Rehabilitation and Community Forestry in the Xizhuang Watershed

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Abstract

A series of forest activities have been carried out in the Xizhuang watershed as part of the People and Resource Dynamics Project (PARDYP) in mountain watersheds of the Hindu Kush-Himalayas. Three nurseries were established to provide (tree) seedlings, legumes, and new varieties of tea bushes, and the local capacity to promote afforestation was enhanced. Several PRA tools such as matrix scoring and ranking were used to facilitate species selection by the farmers, and to document decision making in forest resources management. During the two years of project implementation, farmers selected and planted thousands of timber species (Pinus armandi), nitrogen-fixing legumes, fruit trees (pear and walnut), and bamboo plants for gully erosion control. Two degraded forests in the watershed were selected for rehabilitation research. A range of species has been planted to control soil erosion and improve soil fertility. Efforts are being made to improve the technical training, local capacity, and organisation of community forestry groups. This training is crucial for sustainable forestry development in this watershed.

Introduction

The Xizhuang basin, a typical watershed, lies between 99°06′ and 99°13′ E and 25°13′ and 25°17′ N in the mid-mountain region of western Yunnan near Baoshan City. As a result of heavy long-term human exploitation of the natural resources, degradation is widespread and enormous efforts are needed to arrive at a sustainable use of the natural resources. The watershed was selected as a study site in 1996. The aims of the research in the area are to understand the causes and extent of environmental degradation, to identify the constraints, to seek practical solutions for management problems, and to involve the community in the research. Forest resources are critical in the daily life of the local people and form an integral part of the agricultural system. In a watershed context, forests are linked to water and soils, and in order to improve the resources an integrated management approach is needed. This requires a long-term view and stakeholder involvement from the beginning. A series of forestry activities have been carried out during the past three years. These include baseline surveys, establishment of nurseries, and reforestation of degraded sites. The project is still in the early stages, thus only the first findings of these research initiatives are presented.

The Forest Resources in the Watershed

The Xizhuang watershed is located in the southern section of the Hengduan Mountains. Influenced by the regional geological history and active tectonic movement, the landforms are complex and diverse. Air currents from both the south-western Indian Ocean and the south-eastern Pacific Ocean influence the climate in the watershed. The annual climatic cycle is dominated by distinct wet and dry seasons. Red soils dominate. They originate from many metamorphic parent rocks (slate, gneiss, phyllite) and from igneous granitic rocks.

The original natural vegetation consisted of a semi-moist broadleaved forest, but much of this disappeared many years ago. As one of the older cities in China, Baoshan has a very long history of human activity that can be traced back to the Neolithic Age. The Yuan Dynasty period (1279-1368) was especially active, a time when a great number of inland people migrated from eastern China to Baoshan. Most of the natural forests were destroyed through shifting cultivation, the traditional practice, and then replaced by dry-tolerant, secondary pine forests. Three distinct major deforestation events in the current century were identified through field surveys and interviews. In the 1920s and 1930s, when the population in the watershed was still small, shifting cultivation, the introduction of intensive plantations of opium and buckwheat, and overgrazing, caused a rapid decline in forest cover. At the end of the 1950s, large areas of forest were felled to provide firewood to fuel iron and steel factories during the 'Great Leap Forward'. At the beginning of the 1980s, forest resource use and management rights were allocated to individual households, which in many cases resulted in an unexpected over-harvesting of forest resources.

Most of the pine forests in the Xizhuang watershed were planted between the 1970s and the present using pit-planting or aerial seeding methods. The forest coverage has clearly increased over the past 10 years, particularly in Lijiasi and Qingshui villages (Xu *et al.* these proceedings). This is the result of a significant improvement in the community's awareness of the benefits of afforestation, and of the enforcement of forest protection by local institutions. Updated statistics have been compiled on the distribution of tree species, genera, and families in the watershed on the basis of a recent inventory.

Local residents are generally very knowledgeable about the use and management of forest resources, and the importance of forests as a source of construction materials and firewood for household use. Local people also collect many kinds of non-timber forest products such as mushrooms, fodder, and forest litter for composting. Some patches of forest land are also used for grazing. Many people realise that forests play an active role in influencing microclimatic conditions and controlling environmental hazards.

There are many different users and owners of the forest resources. In the high-mountain area of the watershed the forests are state-owned; in the central section of the watershed most of the forests are collectively-owned or household-owned; and in the downstream area and lowlands most forest land has been transformed into farm land to meet rapid demands

for crop production, and is thus registered to households. Some steep slopes have been entirely degraded as a result of deforestation or cultivation.

