Harnessing Ecosystem Services for Local Livelihoods: the Case of Tea Forests in Yunnan, China

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Key Message: Multiple values of traditional tea forests have been thoroughly assessed and rediscovered through a process of multi-stakeholder learning.

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1. What was the problem?

Yunnan is a mountainous province in Southwest China bordering with Myanmar, Laos and Vietnam. Yunnan is distinguished globally for its bio-cultural diversity. Although it covers only 4% of land areas of China, it harbors about 50% of plant, birds and mammal species. It is home to 25 of 55 minority ethnic groups in China. However, Yunnan's economy lags far behind many other provinces in China. Loss of biodiversity is often a major causality following the conventional interventions, such as extension of monoculture plantations to boost economic development. This case study uses tea cultivation as an example to deal with the challenge of how to integrate biodiversity conservation with the expanding plantation economy.

The study site is Mangjing Village located in Lancang County, Yunnan Province. The terrain is mountainous with elevation in the range of 1100-1700 m above sea level. The climate is subtropical monsoon type, with May-October being the wet period and November-April being the dry period in the year. Average annual rainfall is 1800 mm. The village community comprises 582 households with a total population of 2786 in 2012 dominated by the Bulang minority people who are believed to be one of the earliest cultivators of tea. Tea cultivation has remained the most important source of local livelihoods for the Bulang people since ancient time. A Bulang proverb says "*Pa-ai-neng* is our ancestor, who has blessed us with bamboo houses and tea gardens as the crutch for our livelihoods". Apart from producing tea, the Bulang traditionally grew upland crops (such as upland rice, Job's tears, maize, cotton, buckwheat) under shifting agriculture. Many families have recently adopted wet rice system on terraced slopes with access to water. Nevertheless, upland fields accounts for 3.5% of the village area while the rice terraces occupy only 1.5%. The forests are the dominant land use-land cover in the village, encompassing 64% of the village area.

Tea cultivation covers 7.3% of the village area in 2012. The traditional tea (*C. sinensis var. assamica*) gardens were cultivated in natural forests generations ago by the ancestors of the Mangjing people. Tea here is in the form of short trees (4-5 m) growing under the forest canopy (30-40 m), such as Chinese Banyan (*Ficus microcarpa*), camphor (*Cinnamomum camphora*), giant dogwood (*Cornus controversa Hemsl*), alder (*Alnus nepalensis*), birch (*Betula alnoides Buch Ham.*). Tree density, diversity and crown cover in these tea forests are such that they are mistaken for dense natural forests from a distance. The modern monoculture of intensive tea plantations on terraced slopes with use of chemical inputs have come up for high productivity since the last few decades. Local people refer to the traditional tea gardens as “tea under forest canopy” or “tea forest” and the modern tea monoculture on terraces as “tea on terraces” or “tea terraces”. This recent land use of tea terraces now account for 2.2% of the village area while the traditional tea forests cover 5.1%. Introduction and expansion of tea terraces have increased tea productivity, but at the cost of loss of a significant area of forest fallows and traditional tea forests and associated bio-cultural values. An objective assessment of all values and services of tea forests may lead to more rationale land use decisions and thereby lesser threats to conservation of natural capital and sustainable livelihoods.

Figure 1 - Tea forests (Copyright: Xiang Yueping)

Figure 2 - Tea terraces (Copyright: Liang Luohui)

2. Which ecosystem services were examined and how?

Tea forests integrate all provisioning, regulatory, cultural and supporting services. The assessment of these services from tea forests made full use of indigenous knowledge in many of those goods and services in their traditional terms (such as ethno-botanical knowledge) but not in very scientific terms. The assessment of tea forests was mainly qualitative in comparison to tea terraces so that local people were able to understand and contribute to the analysis of goods and services from both tea forests and tea terraces. Moreover, the assessment involved local farmers, officials and extension workers and facilitated exchange and integration of indigenous knowledge and scientific information about ecosystem service. Finally, the assessment has been a multi-stakeholder process with incremental contributions

from different stakeholders. For example, Chinese Academy of Science made a scientific and taxonomic inventory of plant species in the village (Qi et al., 2005).

Comparisons of inventories of plant species in different land use-land cover types showed the significant supporting service of tea forests to harbor rich plant biodiversity (Qi et al., 2005). There was frequent occurrence of tree species *Toona ciliata, Dalbergia fusca* var. *enneandra, Premna szemaoensis*, *Calophyllun polyanthum, Helicia terminalis, and Cinnamomum mollifolium* in tea forests but their rarity in natural forests. Tea forests harbored 15 rare and endangered plant species. Total species richness (244 species) in tea forests was comparable to that of natural forests (241 species) although percentage of arbor species (24.05%) in tea forests was less than that of natural forests (38.5%). The forest canopies hosted predators (spiders, birds and wasps) of crop pests providing natural pest control in the tea forests.

Participatory rural appraisal (PRA) was the main approach to assess provisioning, regulatory and cultural services of tea forests. In addition, questionnaires and field measurements were also carried out to supplement PRA based information. The provisioning service included tea leaves, medicinal plants and wild foods. Questionnaires as well as field measurement were used to investigate productivity of tea leaves. A market survey helped to understand tea price and consumer preference. An inventory of medicinal and edible plants was carried out through key informant interviews, group interviews/discussions, ethno-botanical and market surveys to complement the previous surveys. Regulating service contains soil and water conservation on the slope by tea forests to avoid needs of terracing, pest regulation by nurturing pest predators (birds, wasps, ants, spiders, etc) in the tea forests so that use of pesticides is avoided, local climate regulation (humidity maintained by forests during dry season) to reduce risk of drought, global climate regulation (carbon storage in tea forests). The regulating service was examined through group interviews/discussions and field survey (estimation of carbon stocks in tea forests). Supporting service contains nutrient cycling through rich forest litters pumping from deep soils as green manure, and flora and fauna habitats as many plant species, including endangered species are found in tea forests. Interviews and field surveys as well as review of secondary data and relevant literature were the main tool to understand the supporting service of tea forests. The cultural service includes the family worships of the best tea plants for hosting the tea spirit in the family plots in tea forests and the annual worship of the Bulang ancestor in tea forests during the traditional festival for good harvests and livelihoods. The cultural service was examined through interviews, literature review as well as participatory observation.

