulk of NTFP harvesting worldwide. FSC is beginning to look at new models of community-based certification where a number of harvesters are certified as a group or where a resource manager is certified to oversee multiple harvesting operations (see below).

For small scale NTFP operations, as is the case for most food and medicinal product harvesting, organic agriculture certification provides a reasonable alternative. The range of criteria addressed under organic certification is narrower than under FSC, with an explicit focus on building soil fertility and crop management techniques. However, organic certifiers are beginning to look at landscape level issues as well as social concerns. Given the relatively low cost of certification and strong consumer recognition for organic, this certification may be appropriate for many NTFP harvesting operations.

Fair trade is also an option for NTFP certification although only for southern producers. Fair trade is beneficial for small producers since its primary focus is on ensuring that they receive a fair deal for their products. The costs of certification are borne by the retailer and consumer rather than by the producer. The current scope of products covered under fair trade only includes a few agro-forestry products although it is likely that this product base will grow to include NTFP.

3. FSC AND NTFP CERTIFICATION

In 1996 FSC formed an NTFP Working Group, which produced in 1997 a draft "FSC Principle 11" to address NTFP. However, the FSC accredited Certification Bodies have since then developed a range of species-specific NTFP standards.

Table 1: The following table gives examples of NTFP currently certified according to FSC Forest Management standards and the forest products (see data base on www.fsc.org (2) :

NTFP	**use / description**	**origin**
Examples for NTFP certified under FSC forest management		
Chicle (latex) Manilkara zapota	Ingredient in chewing gum (also certified as organic and fair trade)	México
Venison Cervus elaphus	Food	Scotland, Germany
Christmas greenery	decoration	Europe, N-America
Seeds	for tree nurseries	Europe, N-America
Bamboo, Rattan	Multipurpose	Asia
Acai palm (heart & sprouts) Euterpe edulis	Beverage & food product	Brazil
Oak tree bark Quercus robur	Medicinal tea (also certified as organic)	Denmark
Shiitake mushrooms	Food	México, Japan
30 species of plants	Cosmetics & medicine	Brazil
within FSC forest management certification, but specific standard prepared for accreditation:		
Bamboo „Gadua"		Colombia
NTFP certified within FSC forest management areas, but with specific FSC standard:		
Brazil Nuts Bertholletia excelsa	Food product	Bolivia, Peru
Maple syrup Acer saccharum	Food product, beverage, sweetener	USA

The FSC accredited Certification Body SmartWood published in 2002 generic guidelines for assessing NTFP. The Non-Timber Forest Products Certification Standards Addendum provides guidance for forests managed principally for timber production, but with the possibility to incorporate commercially harvested NTFP within the forest management area. The NTFP Addendum is a complement to FSC Forest Management standards. The NTFP Addendum is so far focussed on plants only; in future guidelines for production systems incorporating the harvest and management of animals will be included (8).

An example for a specific NTFP FSC standards is the Non-Timber Forest Products Addendum with Special Reference to Maple Syrup (9).

As shown above, many NTFP are managed by local communities and groups of users. The number of these types of NTFP certified, either by FSC alone or jointly with other certification schemes, is still low. One reason for this is that local communities cannot bear the costs for regular forest management or organic certification, or that they cannot follow the regulations for certification, especially those related to the documentation of their management. In 2004 FSC developed the concept of **Small and Low Intensity Managed Forests** (SLIMFs) to reducing certification costs for small producers by publishing its draft standards on FSC SLIMFs Eligibility Criteria (10) and summarized in the FSC SLIMF Streamlined Certification Procedures (11). NTFP collectors (including women and those who harvest on land which is not theirs) are one of the target groups focussed on by the SLIMFs standard. The SLIMFs Streamlined Certification Procedures are applicable to:

- Small forests with areas is less than 100 ha (in reasonable cases up to a maximum of 1000 ha).
- Low intensity forest for NTFP production only: All natural forests being managed exclusively for NTFP (with the exception of NTFP plantations) are considered 'low intensity'.
- Groups of SLIMFs: All group members are either 'small forests' or 'low intensity forests', as defined above, without limit on the number of members in a group of SLIMFs.

The FSC SLIMFs Streamlined Certification Procedures recommend that requirements for monitoring and assessment be modified to include shorter, more concise public summaries, a checklist for forest management evaluations, automatic renewal of five-year certificate if annual audits are satisfactory, and fewer audits and peer reviews than for regular forest certification.

