

## SPECIAL REPORT

# Where the rubber meets the garden

China's leading conservation centre is facing down an onslaught of rubber plantations. **Jane Qiu** reports from Jinghong.

With a combination of carefully groomed landscapes and the natural splendour of tropical rainforests, Xishuangbanna Tropical Botanical Garden (XTBG) in China's south-western Yunnan province is renowned for its exceptional beauty. The 900-hectare garden, which has a collection of 11,700 plant species, is the Chinese Academy of Sciences' flagship institute for conservation research. Around it, however, the forests have increasingly been being replaced by row upon row of rubber trees; from the air, they look like gigantic mazes hemming in the conservation centre.

The stark contrast between garden and rubber "is a painful reminder of the responsibility of botanical gardens in wider conservation efforts in the real world", says Joachim Gratzfeld, director of regional programmes at Botanic Gardens Conservation International in Richmond, UK. He was one of about 100 experts who gathered at the XTBG earlier this month to commemorate its fiftieth anniversary — and to discuss its future as rubber plantations proliferate.

Ironically, the garden owes its existence to rubber. During the 1950s, in a bid to produce its own rubber in the face of mounting international isolation, the Chinese government sent a team of botanists to Xishuangbanna — at the time a hinterland where diseases ran rampant — to test whether rubber trees could be grown at such high latitudes. The researchers discovered a tropical paradise and so set up the botanical garden as a research base.

But as rubber prices have tripled over the past decade, rubber plantations have boomed in Xishuangbanna. Now covering about 400,000 hectares, they occupy 20% of the prefecture's land. The economic gain from rubber is evident during a drive around Jinghong, the capital of Xishuangbanna 70 kilometres from the garden, with its luxury shops, roaming BMWs and Mercedes, and European-style villas in the suburbs. "The force of economic development is beyond our imagination," says Chen Jin, director of the XTBG. And as researchers push into other potential cash crops in the region — including jatropha and palm trees for biofuels — many worry that appropriate regulation and controls may come too late.

"Xishuangbanna will be pushed over the edge if no immediate action is taken to prevent further forest destruction," says Xu Jianchu, an ethnoecologist at the Kunming Institute of Botany and China's representative at the World Agroforestry Centre, an international think tank headquartered in Nairobi, Kenya.

Next month, the Xishuangbanna prefecture government will finish drafting a plan that would, if enacted, work to restore the region's ecosystems. But it is not clear whether environmental regulations will be enough to compete with the lucrative rubber crops. "We could make as many laws as we want," says Jiang Pusheng, the Communist party secretary of the prefecture. "But until we provide the farmers with appropriate compensation and alternative economic means, none of the laws can be effectively implemented."

To feed its booming automobile and tyre industry, China plans to increase its natural-rubber production by 30% from 2007 levels — to 780,000 tonnes per year by 2010 — and is investing aggressively in nearby countries such as Laos, Myanmar and Cambodia. To meet demand, scientists are looking into ways to breed and select rubber trees that can survive at higher elevations. They are also trying to



The rainforest canopy in Xishuangbanna traps water vapour, helping plants to survive dry spells.

China's rainforests are being stripped to make way for rubber plantations.

raise output by making rubber trees mature faster than the current seven years.

"The large-scale rubber cultivation has taken a heavy toll on the local environment," says Zhu Hua, an ecologist at the XTBG. Satellite studies show that between 1976 and 2003 forests were cleared at an average annual rate of almost 14,000 hectares, shrinking the total forest cover in Xishuangbanna to less than 50% and that of primary rainforests to 3.6% (refs 1, 2).

In Xishuangbanna, hydrological systems have been hardest hit. Average rainfall over the region is about 1,400 millimetres per year, and occurs mostly during the rainy season. In winter, a dense fog of water vapour trapped beneath the rainforest canopy keeps the myriad plant species alive.

## Big drinkers

But the winter fog is becoming less pronounced as rubber trees take over the landscape, says Zhu. The non-native plants, known as 'water pumps' by the locals, suck up water and cause more surface runoff. As the soil water content is reduced, less evaporation takes place<sup>3,4</sup>. More water is also lost from the spaces between rubber trees, which grow farther apart than rainforest vegetation. As a result, streamflow has dropped and wells have dried up in many villages in Xishuangbanna.

Rainforest loss in Xishuangbanna also has implications for carbon dynamics and climate change in the region. Using a combination of remote sensing and forest inventory data, Ma Youxin, an ecologist at the XTBG, and his colleagues have calculated that 6 million tonnes of biomass carbon stock were lost in the prefecture between 1976 and 2003 (ref. 1). "This might be affecting the regional climate," he suggests.

Temperature and precipitation data from meteorological stations in Xishuangbanna

ZIBO

ZHUMIN



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A special village committee runs the fund, and farmers can borrow from it as microcredit. The initiative also tries to raise awareness of biodiversity among villagers and help them to plan and manage their land better.

"If villagers can get a few cows to care for, if they have clean water and their children can go to school, they are less likely to go around chopping down trees," says Hu, who runs the Xishuangbanna arm of the project.

