

Landscape and land use in southern Hainan Island, China

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Abstract According to the landscape/land use relation of southern Hainan Island, four main zones are considered: the mountain and high hill zone, the inner coastal zone, the shoreline zone and the marine zone. The economic boom has led to an increase in urbanization and development of tourism, at times harming the local environment.

Keywords: landscape, land use, southern Hainan Island.

Hainan Island, the second largest island in China, is located in the South China Sea, separated from the mainland by the 18 km wide of Qiongzhou strait. Population there is about 8 million and Li is the major native inhabitant^[1].

The southern Hainan Island is located in the south of the Wuzhishan Mt. (Alt. 1876 m), and has Sanya as its principal municipality. Because it is located at low latitude area (18°10'—20°10'N) and under tropical monsoon climate, the area is characterized by the high abundance of bio-diversity, various types of soil, geological and geomorphologic complexes. Rice, vegetables and tropical fruits are major supply to the mainland especially during winter season, with additional production of rubber, tea and tropical flowers. Besides, fisheries, aquaculture, salters and minor mining are the new industries developed in the area. Offshore natural gas and marine islands tourism are being developed^[2,3]. The new trend of economic boom since the 1980s has expended urbanization, decreased the farmland and done harm to the local environment qualities. More sensible and regulated activities are now envisaged under an eco-province development plan.

1 Landscape and land use

The southern steep flanks of the central high mountains, which grade into variously terraced hills and coastal promontories, characterize the landscape of southern Hainan Island. Coastal plains have developed as well from foothill to the sea, some in part underlain by alluvial deposits, most by coastal marine deposits. The latter are generally constituted by a series of sand ridges alternating with lagoons of various sizes. Fronting nearshore area there is a gently slope offshore area down to the water

depth of 40 m^[4]. Small islands and islets occur in the shallow water zone not to a great distance from the seashore of main inland.

Of the total 1920 km² area, about 75% belongs to the mountain, hills and associated terraces, only 1/4 to the plain. Off the total available land in the city only 15% is used for agriculture, 36% for plantations, and 53% is covered by trees that include plantations of *Eucalyptus*, semi-natural second growth forest and park areas. Indeed the green cover of the city area has changed drastically during the last 60 years, from a maximum of 90% of the land in 1940, to minimum of 8.3% in 1976, and as steady recovery since then to a 54% coverage in 1998, due to protection and reclamation policies, establishment of parks, and increased *Eucalyptus* plantation.

To synthesize the landscape/land use relation of southern Hainan Island, four zonations have been considered: the mountain and high hill zone, the inner coastal zone, the shoreline zone and the marine zone.

(i) Mountains and high hills zone. This zone (Alt. 400—800 m) is characterized by relatively steep slopes as well as local undulating intramontane basins.

The whole of Hainan Island was covered by tropical plants about 700000 aBP with a great number of species. Since about 111 BC, the area of tropical rain forests has been continuously reduced. Now, only patches remain in Sanya area with second-growth forest and dense bush in large areas. Characterized by seasonal fluctuations in precipitation, a plant succession has developed with elevation in the southwestern part of the island with tropical semi-deciduous seasonal rain forest and grass with sparse trees at lower elevations, and tropical mountain rain forest and moss with short trees at higher elevation up to the top of the mountains. In protected areas the tropical forest still harbors numerous animal species.

The steep highland slopes are not suitable for cultivation or commercial plantations and still covered by tropical forest. Besides being environmental sound, it is also profitable as a tourism attraction and a practical method for water and soil conservation. The gentler highland slopes and the flatter intramontane basins are, on the other hand, used for tea and rubber plantations on artificial terraces, and sustenance agriculture on the bottom, flatter lands with main crops being rice, sweet potatoes and vegetables. To increase production multi-species and multi-storied communities are been implemented in the plantations, simulating the functionality of a tropical forest. One example of this is the rubber-tea community that reaches higher productivity than monocultures of the same plants.

One environmental drawback of plantations is that the plants need rotating and the terraces must be reworked after a certain number of years. Care must be taken to avoid excessive soil erosion. A second drawback is the

large low-pay labor they require; these highlands are primarily populated and worked by minorities such as Li and Miao.

The natural beauty of the landscape, the variety of plant and animal species and the cultural asset make this zone a prime target for developing eco-tourism. This has been initiated by constructing some tourism facilities (restaurants and hotels) in mountain towns like Tongzha, and in establishing tourist villages resembling those of local minorities.