4 OUTLOOK

The demand for certified NTFP is growing, as well as the need for sustainable management of the resources and for stable income for the rural poor. One probable scenario for future cooperation of producers, certification schemes and market is that certification schemes will continue to develop projects that integrate two or more systems of certification at different stages of the certification or accreditation process. This may include projects to promote certified products in general, market studies, mutual support and recognition in monitoring and chain of custody, or development of common policy positions in trade discussions. There is a general trend towards more comprehensive standards and criteria for certification. This will result in increasing overlap between certification systems, and may provide stronger motivation for clients and certification organisations to participate more in the certification of NTFP for the benefit of the ecosystems and the people involved in management.

The author Dr. Marion Karmann is currently working at the FSC International Center in Bonn, Germany. In 1995–2002 she did research in the area of NTFP sustainable harvest in the tropics.

REFERENCES

1. FSC (2004); FSC Principles and Criteria for Forest Stewardship, FSC, Bonn, Germany.
2. The Forest Stewardship Council: What is FSC, work in progress, get involved. www.fsc.org
3. Fairtrade Labelling Organizations International (FLO) (2006): Standards and certification body for the Fairtrade movement. www.fairtrade.net/standards.html
4. IFOAM (2006); The IFOAM NORMS for organic production and processing 2005, IFOAM, Bonn, Germany
5. KARMANN, Marion (2000): Bark harvesting as an example for ethnic and gender oriented work. Paper for the Joint FAO/ECE/ILO Committee Seminar on Harvesting of NTFP, October 2000, Izmir, Turkey. Proceedings.
6. KARMANN, Marion; LORBACH, Ingrid & THALOUK, Salma, 2001: Gendered knowledge about NTFP. European Tropical Forestry Network ETFRN News No. 1.
7. KARMANN, Marion (1999): Zertifizierung von forstlichen Nebennutzungen. / Bericht von der 2. FSC VV in Mexico. Forstliche Mitteilungen 8/99.
8. SmartWood (2002); Non-Timber Forest Products Certification Standards Addendum: Guidance Notes, RainForest Alliance, New York, USA.
9. PIERCE, A.; LAIRD, S. and MALLESON, R. (2002): Non-Timber Forest Products Addendum with Special Reference to Maple Syrup. Annotated Collection of Guidelines, Standards, and Regulations for Trade in Non-Timber Forest Products (NTFP) and Botanicals, Rainforest Alliance, New York, USA.
10. FSC (2004): SLIMFs; SLIMF Eligibility Criteria (draft 2-0); FSC, Bonn, Germany.
11. FSC (2003); SLIMF Streamlined Certification Procedures: summary; FSC, Bonn, Germany.

Further literature:

1. BROWN, Larianna; ROBINSON, Dawn and KARMANN, Marion (2002); The Forest Stewardship Council and Non-Timber Forest Product Certification: A discussion paper, FSC, Bonn, Germany.
2. COURVILLE, S. (1999); Promoting Biological Diversity Through Sustainable Certification and Fair Trade, Institute for Agriculture and Trade Policy, Minneapolis, USA
3. ETFRN NEWS 32: NTFPs. European Tropical Forest Research Network, Wageningen, The Netherlands, http://www.etfrn.org/etfrn/
4. MALLETT, Patrick (1999): NTFP Certification and Marketing Program, Falls Brook Centre, New Brunswick, Canada, http://www.fallsbrookcentre.ca/forestry/NTFP_Web/analysis_doc.htm)
5. MALLETT, Patrick (undated): NTFP Certification Challenges and Opportunities, Falls Brook Centre, New Brunswick, Canada, http://www.fallsbrookcentre.ca/forestry/NTFP_Web/certification_challenges.htm (accessed September 2006)
6. MALLETT, Patrick & KARMANN, Marion (2001): Certification of Non-Timber Forest Products. An emerging field. European Tropical Forestry Network ETFRN News No. 1

7. SHANLEY, Patricia; PIERCE, Alan and LAIRD, S. (2005); Beyond Timber: Certification of non-timber forest products, Forest Trends, CIFOR and Plants and People International, USA

SYMPOSIUM PROGRAM

Sunday 12 March 2006		
21:00	Arrival Welcome at Hotel “Eden”, the *Symposium Venue*	Organizers

