Can intercropping innovations bring ecological and economic goals together? The case of Nabanhe Nature Reserve, China

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Abstract: *Farmers in medium and high altitudes in the Nabanhe National Nature Reserve (NNNR), Yunnan province, China grew accustomed in recent years to watching their lowland counterparts enjoying rapid economic growth. Not being able to grow rubber trees - an economic driving force, which can be grown up to approximately 1,000 m a.s.l. – brings farmers to consider alternative farming livelihoods. Other stakeholders in the NNNR have different goals of biodiversity conservation and sustainable environmental development. As a result, a conflict is often created between farmers' economic goals and external stakeholders' ecological goals. In this study, agriculture innovations, such as tea-intercropping were examined to assert whether they can bring those contradicting goals together. From the field of ecological economics Richard Norgaard's theory of coevolution was used to examine the interlinked and mutually influenced development of society and environment on each other. In conjunction with this aspect of the research, Everett M. ROGERS's adoption of innovation theory was applied to look at the reasons for adopting tea-intercropping innovation. Therefore, the two theories were used to assess whether tea-intercropping can really improve the liveability of the farmers, both in economic and ecological terms. Semi-structured in-depth interviews were the main method used in the study. The research disclosed three key findings: (1) Altitude leads to crop choices which can be positive for both economic and ecologic goals; (2) Tea-intercropping reduces economic uncertainty and improves life in the farms of the high altitude; (3) Tea-intercropping production systems coexist in adjacent to forest ecosystems.*

Keywords: *Tea-intercropping, agriculture innovation, alternative livelihoods, Xishuangbanna, China.*

Introduction

Background of the problem

In recent years, local communities in the mountainous area of Xishuangbanna prefecture of Yunnan province, China drifted apart by rapid development of the rubber industry. The Nabanhe National Nature Reserve (NNNR) is no exception. Farmers in the lowlands of the reserve are able to enjoy economic benefits deriving from the constant demand for rubber. This is mainly due to China's growing auto industry and – as a result – an increase in the prices of rubber, backed up by the federal government encouragement to plant more rubber (Tang et al., 2009). Their neighbours who live higher up the mountains of the reserves do not enjoy the same rate of economic growth. In Xishuangbanna Prefecture in the southern part of Yunnan Province, minority nationality groups such as Akha (Hani) and Lahu live both in the low and high altitudes, now separated by the imaginary rubber line. Those who live above that line have relative slow economic growth in comparison with their low altitude neighbours.

Economic goals

In the low altitude the growth of the rubber industry has provided for constant rise in income, development of infrastructure, more private ownership of machinery, building of new cement houses and an increase of leisure time (Lilac, 2008). In the low altitude, on the other hand, prices of tea – a major crops of the region – dropped in the last five six years, farmers enjoyed some economic development albeit a slow one, and roads connecting the villages are still an indicator to their disconnectedness from markets in the area. When changing the perspective of the previous sentence, these problems can be seen as the economic goals of the farmers in the high altitudes:

finding alternative livelihoods, reducing feeling of instability and financial uncertainty, improving marketing orientation, and improvement of social services such as medical care.

Ecological goals

The demand for rubber pushed the clearing of forests for growth of rubber to as high altitude as possible which is known to be limited to about 1,000 m. a.s.l. This is considered to be a major environmental problem as the area is known to have had some of the highest biodiversity rates in the world (Lilac, 2006). The NNNR has a status of national nature reserve and therefore has laws for protection of forest and river. Thus, the reserve has three management zones: (1) Core Zone – in which no research or agriculture production is allowed; (2) Buffer Zone – villages exist but have strict rules of what can be produced or cut from the forest; (3) Production Zone – where farmers are allowed to produce agriculture but have constricting rules regarding usage of the forest. Various stakeholders have interest in conserving biodiversity and protecting the environment. These are the NNNR management, the Forestry Department and also more external stakeholders such as domestic and foreign researchers. The latter are trying to find ways to develop alternative more sustainable and 'biodiversity friendly' land use strategies. In addition to that the farmers themselves have an interest in preserving the quality of soil and water around their villages.

