

## The development and protection of natural resources in Hengduan Mountains

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**Abstract.** The Hengduan Mountains stretching from 97°-104° E and from 26°-34° N is one of the best known areas in China. It is characterized by great diversity in the vertical distribution of resources and by a vulnerable ecological environment. Avoiding environment degradation by irrational exploitation of natural resources and maintaining coordination and balance among population, resources, environment and economic development, requires strategies for reasonable utilization of wild plant and animal resources, for establishment of nature conservation, for developing mountain eco-agriculture, for actively tapping other energy sources and for protecting mountain forests.

**Key-words:** Mountain resource, development, protection, ecology, agriculture

### Introduction

The Hengduan mountain area is situated in the border area of Tibet and of Sichuan and Zunnan provinces of Southwest China. It stretches from 97° E to 104° E and from and from 26° N to 34° N. It is a high mountain area with the peaks Gonggasham (7,556 m), Sijiemei (Four-sisters-6,250 m) and Queer Mountain (6,166 m). The northwest part of the area stands over 4,000 m above sea level, while the elevation of the southeast valleys only is 1,000-1,300 m. Such marked relief produces a complex environment. As a result, the area supports rich natural resources.

### Key characteristics of the natural resources of the area

1. *Great diversity in the vertical distribution of resources.* Since the area exhibits dramatic differences in elevation, vertical zonation is apparent in physical elements of climate, vegetation and soil. The major landscape types from high to low altitudes are: alpine scrub and meadows, cold temperate needle-leaf forests, mixed needle broad leaf forests, evergreen forests and warm needle-leaf forests. There is a corresponding variation in agricultural activity with a diverse range of enterprises:

(i) Alpine scrub and meadow. The zone is occupied by alpine scrub, meadows and marshes, which used solely as rangeland for yak and sheep with no other agricultural or forestry activities.

(ii) Cold-temperate needle-leaf forests. Forestry is mainly practised here with *Picea abies* etc. as timber forest. Yak, sheep and horse grazing are carried in the grassland. Only a few crops are cultivated where microclimate is favourable. These include highland barley, spring wheat, rape and beet.

(iii) Mixed needle broad-leaf forests. The natural forests have Hemlock Alpine Pine, Yunnan Pine and various broad leaf species as dominants. There are economic production of apple, pear and pepper. Cattle and goat grazing is undertaken partially in forest pasture and grassy thickets in valley bottoms. Two or three cropping in two year stations of wheat and maize is practiced in the valleys.

(iv) Evergreen broad-leaf forests. This zone includes sites in dry-hot valleys. The forestry is based on Yunnan Pine and miscellaneous evergreen timber species in the some economic stands of citrus, Balbis Banana, tea and oil tea. Cattle, Water Buffalo, horses and goats are grazed in forest pastures and near farmland. The crops consist of rice, wheat, maize etc. with two to three harvests per year. Other economic crops of sugarcane, tobacco and cotton also are cultivated in this zone.

2. *Rich and colourful biological resources.*

The uniquely varied ecological environment supports complex biocoenoses. The very rich wild animal and



plant resources make the area of outstanding importance for China's gene pool. More than 180 large animal species and over 500 bird species make up nearly half the total number of such species in China. They include relict and endemic species such as Giant Pandas, Golden Monkeys, pheasants, takins, White Lip Deers. Leopards, Himalayan marmots, muntjac, deers, bears and musk-deers are animals of importance for fur, meal and medicinal uses. There are over 10,000 vascular plant species growing in this area which amongst those with the most species per unit area in the world. Wild plant are an important local resource and include medicinal plants such as *Cordyceps*, *Fritillaria*, *Picrorhiza*, *Rheum officinale*, *Gentiana macrophylla*, *Engelhardtia roxburghiana* and *Saussurea involucrata*, some well-known flowers such as *Rhododendron*, *Camellia*, *Giantiana scabra* and *Lilium* as well as some aromatic, oil-, fiber- and tanin-plants and edible fungi. In addition dozens of species of wild and cultivated fruit trees are grown, such as apple, pear, peach, mango, walnut, kiwifruit, pomegranate, citrus, sweetpeach, aristate goosefoot and grapevine. There are other plants of economic importance such as pepper, oiltea, tungoil tree which have great potential to be developed.

