The Pakistan Development Review
32 : 4 Part I (Winter 1993) pp. 501–521

Distinguished Lecture

Agricultural Development and Environmental Protection: Some Key Issues of Potential Relevance to Pakistan

HARTWIG DE HAEN

1. INTRODUCTION

Pakistan has made noteworthy attempts to incorporate environmental concerns into its policy and planning framework. Environment legislation and the establishment of the Pakistan Environment Protection Agency now date back more than a decade. In 1988 it was also one of the first developing countries to begin designing a comprehensive national conservation strategy. Proposed investments and adjustments to policy arising from the strategy are incorporated in the Eighth Plan 1993–98; and continue to be debated in national fora [see Amir, Chaudhri and Nasir (1992) for example]. Such actions reflect the growing concerns on the wide range of environmental problems facing Pakistan, the result of a still rapidly growing population (more than 3 percent per annum) confronting widespread natural resource degradation. The main purpose of this paper, therefore, is not to underline the well known need to take account of the environment in agricultural planning and policy-making in Pakistan, but to raise some general issues regarding the complementarities and trade-offs between maintaining agricultural production growth on one hand and natural resource conservation on the other.

2. THE BASIC ISSUES[1]

All forms of agriculture involve alterations of the ecological system. To claim that agriculture should leave nature in its original state is unrealistic. The challenge is rather to direct the interference in a way that achieves an acceptable balance between the short-term benefits derived from the productive use of the resources and the long-term benefits from the preservation of their ecological and

Hartwig de Haen is Assistant Director-General, Agricultural Department, Food and Agriculture Organisation, Room.

Author's Note: I thank Mr J. Dixon and Mr S. K. Barrat for their helpful contributions to first drafts of this paper. The views expressed in the paper are personal and not necessarily those of the Organisations.

[1]The following chapter follows closely another publication of the author [de Haen (1991)].

other functions. Whether this balance is optimised depends on people's needs and preferences on the one hand and the availability of alternatives on the other.

Many people in high income countries tend to give more weight to the ecological side of the balance. This may reflect their increased preference for the conservation of nature, relative to income growth. Surpluses on agricultural markets and widespread overnutrition make it easy for them to accept a slower economic growth, in so far as this is in the interest of the environment. Moreover it is more and more recognised that some forms of intensive modern land use on which much of agricultural growth in industrial countries was based over the last few decades have led to a destruction of biodiversity and degradation of soil and water systems [Young (1991)].

Does this imply that a typical developing country with desperate needs for more food and with good economic arguments for a strategy of agriculture-led economic growth is bound to tolerate more environmental damage as a necessary consequence? This may in fact be the conclusion which some of them have so far implicitly drawn. What else could they have done? Where alternative opportunities did not exist or were too costly, farmers were forced to over-exploit the resource base in pursuit of survival. While survival through overuse of resources may be privately rational, it cannot be a viable long-term national strategy. The range of opportunities must be widened. In order to keep the ecological damage low, those countries must provide incentives which favour sectors and technologies less dependent on natural resources.

As far as agriculture is concerned this requires a more or less radical redirection of the technology set. Neither the traditional land-intensive technologies nor the available external input-intensive packages are universally applicable. Vast areas of fragile lands require new forms of "sustainable intensification" which achieve productivity growth through environmentally friendly combinations of external and internal inputs, including labour. Reduced pressure on the natural resource base must also be achieved through diversification, both within agriculture and, where the agricultural carrying capacity reaches its limits, through more employment and investment outside primary agricultural production.

Over-exploitation of resources can be interpreted as an undesirable pattern and intensity of resource use. Discrepancies of real and desirable resource use may have several reasons, one of them being the existence of externalities. In this case externalities are the result of costs which occur through the use of land, water or genetic resources which the individual land users do not have to bear and therefore they neglect them in their calculations. Such externalities may have a number of causes, including inappropriate property rights and entitlements, an unregulated private use of common property resources, private discount rates which exceed socially accepted discount rates, or simply ignorance with regard to the long term

degradation associated with inappropriate resource use. Each of these causes leads to different conclusions concerning how policy instruments can help to internalise those externalities and thus alternate the problem.