Almost two years in, a pilot programme involving six villages in Xishuangbanna has shown some encouraging results. With a revolving fund of up to 50,000 renminbi each, the villages have agreed to protect and even restore the habitats of designated areas. Two new prefecture-level conservation corridors have also been approved by the Xishuangbanna government. The plan is to upscale the programme to another 40 villages, totalling 11,000 farmers and 8,000 hectares of forested areas, in the next five years. Other similar projects, such as the World Agroforestry Centre's Making Mekong Connected initiative, are exploring the potential of carbon trading and biodiversity offsets to help conserve the land and reduce poverty.

Meanwhile, Chen is looking to turn the XTBG into a Chinese version of the Panama-based Smithsonian Tropical Research Institute. This July, a brand new research centre is to open in Xishuangbanna at a cost of 90 million renminbi. It is to house 300 full-time researchers — twice the garden's current number — with greater capacity for visiting scholars, and cutting-edge facilities for conservation research.

The XTBG is also seeking a greater advocacy and policy role in biodiversity conservation in the region. Its system for evaluating its researchers, which is based solely on the number of publications in journals that use the Science Citation Index, will be reformed to encourage scientists to participate in regional development projects. "The future of the botanical garden is intimately linked to the future of the ecological environment of the region," says Chen. "The day when the forests are gone and rivers dried up would be the end of the XTBG." ■

1. Li, H., Ma, Y., Aide, T. M. & Liu, W. *Forest Ecol. Manag.* **255**, 16–24 (2008).
2. Li, H., Aide, T. M., Ma, Y., Liu, W. & Cao, M. *Biodivers. Conserv.* **16**, 1731–1745 (2007).
3. Liu, W., Meng, F.-R., Zhang, Y., Liu, Y. & Li, H. *J. Trop. Ecol.* **20**, 517–524 (2004).
4. Guardiola-Claramonte, M. et al. *Ecohydrology* **1**, 13–22 (2008).
5. He, Y. & Zhang, Y. *Mountain Res. Dev.* **25**, 341–348 (2005).
6. Hu, H., Liu, W. & Cao, M. *Environ. Monit. Assess.* **146**, 147–156 (2008).

show that the region has been warming since the 1960s, with less rainfall and more severe droughts<sup>5</sup>. Ma notes that various factors may be contributing to those changes, but stresses that large-scale deforestation is likely to have a role.

"Destroying ecosystems will backfire and hit economic development in the long run," argues Cao Min, an ecologist at the XTBG. Hu Huabin, director of the garden's research-planning and foreign-affairs division, and his colleagues have calculated the changes in the value of ecosystem services — such as nutrient cycling, erosion control, climate regulation, water treatment and recreation — due to changes in land use in Menglun, a typical township of 33,500 hectares in Xishuangbanna. Between 1988 and 2006, rubber plantations increased from 12% of the total land cover to 46%, whereas forested areas dropped from 49% to 28% (ref. 6). As a result, the value of ecosystem services dropped by US\$11.4 million. "We will soon hit the wall in an ecological credit crunch," says Cao. "This is hardly a viable investment."

But until recently, local officials were evaluated on just one criterion — gross domestic product — which largely determined the incentives and local policies they established. Although energy efficiency and the levels of industrial pollution discharges are now part of the assessment package, protection of natural resources remains optional. "This is a major problem," says Chen.

Jiang, the prefecture party secretary, is adamant that the people in Xishuangbanna have the right to develop and lead a good life. He does, however, admit that the environmental problems caused by deforestation need to be tackled. "It's a tough call," he says.

Jiang is spearheading a regulatory plan due

to be completed next month that would strengthen the control of forests in protected areas and restore some of those in the buffer zones of national nature reserves that have

been converted to rubber plantations. It would also prevent the destruction of 'collective forests' — those that used to belong to villagers but were, in a controversial move by the State Forestry Administration last year, allocated to individual farmers.

Still, rubber's sheer profitability means that any conservation efforts will be extremely challenging. Farmers in Xishuangbanna can earn a net income of 15,000 renminbi (US\$2,200) per hectare for rubber a year, compared with 2,000–3,000 renminbi for rice or tea. Unless the market takes into account the value of ecosystem services lost owing to the cultivation of rubber and other crops, the conflict between development and conservation will never be reconciled, says Joachim Sauerborn, an agriculture researcher at the University of Hohenheim in Stuttgart, Germany.

### Protection plan

"It is an uphill struggle — this is why conservation and poverty reduction go hand-in-hand," says Hasan Moinuddin of the Manila-based Asian Development Bank. Moinuddin, stationed in Bangkok, is the task leader of the bank's Biodiversity Conservation Corridors Initiative in the Greater Mekong Subregion. The scheme provides a revolving fund to villages that agree to establish new protection zones in their areas, to serve as crucial links between islands of existing nature reserves.

**"Destroying ecosystems will backfire and hit economic development in the long run." — Cao Min**