Although forest coverage in the Xizhuang watershed is clearly on the increase, there are still many problems and constraints that affect the sustainable use of the forest (see Yang, Wilkes, and Xu these proceedings). For example, the large-scale monoculture of several pine species (e.g., *Pinus yunnanensis, Pinus armandi,* and *Pinus kesiya var. langibianensis*) has led to a decline in biodversity, and restricts the multiple use of forest resources. External technical support is needed for community forest management for establishing nurseries, plantations, pest and disease control, forest development and planning, and forest monitoring. In some degraded areas, the recovery and growth of native plant species is very difficult or even impossible because of habitat deterioration, and it is a challenge to plan and design reforestation activities, including the introduction of exotic plant species. Significant issues that need to be addressed are how to motivate local participation in community-based forest management, and how to build capacity within the local institutions.

PARDYP Forestry Activities and Achievements

Establishment of Nurseries

In previous tree-planting projects most seedlings were provided by state-owned forestry nurseries. The survival rates in the new plantations were very low as a result of the poor quality of the seedlings after long-distance transport, and the lack of community participation in the programme. The establishment of community-based nurseries should decrease the expense of seedling production, and help sustain local forest plantations better. For this reason, PARDYP paid special attention to building community nurseries within the watershed. Three nurseries were established to provide timber seedlings, legumes, and new varieties of tea. During the first two years of the project, more than 70,000 plants of *Pinus armandii* and nitrogen-fixing leguminous plants were distributed to villagers for the establishment of plantations, and nearly 40,000 quality tea seedlings will be distributed in 1999.

Rehabilitation

In the first phase of PARDYP, two sites in the Xizhuang watershed were selected as rehabilitation sites. One is located in the downstream section of the Xizhuang River near Tiger Cave, at an elevation of 1820-1860 masl. As a result of the steep slopes and heavy soil erosion in the past years, the topsoil is very thin, lacks soil nutrients, and has low productivity. The existing plants grow very slowly and natural plant regeneration has been poor. A series of different combinations of plant species, cropping patterns, and land preparation techniques were used to rehabilitate the area (see Figure 30 and Table 41).

The second rehabilitation site is in Ganwangkeng near Qingshui village. A major landslide generated extensive soil erosion problems which are threatening the nearby farm land and

settlement. Some nitrogen-fixing plant species (of the types shown in Table 41) have been cultivated on this site to improve the soil fertility.

Agroforestry

Agroforestry techniques have been identified as useful for improving biomass production and stabilising the soils in the farming systems in mountainous regions. These techniques help protect the environment and meet the multiple local resource needs. Field surveys showed that the local people are enthusiastic about planting fruit trees as a part of the existing farming system. A matrix scoring of preference was carried out in the watershed, the results are shown in Table 42. The villagers chose pear and walnut as their preferred species for planting. So far, 1,700 pear tree seedlings and 1,300 walnut tree seedlings have been cultivated in Qingshui and Xizhuang. These trees are inter-cropped with wheat or maize on cultivated farm land. A further 2,050 seedlings of Japanese sweet persimmon were planted in the watershed this year.

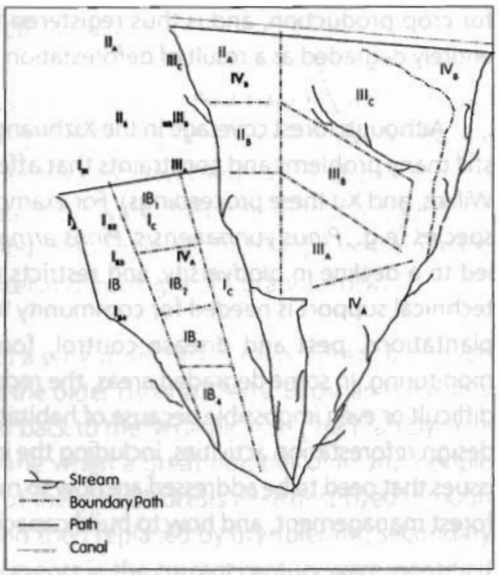

Figure 30: **Sketch Map of Plan for Rehabilitation at the Tiger Cave Site**

Table 41: **The Reforestation Design for the Tiger Cave Rehabilitation Site**

Plot			Land preparation	Tree species	Cropping Pattern
I	IA		Pit-digging	*Leucaena leucocephala*	Plot
	IB	IB1	Contour	*Tephrosia candada*	Plot
		IB2	Contour	*Leucaena leucocephala*	Plot
		IB3	Contour	*Acacia yunanensis*	Plot
		IB4	Contour	*Acacia mearnsii*	Plot
	IC		Pit-digging	*Acacia mearnsii*	Plot
II	IIA		Pit-digging	*Tephrosia candada,* *Acacia richii*	Plot
	IIB		Pit-digging	*Acacia richii*	Plot
III	IIIA		Contour	*Acacia mearnsii,* *Acacia yunnanensis* *Leucaena leucocephala*	Line
	IIIB		Contour	*Acacia mearnsii* *Leucaena leucocephala* *Tephrosia candada*	Line
	IIIC		Contour	*Acacia yunnanensis,* *Acacia mearnsii* *Leucaena leucocephala* *Acacia yunnanensis* *Tephrosia candada*	Line
IV	IVA		Pit-digging	*Leucaena leucocephala*	Plot
	IVB		Pit-digging	*Acacia mearnsii*	Plot

