

Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-Eastern India. MAB Series 10. P. S. Ramakrishnan. UNESCO and Oxford University Press. 1993. 424 pp. Rs 475.

The north-eastern India, endowed with extremely diverse fauna, flora and people (tribes), is among those landscapes of the globe where shifting agriculture has been a predominant land use for centuries. Despite continued criticism and bid to ban, about 3 million hectare land is currently brought under shifting agriculture per year in this humid tropical region, influencing moist deciduous forest at foot hills to wet evergreen forest at mid-elevation to temperate habitats in eastern Himalayas in Arunachal Pradesh, which together constitute nearly 42% of the total geographical area of the region.

Man has lived in the midst of the dense forest for centuries and has derived his livelihood from various forest products. Shifting agriculture, which is popularly known as 'Jhum' in north-eastern India, has been the principal mode of raising crops in the forest. What is essentially done in Jhum is the selection of a piece of forest, slashing of the stock and burning the slash on the same ground and then cultivating it generally for one year, or in stray instances for two years, and finally leaving the cultivated land fallow for natural recovery, i.e. the redevelopment of the forest. Several variants of this basic Jhum practice can be found with varying altitude and also between different tribal societies. P. S. Ramakrishnan, an acknowledged scholar on Jhum, has invested his knowledge, experience and wisdom in the book *Shifting Agriculture and Sustainable Development* to illuminate the patterns and processes related to shifting agriculture with special reference to north-eastern India. In the three major sections of the book, he not only highlights the problems associated with this land-use system, but also attempts to resolve many of them.

In the first section, which deals with Agroecosystem and Village Ecosystem Function, the author has worked out energy and economic efficiencies of Jhum and its various variants prevailing in north-eastern India. Two major con-

clusions have been derived: a) the economic and energy efficiencies decline as the Jhum cycle is shortened, and b) a 10-year cycle is the cut-off limit if Jhum in the present form is to be sustained. There has been an intensive search for alternative land use systems for Jhum. Terrace cultivation, which was offered as an alternative to Jhum has been a big failure as it was not comprehended by the farmers for justified reasons like high energy and economic inputs and environmentally non-compatible nature due to irreversible site degradation. A package of three-tier cropping system developed by the North-Eastern Regional Centre of ICAR yet awaits practical popularity among the farmers owing to its proclaimed success widely debated within the scientific community. The author suggests the plantation and cash crop economy as a land use option for the development of the region. While employing such mixed cropping systems, yield could be maximized by maintaining an appropriate proportion of biological nitrogen fixer species and the farmer can save on the fertilizer investment. Yet another aspect emphasized in this section is that in an array of cropping systems, some are more efficient than the others. This is not only because of the environmental (climatic and edaphic) diversity in the region, but due also to varied technical skills of farming with the peasants belonging to different tribes and cultures. Surprisingly, there are at least as many languages spoken in this region as many tribes fostered. Owing to the language bar, the transfer of technology between societies (tribes) is not facilitated at grassroots level which could otherwise add significantly to optimize the yield and economy.

Jhum introduces large-scale changes in the ecosystem. The well-developed mature forest is cut-down which results into loss of species, depletion of biomass and opening of nutrient cycling. In addition, the burning of slash which is done with a view to unlocking the nutrients stored in the biomass, impoverishes the system severely by fire-related hazards; for instance, loss of nutrients through volatilization and ash-convection, and death of perennating buds and propagules of several species, particularly climax or late seral species. Not only that, microenvironmental conditions are altered dramati-

cally as the site becomes open, i.e. interception of light is increased and humus layer is spoiled. The opportunistic weeds find the way to invade such sites. In olden days, the Jhum cycle used to be sufficiently long, i.e. 40-50 years or more paving the way to the system to recover through succession. But, increasing population pressure led to shortening of Jhum cycle to 4-5 years and consequently there is not adequate time left to the system to undergo natural afforestation. For succession to occur, the site is left fallow to be invaded and colonized naturally by primary successors followed by secondary successors and finally climax species. Expected in this process of succession is the increase in species diversity, build up of biomass and tightening of nutrient cycling. The second section of the book describes the patterns of vegetation dynamics, biomass and productivity and nutrient cycling during secondary succession in Jhum fallow. Three species of *Eupatorium* (*E. odoratum* at low altitude and *E. adenophorum* and *E. riparium* at high altitude) and *Mikania micrantha* have been identified as the most aggressive exotic weeds which invade the cultivated site and interfere with the natural succession. These weeds take over rapidly and suppress the growth of endemic shrub and tree species. Continuous cultivation of land by maintaining 4-5 year Jhum cycle arrests the secondary succession and the site reaches to high levels of degradation. Based on the studies on growth strategies, the author suggests the introduction of large shrub/tree species in the early phase of succession to suppress the weeds by shading effect. This however remains to be substantiated experimentally. I have witnessed at several occasions during field errands in north-eastern India that the sites degraded by Jhum have been afforested under reclamation programmes by secondary successional species. And in many cases, the efforts have gone, as they would, in drain simply because the tenet of succession theory, that late-successional species will tend to fail when introduced into a disturbed or open site due to unfavourable water and nutrient relations, has been ignored.