When economic and ecological goals are in conflict

The growth of rubber has generally led to landscape (in Xishuangbanna and also in the NNNR) that is referred to by local town people and researchers as "Green Desert". The term refers to how from above rubber plantations look green, but biodiversity is very low, soil quality was drastically reduced and rivers and streams in the area are drying up. Farmers, though, are trying to grow rubber up to as high altitude as they can for its undeniable economic benefits. Moreover, farmers in the high altitudes are trying to achieve similar economic goals.

Adoption of intercropping innovations as land use strategies

The situation created by these conflicting ecological and economic goals brings farmers and the other stakeholders to consider various solutions (i.e. to come up with new land use strategies and agriculture innovations). In the lower altitudes the choice for the farmers is quite clear, thus economic goals are usually perused with higher priority. In the higher altitude however, the conflict is more complex and as a result how to improve the lives of farmers is more challenging for all relevant stakeholders.

Apart from altitude several other parameters are involved in the need to introduce agriculture innovations, and in the process of adopting such innovations. Indeed, the process of introducing and adopting agriculture innovations is dependent on various environmental parameters (biological and physical) and those of the social, cultural and economic spheres (Rogers, 2003).

A combined theoretical perspective was used in order to assess whether tea-intercropping can improve the lives of the farmers, both in economic and ecological terms. The first, *Everett M. Rogers's* (2003) adoption of innovation theory was the frame for looking at the reasons for adopting tea-intercropping, and for the division of adopter groups and the reasons for that. The second, *Richard Norgaard's* (1994) theory of coevolution was used to examine the economic and ecological conflict through the mutually influenced evolution of society and environment. According to Norgaard (*ibid*.), in rural development (see figure 1) there is a constant link between components of society and those of the natural environment, which cause developmental changes in each other.

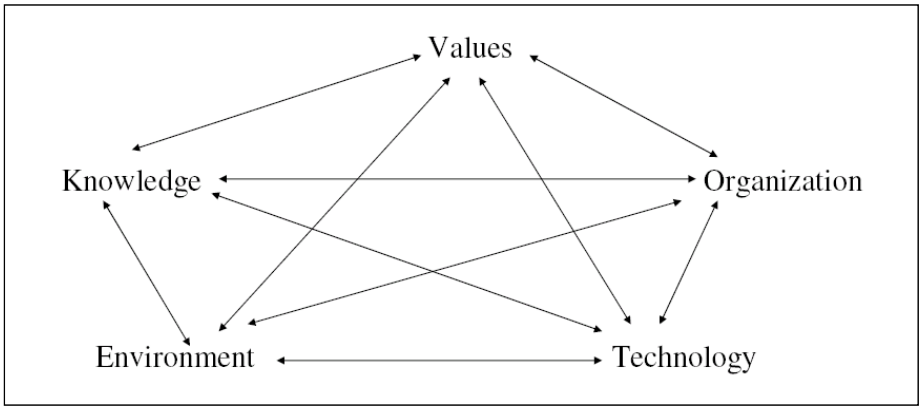

Figure 1. Coevolution Scheme of Rural Development.
Source: Norgaard, 1994

There are several theoretical assumptions that are involved in the process of coevolution examination of the tea-intercropping innovation. One is that it is within the interest of all stakeholders to improve socio-economic conditions in the examined villages. The second is that basic environmental parameters influence the society in the village, its culture and more specifically agriculture choices. The latter, in return, influences the surrounding ecosystems. As part of a research that is meant to find more sustainable alternatives for land use, we assume that healthy ecosystems are favourable in the long run for the social system.

The aim of the research

The study was carried out in the frame of the Living Landscape China (LILAC) project, a consortium of German and Chinese universities researching sustainable land options and biodiversity conservation in the Nabanhe National Nature Reserve.

The aim of this study, as follows from the previous sections, is to gain better understanding of the complex relations between society and environment, through examination tea-intercropping innovations. This understanding is hoped to enhance the knowledge that will contribute to finding sustainable land options and to biodiversity conservation. In other words, whether adoption of intercropping innovations is part of what can be labelled as positive socio-environmental development which brings ecological and economic goals together.

Methodology

Research location

The location chosen for the project was the Naban River watershed in the Dai Autonomous Prefecture of Xishuangbanna, Yunnan Province, Southwest China (figure 2).