#### 3. Forestry and animal husbandry.

The arable land here is limited, being mostly concentrated in the basins and wider valleys which enjoy better conditions of water and temperature. In fact the under-cultivated land resource is extremely limited. In contrast, land for forestry and animal husbandry is more extensive in area and better maintained. There are 7 million hectares of forest land with about 18% coverage of forest of 1.3 billion m<sup>3</sup> timber stock. This is the major part of China's Southwest forest region. The dominant species of *Picea* and *Abies* are characterised by excellent wood properties and high productivity of 300-600 m<sup>3</sup> and even up to 1,000 m<sup>3</sup> per hectare. The natural grassland occupies almost 20 million hectares constituting 40% of the total area of the region. Except for a new of the forest pastures and dry valley scrub-grasslands, the alpine meadows, scrubs and marsh meadows are generally good grazing, supporting fresh palatable grass production up to 3,000-5,000 kg/ha.

#### 4. Vulnerable ecological environment.

Since the area is located at the junction of the circum-Pacific belt and the palaeo-Mediterranean it is influenced by the strong tectonic activity. Earthquakes are more frequency and stronger than elsewhere in China. Moreover, the precipitous terrain, constrained with the comparatively concentrated precipitation leads to active mass movement. The most hazardous debris flows in China occur there. Soil erosion resulting from improper resource exploitation threatens the stability of mountain ecosystems and the quantity of natural resources. This lowers the productivity of forests and rangelands or even

destroys them. Wild animal and plant resources also are susceptible to damage.

### Some problems in the exploitation of natural resources

#### 1. Excessive hunting and harvesting of biological resources.

Utilising biological resources in this area is an important source of local income. With the decline of forests and the degradation of natural ecosystems, as well as excessive hunting, the resources have been seriously damaged. Musk and a few animal and plant drugs are being produced in controlled production. Most big animals offering valuable fur and medicinal products and the medicinal plants have sharply in numbers. Protection of the famous local products of musk, bulb of fritillary, pilosa antler and those from muntjac, Himalayan Marmot and leopard is in progressive decline. The yearly output of musk used to be 1,500 kg, but has dropped to less than 30 kg since the 1970s. The number of pelts has decreased significantly from 100,000 to several hundred.

#### 2. Overgrazing and limitations to animal husbandry.

Grazing of natural grassland is limited to summer and autumn. There is serious shortage of supply of herbage in winter and spring. This is because grass remains green for 5 months and improved grasslands are few in number. Therefore, the current carrying capacity is almost saturated. Serious grassland degradation has resulted from primitive methods of utilization and management. Even the formerly luxuriant grassland of Rouergai is being desertified. A current survey show the desertified grassland to exceed 3,000 ha in extent. At the same time herd quality is declining for lack of scientific breeding. The dominance of livestock production is thus threatened. In addition, shortage of processing, storage and transport facilities reduces the economic efficiency of animal husbandry.

#### 3. Excessive deforestation and under-development of economic forests.

The forest coverage is being reduced tremendously as a consequence of its vulnerability and because of long-term practices of „cutting more and planting less“ and the expansion of reclaimed land. Forest area in some counties has suffered a fifty percent decline during the last 20 years. For example, the coverage in Lixian, Songpanxian, Heishuixian, Wenchuanxian and Maowenxian counties in the upper reach of Mianjiang river was once 50%, 30% thirty years ago, but was only 18.8% on a recent survey. Not only are many cutting areas on the verge of exhaustion, but improper management of clearcutting and trailing is common. For example, clearcut areas occupied 89.9% of some counties and even included reservations with steep slope of



45° among the 0.2 million ha forests cut during 1949-1979 in the western mountain area of Sichuan. As a result, soil erosion, in the areas suitable for forest, is extremely serious. In addition area of desertified valleys is being enlarged. The upper limit of some dry valleys is over 200 m higher than when the forests were intact. Many large valleys and basins enjoy microclimatic conditions suitable for economic forests including fruit trees. The potential cultivated area for apple and pear is about 10 times that cultivated of present. Unfortunately because of limitation in management and technology the cultivation of these fruits is still restricted and low in yield. Production of tea, mulberry, tungoil, camellia and walnut is small scale and largely without of management.

#### 4. Inappropriate resource exploitation and low grain yield.

The remote geographical environment, backward economy and primitive culture make it difficult to tap the agricultural resources of this area. The development of a self-supporting economy relies too much on cultivation and neglects livestock raising and any idea of multi-pattern management. Less than 3% of arable land produce more than half of the total cultivation output. Less than 4% of the total seeding area is used for economic crops like sugarcane and tobacco. Of the rest, the majority is for food crops of low productivity. Little fertilizer and poor cropping techniques are used. Land fertility is maintained through primitive practices such as „burning“ and „waste-in-rotation“. Food crop yields are less than 2,250 kg/ha and many districts are not self-sufficient in food. In short, the natural resources are under-exploited and poorly managed. Environment and resources face deterioration and destruction. There is, therefore, an urgent need for resource protection.

