



Tropentag 2009
University of Hamburg, October 6-8, 2008
Biophysical and Socio-Economic Frame Conditions for the
Sustainable Management of Natural Resources

Rubber contra Biodiversity? An Analysis of the Adoption Processes of Selected Innovations in Xishuangbanna, Southwest-China

Grötz, Patrick Artur^a, Lixia Tang^b, Thomas Aenis^{a*}, Uwe Jens Nagel^a, Volker Hoffmann^c

^aHumboldt-Universität zu Berlin, Department of Agricultural Economics and Social Sciences, 10099 Berlin, Germany

^bChina Agricultural University, College of Humanities and Development, 100094 Beijing, PR China

^cUniversity of Hohenheim, Department of Agricultural Communication and Extension, 70599 Stuttgart, Germany

Introduction

Xishuangbanna, a Dai Autonomous Prefecture in Yunnan Province, Southwest-China, undergoes a rapid change experiencing fast economical growth and infrastructural development. The driving engine therefore is rubber production, and the region stands currently for the second largest producing area in China (XISHUANGBANNA SINOCEM 2008). Contrariwise, it is one of the world's "biodiversity hotspots" and accounts for a number of ethnic minorities showing a huge variety of different languages, cultural traditions and land use systems. Recent changes in land use are dominated by loss of tropical rain forest, causing a tremendous decline in biodiversity (LI et al. 2007, LANGENBERGER et al. 2008).

Being part of the Sino-German research cooperation "LILAC- *Living Landscapes China*", the authors examine the case of the NabanHe National Nature Reserve (NNNR). The reserve is located in JingHong County, close to the borders of Laos and Myanmar and it is part of the Mekong river watershed. It is multi-ethnic, populated by six different minority groups (Dai, LaHu, Mountain Han, HaNi, Yi and BuLang) and the main source of income is agricultural production.

The overall project investigates the effects of recent land use changes on biodiversity. The subproject "Land-use related innovations and knowledge flows" is looking for the relevant options of potential innovations, which in the future may enhance the existing production systems in order to help keeping the status quo of biodiversity. This will give important orientations for the implementation of the LILAC-scenarios, and for further development.

Materials and Methods

After an initial baseline study in 2008, an in-depth analysis on the adoption and diffusion processes of four typical innovations has been carried out combining, amongst other PRA tools, narrative interviews, participant observation, expert interviews, and stratified, semi-standardized household surveys. Two villages (one Dai on a lower altitude, one LaHu/Mountain Han on a higher altitude) have been selected as case studies for "innovation histories". Four typical innovations (rubber, hybrid paddy rice, tractor and tea-intercropping) of the recent past and their

*Corresponding author. Email: thomas.aenis@agrar.hu-berlin.de

adoption processes have been analyzed, which serve as case studies. The authors elaborate not only the relevant adoption factors in the innovation processes, but also highlight connections and interdependency of such processes.

Results and Discussion

The “Chinese Land Tenure Reform” in 1982/1983 and the formal Governmental Agricultural Extension have been the main driving forces for the introduction of new crops and varieties such as “rubber”, “hybrid paddy rice” and most recently “hemp” in the NNNR. These market-oriented innovations are the main driving forces of economic development in the research site.

The introduction of rubber in the mid-1980s was unquestionable a key event, which has led to fundamental changes not only in land use, but also in social life. Rubber has become the main source of income for many farming households. Because of its high economic profit, the size of rubber plantations grew rapidly and by 2004, the total planting area covered nearly one quarter of the landscape.

However, since rubber trees cannot be cultivated on altitudes higher than 1000 m above sea level (a.s.l.), the innovation has resulted in a division of the region: whereas farmers on lower altitudes gained rapid economic growth through the disposal of natural latex, their counterparts on higher altitudes experienced a comparatively slow economic development.

A precondition for the introduction of rubber was the improvement of the infrastructure in the region, most notably the construction of a road. This in turn was a basic requirement for the introduction of further innovations. The in-depth analyses of the adoption processes of the selected innovations have clearly indicated that these processes are not disconnected scenarios, but rather highly interlinked and mutually influenced each other.

ManDian village (A) is located near to the entrance gate of NNNR in an altitude of 670 m a.s.l. It consists of 56 households with 287 inhabitants and the main sources of income are tea, paddy rice and most important: rubber (LILAC 2008).