Widening the range of options and cost-reducing technical change will facilitate adaptation of more sustainable resource use practices by the rural population. Such change must help them in ensuring entitlements to secure basic goods and services needed for their immediate survival. Often it is immediate food security which compels them to encroach on forests, wetlands and grazing lands. Therefore the real challenge is to offer these people economic and technical alternatives for increased food security, employment and growth which not only promise fulfilment of people's needs of today, but also benefit the environment tomorrow.

Strategies towards sustainable agriculture and rural development in developing countries must aim to combine efficiency of resource use with incentives to prefer practices that keep any environmental damage withing tolerable limits. To achieve this, the establishment of a market framework must be combined with institutions and legal norms that induce development and use of innovations which are both more productive and environmentally friendly. The most comprehensive and profound plea for such a strategy is contained in Agenda 21, endorsed at the United Nations Conference for Environment and Development.

3. EXTENT AND TYPES OF DEGRADATION–AN OVERVIEW

Following is a brief overview on some key environmental issues relating to land and water, resources of major importance to Pakistan. A lack of time prevents discussion of other important local resources such as plant and animal diversity and global environmental issues such as climate change.

A recent UNEP project has provided a "Global Assessment of Soil Degradation" [UNEP/IRIC (1991)] with alarming implications worldwide for *land resources*. In Asia, about 450 million ha are moderately or strongly degraded. The major man-made causes are deforestation followed by mismanagement of arable, including irrigated land and overgrazing. In Pakistan, the rainfed (*barani*) lands at present are being managed at extremely simple levels of technology. Although these lands constitute 24 percent of cultivated area [20.5 m ha; Table 1, Khattak (1992)], they yield only 10 percent of Pakistan's agricultural production. Consequently, in these areas, farm incomes are low and production is subsistence-oriented. It has been established that two to four times more yields can be obtained in wheat, oilseeds, pulses, maize etc. by adopting an improved technology package: (i) sustainable high yielding crop varieties (ii) better and timely land cultivation for soil moisture conservation (iii) use of fertiliser at right times. There is some indication that these technologies could have a noticeable impact leading even to a resur-

gence of the Green Revolution [Aslam (1992)]. Hence, the current trend of stagnating yields could be overcome, provided appropriate measures are taken to lower the rate of soil degradation to which these areas are highly prone.

Table 1

Land Resources in Pakistan

Total Land Area	m ha
Cultivated	20.70
Cultivable	11.80
Land not Available for Cultivation	25.80
Forest	4.57
Unclassified	15.00
Total	77.87

Source: [Khattak (1992).]

About 11 million ha are under irrigation in the Canal Command Area (C.C.A.). Chemical degradation, such as *salinisation* through poor water management, occurs on more than 3 million ha (or 23 percent). A further 2.6 million ha is affected outside the C.C.A. area [Government of Pakistan (1992)], adding up to about one quarter of the cultivated area being affected by salinity (Table 2).

Table 2

Extent and Nature of Salt-affected Soils in Pakistan

Area in m ha

Nature of Problem	Area	Proportion
Saline	0.63	18.2
Saline Sodic	5.13	80.1
Gypsiferous Sodic	0.12	1.7
Total	5.88	

Source: [Khattak (1992).]

Depleting soil fertility is a major concern in Pakistan. Laboratory studies have revealed an annual loss of 8.76 ppm and 0.23 ppm in potassium and phosphorus, respectively. Similar trends were observed in the control plots where decrease in yield of wheat crop was 14 kg/ha/yr. Decreasing yield trend in Punjab of wheat crops in the long-term field plots were noted as below:

Table 3

Decreasing Yield Trend in Wheat in Punjab

	Fertiliser Level (kg/ha)	
Year	0	50kg
	(kg/ha Grain)	
1965–71	3,725	4,109
1975–83	2,924	3,273
1987–90	2,791	3,262

Source: [Malik (1992).]

About 4.45 m ha are threatened by *water erosion* and directly affected by loss of productivity, gullying and mass wastages of water. In addition to the loss of valuable top soil and water the massive siltation in the down stream reservoirs, flood plains, river beds, canals and water distribution system virtually proves to be a phenomenal problem. Due to siltation the nation is foregoing large amounts of national product due to loss of fertile soil, shrinkage of storage capacity, reduction in agricultural products, power generation and industrial output.

