



# SUSTAINABLE LAND MANAGEMENT

## WAYS TOWARDS MORE SUSTAINABLE RUBBER CULTIVATION





Traditional land use: rice cultivation in the Naban River valley.

- Natural rubber is an important primary product in the global economy. However, the growing of rubber tree monocultures also has negative effects on important processes in the ecological balance. German and Chinese scientists are now working together in a joint project to develop solutions which will allow farmers to grow rubber in an ecologically and economically sustainable way.**

Latex mattresses, rubber gloves, tap washers natural rubber can be found in many useful everyday objects. By far the biggest quantity of this natural resource – around three-quarters of world production – is needed by the tyre and automobile industry. Demand for rubber has grown enormously with the economic upturn in Asia. One-third of the rubber produced worldwide is now consumed by China – more than the consumption by the EU member states, USA and Japan combined. Natural rubber is obtained from latex, the sap of the rubber tree (*Hevea brasiliensis*). Although the tree is native to Amazonia, today around 91 percent of all rubber originates from the tropical regions of Asia. More than half of this comes from the so-called Greater Mekong Subregion (GMS), comprising the countries bordering the Mekong River (Cambodia, Laos, Myanmar, Thailand, Vietnam and the Chinese province of Yunnan).

Rubber is grown almost exclusively in monoculture plantations in these countries, with



Land cleared ready for new rubber plantations.

farreaching consequences. These are evident for example in the southern part of the Chinese province of Yunnan, in Xishuangbanna, the second largest rubber growing region in China. Originally covered by tropical rainforest, the landscape here is today dominated by rubber plantations. Primary rainforest is now found only in a few remaining areas of nature reserves. Driven by the high income potential, countless small-scale farmers in the region have switched from their traditional, subsistence-oriented farming to rubber production. This has consequences not only for the forest regions and their species diversity but also for the natural balance of ecological processes.

#### Questions and objectives

How does the rubber boom affect the environment and the living conditions of the local population, and what are the possibilities for minimising the negative effects? These questions are being investigated in the joint German-Chinese project SURUMER (acronym for Sustainable Rubber Cultivation in the Mekong Region) in southern Yunnan, led by the University of Hohenheim in partnership with other national and international institutions. The German Federal Ministry of Education and Research (BMBF) is providing funding of 4.6 million Euros for this major project, and scientists from 19 universities and research institutes in both countries are participating in the consortium headed on





Typical landscape dominated by rubber plantations in Xishuangbanna, Southern Yunnan.

the German side by Professor Georg Cadisch from the University of Hohenheim.

»The objective of the project is to investigate the effects of rubber plantations on the natural ecosystem processes and to develop scenarios for a sustainable, ecologically and economically viable land use system for rubber cultivation«, the tropical research scientist explains. »The freely available natural services and functions of the ecosystem are threatened by intensive rubber cultivation«.

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#### **Ecological analysis of the system**

Chinese and German scientists are working together in nine SURUMER sub-projects to investigate specific aspects. One sub-project is concerned with the carbon turnover in intensively cultivated rubber tree plantations of different ages compared to a natural forest ecosystem. The scientists are analysing the soil and plant carbon stocks, the gaseous discharges from the systems and the losses through soil erosion. Another focal point is the hydrological cycle. The scientists are investigating the importance of water release through evaporation from rubber



Undergrowth killed off by herbicides in a rubber plantation.

plantations for the local water balance and the effects of rubber cultivation on the quality and quantity of water resources.

The University of Stuttgart Water Research Centre, the Tongji University in Shanghai and the Tsinghua University in Beijing are jointly developing a water management system. This should allow the authorities responsible for the Naban River Watershed National Nature Reserve (NRWNNR) in southern Yunnan to assess the effects of possible measures and scenarios on ecosystem services such as clean drinking water.

In order to determine the present state of the water body and to create the models to be used, the scientists are gathering and evaluating large volumes of data. They are taking water samples and investigating how water quality is affected by the present land use. Because many of the rubber plantations are established on hillsides and lack ground cover vegetation, the humus topsoil is eroded by heavy rains. Sediment, pesticides and nutrients such as nitrates and phosphates are then washed into the nearby Naban River and its tributaries.

