# Chapter 34

# An Inquiry into the Relationship between Agricultural Research, Development, and the Issues Facing Agricultural Biodiversity Management in the Hindu Kush-Himalayan Region

A. Rastogi

## Firing the Engine

*The Dilemma of Growth Dominated by Science and Technology*

Scientific progress has made such an impact on society that technology and human development have become synonymous with each other in popular parlance. However debatable and questionable this growth may have been in certain sectors, scientific developments continue unabated, with knowledge developed in one field being applied to development in another. For example, nuclear technology makes such a useful contribution to developments in the basic life-supporting fields of agriculture and medicine that future technological breakthroughs in this area are not discouraged, despite the well-known hazardous off-shoots of the technology. The faith in scientific and technological development is so strong and deep-rooted that the only way to try and bring about a paradigm shift in this way of thinking is by questioning some of the basic premises of the foundation. Many issues raised by the sustainable development paradigm in the recent past have made an enormous contribution in this direction. Path-breaking work has been done by leading economists and ecologists in the field of agriculture (Jodha et al. 1992, Ramakrishnan 1992, Sachs 1993, Bawa and Gadgil 1997, Rhoades 1997) and eminent doctors in the field of medicine (Bolar 1991, Chopra 1993) that has helped steer the focus in agriculture from crop yields to nutritious food, and the focus in health care from medicines to healthy living.

This process of acculturation of science, though in its infancy, has begun. The skills and knowledge of communities following traditional practices that were looked down upon as unscientific are beginning to be understood in a better light. This paper highlights some of the problems with the rapid advancement of agricultural science that led to the neglect of native cultivators and raises some issues that challenge the incorporation of scientific principles in traditional agricultural practices. It is an attempt to build a case for greater recognition of and participation by the average subsistence mountain farmer in future agricultural research and development.

## Hoarding the Growth

*Institutional Fueling of Industrialisation*

The pace of agricultural developments has been very rapid since the second world war, and the release of hybrid dwarf varieties of rice and wheat during the sixties particularly brought a revolution in the field. The promise of improved crop yields provided new hope of meeting the increasing demands of the burgeoning world population. The Consultative Group on International Agricultural Research (CGIAR) was created in 1971 with a global mission to eradicate hunger from the face of the earth. Armed with the strength of being able to create and transfer new technologies, CGIAR continued to expand and diversify. It now has 18 centres world-wide. These centres, together with other international and regional aid agencies and multilateral and bilateral donors, have dominated the scene of agricultural research in the last three decades. The national research centres and agencies have worked in unison with this international effort bringing about a watershed impact on the overall food production scenario in the world. Such is the international appeal and the pace of development that there is practically no space for incorporation of farmers' knowledge systems. As a result, traditional farming practices have been discarded as an unnecessary burden in formal agricultural research. The impact of the Green Revolution technological package, however, has been fairly uneven between countries and between different regions in a country, depending on the internal capacity to mobilise resources and investments in rural infrastructures such as irrigation, electrification, roads and communication, and research and extension.

## Tilting the Balance

*Limitations of the Reliance on Industrial Agriculture*

The package approach of extension backed by TOT (transfer of technology) has had limited success in the context of the complex, fragile, and diverse marginal environments of mountain regions (Sen 1993). The reasons for the incompatibility can be traced to the inherent biases in the technological package: the chemical bias of the high response varieties, which need artificial fertilizer and pesticides to deliver the promised yields; the crop bias towards a few staples of international relevance; the big farmer bias of trickle down development doctrine; the monoculture bias against indigenous farming systems; and the political bias against the farmer and third world authorities (GRAIN 1994). Besides worries about the associated environmental problems, which are often put to rest by the offer of friendlier technological solutions in future, the economic feasibility of the package has become a big question mark. The increased dependence of governments of the southern countries, many of them in heavy debt and facing severe crises in their balance of payments situation (Bhalla 1992), on international organizations, northern donor countries, and multinational corporations has provoked discussions on the basic issue of the sustainability of this approach. Shiva (1991) suggests that the Green Revolution has not only benefitted rich farmers, but has also contributed to the impoverishment of smaller farmers. Rhoades (1997) has described the adverse impacts on marginal mountain farmers. As an example, note the undercurrent of frustration with the process of the development of technology in the following excerpts from a response to the Quinquennial Review Committee of the Indian Council of Agricultural Research (ICAR) by the Secretary of the Department of Agriculture of a northeastern hill state in India about the selection of a site for a research station.