Availability of *irrigation* has been a major source of production growth. Yet considerable irrigated areas are abandoned annually, mainly due to salt damage. Other problems of environmental concern are sinking groundwater levels and salt water intrusion in coastal areas. Still another problem, occurring typically under intensive agriculture, is the pollution of acquifers by nitrates and pesticide residues. In Pakistan, the area of irrigated agriculture has increased by 55 percent since the early 1960s. Yet, the efficiency of water use is low–less than 60 percent for the canal system as a whole. About 2 million ha or 11-12 percent are estimated to have deficient drainage. Of particular concern is the drainage problem in the saline groundwater areas because not only are there serious problems in disposing of large quantities of saline water, but the tubewells themselves deteriorate rapidly under saline conditions.

In summary, the traditional resources on which past agricultural growth was based are extremely limited. A simple expansion of use at constant technology

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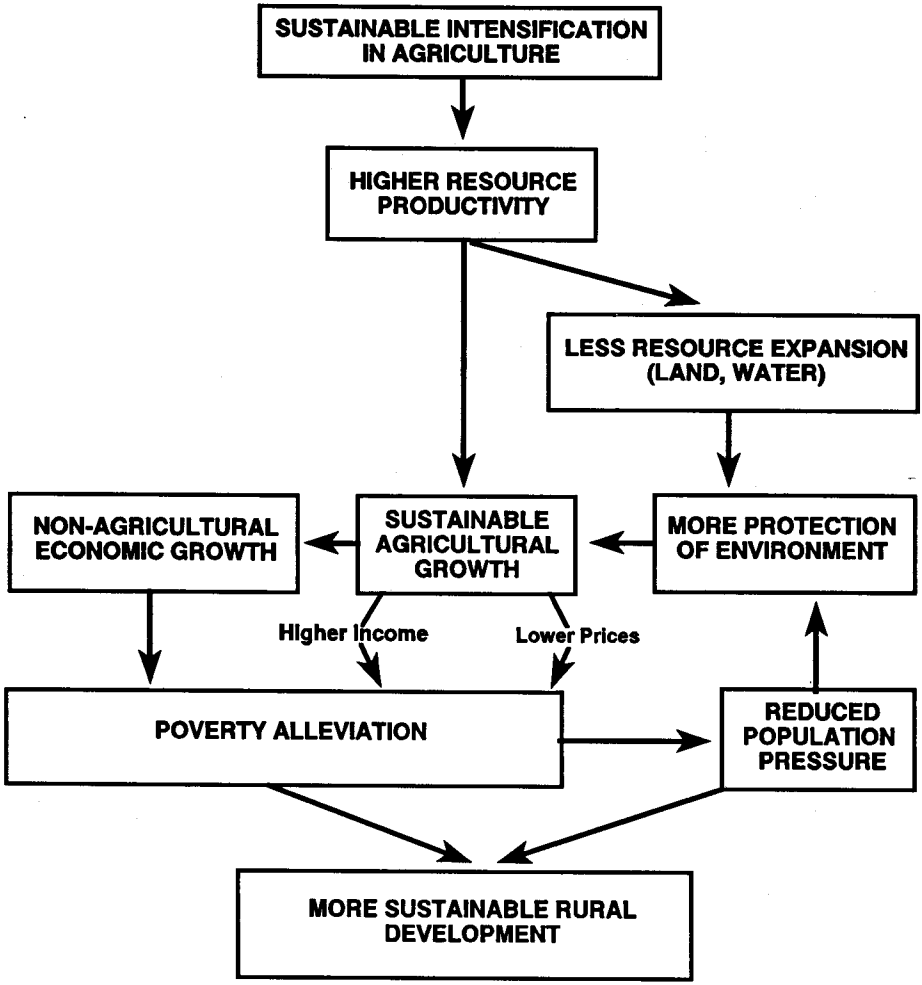

Fig. 1. The Role of Sustainable Agricultural Intensification in Spurring Rural Development.

In Pakistan, the current forest area is only 4.6 million ha or 5.2 percent of the land, of which less than 30 percent is economically productive. Excessive extraction, inadequate planting and regeneration have resulted in this dire situation. The speed of reafforestation in the last 25 years has been only 22,000 ha per year.

In overall Asia, most of the potentially arable fertile land is under cultivation, and farmers have been encroaching into forest areas and marginal lands with low nutrient retention, erosion-prone slopes, aluminium toxicity, etc. Thus, the pressure had grown for a major breakthrough in agricultural technology enabling a growth path based on intensification, rather than land expansion.

