

Asia's marginal lands

Robert Orr Whyte examines the prospects for reclamation of an important natural resource

There are no unproductive regions. There are only poor methods for cultivating land; there is no such thing as poor land. Provided only that people manifest in full measure their subjective capacities for action, it is possible to modify natural conditions.

Mao Tse-tung

IF the countries of monsoonal and equatorial Asia are to act upon the injunctions of United Nations and bilateral agencies and learn to feed themselves, they must utilise all their land and sea resources to the full. At present, there is insufficient knowledge of the real nature and magnitude of the land resources to show whether and to what extent this enormous target can be met. An assessment of land resources on modern lines is essential to confirm or adapt the existing land classes, and to define their relative areas and potential. The classes usually recognised are forests (protective or productive), grazing lands, uncultivable land other than forests, and cultivated land, whether used under systems of shifting cultivation, for plantation agriculture, or for dryland or irrigated crop production. However, one major land class which does not regularly appear in the statistics is marginal land.

Definition of the term depends upon the discipline of the speaker. Most of the uncultivated land, and much of the cultivated land that one sees in flying over the South Asian subcontinent or over the People's Republic of China, is marginal in nature. The agriculturist regards land as marginal when, because of terrain, soil or climatic conditions, the cultivation of arable crops becomes a risky enterprise, involving complete or partial crop failure in two or more years out of ten. The forester regards land as marginal when he cannot apply the appropriate silvicultural techniques to stands of natural vegetation, or when he cannot plant, maintain and harvest the produce from reforested blocks. Grazing land, particularly in arid and semi-arid regions, is marginal when it cannot supply feed of adequate quantity and quality to nomadic and migratory flocks and herds within a radius of daily walking distance, or when resources for stock watering are inadequate.

Land may be marginal in its natural state, or may have been rendered marginal due to the activities of man. The

total area of marginal land of all types is not known. It is probably at least as large as the area under non-marginal cultivation at present. Only part of the marginal land of the region comes within the scope of the UN Environment Programme's Conference on Desertification, to be held in 1977.

It is debatable whether the greater potential for reclamation and increased production does not lie in the more densely populated countries of humid tropical Asia. The final criterion must be economic—whether the expense involved in bringing land back into economic use or in raising it from one plateau of production to the next above for the benefit of the local population can be justified under present conditions.

Attention to the problem of marginal lands must also be seen in correct perspective. It takes second place to the increase of productivity on existing cultivated land, which remains the great potential. The world average production of cereal grain per hectare is 1,898 kg. If the standards of Japan and other developed countries were to be achieved, the world output of cereals from existing cultivated land would be 3,286 million metric tons, or 859 kg per capita, or 95% of American consumption (see Lincoln Gordon and C. A. Pryor, *Science*, September 19, 1976). Yet we are still losing ground in this respect. In India, net availability per capita per day of cereals and pulses from domestic production was: 1956, 15.2 oz; 1974, 15.97 oz, and 1975, 14.65 oz.

Area increasing

The shifting cultivator has made the largest contribution to the man-made area of marginal land, and the area is still increasing rapidly year by year. Increased pressure of population on existing land resources and the progressive loss of traditionally exploited forest land to settled cultivators and timber extractors cause progressive reduction in the period of bush fallow. Regeneration of vegetation does not occur between successive periods of cultivation, and soil fertility deteriorates. What remains in humid tropical South-East Asia are pure stands of *Imperata cylindrica*, the 'green cogen deserts', much of which may still be reclaimed and can be regarded as marginal.

An estimated 2.5 million hectares of potentially productive land are lying barren, because of high sodicity (alkali

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Turning poor soil to farmland

or sodic soils), in the west of the region and in the Indian States of Punjab, Haryana and Uttar Pradesh in particular. Inadequate surface drainage and consequent stagnation of water for prolonged periods, and a rise in the ground water table and accompanying physicochemical changes, appear to have resulted in the formation of these soils. These areas are currently grazing grounds for domestic livestock of low productivity or for abandoned bovines which have reverted to a semi-wild condition.

Probably at least comparable in area to the marginal lands created by shifting cultivation are the areas abandoned after deforestation. This happened in historical times in the Himalaya and their associated ranges and in China, and in recent and modern times in the Philippines, Indonesia and East and West Malaysia. Only limited areas have been reforested or transferred to plantation and arable agriculture in new economic ecosystems. These, however, rarely have the same conservation value as the biological ecosystems they have replaced.

The slaughter of the tropical rain forest in South-East Asia is eliminating the last remnants of a unique biological ecosystem, with its relatively unexplored genetic resources of plants and animals. And the areas from which marketable timber have been removed are left in such a condition after the operations of logging and extraction that further deterioration is inevitable, in terms of plant cover, soil erosion, desiccation of the environment and increased carbon dioxide content of the atmosphere—all factors not so far assessed accurately.