*"From the beginning (mid 1960s) there has been some misunderstanding between the Agriculture Department of the State and the ICAR. The points of contention are as follows. Firstly, the ICAR felt that the selected site was on hilly terrain with virtually no flat land and was therefore not suitable for conducting research; whereas the Agriculture Department felt that if any research work was needed then it should be for hilly terrain, and that the area represented the average climatic and topographic conditions in the State. Secondly, the ICAR contended that the irrigation facility at the selected site was too limited; whereas the Agriculture Department felt that there was a need for research into cultivation under rainfed conditions and that the priority should lie here. There are 1,200 villages in the State. Out of a total geographical area of 16,579 sq.km., the estimated ultimate irrigation potential is only 1,790 sq.km. About 75 per cent of this potential belongs to only 25 per cent of the villages, and only about seven per cent of the land is under the control of the government. To add to this complexity, the altitude of the land that can be irrigated varies from 200 to 1,800 metres. Redistribution of land cannot be done under the current framework of customary and statutory laws and the State government has no programme for land reforms in this direction."*

The response letter (Kevichusa 1996) goes on to add that *"the Agriculture Department feels strongly that the problem does not lie in the ideally suited areas having relatively flat lands and irrigation facilities. If such suitable lands were available, then the problems would be much less. If the desire of the ICAR is to produce research findings under ideal conditions like warm climate, good soils, and vast flat lands having irrigation potential, then the research results from the neighbouring State of Assam or any other part of the country could be largely* *applied in the foothills and valleys of the State, and therefore the priority should lie somewhere else."*

## Completing the Circle

### *The Challenge of Farmer-centred Research*

The professional challenge of both international and national public agricultural research is to acknowledge the mismatch between the TOT model and the priorities of the poor farmers cultivating marginal lands (Pimbert 1994). Referring to the failure of alternative models for shifting agriculture proposed by the ICAR, Ramakrishnan (1993) emphasises the fact that a drastic departure from traditional land-use practices cannot work because it requires a sudden disruption in society. Development interventions and alternatives should complement farmers' technical knowledge and resources, which are in a state of dynamic evolution as a result of innovative responses to changing socioeconomic and ecological conditions. Though there is a certain level of scientific interest in acquiring greater understanding of traditional practices, there are many daunting challenges to carrying out this participatory learning process.

The fundamental issue is that of the different world views being shared by scientists and native cultivators. Dirk and Box (1993) have said that scientific knowledge systems assume that people have the potential to understand the process of nature, to express underlying causalities in theory, and to harness theory to manipulate the environment. In contrast to this voluntaristic world view of scientists, the cultivators have an adaptive world view of supernatural control. For example, when crops belonging to the *Padam-Minyong Adi* community in the eastern Himalayan State of Arunachal Pradesh, India, are attacked by pests and diseases, farmers resort to many traditional techniques. In one of the methods an altar is erected in one corner of the field. It is made of small branches of some selected trees such as *kow*, leaves of the *talo* (*Bauhinia* sp)creeper, and a bamboo tumbler, and is decorated with different types of bamboo festoons. Ten to 15 big containers of *apong* (a fermented local beverage), a small quantity of rice, small pieces of ginger, and a red coloured fowl are placed near the altar. Small amounts of rice, *apong*, meat, and ginger are placed at the base of the altar, a fire is lit, and the priests start chanting verses to the glory of Kiine-Naane, the goddess of crops. The scientific recommendation would be for the farmer to use DDT to control the pest infestation.

