

tered approach. Sustainable farming systems and happy farming families can alone lead to an ever-green revolution.

The concluding part of this Report deals with rural non-farm income in developing countries. This section helps to remove the traditional image of farm households in developing countries that they concentrate exclusive on farming and undertake little rural non-farm (RNF) activities. In fact, multiple livelihood opportunities are essential for household nutrition and income security in rural areas.

Among developing countries, China is unique in giving concurrent attention to on-farm and off-farm employment. China's Rural Township Enterprises programme has helped to withdraw over 100 million men and women during the decade of the nineties from the routine operations of farming and involve them in industrial pursuits related to agriculture. Thus, China's economic miracle is based on the foundation of agricultural progress and emphasis on RNF activities. Other developing countries including India can learn much from China's rural and agricultural renaissance-led economic transformation.

Quoting from studies in India, the Report points out that on an average, a 100 rupee increase in farm income is associated with a Rs 64 increase in RNF income.

The pathway to poverty eradication in India is integrated farm and non-farm employment generation. About 35% of rural families still live below the poverty line and nearly half of them are chronically undernourished. Agriculture accounts for 30% of GDP, while employing 62% of the labour. Concurrent attention to technology, training, techno-infrastructure and trade (both home and external) are essential for creating new livelihood opportunities in rural areas through off-farm enterprises. The Report gives many examples to show how RNF activity makes a significant contribution to food access and food security. This is an area where the corporate sector can help by providing assured marketing outlets.

FAO deserves our gratitude for providing each year not only a comprehensive report on the state of food and agriculture in the world, but also an indepth analysis of an area vital for food

security, such as RNF in this year's report.

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Annual Review of Entomology 1999. M. R. Berenbaum, R. T. Carde and G. E. Robinson (eds). Annual Reviews Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 44, pp. 635. Price: US \$65 (Individual), US \$130 (Institutional).

Another year and another set of Annual Reviews. This year I have been asked to review the *Annual Review of Entomology (ARE) 1999*, vol. 44. The annual review series is indispensable and extremely useful both for teaching and research. Annual reviews have always focused on the growing area and new trends in science and the 44th volume of *ARE* is no exception. The 22 chapters cover a wide range of subjects that can be broadly grouped under basic and applied entomology. Of the 22 chapters, 9 deal with topics in agriculture, 8 deal with ecology, evolution and systematics, 3 concentrate on medical entomology and 3 cover issues in ecology/evolution with implications on agriculture. The authors of the reviews have consolidated the recent progress and projected future line of research that could be envisaged.

First, I will talk about the reviews that have dealt with agricultural entomology either directly or indirectly. This is important, as nearly 800 million of the 5.8 billion world population do not have enough food. Various factors like crop pests, diseases, weeds and natural calamities like floods and drought account for great reduction in the food production. In the light of this, it is important to design ways and means by which food production can be increased. One way of achieving this is by effectively protecting crops from insect pests. Both biological and chemical control of insect pest as well as vectors of disease-causing viruses have been

extensively reviewed in this issue of *ARE*. Biological control agents have been a major focus of attention of Integrated Pest Management. For the biological control agents (entomophagous insects) to be effective, it is important to understand their feeding habits and nutritional requirements. Thompson reviews this topic and suggests work in the areas of genetic selection and engineering and creating new methods for manipulating parasites and predators, including selection of strains most suitable for rearing under specific nutritional conditions and for release into particular environments. There is a review by Hopper on risk-spreading or bet-hedging. Risk spreading has implication for insect pest management (and conservation biology). According to risk-spreading theory, under unpredictable environments genotypes with lower variance in fitness are favoured. Variance in fitness can be reduced by physiology or behaviour that spreads risk in time or space. Spatial risk-spreading by parasitoids might explain low levels of parasitism and thus lack of impact of biocontrol agents; spatial risk-spreading by herbivores might explain patterns of attack on crops. Specific detailed, testable hypotheses have not been developed by the theory of risk-spreading despite being voluminous and well developed in some ways. To date there have been no tests that show risk-spreading to be a major factor in the evolution of insect behaviours or life histories. Hopper points out that most of the phenotypic variation observed in literature can be explained by genetic variation and conditional response to environmental cues without invoking risk-spreading. This does not mean that risk-spreading does not contribute to the evolution of behaviours or life histories, but it does make testing for risk-spreading difficult. Phenotypic variation in many traits has some genetic as well as non-genetic components and the non-genetic component may indeed be risk-spreading. I particularly liked this review, as it shows how very basic research can give insights into applied aspects. There is also a review by Sullivan and Volkl on 'hyperparasitism' in which they discuss the impact of hyperparasitism on biological control. Moscardi has reviewed the topic of Lepidoptera pest control by baculovirus.