In 1983, rubber has been introduced by the Government to the village. Nowadays, almost all available areas are cleared and planted with rubber trees. Due to the highly increased household incomes, many have given up their traditional farming systems and rely completely on rubber. Certainly, farmers experienced first crises in the business e.g. through recent market price drops (from nearly 30 Yuan per kg dry rubber in the beginning of 2008 to around 8 Yuan in the end of the year) or the occurrence of pest outbreaks. Since the rubber trees have been taken over more and more of the area, the winter fog is becoming less. Rubber trees are known as huge water consumers, even considered by the locals as so-called “*water pumps: the trees suck up the water*”. Erosion is another problem: compared to the rain forest, more water seems to be lost from the spaces in between since there are no plants which can hold the water back or store it, causing more surface water run-off during the rainy season. As a result, the water content of the soil will be reduced and in consequence, less water can evaporate. And further, a drop down of the stream flows and dwells and rivers are likely to dry out (QIU 2009). Nevertheless, even though farmers reported on negative impacts on the water balance after the introduction of rubber and are aware of negative environmental changes, their rational decision goes clearly towards enlargement of the rubber production.

In 1985/1986, people started to use first tractors for the cultivation of their rice fields. During this period, still 30 to 40 buffaloes have been kept by the farmers. However, the number of animals decreased steadily year by year, and from 2005/2006 on, villagers use exclusively tractors. Buffaloes lost their importance mainly due to the fact that grazing land and land for fodder production for the animals has been turned into rubber plantations. In the plain paddy rice fields, tractors can easily be used to cultivate the fields, different to the paddy rice terraces on the slopy

land in higher altitudes where buffaloes are still needed. If there is no real need to keep buffaloes anymore, most farmers will soon give up, because the work is highly labor intensive and also risky since the animals are very likely to have diseases or accidents. In such case, the farmer has to sell the buffalo on a very low price, if it can be sold at all.

Rubber production has the highest priority in the village. Rubber farmers who suffer a loss in their rubber fields caused by buffaloes can claim for high compensation. Therefore, a buffalo keeper living in a rubber-planting village takes a high risk to lose huge amounts of money.

In 1985, another innovation came to ManDian village, introduced same as in the case of rubber by the Government: hybrid paddy rice. The big advantage of hybrid rice is its by far higher yield in comparison to local varieties. The disadvantages are the higher demand on pesticides, herbicides, fungicides and fertilizer. And the fact that farmers need to buy seeds from outside companies since hybrid varieties cannot be reproduced by the villagers themselves. Moreover, in case of any bigger problem, farmers depend on external knowledge to be able to solve it. Therefore, the successful introduction of the innovation has to be strongly linked to road construction and the accessibility of agricultural traders in JingHong or MengHai County.

Another investigated innovation is tea-intercropping. In ManDian village, farmers started in 1966 to plant tea bushes. After the introduction of rubber to the village, more and more young rubber trees have been planted into the tea plantations. Since 2000, there is no more “pure” tea plantation left, but only tea-rubber-intercropping. In some rare cases, farmers are mixing rubber with tea and teak trees.

Basically, rubber and tea can be cultivated together because of the high shade tolerance of the tea plant. However, usually this kind of intercropping is not very sustainable in reality, mostly due to the economic-driven dominance of rubber and the sharply decreased price for tea. Villagers are only continuing taking care and harvesting the tea plants until the rubber trees are old enough to be harvested. Then, depending on the farmer, he/she will either cut down the tea bushes, leave them without taking further care or continue harvesting the leaves for home consumption and/or for selling.

XiaoNuoYouShangZhai village (B) is a LaHu/Mountain Han mixed village, located on an altitude of approximately 1536 m a.s.l. Currently, there are about 33 households with around 150 persons living in the village. It is located at a very remote place and got connected to other villages through road construction not before 1993. The altitude of the village is by far too high for rubber cultivation, so the main sources of income are tea, rice, corn and introduced just recently: hemp. Villagers also collect so-called “Non-Timber Forest Products (NTFP)” on a regular basis. In addition, farmers try to intercrop tea with other trees or plants such as walnut, wild apple, corn or bamboo in order to diversify their agriculture production systems. To this day, most farmers obtain a great store of knowledge on edible wild plants and are always searching for additional sources of income and food supplementation. The village offers also a wide range of livestock such as chicken, pigs, buffaloes, and bee-hives etc. (LILAC 2008).

