Third World development

The development of marginal lands in the tropics

from Gordon R. Conway, Ibrahim Manwan and David S. McCauley

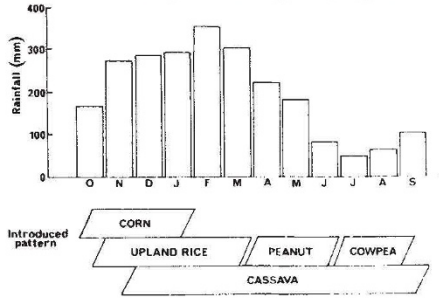
THE past decade has seen great progress in the agricultural development of the irrigable lands of the tropics, particularly in South-East Asia. Today it is common for two crops of rice to be grown on such land with yields of 5 tons or more per hectare per crop. Attention is now turning to the development of those lands which, on various criteria, are more marginal. Following an earlier workshop[1] which examined the consequences of the intensification of better-quality land in Indonesia, a further meeting was held in January 1983 at Malang, East Java, under the auspices of the Centre for Agricultural Research Programming and the Ford Foundation, to consider the specific agricultural, ecological and socio-economic problems of developing marginal lands.

In Indonesia there are three major categories of marginal land: the tidal swamplands, primarily of Kalimantan and Sumatra (approximately 35 million ha); grasslands covered by *alang-alang* (*Imperata cylindrica*; about 15 million ha); and 'critical' uplands, mostly on Java and Bali, which are defined as lands suffering from severe degradation because of erosion (between 10 and 40 million ha).

In total these lands may cover as much as one-third of Indonesia's land surface, encompassing a wide range of ecological and socio-economic conditions. Thus whereas the development of the better-endowed lowlands has been achieved by disseminating widely adapted crop varieties and cropping techniques, the more diverse and severely constrained marginal lands require a more finely tuned approach. As a first step towards targeting the areas for research and development, the workshop participants felt strongly that the land should be zoned not only according to agroecological factors, but also in terms of socio-economic criteria. *Alang-alang* land, for example, should be characterized not only by climate, soil and topography but also by who owns or cultivates the land, their cultural and economic circumstance and, in particular, whether they view *alang-alang* as a weed to be eradicated or as an asset to be preserved.

Marginality arises partly from limiting factors, for example acid sulphate soils in the tidal swamps, low levels of soil nutrients in *alang-alang* land and steep slopes in the critical uplands; and partly from their inherent environmental instability. Tidal swamplands are subject to considerable seasonal and daily fluctuations in levels of water and salinity. *Alang-alang* lands experience frequent burning and, in some areas, severe drought, while critical uplands suffer from periods of intense rainfall.

Such variability tends to be viewed as a constraint, but it can also provide opportunities for development. For example, the critical problem in the tidal swamps is that excessive drainage leads to destruction of the surface peat layers followed by acidification of the underlying soil and the production of toxic aluminium. Expensive engineering works



New cropping pattern for Indonesia's red–yellow podzolic soils[3].

which carefully control the water level are one solution, but in Indonesia areas for rice production have been successfully opened using simple communally operated gates which permit tidal flows to flush away the acids yet retain sufficient water to prevent oxidation.

A similarly simple and inexpensive solution is the use of burning to manage *alang-alang*. Although often an indicator of degraded and apparently abandoned land, anthropologists argue that in many cases *alang-alang* is a productive resource. In South Kalimantan *alang-alang* is an essential part of a rice–fallow system; on Sumbawa island it supports productive game hunting — the deer being attracted by the regrowth after burning — and in Bali it is an important cash crop, providing the materials for traditional thatched roofs which are coming back into favour.

Many of these traditional agricultural systems[2], although not highly productive, are sustainable, having evolved resilience to stress and perturbation. But under the demands of population pressure and economic necessity they may give way to less appropriate systems. The challenge is how to increase the productivity while retaining sustainability.

One answer is to blend new varieties and techniques with old patterns. For example, swamplands traditionally have been cultivated using photoperiod-sensitive rices that are transplanted two or three times and mature over 8–10 months. New early-maturing photoperiod-insensitive varieties are now being sown on part of the land to produce a quick first crop while the traditional varieties are still being transplanted. Sustainability is retained if drainage is not excessive and the level of organic matter is maintained.

A particularly productive and apparently sustainable cropping system has been designed[3,4] for the red–yellow podzolic soils which occupy about 15 per cent of Indonesia's land area. Traditional cultivation consists of a mixture of crops followed by a fallow of *alang-alang*. The new system developed by the Central Research Institute for Food Crops comprises a more organized inter- and relay cropping, grown in a continuous cycle without a fallow (see the figure). About 1 ton per ha of burned limestone is applied initially, phosphorus is spread in the furrows, nitrogen and potassium are placed below and beside the seed, and all crop residues are returned as mulch. The benefits lie in the evenness of labour demand and the steady flow of produce and income. Five years of such continuous cropping have produced yields, in food calorie terms, of 12–25 tons per ha per year of paddy rice equivalent.

The development of sustainable systems for the critical uplands will be more difficult. The emphasis of government programmes has been on reforestation of both public and private lands and more recently on the construction of bench terraces and check dams. But such projects are generally costly and of limited immediate benefit to upland farmers.

An alternative strategy is to develop and extend traditional agro-forestry systems, such as the home and forest gardens[5-9]. These are typically multistoried and highly diverse cultivation systems with perennial tree crops and a rotation of mixed annuals underneath. They provide the farmer with a steady flow of food, fibre, wood and cash crops, and because of the high degree of nutrient recycling and the completeness of the ground cover they also conserve the soil even on fairly steep slopes.

A 'Committee on the intensification and sustainability of Indonesian agriculture' has been formed to plan further workshops on specific target agroecosystems and to promote and seek funds for further policy and field research in this area. □

Gordon R. Conway is Professor of Environmental Technology at Imperial College, London SW7 1LU; Ibrahim Manwan is Director of the Centre for Agricultural Research Programming of the Indonesian Ministry of Agriculture; and David S. McCauley is a resource economist with the Ford Foundation, Jakarta, Indonesia.

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