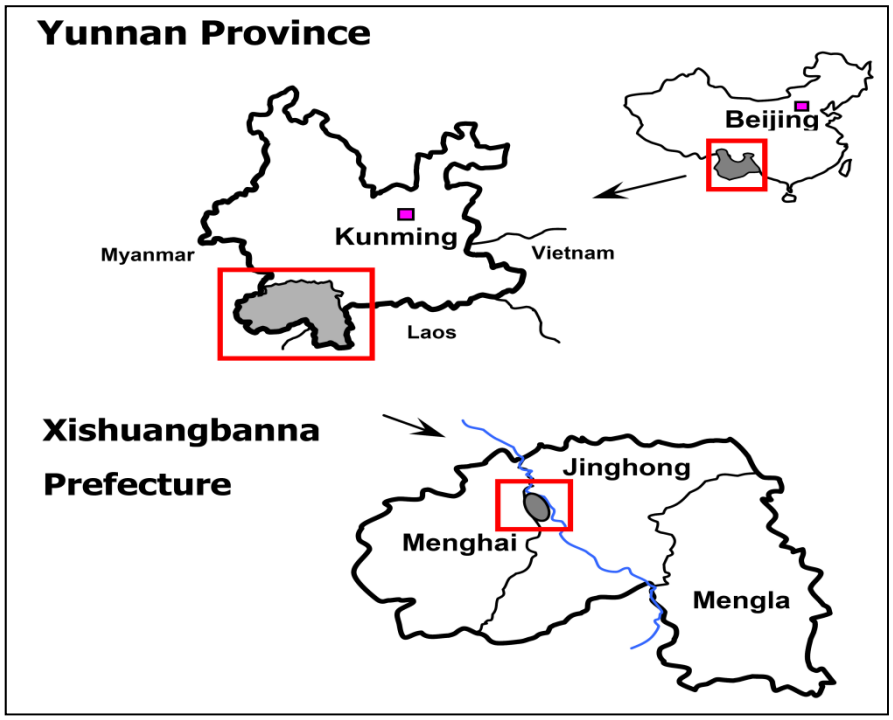

Figure 2. Research Location.
Source: LILAC 2008

Research methods

As the aim of this study was to examine social as well as environmental processes under different geographical and social conditions, a triangulation of qualitative research methods was applied.

Two villages have been selected for this study; both with recently adopted tea-intercropping innovations, but with considerable differences in environmental and socio-economic conditions (table 1). 25 semi-structured in-depth interviews have been conducted with farmers either individually or as group interviews with the whole family, usually two to three people. In order to create openness and achieve cooperation of the farmers, the interviews took place in various unbiased social and work situations such as working in the fields with the farmers, dining with them etc. In addition to that, systematic observations, often during walks in and around the villages helped to crosscheck the information gained from the interviews. To complement farmers' views and knowledge, 15 experts have been interviewed in the prefecture's capital Jinghong, and also in Beijing. "Experts" are people who are familiar with the area's socio-cultural or economic situation and/or have knowledge of the area's agriculture systems and forest ecosystems.

Table 1. Overview of the villages.

	XiaoNouYouShangZhai	BengLong
Ethnicity	Lahu minority and Mountain Han	Hani (Akha) minority
Altitude	1550 m a.s.l.	900 m a.s.l.
Households	33	10
Proximity to main road	30-60 minutes of winding gravel road	10 minutes of easy drive
Main crops	Paddy rice, corn, tea, and hemp	Rubber + paddy rice (tea, corn, litchi, pomelo)
Farming conditions	85% of the farmers' arable land is sloping land for tea	Slops not very steep; farmers have access to arable land for rubber **and** paddy rice
Animal husbandry	Pigs, chicken, buffalos and wild bees	Pigs, chicken and few buffalos

Findings

Altitude is unmistakably influential on the choice of crops. In Xishuangbanna this is quite fundamental because altitude is a precondition for the possibility (or the lack of it) to grow rubber. In fact, being able to grow rubber or not has direct and indirect impact on societies, agriculture (selection of alternative crops), and the environment. Inhabitants of neighbouring villages, often not more than 10-15 km away from each other, behave very different. One evident indicator for development is the housing that changed in the low altitude into big cement houses. In the high altitude the houses are made of wood and brown bricks and are not built upwards like the cement houses. Although many farmers consider cement housing as an economic improvement and a status symbol, these houses are also very difficult to heat up. Another impact of the altitude was observed in the openness of people to agriculture innovations. The two villages observed, BengLong and XiaoNouYouShangZhai showed differences in their attempt to use their limited arable land more efficiently. In both villages tea-intercropping with rubber and with walnut respectively, led to improvement in environmental performance as was testified by the farmers.