In 1985, the Government introduced hybrid paddy rice to the village and since 1991, most people in the village started to plant hybrid rice. The process has taken about six years because of the step-by-step improvement of the infrastructure and the fact that more and more different hybrid varieties have been available on the markets, which are also suitable for the colder conditions on higher altitudes. Currently, there are only two households left in the village which cannot plant hybrid rice because their rice fields are located above 1250 m a.s.l. and there, the water is too cold. Only local varieties can be cultivated under such harsh conditions.

In 1995, the first tractor has been brought to the village. Nowadays, nearly all families (except two households) have their own tractor. However, the farmers in high altitudes such as XiaNouYouShangZhai need to continue keeping buffaloes due to various reasons such as ploughing their rice terraces, which cannot be done by tractors. In the recent years, new land use

conflicts occurred, as the following case of XiaoNuoYouShangZhai and its neighboring rubber-planting village illustrates. Usually in the morning, farmers bring their buffaloes to the forest and let them for grazing the whole day inside. Thus, villagers have no control over the animals, they only can recognize their roughly position by hearing the sound of their cowbells. After grazing, the animals return to the original point of entry when they hear the voice of their owners calling them. However, there is no good practical solution on how to restrict buffaloes from entering young rubber plantations. Grazing buffaloes destroyed young rubber plantations. The affected farmer claimed for high compensations which could not be solved. Finally, the buffalo was poisoned, and died.

Looking on the innovation “tea intercropping”, the situation is also very different from villages in lower altitudes. Tea was already cultivated since 1957, and today, nearly every household in the village has tea plantations. In recent years, due to the heavily decreasing tea prices, many people have been searching for additional sources of income, and thus, they started to intercrop tea with various other plants. Most tea plantations are now covered by fair amounts of shrubs and trees such as various fruit trees, walnut trees and bamboo.

Conclusions and Outlook

Rubber introduction in the early 1980s to the NNNR was strongly supported by the Government. After the start, the adoption took several years of trial and comparison. Farmers regarded a number of factors: driving forces such as the regular or even increased income and as a result the immense higher personal welfare; but also the higher risk due to monoculture and changing prices. Villagers are aware of the environmental conditions including changes in soil fertility, the tremendous change of the landscapes, and also ecologic problems. However, decisions were rational and clearly towards rubber. Meanwhile, rubber is the main source of cash income. It has not only influenced agricultural activities and the seasonal calendar of the farms; but also everyday lives and behavior of the people with a complete change of their daily routines.

Future prospects for the region may not lie in an attempt to reconstruct the environmental conditions to such as before the introduction of rubber. One has to accept a fact that especially the Chinese automobile industry demands huge amounts of natural latex, and the central Chinese Government is aiming for a high level of self-supply. The capability lies rather in potential innovations which may improve the current land use systems and retain or even upgrade the existing status of biodiversity. For this purpose, the case study on rubber monocultures in the NNNR may also serve as an example for other areas in Xishuangbanna. Further, the results of this research can also give an important hint on how to improve other monoculture systems in the region such as sugar cane, banana or tea.

References

- LANGENBERGER, G. et al. 2008: Rubber-boom in Xishuangbanna- where will it end? In: The Uplands Program. International Symposium. Interdependencies Between Upland and Lowland Agriculture and Resource Management. 1-4 April 2008, Stuttgart, Germany, 185-186.
- LI, H.M. et al. 2007: Demand for rubber is causing the loss of high diversity rain forest in SW China. *Biodiversity and Conservation* 16: 1731-1745.
- LILAC 2008: Report Baseline-Survey in the NNNR, January/February 2008. Unpublished. Jinghong, PR China.
- QIU, J. 2009: Where the rubber meets the garden. In. *Nature* 457, 246-247.
- ROGERS, E.M. 2003: *The Diffusion of Innovations*. Fifth Edition. The Free Press, New York, U.S.A., 550pp.
- XISHUANGBANNA SINOCEM (2008): Xishuangbanna Sinochem Rubber Co. Ltd. Lay Foundation for Jinghong Rubber Plant. www.sinochem.com, 18 December 2008.