South Asia's marginality

The establishment of the drought-resistant plant and animal communities in the South Asian subcontinent, formerly tropical rain forest, followed the

creation of the monsoonal climate. This may in terms of land productivity be regarded as a marginal ecoclimate. The already marginal potential of most of the subcontinent became affected by the arrival of the Aryans with their browsing and grazing animals, their use of fire, and later of iron tools. The ecosystems in South Asia, with which the modern planners of use of arid and semi-arid lands have to cope, have been further reduced in potential in recent and modern times by the great increase in human and livestock populations, the latter due largely to politico-religious factors beyond the control of the land scientist.

In a region where the amount of arable land per person is estimated to have been 0.36 ha in 1950, 0.30 ha in 1965, 0.24 ha in 1975, and to be 0.19 ha in 1985, it is realistic to propose that any major developments in animal husbandry will be limited to marginal land which cannot produce cereal and legume grains for direct human consumption. In terms of the grazing and browsing resources of South Asia alone, the botanical composition of plant covers of the arid and semi-arid lands has deteriorated from a condition in which the superior perennial grasses provided reasonably good feed to livestock in the monsoon and subsequent months to less valuable grass covers of inferior perennials and annuals.

In the East, especially in Japan, Taiwan and China, there are large areas of sloping land, originally under a forest type in conditions between lowland monsoonal and upland temperate, which have been rendered marginal in terms of forest production and agriculture.

Matter of concern

To the conservationist, the ever-increasing area of land being rendered marginal is a matter of profound concern. Idealistic proposals for the total conservation of the environment are difficult to maintain with the population/land position in large parts of Asia. Marginal land *per se* generally represents a continuing and frequently increasing danger in terms of its own conservation, and of the conservation of soil and water on lands lower in the same catchment not yet rendered marginal. A realistic plan for conservation would embrace the preservation of natural biological ecosystems wherever this can be socially and economically justified. It would cover the reclamation of marginal lands either to their original condition or to a new balanced economic ecosystem in which sustained soil fertility and productivity can be maintained by the application of appropriate measures for conservation.

The reclamation of marginal land in

either direction has so far been a matter of economics. The rural people responsible for making land marginal have had neither the knowledge nor the financial resources necessary for its correct treatment. Governments of Asian countries in which the return of marginal land from an unproductive to a productive state would be of great economic importance have not approached the problem with the energy it demands.

Again, this is largely because they apply the principles of conservation economics, of return upon capital investment, cost/benefit, input/output ratios and so on. But if most of the countries of Asia are at the age where it is the economics of survival which apply, a different set of criteria will be necessary if measures are to be applied on a sufficient scale.

The administrative structure of most Asian countries does not permit them to emulate the People's Republic of China, where in the winter of 1975-76 130 million rural workers were mobilised for what BBC monitors translated as farmland capital construction projects. These ranged from the reclamation of desert grasslands of Inner Mongolia and Sinkiang and the reforestation and levelling of land for irrigated cultivation in the eastern provinces, to the terracing of mountain slopes in the humid tropical island of Hainan.

Elsewhere some research is in progress. Increased productivity of marginal drylands is an important objective of the Indian government in association with the Canadian government, and at the International Centre for Research in the Semi-arid Tropics (ICRISAT), in Hyderabad. During the past six years the Central Soil Salinity Research Institute at Karnal, Haryana, has evolved economic and speedy methods for the reclamation of alkali soils of the Indo-Gangetic plains.

The essential components are land

levelling, the application of gypsum or other additive, the application of fertilisers including micronutrients, the selection of suitable crops and crop varieties, and the adoption of suitable management practices. Semi-dwarf, high-yielding varieties of rice are ideally suited in the *kharif* (rainy) season, to be followed by wheat in the *rabi* (winter) season. Large-scale reclamation programmes based on this research are now being launched to reclaim lands which have been lying uncultivated.

Delaying action

Foresters in the region are conducting a delaying action against rival claims on land for agriculture or for the grazing of livestock. The tropical rain forests present a major problem. Foresters still talk of the promotion after logging of natural regeneration on 100-year cycles, but this is rarely followed in practice. In Java, the relict vegetation on denuded land which might theoretically be reclaimed is used for fuel collection by thousands of people who have few alternative sources of income. Claims are made for the control of *Imperata cylindrica* by deep ploughing (Sumatra), replacement by sown fertilised pastures correctly managed to prevent regeneration (Sabah and the Philippines), or the use of systemic selective weed killers (Malaysia).

The marginal nature of the grazing and browsing resources of arid and semi-arid India are the concern of three research institutes, the Central Arid Zone Research Institute, the Indian Grassland and Fodder Research Institute and the Central Sheep and Wool Research Institute. These compare the relative merits of slow but cheap ecological progression and of reseeding with species of the local climax covers. A substation of the Japanese National Grassland Research Institute at Nishinasuno is developing methods for hill slope utilisation by the cheap method of hoof cultivation for the rearing of Holstein heifers for the dairy industry—a technique that may well be applicable in mainland China, Korea and Taiwan.

The reclamation and planning of future use of marginal land fall between a number of departments and institutes of central or state administrations. If these were to be regarded as a discrete aspect of land use the economic benefit would be great, particularly for the livestock and forest industries. That some type of joint action on a regional basis would be profitable, through ASEAN, the Asian Development Bank or the UN International Consultative Group for Agricultural Research, seems almost indisputable. □

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Terraced fields in China