The farmers' practices were rejected outright by orthodox scientists. When the toxic side effects of DDT became known, however, the insecticide was also rejected, but only after it had had a disastrous impact on soils and human health. Thus both the responses might be considered, inappropriate. Even so, scientists could have taken a more analytical view of the farmers' actions because they do actually lead to effective pest control. Kohli (1993) in a pioneering attempt said: "*the chanting of mantras by the priests at different times in the agricultural cycle has different effects. It is believed that the sound frequency produced during the chanting of the mantras by a priest may be instrumental in preventing the mating of certain insects and pests, stopping further multiplication. Specific odours produced in sequence and in various combinations by burning the ingredients placed at the base of the altar drive the insects away. The ash too has certain insecticidal properties.*"

As a result of the basic difference in their world views, farmers and scientists develop different value systems. In the above example the farmer offers favoured food resources (wine, meat, and spices) for the intervention of supernatural powers to save the crops, whereas the scientific recommendation is to spray poisonous chemicals! The development of knowledge is based on the values of a society. The thinking of a farmer is more integrated and holistic, whereas the specialists in particular subjects in scientific circles help develop knowledge in specific directions. To illustrate this point further, take the example of Apatani farmers (in Arunachal Pradesh, India) who maintain a carefully designed irrigation network. Each large stream rising on the wooded heights that ring the Apatani country is tapped soon after it emerges from the forest and reaches a gully wide enough to accommodate a series of narrow terraces. A short distance from the terraces, the first diversion is made from the stream, but usually only a little water is deflected here; the stream continues on its course, while the feeder channel branching off at an angle leads water along the side of the series of terraces so that any field can be flooded or drained as required by blocking or opening the connecting ducts. The sharing of water is such a delicate issue among neighbouring farmers that no farmer who is a part of this water sharing network may use pesticides. The use of pesticides by one farmer adversely effects the fish growing in the paddy fields of other farmers.

From the above two examples it is apparent that the knowledge of the farmer is locally restricted and conditioned, while the appeal of scientific knowledge is more universal. Limited by this vision, the farmers strive to establish linkages between the various land-use units in the rural landscape. For example, in the case of shifting agriculture, an indigenous system of agroforestry, farmers have linked their households to the forest ecosystems and effectively incorporated animal husbandry, thereby establishing ecological and socioeconomic linkages (Ramakrishnan 1992). Effective management of a diverse set of resources enhances livelihood security. This factor determines the risk perceptions of a farmer, which in turn influences decisions on the acceptability of new elements from the scientific knowledge system. According to Dirk and Box (1993), a farmer's assessment of risk may include supernatural sanctions, a holistic view of the environment, an awareness of the consequences of particular interventions for the household and the community, and, in the context of economic insecurity, an aversion to taking risks that can endanger the existence of the household. Therefore traditional practices not only promote the maintenance and integration of a diversity of land-use units (wet rice cultivation fields, shifting agriculture areas, terraced fields, home gardens, forest gardens, multiple use forest areas, and hunting reserves) but also of more species and varietal diversity in each of these units.

## Serving the Future

### *The complexities of conserving agrobiodiversity*

If scientists recognise one indisputably positive aspect of traditional agriculture, it is the fact that these practices harbour a tremendous range of biodiversity. However, there is even a difference in perception of the value of this: while farmers have considered and promoted Genetic Diversity over the generations as a dynamic resource, scientists think of it in more extractive terms as a static reservoir of desirable characters. This is reflected in statements like the following: *"The Indian subcontinent is an important centre of origin and diversity for more than 20 major agri-horticultural crop species and their wild relatives - rice, beans, sugarcane, cotton, pigeon pea, citrus, mango, banana, yams, several vegetables, spices, condiments (turmeric and ginger), and a variety of medicinal and aromatic plants. Nearly 160 domesticated species of economic importance, more than 350 species of their wild relatives, and above 800 species of ethnobotanical interest are native to this region. They constitute an invaluable reservoir of genes needed by plant breeders for the development of superior crop varieties."* (ICAR 1995).