Certainly, the green revolution was such a breakthrough, and has brought food security for hundreds of millions of people, mainly in Asia. Pakistan was a key beneficiary, with about a half of its wheat area being under modern varieties as early as 1970. Yet, the unwanted ecological side effects as well as the need to increase production further challenge the collective creativity of national and international research. New forms of more sustainable, yet no less productive, intensification are needed.

5. COMPLEMENTARITIES BETWEEN INCOME GROWTH AND RESOURCE PROTECTION–EXAMPLES FROM ASIA

The success of measures to intensify agricultural production while protecting and rehabilitating the natural resources much depends on the broad participation of farmers and rural people, which is enhanced if they perceive benefits from such measures.

There are some promising technologies which combine improved resource management with growth of agricultural incomes. A few selected examples may illustrate their potential.

Restoration of Soil Fertility

Numerous economic evaluations show that integrated plant nutrition systems can be profitable at farm level, even taking into account some risk factors. They enable farmers to derive maximum benefit from the already available plant nutrients. In many countries such as China, cow dung has been abundantly available for use as an organic source of plant nutrients. Adding farmyard manure or crop by-products can enhance the yield increasing effect of mineral fertiliser, in many cases lowering the cost of yield increases. Of course, there may be opportunity costs in cases where this manure has previously been used for fuel or feed as is the case in many situations. But even then the overall effect often turns out positive.

Prior to the Green Revolution the use of chemical fertilisers in Pakistan was negligible partly because the existing varieties of wheat and rice were prone to

lodging when heavily fertilised and partly due to the generally poor response to fertiliser use in the absence of other supporting (external) inputs like mechanisation, water and plant protection. Now, with the availability of such inputs in parts of the country, the total annual fertiliser use in Pakistan reached 90 kg/ha during the post-Green Revolution, as compared to about 20 kg/ha in early Green Revolution years.

Animal wastes, biological nitrogen fixation and green manuring as components of integrated plant nutrition systems (IPNS) deserve priority attention. Substantial amounts of animal waste are available, some of which remains uncollected. Through suitable techniques, green manuring, e.g., with legume crops, plants and shrubs, could also be incorporated with economic benefit into cropping systems.

Reducing the Use of Pesticides

Inappropriate use of pesticides is often not only harmful to the environment, biodiversity in particular. In many cases it is not even profitable. Yet, farmers tend to use excessive doses, in some cases as a measure of precaution, but also through ignorance of the negative impact on the ecological system. They are often also misled by false information and may even poison themselves.

Also, in Pakistan, chemical pest control has grown considerably. But pesticide resistance in several important pest populations has also become common and previously unknown pests emerge, leading to a sharp decline in overall agricultural efficiency. Cotton is the most important cash crop and cotton sales constitute more than 40 percent of cash income of rural households. However, in general 20 to 30 percent of cotton production is lost annually to insect pests and diseases; and the 1992 cotton crop in Pakistan has suffered heavy losses due to an unknown emerging virus attack even in the presence of well sprayed fields. [Government of Pakistan (1991)].

Integrated Pest Management (IPM) campaigns can persuade farmers to apply fewer sprays, and to replace toxic chemicals by biological or mechanical protection techniques. FAO's regional programme in Asia on IPM for rice based production systems is one such successful campaign. It has turned nearly 600,000 rice farmers into IPM experts through a system of "train the trainers", [FAO (1990)] and persuaded politicians to eliminate subsidies on pesticides, thus avoiding inappropriate economic incentives for excessive use of pesticides. The results were higher farm income, reduced use of chemicals and even increased yields per hectare.

The adoption of the more environmentally friendly technologies is being facilitated by accompanying public investment, in this case mainly for training and research institutions. The cost per successfully trained farmer is still relatively low [around US $10 in FAO IPM activities in the Philippines FAO (1990)].