Vast tracts of land have been cleared for practicing Jhum cultivation apart from mining, industries and hydro-

electric projects during the recently elapsed few decades. Still demand for land is unabated with increasing human population, and thus pressure continues to mount on forests to meet the food requirement. Jhum cultivation when practiced under a sufficiently long cycle of 40–50 years allowed the regrowth of forests and maintained the ecological balance. But with the shortening of Jhum cycle to only 4–5 years, the recovery of the land has severely gone down and consequently degraded sites have mushroomed. Two major questions are pertinent in this context: a) how could the organic yield be sustainable in the agroecosystems (Jhum) so that not only the economy of the farmers is maintained, but also the diverse food need of the people is met, and b) what could be the possible package of prescriptions to revert back the degraded lands, created by Jhum, to their original forest status? In the third section entitled 'Management Implications', the author has discussed several strategies to answer the first question. The second one however remains unanswered and offers a challenging opportunity to the ecologists to do more on this line in the years to come.

On the whole, the book, which is a potentially fascinating compendium of about two-decade long experience of the author and his research team on various aspects of shifting cultivation, offers a few more new insights over those published previously by the author through about 150 papers cited in the reference section. Yet, this endeavour would have been more informative and ingenious had the work on several other aspects, notably, dynamics of microbial populations during succession on the Jhum fallows, which is in fact investigated by a number of workers particularly at the North-Eastern Hill University, Shillong, been solicited. Nevertheless, the book would not only be a useful review of the background information, but also a wealthy reference guide for researchers, especially those making a dent in this field. Finally, as rightly emphasized by the author with zeal in the foreword, that this study is though location-specific as well as problem-specific to the north-eastern hill areas of India, the concepts and principles involved may have wider applicability for re-developing traditional societies else-

where, particularly in the humid tropics.

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Molecular Biology of Bacterial Infection: Current status and future perspectives. Hormaeche, C. E., Penn, C. W. and Smyth, C. J., eds. Society for General Microbiology Symposium 49, Cambridge University Press, Cambridge CB2 1RP. 1992. 329 pp. Price: £ 55.

Studies aimed at unravelling the molecular basis of bacterial pathogenesis are no more in their infancy and seminal contributions are being made in this area. The book under review presents a timely account of such contributions made in the recent years. The fifteen-odd reviews included in this volume can be classified into six groups, viz. methodological aspects of molecular approaches to studying bacterial pathogenicity, environmental-factor-dependent regulation of virulence determinants, antigenic variation, toxins, intracellular parasitism and miscellaneous aspects.

There are two reviews on methodological aspects. Finley outlines the various molecular genetic techniques such as recombinant DNA technology, transposon mutagenesis, suicide plasmids, etc. and dwells upon some of the limitations of these methods when applied to the study of bacterial pathogenesis. He, however, suggests several strategies to overcome these limitations. In the second review Foster analyses retrospectively several important studies which employed molecular genetic techniques to study bacterial pathogenicity and identifies some equivocalities therein, suggesting, at the same time, ways to improve the objectivity of future studies. He also points out several leads work along, which must be undertaken to answer certain missing links in our understanding of the pathogenicity of some well-known bacterial pathogens. This review is the most critical in the volume and will be of immense utility to researchers as it would help them identify and avoid pitfalls, in both the experimental

designs and interpretation of results, when employing tools of molecular biology to the study of bacterial pathogenicity.

The recognition, in the recent years, that expression of virulence determinants is modulated in a co-ordinated manner in response to changes in the environment, has greatly expanded the intellectual horizons of our understanding of the mechanisms of bacterial pathogenicity. This modulation is accomplished through the two-component signal transduction systems and serves to provide expression to virulence determinants at appropriate time. Dorman and Ni'Bhriain discuss environmental modulation of both the dedicated virulence regulons such as those regulated by ToxS/ToxR (*Vibrio cholerae*) and bvgS/bvgA (*Bordetella pertussis*) and, regulons having roles in commensal as well as pathogenic life of bacteria such as those regulated by EnvZ/OmpR and phoP/phoQ systems. Regulon networking and, role of DNA topology and nucleoid-associated proteins in regulation of gene expression have been discussed. In the same context Cornelis presents a working model for the temperature and, temperature and calcium controlled regulation of *YadA* (*Yersinia adhesin A*) and *Yop* (*Yersinia outer membrane protein*) gene expression respectively. Taken together the two articles constitute an excellent review on the global regulation of gene expression and its implications in bacterial pathogenesis.

Antigenic variation is the pathogens' answer to extensive defence repertoire of mammalian immune system. It not only allows the pathogens to escape the host's specific defense, but also helps them fine-tune their virulence factors by optimization of receptor-ligand interactions. Three groups of investigators discuss this important subject from three separate aspects. While Robertson and Meyer focus on variation and regulation of expression of bacterial fimbriae, Smyth and Smith discuss the molecular mechanisms which underlie such antigenic and phase variation. Moxon and Maskell view this subject in particular reference to variable LPS epitope expression in *Haemophilus influenzae*. To sum up: the mechanisms which determine antigenic and phase variation include intragenomic and intergenomic homologous recombination (e.g. *Neisseria*