Through the assessment, stakeholders have re-discovered many advantages of tea forests over modern tea terraces as follows:

	Traditional tea forests	Modern tea terraces
1. Yield / ha (dry leaves)	525kg	900kg
2. Quality of tea	Natural organic products	Product from intensive cultivation using chemical inputs
3. Market price (dry leaves) (US$ 1= RMB 6.3)	High (RMB 300/kg)	Low (RMB 80/ kg)
4. Wild medicinal & edible species richness	High	Low
4. Soil & water conservation	Dense protective forests and litters cover on slopes	Terracing
5. Pest regulation	Natural control mechanisms	Application of pesticides (RMB 750/ha)
6. Local climate regulation	Shading of tea plants, inception of dew and mitigation of frost by forests in dry season	Lack of shading forests to incept dew, moderate the blazing sun and frost risk in dry season
7. Global climate regulation	High carbon storage	Low carbon storage
8. Fertility	Nutrient cycling through forest litters and manure	Application of chemical fertilizers (RMB2400 /ha)
9. Biodiversity	High, including endangered species	Low (84 species, mainly herbs)
10. Cultural service	Cultural heritage; worships of the tea spirit and the Bulang ancestor in tea forests	Introduced (terracing, monoculture, and use of chemical inputs)
11. Labor inputs	Low (weeding only)	High (pruning, weeding, terracing, application of chemical inputs)
11. Costs of chemical inputs	None	High (RMB3,150/ha)
12. Income (yield x price – costs of chemical inputs)	High (RMB157,500/ha)	Low (RMB68,850/ha)
13. Resilience	Resistant to pests, drought, soil erosion	Vulnerable to pests, drought, soil erosion

(Adapted from Xiang, et al. 2008)

3. Did the examination of ecosystem services generate impacts on decision-making or policies and, if so, how?

The comparative assessment of services rendered by tea forests and tea terraces has influenced decision-making and policies at several levels. Individual families have restored traditional worships of the best tea plants in the family plots of tea forests as they believe the tea spirits residing in such plants show blessings for good harvest and happiness. Along with the increasing income from tea forests increased frequency of visits to fields for cultural or technical reasons resulted in avoidance of encroachements and appreciation of traditional system of land tenure and resource ownership. Many farmers converted a significant area of “tea terrace” towards “tea forests” by planting trees at their own costs. During the household interview, one farmer told us that he regretted so much for removing trees when he developed tea terraces few decades ago. He had made so many efforts to restore the shade forests in his fields which face southwest. This farmer was one of pioneer farmers to reduce the tea plant density and plant shade trees in his fields. He selected a strong tea plant as the host of the tea spirit and wished that his tea terrace would become a tea forest with help of the tea spirit in future.

At the community level, restoration of traditional worship of the Bulang ancestor in tea forests has helped raise awareness of traditional rituals and values and pass them on to the young generation. Mangjing Village has formulated the village rules for conservation of tea forests, and established the Mangjing tea forest cooperative to collaborate in management, processing, branding and marketing “Abaina” tea produced from the cooperative and to be able to benefit from the whole production chain.

Recognizing the advantages of tea forests over the tea monoculture in terms of quality, marketing and environmental benefits, local governments at county and prefecture levels are now providing both technical and financial support for weaker farmers to reduce the tea plant density and plant shade trees, such as camphor (*Cinnamomum camphora*), giant dogwood (*Cornus controversa Hemsl*), etc in tea terraces. In addition, the traditional management of tea plants with infrequent pruning is gradually restored for the tea plants to grow taller and larger in the tea terraces. Tree planting and infrequent pruning will gradually facilitate conversion of tea terraces to “tea forests”. Moreover, the local government has applied to FAO for global recognition to the traditional tea forests and associated ecosystems around them as Globally Important Agricultural Heritage Systems (GIAHS). FAO officially listed tea forests as GIAHS in September 2012. Pu’er tea made of tea leaves from tea forests, a natural organic product, has turned as an attractive source of income to local people together with restoration and conservation of ecosystem services.

4. Lessons learned

Assessment and rediscovery of multiple values of tea forests has been an iterative process of multi-stakeholder learning rather than a rapid rural survey. Local farmers have realized the drawbacks of their decisions to convert their traditional tea forests with low provisioning but high levels of other ecosystem services to the tea monoculture terraces with high levels of provisioning services and income in the short term but lower level of other regulatory, cultural and supporting services with

negative consequences for sustainability of their livelihoods in the long term. Productivity meant profitability when the market did not recognize the quality and price difference between tea forests and the tea terraces a few decades ago. Realization of health hazards from tea cultivation with intensive agrochemical use has prompted consumers to switch over to the organic tea and their willingness to pay premium for the latter. This has resulted in higher profitability from the traditional tea forests despite of their low productivity compared to the modern tea terrace systems. Revival of traditional tea culture and rising awareness of healthy tea and environment has also contributed to appreciating tea forests at all levels.

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