Monday 13 March 2006		
08:30	Registration of participants in the Symposium room	
09:00h	Opening Vice-President of Georg-August-Universität Göttingen Welcome on behalf of the Sino-German Center for Research Promotion, Beijing Welcome on behalf of the Symposium organizers	Reiner Kree Zhao Miaogen Yang Yonping Christoph Kleinn
09:30h	Sustainable use and conservation of Non-Timber Forest Products in Southwest China: Status, challenges and prospects	Yang Yongping
10.00h	Forest management systems and diversified production (NTFP): principles of sustainable management of natural renewable resources	Achim Dohrenbusch
10:30h	*Tea / coffee*	
11:00h	Harvesting of Non-Timber Forest Products in the alpine region of Northwest Yunnan and its impact on biodiversity conservation	Sun Hang
11:30h	Biologically Active Substances from Higher fungi in Yunnan, China	Liu Jikai
12:00h	Management of Matsutake in NW-Yunnan and key issues for its sustainable utilization	Yang Xuefei
12:30h	*Lunch*	
14:00h	Diversity of mushrooms in Hengduan Mountain region, Southwest China	Miss Wan Lan
14:30h	Applied research on bee products for human health protection	Ms. Jie Dong
15:00h	Bamboo development for rural livelihood and its impacts on biodiversity and environment in China	Lou Yiping
15:30h	*Tea / coffee*	

16:00h	Barriers and success factors for implementing mechanisms for the sustainable use of biodiversity	Susanne Stoll-Kleemann
16:30h – 17:30h	Resource data provision as basic component of sustainable management of the forest resource Discussion on issues of information status and requirements.	Christoph Kleinn (presenter and moderator)

Tuesday 14 March 2006		
08:30h	Close-to-Nature Forest Management for biodiversity conservation	Lu Yuanchang
09:00h	Collective action for promoting communities' marketing capacity: Sustainable NTFP management in the context of the Community-Based Natural Resource Management (CBNRM) mechanism	Zheng Baohua
09:30h	Silviculture for wood and NTFP production in tropical rain forests: Contradiction or chance? An example from the South Pacific Islands	Michael Mussong
10:00h	How can we enhance NTFP conservation by strengthening farmer's access to forest: lessons from Matsutake mushroom and bamboo shoots	He Jun
10:30h	*Tea / coffee*	
11:00h	Interrelationship between the ontogenetic type of pine trees and resin production	Hubertus Pohris
11:30h	Chinese Research Environment, Challenges and Opportunities for International Collaboration	Horst Weyerhaeuser
12.00h	NTFP in Timber Production Forests	Carol Grossmann
12:30h	*Lunch*	
14:00h	Assessment tools for forestry decision-makers - Experience from forest devolution in Vietnam's Central Highlands	Thomas Sikor
14:30h	Transfer of scientific expertise into successful forest policy - concepts for evaluation and monitoring for sustainable forestry in China	Michael Böcher, Max Krott, Xiao Jianmin
15:00h	Politics and policies of natural resource conservation in China: Capacity building for sustainable resource use	Nana Kuenkel
15:30h	*Tea / coffee*	
16:00h	Certification issues in sustainable utilization of renewable natural resources	Marion Karmann, FSC

16:30h	Collaboration between the University of Göttingen and Chinese Scientific Institutions Presentation of the Center for Tropical and Subtropical Agriculture and Forestry, Georg-August-Universität Göttingen	Paul Winkler Uwe Muuss
17:15h	Preparation of Wednesday-Workshop	Moderators

Wednesday 15 March 2006		
8:30h	Introduction to workshop, forming working groups, assigning tasks and responsibilities	Moderators: Yang Yongping, Christoph Kleinn, et al.
9:00h *10:30h* *Tea/coffee*	*Workshop / Working groups:* Summarize the current state of knowledge and identify major gaps of knowledge and topics for future collaborative research: Tentative topics: Potential and success factors of sustainable NTFP harvesting. Instruments for assessment and monitoring for the sustainable harvesting of NTFP in China. Challenges of balancing the role of NTFP within multifunctional forest use. The final definition of working gourp topics will be an outcome of presentations and discussions during the first two symposium days.	
12:30h	*Lunch*	
14:00h	Preparation of working group presentations	participants
15:00h	Working group presentations to plenary. Discussion	Yang Yongping / Christoph Kleinn (moderators)
16:00h	*Tea / coffee*	
16:30h	Discussion: Final definition of program and topics for the Friday morning workshop. Assigning responsibilities.	Yang Yongping / Christoph Kleinn (moderators)
17:00h	Information on field trip and program of 16 and 17 March	Achim Dohren- busch, Torsten Sprenger