»This can have adverse effects on water quality and the spawning conditions for fish«, says Manuel Krauss, a research assistant at the Water Research Centre. To counter these effects the farmers could reduce their use of pesticides and



Collection point for the tapped latex, which is transported to factories for processing.

could also use plants as undergrowth in the rubber plantations to reduce the risk of erosion. »It would also be possible to establish buffer strips of shrubs and small trees along the streamside in order to reduce the quantities of fertilisers and pesticides entering the river«, Krauß suggests.

**»Rubber monocultures exhibit extreme poverty of mammal, bird and insect species compared to natural forests.«**

The expansion of the rubber plantations at the expense of natural forests and traditional land use systems also presents a major threat to the diversity of natural animal and plant species. This is all the more serious in the southern Yunnan region because it is part of the so-called Indo-Burma biodiversity hotspot and thus one of the most important areas for species diversity worldwide.

Protected areas such as the Naban River Watershed National Nature Reserve have been established to preserve this species richness. Around 2,000 species of vascular plants and nearly 400 species of vertebrates have been recorded in this region alone.

»Rubber monocultures exhibit extreme poverty of mammal, bird and insect species compared to natural forests. For this reason they are also



Station for measuring water quality on the Naban River in the Naban River Watershed National Nature Reserve (NRWNNR).

known as »green deserts«, says ecologist Dr. Konrad Martin from the University of Hohenheim. To allow a more accurate assessment of the importance of various natural and agricultural habitats for species diversity in a landscape dominated by rubber plantations, Martin and his research team and partners from the Chinese Academy of Sciences are investigating the wild bee fauna in the region. This insect group has been chosen with good reason: wild bees are the most important pollinators of wild and cultivated plants in tropical Asia. »The forests are an important habitat for the wild bees; they depend on them«, Martin explains. If the rainforests are sacrificed to make way for the rubber plantations, many species would vanish. This would also have negative consequences for humans. »Most agricultural fruit and vegetable species are pollinated by insects«, says Martin. If the wild bees disappear from the landscape they will be not be available for crop pollination. The farmers in the region also gather honey from various wild bee species.

**Socio-economic effects**

By taking the decision to swap their traditional, subsistence-oriented agriculture for rubber production, the small-scale farmers in the region have so far been successful. The changeover has proven an effective way of escaping poverty. »The profits to be made from rubber cultivation are significantly higher than those from traditional





Wild bees also provide honey and bee larvae, which are prized as a delicacy.

agriculture«, says agricultural economist Professor Hermann Waibel from the Leibniz University Hanover, who is working with Chinese agricultural economists in another SURUMER sub-project to gather socio-economic data from 600 families in around 40 villages in the Xishuangbanna Dai Autonomous Prefecture. The

**»Rubber is used almost exclusively for industrial purposes, so its demand depends heavily on the dynamics of the world economy.«**

scientists wish to conduct an economic analysis to investigate the financial risks associated with rubber cultivation for the family households.

»Rubber is used almost exclusively for industrial purposes, so its demand depends heavily on the dynamics of the world economy. This means that there are often large fluctuations in rubber prices, which can sometimes fall through the floor as happened in the world economic crisis of 2008«, says Dr. Gerhard Langenberger, coordinator of the SURUMER project on the German side.

The small-scale producers' total dependency on a single product exposes them to further risks. By deciding to grow rubber they are committing themselves for decades to come, and are thus unable to react flexibly to economic



***Alpinia oxyphylla***, a medicinal plant growing as undergrowth in a rubber plantation in Hainan.

and ecological crises caused for example by crop disease, pests, unfavourable weather or changes in climate. Yet evidently many farmers think only of short-term financial gain before all else. Waibel's interim results confirm this. »In Xishuangbanna, significantly fewer people than we first supposed live below the absolute poverty line of 1.25 US dollars per head per day defined by the United Nations«, says Waibel. The Chinese-German research team also wishes to find out whether the farmers set aside reserves from their rubber profits to tide them over when money is tight. »In times of crisis the farmers tend to prefer to sell their assets rather than forego personal consumption«, Waibel reports, referring to findings from other Asian countries where rubber cultivation is also expanding. This could even lead them to a relapse into poverty.