### Proper exploitation and protection of natural resources

In order to develop the economy in Hengduan Mountain area attention should be paid not only to a proper exploitation of resources, but also to their protection. To keep renewable resources in continuous use and the unrenowable ones in efficient use requires coordination and balance between population, resources, environment and economic development with the following strategies:

#### 1. Rational use of wild plant and animal resources and establishment of nature conservation programme.

There is a need, both to domesticate birds and animals and introduce medicinal plants and to adopt of scientific hunting and harvesting systems of the common wild animals and plants. Illegal hunting should be prohibited especially for endangered and valuable species. An overall planning strategy must be created for different types

of natural reserves in different districts in addition to the existing Wulong (for panda) and Jiuzhaigou Reserves. Such reserve should include lakes, marshes, dark coniferous forests, alpine glaciers and various refuges improving institutions at the grassroots level and allowing reserves to operate at different levels are of great importance in management.

#### 2. Developing mountain eco-agriculture.

Especially important for the development of agricultural economy and environmental improvement, is the establishment of a managed mountain eco-agrosystem. It is necessary for the improvement of agricultural structure and development of forestry and animal husbandry in such a diverse area. The main patterns of mountain agrosystem from high to low elevations should be : alpine (or plateau) animal husbandry, forestry including the development of forests for conservation of water supply, timber forests, firewood forests and economic forests on gentle slopes, cultivation and livestock breeding in the valleys.

(i) To set up a scientific production system for animal husbandry and protection natural grassland.

The alpine and plateau area above 3,500 m are occupied by extensive natural grasslands which are suitable for breeding various kinds of domestic animals. But the first problem is to decide the scale of production and type of grazing system to avoid overgrazing, the second problem is to accelerate the planning of improved herbage such as White Clover (*Trifolium repens*), Ryegrass (*Lolium perenne*) and alfalfa. At the same time rotation grazing is needed in seasonal pasture to improve production of winter forages, to adjust herd structure towards breeding stock and to improve the herd quality. In addition, improving the productivity of the local Xizang sheep and of yak is crucial to livestock breeding.

(ii) Rational exploitation and increased use of forest resources.

Whether or not forest resources are properly exploited relates directly to economic development and environmental protection. Forest management should emphasise tending and managing rather than cutting. It is necessary not only restrict cutting to yearly growth, but also to regulate production patterns to protect seed trees. A certain number of forest trees should be left to maintain a favourable environment for seeding and sapling growth in the mature and overmature forests. The practice of hauling and skidding should be abandoned to soil and vegetation damage. Fire control should be improved. A series of forest product processing facilities need to be established, such as for fiberboard, packing boxes, gum, resin, and alcohol in order to raise the efficiency of timber use, which currently is only 40%.

(iii) The valleys and basins where population and farmland are concentrated are the focal area for ecological agriculture development. The major tasks are:

*Tree planting and afforestation.* Combined tree, shrub and herbage planting is a good design for greening waste slopes in dry, hot valleys. Contour patterns of shrub-herbage in sloping farmland are beneficial for soil and water conservation and for stabilizing the agro-ecological environment.

*Improvement of cultivation method.* Increased yields of food crops can be achieved through water conservation, building terraced fields and selecting and breeding superior crop varieties. On this basis, it will be feasible to bring low yield fields in alpine area slopes over 25° back into forestry and animal husbandry production, to change the traditions of „slash and burn“ and „wide seeding but little harvesting“ and to promote the intercropping or interplanting of tree-crop or crop-herbage at different altitudes. It is necessary to adjust the land-use structure to increase the proportion of suitable economic crops, fruit trees and forests, to build production bases of rape, sugarcane, tobacco, pear, apple and pepper with their associated processing industries and to develop intensive feeding and farming for pigs, cattle, sheep, horses, poultry, bees, fish and edible fungi (mushroom).

*3. Actively tapping other energy sources and protecting mountain forests.*

An adequate energy supply is essential for local people's daily life for the processing industries. Utilising a variety of local energy resources in different ways is an important strategy for the mountain forest and for ecological environment protection in general. From a long-term perspective, the principal way to achieve this variety is to tap the rich water energy resource and to replace fire wood by electricity. In addition to large power stations which could be built in the main stream of the Yalongjiang and Daduhe rivers, some medium and small sized power stations could be constructed on tributaries. Other energy resources could be developed from small coal mines, from biogas production, wind energy and solar energy according to local conditions. In any case, it is especially significant to establish fire wood sources near to residential areas in dry valleys, where both the energy demand of farmers and the protection of mountain eco-environment are urgently needed.

*Received 1 August 1991; revised 23 May 1992; accepted 5 July 1992*