Field Trip

Thursday 16 March 2006

8:00h 10:00h	Departure from Hotel Eden: Visit to the Planning Office of the Forest Service of the State of Lower Saxony (in the city of Wolfenbüttel): Topics: Forest management planning in state, community and privately owned forests.	 Dr. Böckmann and Dr. Kleinschmit (Forest Service of the State of Lower Saxony)
13:00h	Lunch (in the town of Goslar)	
14:30h	Brief visit to the *Kaiserpfalz* in Goslar (the emperor´s residence in medieval times). Onward to Clausthal Zellerfeld	Achim Dohren-busch, Torsten Sprenger
16:00h	Visit of the mining museum in Clausthal Zellerfeld (the history of mining is in Germany closely linked to the history of forestry. In fact, it was a mining engineer, Carl von Carlowitz, who first described - in 1757 - the principle of sustainability as a strategy to guarantee sufficient wood production on the long run for the mining industry!).	
About 19:00h	Return to Göttingen	
20:00	NTFP Dinner	

Friday 17 March 2006

8:00h *10:30 Tea/coffee*	*Workshop:* Tasks and topics include: - Planning of further activities, - Preparation of workshop documentation, - Preparation of workshop reporting.	Yang Yongping Christoph Kleinn
12:00h	Closing session	
12:30h	Lunch	
14:30h	Guided tour in Göttingen city (“History of Göttingen” or “Gauss in Göttingen”).	

Saturday 18 March 2006

	Return	

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Natur und Wissenschaft

Schätze aus Chinas Wäldern

Auch die ländlichen Regionen sollen am Aufschwung teilhaben

Tannenhonig und Heidelbeeren, Bärlauch und Steinpilze – neben dem Holz der Bäume haben Wälder noch manch anderes zu bieten. Hierzulande hat das zwar kaum eine wirtschaftliche Bedeutung. Weltweit sind laut einer Studie der Vereinten Nationen jedoch mehr als eine halbe Milliarde Menschen auf solche Produkte angewiesen. Auch Chinas Wälder liefern viel Nützliches, von Wildgemüse und Heilkräutern bis zu pflanzlichen Farben und Lacken. Manches davon wird auch auf den internationalen Markt gebracht. So willkommen solche Einkommensquellen sind, so groß ist freilich die Gefahr, daß sie, weil allzu eifrig geplündert, rasch versiegen. Wie sich der vielfältige Reichtum des Waldes langfristig erhalten und nutzen läßt, war dieser Tage das Thema eines Symposions in Göttingen. Chinesische Fachleute trafen sich dort mit deutschen Forst- und Agrarwissenschaftlern, um die Grundlagen für eine enge Zusammenarbeit auszuloten.

Chinas Milliardenvolk lebt immer noch vor allem von der Natur. Doch die Ausbeutung der Wälder könnte bald schon deren Ruin bedeuten. In Göttingen haben chinesische und deutsche Forscher nach Lösungen gesucht.

Nachhaltige Forstwirtschaft hat in China noch keine lange Tradition. Vielerorts wurden selbst steile Berghänge großflächig abgeholzt. Die wenigen Wälder, die nahezu unberührt blieben, stehen mittlerweile jedoch unter Schutz. Künftig sollen Plantagen einen Großteil des Holzbedarfs decken. Zugleich soll das ehrgeizige Aufforstungsprogramm die Bodenerosion beenden und den Wasserhaushalt verbessern. Meist sind die Aufforstungsflächen allerdings Monokulturen. Mal wachsen dort chinesische Kiefern, Lärchen oder Pappeln, mal australische Eukalyptusbäume. Etwas mehr Abwechslung, so räumte Lu Yuanchang von der Chinesischen Akademie für Forstwirtschaft in Peking ein, könnte nicht schaden. Schließlich steht eine reiche Palette heimischer Baumarten zur Auswahl. Dabei hat Lu Yuanchang nicht nur die Holzproduktion im Blick. Die chinesische Eßkastanie (Castanopsis hysterix) etwa trägt wie ihr europäisches Pendant auch nahrhafte Früchte.

Gräser der Bambusfamilie können ebenfalls zu einer attraktiven Einnahmequelle werden. Wie Lou Yiping vom Internationalen Netzwerk für Bambus und Rattan in Peking erläuterte, läßt sich aus den oft baumlangen Bambushalmen fast alles herstellen, was üblicherweise aus Holz gefertigt wird: Dachbalken, Fußböden und Möbel ebenso wie Papier oder Zellulosefasern für Kleiderstoffe. Darüber hinaus liefern manche Bambusarten eßbare Sprosse, die nicht nur als Gemüse taugen, sondern sich auch zu Bier oder Softdrinks verarbeiten lassen. Mit Bambus, ob wildwachsend oder angepflanzt, läßt sich fernab der großen Städte Geld verdienen. Ganz im Sinne des neuen Fünfjahresplans, nach dem nun endlich auch die ländlichen Regionen an Chinas wirtschaftlichem Aufschwung teilhaben sollen.