(ii) Inner coastal zone. It refers to the lower hills, terraces and alluvial/coastal plains and raised older sand ridges and drained lagoons between the shoreline and mountains. The area is mostly underlain by thick, red brick-color soil that contains organic matter and is relatively fertile.

The hills reach up to 400 m asl. The lower ones show three major terraces at approximately 80 m asl, between 60—40 m and at 20 m asl^[5]. The gentle slopes at the foothill and the plains are formed respectively by alluvial fan deposits, ancient deltas, and coastal deposits of alternating sandy ridges and swales (desiccated ancient lagoons).

The highest, smallest terrace (generally just a notch along steep slopes) is generally covered by second growth forest or, in places, by rubber plantations. The second, sloping terrace is mainly used for agriculture and plantations such as banana, rubber and *Eucalyptus*. The lower terrace, which maybe flanked by coastal sandbars, has villages built on it and is partially used for agriculture, *Eucalyptus* and banana.

This zone is crossed by several rivers that develop relatively wide alluvial/coastal plain in their lower reaches. Other plains are instead dominated by a succession of ancient coastal sandy ridges alternating with swales (dried out lagoons)^[5,6]. The rivers are heavily dammed for irrigation, mined for sand, and locally their banks used for raising ducks. Villages, towns and routes (roads and railway) are constructed in the drier areas either on the banks of rivers or on the sandy ridges. Ridges are also used for small banana plantations, for vegetable production where water is readily available for irrigation, and extensively for *Eucalyptus* plantations. The lower flat lands are used mostly for agriculture and plantations. Growing seeds for many plants, rice in particular, is a major industry of the zone. The seeds have been widely distributed since the 1960s. By 1994, the seed area for agriculture plants was more than 2670 hectare, and had supplied more than 10 t of seed. Furthermore large quantities of rice and traditional local sustenance products, the agriculture produces melons, vegetables in winter and spring seasons, tropical fruits such as coconut, mango, banana, pineapple, and other products are distributed thorough China.

(iii) Shoreline zone. This zone arbitrarily includes

the rocky promontories and the most recent (late Pleistocene-Holocene) sandy ridges and their inland dried-out or still inundated lagoons. It has attracted humans most; hence its environments are highly impacted^[6,7].

Intense agriculture is implemented on drained lagoons close to Sanya town and to communication routes. Cash crops are produced for local consumption, export to other parts of the island and to mainland China. The crops include high quality watermelons, fruits, vegetables, and even flowers. As a result much effort is placed in their production utilizing local ridge-top areas where suitable soil and deepwater wells are available for irrigation. Also, fertilizers are increasingly used to burst agricultural production.

On the shoreline sand ridges, small towns, few small harbors mainly for fishing fleets and salterns have long dotted the shoreline in the past. Since the 1980s, intense development has occurred, leading to a rapid expansion of Sanya town, development of tourist resort areas, such as Sanya Bay and Yalong Bay, and construction of salt ponds on the ridges primarily to raise shrimps such as at Yinggehai to the southwest.

(iv) Marine zone. This zone includes the small islands near the main island and the offshore sea. The islands have not yet developed. Some support a small population mainly dedicated to fishing; others are not inhabited. Plans have been made to develop those closer to Hainan Island for aquaculture (mainly shrimps and small fishes) and for tourism, valorizing the reefs. The nearshore waters are increasingly used for recreational purposes such as skidoos, wind-board sailing in the resort area of Yalong Bay. Offshore activities include extensive fishing by a large local, Taiwanese and Hong Kong flotilla and the exploitation of petroleum. A major gas field that was discovered in 1983 in extensional basins offshore in the South China Sea shelf and entered production in 1995. One of the longest submarine pipelines in the world was constructed, which carries gas to Hainan Island, landing at the Danyou harbor. The ultimate production of the field is expected to be 300 million gross cubic feet of gas per day, most of it destined to produce electricity for Hong Kong.

2 Conclusion

Hainan Island has much to offer and much room to improve economically, such as mineral resources, economic free zone and industrial products. Southern Hainan Island is slanted to become one of the playgrounds of China and southeastern Asia. Development is unstoppable and damage to the environment unavoidable. Learning from the short-lived economic boom of the 1980s and the subsequent downturn, Hainan Province has now embarked on an “eco-province plan” that without denying sensible development would strictly control it to reduce unwarranted damage to the environment. Accordingly sewer

treatment plans are being built in the major cities, marginal factories that damaged the environment closed, future developments, most of them of international standard quality, controlled, and part of the environments damaged in the past is being reclaimed, particularly in the Sanya area.

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(Received September 13, 2001)