This is a true reflection of the international mind-set whereby Herculean efforts have been made to put more and more seeds in deep freeze. According to the FAO there are a total of 6.1 million accessions under *ex situ* conditions, of which 90 per cent are kept under cold storage (FAO 1994, 1996). The problems have been far too many. Besides the fact that many of these gene banks suffer from technical problems, the safety of the collections is questionable because of the lack of regeneration to keep the seeds alive. Almost half (48%) of all seeds lying in gene banks now need to be regenerated; and many may have lost their viability or genetic integrity. It is being recommended to start re-collections of many of these collections, and that indicates the heavy reliance of this system on the native cultivator to whom the system has contributed almost nothing. In fact, this conservation system that leaves out farmers, peasants, pastoralists, and their knowledge, but expropriates their materials — making them available as raw materials to breeders and biotechnologists who may claim intellectual property rights over their creations — is doubly perverse. Not only do farmers lose control over their heritage - the seeds - but they also lose the possibility of continuing with their sustainable and highly productive agricultural practices which build upon biodiversity (GRAIN 1996). So, while the value of gene banks should not be underestimated, the unavoidable erosion of Genetic Diversity in gene banks in the long-term, even under the best storage conditions, questions the appropriateness of this technology as a primary conservation tool for agricultural biodiversity.

The need for greater understanding of farmers' knowledge has surfaced again and again as a result of the limitations that science poses on itself in the process of growth. The dynamism of *in situ* conservation lies in 'niche' based farming practices. Mountain farmers depend on a range of ecosystems that can be ordered approximately according to the intensity of their management. According to Swift et al. (1996) a generalised gradient might move from unmanaged vegetation with restricted use, through 'casual' management (including such things as shifting cultivation, home gardens, and multiple use commons.), to low-intensity management (including traditional compound farms and rotational fallow), middle-intensity management (including horticulture, pasture mixed farming, and alley farming), and high intensity management (including crop rotation, multi-cropping, alley cropping, and intercropping), and finally to modernism (plantation, orchards, and intensive cereal and vegetable production). It is generally acknowledged that diversity decreases as a habitat changes from forest to traditional agriculture to modern agriculture. However, the initial stages of management have only a minor impact on total biodiversity, and further loss is gradual until some critical stage of management intensity is reached. If this relationship holds, then it would follow that planning activities for biodiversity conservation should be focussed on maintaining management intensities below that critical point; rather than aiming at a zero management strategy. Therefore it is imperative to develop a deeper understanding of the dynamics of the traditional practices that enhance biodiversity through selective utilisation of resources, so that they can serve as a complementary approach for long-term conservation needs.

## Changing the Course

### *The New Paradigm of Sustainable Development*

The evidence that indigenous knowledge systems can provide positive interventions in the growth of science and technology is on the rise. Greater integration of the two streams of knowledge has been recommended as a major instrument for developing technologies for sustainable agriculture . Practices and recommendations emanating from the two streams could be reviewed through the attributes of sustainability. Jodha and Partap (1993) have summarised the major limitation of traditional systems as being the reduced feasibility and effectiveness in the face of rising pressure on land, weakening of local collective arrangements, changed technological and institutional environments, and unfavourable terms of exchange for local products. Equally the limitations of modern interventions include the side effects of massive interference with fragile resources (waterlogging, landslides), indifference to resource limitations and totality of farming systems, distortion in local demand patterns and resource use, and increasing heavy extraction of niches as a result of external demand. Integration of the two approaches to maximise benefits and minimise the limitations should shape the future research agenda.

At a more fundamental level of cultural integration, the research agenda would have to overcome the 'efficiency revolution' mind-set that came about as an answer to the 'limits to growth' factor. This response is largely limited to a focus on reducing the throughput of energy and materials in the economic system by means of new technology and planning. Twenty years of trying to 'overcome' the problem using the support of an improved industrial base has proven the futility of using a restricted imagination to revise only the means and not the goal. Acculturation calls for a conceptual shift to an attitude of limiting efficiency with sufficiency. This paradigm shift integrates food production with nourishment of body and soul, and health care with healthy living.

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