Gezielt gepflanzt, kann Bambus mit seinem weitverzweigten Wurzelwerk die Erosion eindämmen. Daß die Bewirtschaftung solcher Plantagen mancherorts zunehmend industrialisiert wird, sieht Lou Yiping jedoch kritisch. Nicht nur, weil großflächige Monokulturen oft mit aufwendiger Bewässerung und einem großzügigen Gebrauch von Düngemitteln und Pestiziden einhergehen. Wo Maschinen ganze Arbeit leisten, verliert die lokale Bevölkerung Arbeitsplätze und Einkommen.

Mühsame Handarbeit bleibt indessen das Sammeln von Speisepilzen, zumindest dann, wenn es sich um sogenannte Mykorrhizapilze handelt. Da diese in Gemeinschaft mit Baumwurzeln leben, lassen sie sich nicht auf Holz oder Strohballen heranziehen. Zu dieser Kategorie gehören zum Beispiel Steinpilz und Pfifferling, aber auch die begehrten Matsutake-Pilze. In den Bergwäldern im südwestlichen China scheinen Matsutake-Pilze besonders gut zu gedeihen. Chinesen finden zwar nach wie vor wenig Geschmack an ihnen. Doch der Export von Matsutake ist zu einem lukrativen Geschäft geworden. Im Nordwesten der Provinz Yunnan, so berichtete Xuefei Yang vom Botanischen Institut in Kunming, schwärmt jung und alt gerne zum Pilzesammeln in die Berge aus.

Nach dem Washingtoner Artenschutz-Übereinkommen gelten für Matsutake-Pilze zwar Handelsbeschränkungen. Aber die jeweiligen Quoten werden so willkürlich festgelegt, daß sie den schwunghaften Handel nicht bremsen. Im Jahre 2005 exportierte Yunnan 1426 Tonnen Matsutake, hauptsächlich nach Japan. Ob die Pilzbestände bereits Schaden genommen haben, ist schwer abzuschätzen. Denn wie bei solchen Gewächsen üblich, sprießen die Fruchtkörper je nach Witterung in manchen Jahren zahlreich aus dem Waldboden, in anderen spärlich. Xuefei Yang plädierte dafür, die Matsutake-Pilze durch Einschränkungen, die auch im Interesse der Dorfgemeinschaften liegen, rechtzeitig vor Raubbau zu schützen.

Lohnen würde es sich schon, wenn man die jungen Pilze schonte. Nicht bloß, weil ausgewachsene Exemplare mehr Gewicht auf die Waage bringen. Mit solcher Ware lassen sich auch die höchsten Preise pro Kilogramm erzielen. Überreife, geschmacklich minderwertige Pilze wiederum stehenzulassen, damit sie ihre Sporen ausstreuen können, wäre kein allzu großes Opfer. Ein Kilogramm Matsutake-Pilze bester Qualität kostet im internationalen Handel bis zu achtzig Dollar. Damit die Pilzesammler davon einen fairen Anteil erhalten, benötigen sie entsprechende Informationen, was aber dank moderner Telekommunikation auch im ländlichen Yunnan zunehmend einfacher wird.

Weite Teile des Hengduan-Gebirges im Nordwesten sind freilich noch immer schwer zugänglich. Mit rund neuntausend verschiedenartigen Farnen und Blütenpflanzen zählt diese Region zu den „Hotspots" biologischer Vielfalt. Daß die vermutlich nicht minder abwechslungsreiche Pilzflora dort noch längst nicht vollständig erforscht ist, bestätigte Lan Wang vom Botanischen Institut in Kunming. Von den gut achthundert wissenschaftlich beschriebenen Pilzarten mit großen Fruchtkörpern sind manche auch aus Nordamerika oder Europa bekannt; andere sind ausschließlich im Hengduan-Gebirge und dem angrenzenden Himalaja heimisch. In dem reichhaltigen Sortiment eßbarer Pilze hofft Lan Wang noch einige zu finden, die für überregionale Märkte taugen.

Ein Waldgebiet auch unter solchen Aspekten zu betrachten ist Christoph Kleinn von der Universität Göttingen keineswegs fremd. Seit Jahren beschäftigt sich seine Forschungsgruppe mit dem mannigfaltigen Potential von Wäldern in aller Welt. Daß sie den Wald vor lauter Bäumen nicht sehen, läßt sich solchen Forstwissenschaftlern gewiß nicht vorwerfen. DIEMUT KLÄRNER