The second aspect of pest management is chemical control of crop pests. Zlotkin, in his review on 'the insect voltage-gated sodium channel as target of insecticides' suggests that due to its pharmacological uniqueness, the insect sodium channel (ISC) may serve as a high-priority target for future selective and resistance-manageable insecticides. Pharmacological specificity of the ISC may lead to the design of insect-selective toxicants, and its pharmacological flexibility may direct the use of ISC insecticides for resistance management. Likewise the review on 'insect P450 enzymes' by Feyereisen, talks about how these enzymes play a very important role in insecticide resistance. This review, I believe will open up research on the inhibitors of insect P450 enzymes.

The third aspect of pest management is the protection of crops against vector-borne viral diseases by effectively controlling the vectors. This topic is addressed by Perring *et al.* In order to effectively control any disease it is very important to have adequate knowledge of the disease epidemiology. This is very well brought out in the review by Perring *et al.*

Yet another way of overcoming food shortage is by looking for alternative food sources. In this regard the review by DeFoliart on 'insects as human food' could not have come at any better time! Insects like alate termites are being occasionally consumed mostly by the tribals in the third world countries. In that sense there is nothing new about insects being used as human food. But, what is important is the attitude of the western world on this issue. The western culture is spreading like wild fire in the developing and underdeveloped countries. In this sense I agree with DeFoliart that the western attitude towards insects as alternate source of food is important. This review will hopefully turn entomologists into looking for insect species that can be used as human food.

The use and management of other insects and non-*Apis* bees for crop pollination is important as in many crops in many locations the ability of honey bees to pollinate is limited. Heard reviews the role of stingless bees in crop pollination. To quote Heard: Stingless bees possess many characteristics that enhance their importance as crop pollina-

tors both as wild populations and managed pollinators. Some of their social life characteristics like perenniality, polylecty, floral constancy, recruitment, harmlessness and resistance to diseases and parasites of honey bees suit them for pollination. Challenges to their widespread use include the lack of availability of large numbers of hives and the dearth of knowledge of the pollination needs and major pollinators of tropical crops. Stingless bees display greater diet breadth (play an important role in pollination of ~ 250 species) and range of foraging behaviour than honey bees, making them likely to be important to future development of pollinators best suited to the needs of particular crops and habitats. A combination of stingless bee species can be employed to pollinate a given crop. Such studies have hardly been attempted. Like Heard, I sincerely hope that this article will stimulate the necessary observations, experimentation and publication on this line.

A review on mate choice in tree crickets by Brown highlights the lack of data on the decision rules the females follow in choosing the males. There is no information on the role of chemical cues in female choice in the Orthoptera. Brown, in a large number of places, quotes his unpublished work. I believe reviews are meant to put published literature in a comprehensive form and draw plausible inferences and indicate future line of work. Therefore, citing unpublished data should be avoided for the simple reason that they have the danger of being cited pending verification by other workers in the field. That aside, there are several interesting questions that can be asked in a system like crickets due to their uniqueness, in the sense that females are in perfect control of the entire process of mating. One such question is, do females cheat? For example, when a female is hungry she may copulate with even an inferior male for the sake of the gift (as her survival itself depends on it) and after feeding she can remove the spermatophore and eat it and then look for a better male.

One would realize that about 70% of my review consists of chapters that have directly or indirectly dealt with agricultural entomology. This is because about 50% of the articles in this volume deal

with this aspect. There are also reviews on mites in forest canopies, the evolution and development of dipteran wing veins, diptera phylogeny, emerging and resurging vector-borne disease, density-dependent physiological phase in insects and so on. The editors have done a commendable job in catering to workers in various fields of entomology from ecology to medical entomology. An overview of the contents of this volume of *ARE* provides a feel for the diversity of topics covered.

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Nurturing Biodiversity: An Indian Agenda. Madhav Gadgil and P. R. Seshagiri Rao. Centre for Environmental Education, Ahmedabad. 1999, pp. 163.

At a time when conservation of the earth's biological diversity (biodiversity) has become more of a social challenge than ecological science, several initiatives have arisen worldwide. And although this transition widely prevailed since the 1972 Stockholm Conference on Human and Environment Development, the UN Convention on Biological Diversity, that came into force in 1993, fully reinforced the need for a social approach to conservation and sustainable use of the earth's biodiversity.

The main emphasis of the UN Convention on Biological Diversity (CBD) is on conservation, sustainable use and equitable sharing of the benefits that arise from the use of biodiversity. All of the nearly 175 nations that are signatories to the CBD are thus obliged to nurture the biodiversity within their respective political boundaries guided by the provisions of the CBD.

India is a signatory of the CBD since February 1994. Amongst the signatory nations, India has some unique qualities. Firstly, it has been globally ranked amongst the 12 megadiversity countries.