#### **Development of alternatives**

One possibility for reducing the economic risks of rubber monoculture in the scientists' opinion is crop diversification, in other words expansion of the crop range to include species that could bring in additional income for the farmers. This idea is being investigated in a further SURUMER sub-project. »In the study region, nearly 500 wild plant species are used as medicinal or food plants«, says project coordinator Langenberger. The challenge is to identify species which are on the one hand, shade tolerant and able to thrive as undergrowth in the plantations, and on the other hand,



Interview with a farmer and his family in the Naban River Watershed National Nature Reserve.

acceptable to the farmers in terms of market value and the effort required to manage them.

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Suitable species can be found in particular among the wild plants of the forests. »The scientists have already identified certain highly promising candidates such as local varieties of asparagus and Herb Paris«, Langenberger continues. An alternative rubber cultivation system with higher species diversity could also reduce the negative effects of monoculture cultivation: suitable undergrowth can counter soil erosion, stabilise the hydrological cycle and provide flowers for wild bees.

#### Expectations and future prospects

The scientists aim to present the results of their research in November 2016. Their local project partners are also hoping for innovative solutions: »I anticipate good results, so that we can practise sustainable rubber cultivation and better protect biodiversity«, says Liu Feng, senior manager of the Naban River Watershed National Nature Reserve. Rubber may bring considerable profit to the region, but it also causes enormous harm to the environment. »Everyone in the region is aware that the present agricultural practices are not sustainable,

and also that they carry great risks for the farmers«, Langenberger confirms. The objective of the research project is to shape rubber cultivation as sustainably as possible. The foundations for this are provided primarily by the cooperation with partners from renowned Chinese universities and research institutes. »The participating scientists have much experience in this area, and all contribute important specific knowledge to this intercultural and interdisciplinary work group«, acknowledges Langenberger. »This is a scientific cooperation on equal terms«.



Production systems that are being investigated in the region are: Agriculture (industrial and extensive), Forestry, Agroforestry, Tourism, Rubber Produktion

#### ■ SURUMER [www.surumer.uni-hohenheim.de](http://www.surumer.uni-hohenheim.de)

#### ■ Project head:

Institute of Plant Production and Agricultural Ecology  
in the Tropics and Subtropics | University of Hohenheim

**Professor Georg Cadisch**

Phone: +49 (0) 711-459-22438

E-mail: [cadisch@uni-hohenheim.de](mailto:cadisch@uni-hohenheim.de)

#### ■ Project coordinator:

Institute of Plant Production and Agricultural Ecology  
in the Tropics and Subtropics | University of Hohenheim

**Dr. Gerhard Langenberger**

Phone: +49 (0) 711-459-24512

E-mail: [langenbe@uni-hohenheim.de](mailto:langenbe@uni-hohenheim.de)

#### ■ Contact in the study region:

World Agroforestry Centre – China Program |  
Kumming Institute of Botany (KIB) | CAS

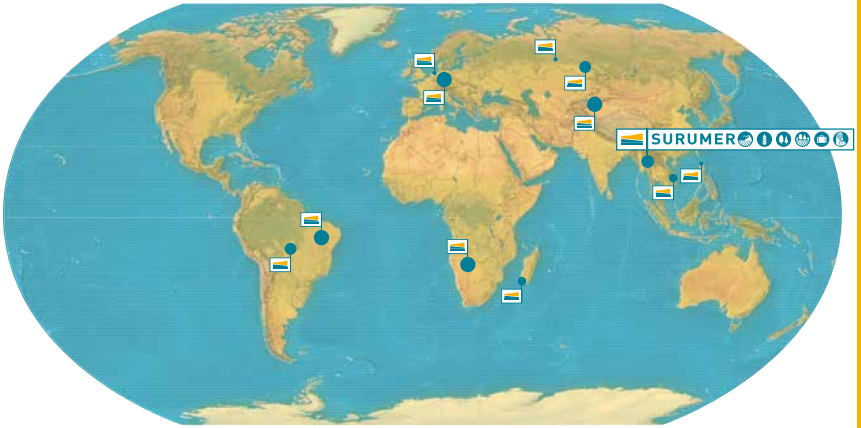
**Prof. Dr. Jianchu Xu**

Phone: +86 871 5223014

E-mail: [j.c.xu@cgiar.org](mailto:j.c.xu@cgiar.org)

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Department of Computational Landscape Ecology  
Permoserstraße 15 | 04318 Leipzig

Editorship: Andreas Werntze, MSc.

E-mail: [andreas.werntze@ufz.de](mailto:andreas.werntze@ufz.de)

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