One of the main things that bothered farmers in XiaoNouYouShangZhai, and to a lesser extant in BengLong, was economic uncertainty. However, not only "*being poor again like before*" was a concern, but also environmental and cultural uncertainty. When several years ago the tea prices dropped and at the same time neighbours from the lower altitudes started increasing incomes by selling rubber, the need for economic risk reduction arose. Intercropping tea served both as economic risk reduction and as maintaining local culture. Farmers held that growing tea with walnut would mean in the future that if one crop will not get good prices, the other will. Also, farmers did not want to cut the tea bushes yet. A crop that has been grown in the area by the minority nationally groups for many centuries. In addition to that Pu'Er tea is renowned for its high quality all over China. In a slower rate than in the lower altitudes farmers started owning televisions, mobile phones and other farm improvements such as tractors and motorcycles.

Although tea - like rubber - is a mono-culture, it was found that it has better abilities to coexist with other crops. In BengLong, tea was grown only with young rubber. That was for the reason that, as one farmer put it: "*mature rubber tree drinks too much water*". The farmers, then, placed young rubber and tea bush with sufficient space between them (In other villages observed, mature rubber and tea were placed in completely different rows). This intercropping was positive for gaining more economic benefits from relatively small amount of arable land in the village. Nevertheless, so far only few farmers adopted this innovation and it is not known if more families in the village will adopt this innovation in the future.

In XiaoNouYouShangZhai, tea and walnut, a relatively recent innovation of the previous year, showed surprising findings. The system works in such way that rows of tea bushes are grown and other crops, rubber or walnut are placed between them. The young walnut trees are placed in a distance of 10 m between each tree. Adjacent to this particular agro-ecosystem, other crop systems existed and the forest ecosystem as well, without any fences. (Rosenzweig, 2003).

When referring to the adoption process of the tea-walnut intercropping, it was found that farmers divided into only two groups of adopters according to two stakeholders who introduced the innovation to them. Either the farmer bought the trees from the forest department, or they got it for free from an investor, who will later share a sum of the profits. The decision on 'from whom do I learn about the innovation' in so far was made according to whether the farmer had initial investment cash or needed to get the walnut in a lease-like agreement. From the perspective of the forestry department farmers achieving economic goals means that they have less motivation to cut trees from the nearby forest. Although some of the older interviews said that they remember times when the forest around the village was almost completely deforested and that they are not interested to go back to that negatively perceived situation. This is a very good example where social collective memory influences the ecosystem, and hence forth serves to gain ecological goals.

Conclusions

The altitude in which a farmer can or cannot grow rubber is a precondition to the discussion on economic and ecological goals in the NNNR. It is a major factor in the determination of economic and ecological goals of farmers and of other stakeholders. This is a primarily environmental factor, which leads the farmers to consider adopting agriculture innovations. Furthermore, this environmental factor can be said to be the most influential factor to initiate a whole ray of agriculture, environmental and social changes.

For the farmers of the higher altitudes of the NNNR uncertainty does not simply refer to economic risk, it is a state of mind. In the villagers' collective memory, uncertainty also refers to cultural and environmental changes. Intercropping in that respect is a good solution for various goals such as economic risk reduction, limited arable land, biodiversity conservation (and therefore crop protection), protection of the community forest, maintaining cultural crops, etc.

Although new crop introductions are usually an external initiative, the adoption of intercropping innovations is motivated by lack of arable land or reluctance to eradicate cultural crop such as tea. It is therefore not certain that farmers will consider this innovation unless those conditions will be filled. In other words, if easier ways to achieve economic goals would have been available it is likely that they would have been chosen (e.g. growing rubber on its own, or cultivation of more forest land).

Finally, intercropping innovations are a relatively easy and available way to bring both ecological and economic goals together. The technical knowledge to adopt such innovation exist; economic and ecological benefits are shown relatively quickly; and lastly those innovations require little financial investment or external help to adopt them.

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