Table 42: **Matrix Scoring of Tree Species in Zhangjia Village**

Criteria	Walnut	Chest -nut	Pear	Small Apple	Crab-apple	Peach	Sichuan Pepper	Persi-mmon	Apple
Survival rate	7	3	8	8	9	10	5	8	8
Seedling survival	7	5	8	8	10	10	10	6	8
Seed collection	7	6	6	6	10	10	9	7	6
Management	8	6	8	7	10	7	6	7	7
Storage of fruit	10	10	6	6	6	5	8	7	6
Transportation of fruit	10	10	6	6	7	5	9	7	6
Market accessibility	10	10	6	9	4	7	9	9	8
Maturation time	5	7	7	8	10	10	8	6	8
Productivity	5	2	6	8	10	8	5	6	7
Growth rate	8	7	8	8	9	10	7	8	8
Price	10	10	7	7	3	9	8	6	8
Plantation history	8	7	10	10	8	10	8	10	7
Method of grafting	8	6	10	9	9	10		8	9
Soil fertility improvement	10	7	7	7	7	7		9	7
Avail. of wild germplasm	+	-	-	-	+	+	-	-	-

Notes: score 1= the lowest preference, 10= the highest preference.

Bamboo Plantation

Bamboo is a typical plant in the watershed and has multiple uses including construction, farm tools, furniture, and food (young shoots). Bamboo plantations are also good for controlling landslides and soil erosion. In 1998, 895 *rhizobium* clumps and stem sections of bamboo were cultivated along water channels in the watershed (245 in Lijiasi, 505 in Qingshui, and 150 in Xizhuang).

Sloping Agricultural Land Technology (SALT)

SALT is now widely used in the Hindu Kush-Himalayan region as an effective way of bioterracing the landscape to prevent soil erosion and improve soil nutrients. As a trial, 32 *mu* (2.13 ha) of farm land opposite Tiger Cave in Xizhuang village have been planted with some nitrogen-fixing leguminous species. However, as a result of local intensification of land use, it will require some time for the farmers to accept SALT.

Training

During the implementation of PARDYP, a three-day training workshop on forest management was held within the watershed. Foresters and technicians from the Forest Departments of Baoshan City and Kunming instructed local farmers in practical knowledge and techniques for nursery establishment and forest management such as seedbed preparation, pest and disease control, grafting, and thinning. In the future, such workshops will be carried out more frequently and involve a larger audience. The criteria used to select tree species for afforestation are shown in Table 43.

Table 43: **Ranking of the Importance of Timber Tree Species**

Criteria	*Pinus yunnan-ensis*	*Pinus armandi*	*Pinus keisya* var. *angbian-ensis*	*Eucalyptus* spp.	*Taiwania flousiana*	*Aluns nepalensis*
Market value	7	9	7	6	10	6
Growth rate	8	8	9	10	8	8
Timber quality	6	8	8	6	10	4
Hardness	10	8	8	7	10	5
Planting scale	3	7	3	4	1	2
History of plantation	10	8	5	6	2	7
Sensitivity to pests and diseases	10	8	8	7	8	10

Note: score 1= lowest preference, 10= highest preference

Conclusion

At least three separate periods of forest degradation have occurred during the 20th century in the watershed. As a result, the forest currently consists primarily of pine plantations that have been established in recent years and which are low in biodiversity. Efforts are under way to introduce fruit tree seedlings, agroforestry practices, and nitrogen fixing plants to improve the forest resources and soil fertility in the community owned forests. In addition, rehabilitation programmes are under way to stabilise slopes in the lower parts of the watershed. Initiatives have also been taken to produce improved tea seedlings for the tea gardens in the central portion of the watershed.

During the implementation of the first phase of PARDYP, modest subsidies were provided to establish local nurseries and bamboo plantations. Some free fruit tree seedlings and forest plants were also provided. These were considered as positive incentives to increase the motivation, enthusiasm, and participation of local farmers in the reforestation efforts. In the future, greater efforts will be made to provide training to improve the abilities of the farmers to manage the timber forests, fruit trees, and tea plantations. The establishment of community-based forest user groups will be crucial for sustainable forestry development in the watershed.

Acknowledgements

These PARDYP forestry activities were implemented with the support of the project team members and many thanks are given to these people for their significant contribution. The authors are also grateful to Prof. Yang Qixiu of Chengdu Institute of Biology and Dr. Tang Ya of ICIMOD for their invaluable advice and assistance. Finally and in particular we would like to thank local farmers for their support and understanding during the implementation of project activities.