Soil Protection

Slash and burn practices of land use, followed by mono- or mixed-cropping without nutrient replacement may have the advantage of immediate returns. But, under conditions of short preceding fallow, the productive capacity declines rapidly in the second and subsequent growing periods. In a case study in the Northern Upland Region of Thailand [Attaviroz (1991)], except for the first year of land use, improved forms of conservation farming were economically superior throughout the 15-year simulation period to exploitive land use. Even combined with, in this case mostly public, investments in land development, including community labour for the construction of contour bunds or wells to water live wind breaks, the expected net present value of benefits is positive. Reduced erosion produces added benefits. Thus it was possible to combine immediate production and income growth with land protection. Such improved forms of conservation farming could also become useful in the *barani* areas (rainfed lands) of the northern mountainous and sub-mountainous and northern plains of Pakistan, where lands are steep and the soils are shallow and prone to erosion under intensive cropping operations.

Rangelands comprise almost 60 percent of the land area of Pakistan and have received little development investment. A major portion of the livestock population depends on rangelands. Overgrazing coupled with the lack of a systematic effort of regeneration has destroyed the capacity of much of the rangelands to support live-stock production, particularly in Balochistan and Sindh. The experience of other regions shows, however, that improved grazing practices and range technologies can lead to sustainable use of rangelands.

The enumeration of such promising technological potentials for sustainable intensification should, however, not mislead to assume that agricultural production growth can always be made complementary to environment protection. There are still many situations where immediate economic gains are achieved at the cost of continuing with further degrading the resource base for some time. As in other developing countries, Pakistan also faces difficult trade-offs between the need to accelerate production growth for the immediate future and the need to make more deliberate efforts to protect and rehabilitate the resource base, even at the cost of some delay in growth.

6. COST OF MORE SUSTAINABLE AGRICULTURAL GROWTH

A central cost factor is time. Investment in environment rehabilitation and the development of more sustainable technologies take time until the benefits materialise. To ensure food security with less dependence on the natural resource base requires deliberate efforts in environment policy and a change in the pattern of growth, in particular sustainable intensification of production per unit of land and

more reliance on sustainable growth of the non-agricultural sectors, the latter allowing also limited food imports. These options can only be accomplished through difficult institutional change and often against considerable political adversary. Meanwhile the immediate needs of the low income groups, including farmers who do not yet have access to either of these alternatives, often continue to lead those people to clear more forest, drain more wet lands etc., sometimes even knowing well the negative environmental consequences.

A number of issues must be resolved in order to achieve more complementarity between agricultural growth and environment protection, all of which imply cost. First, there needs to be a comprehensive and regular assessment of the state of the recource base and its change over time. Secondly, substantial investment is required in order to train people at all levels, raise public awareness and sensitivity for ecological issues. Thirdly, consideration must be given to the political cost of loosing support from the traditional beneficiaries of policies such as subsidies on environmentally harmful inputs which now have to be removed, or from those whose access to common property resources has to be restricted or who are affected by environmental norms and standards. Fourthly, the high cost of establishing and maintaining a system of national research institutions devoted to the development or local adaptation of sustainable techniques, often exerts a heavy burden on a country's financial and institutional capacity, even though the long-term returns from investment in research are known to be rather high.

The realistic policy option is thus not to assume that there are no trade-offs between growth and environment protection, but to give priority to those innovations which minimise the trade-offs. This requires deliberate action at both national and international levels toward technical progress and institutional change.

7. IMPLICATIONS FOR AGRICULTURAL AND ECONOMIC POLICY

Specific strategic options must be identified from an analysis of the root causes of environmental degradation. It has long been recognised and was clearly endorsed in Agenda 21 that sustainability must be addressed through its economic, social and cultural determinants. Solutions must be found through a comprehensive resource assessment, removal of poverty, market orientation, investment, incentives for resource protection and rehabilitation as well as for research towards environmentally friendly technologies.

Resource Assessment

Failure to account systematically for natural resource degradation is often attributable to a general misconception that natural resources are abundantly available as 'free' goods of nature. The starting point for any policy and institutional

reform is therefore an appropriate valuation of environmental resources and their change over time. Such assessments should include land and water and genetic resources for agriculture, fishery and forestry and address quantity and quality as well as causes of any observed degradation. The results must be the basis for formulating environment policies, land use planning and priority setting for the research agenda. Moreover they should guide the evaluation of projects and public investment planning, for which environmental impact assessment and monitoring should be a standing item.

Poverty Alleviation

As stated earlier, poverty alleviation is not only a human and social essential *per se*. It is also a precondition for the long-term solution of many environmental problems in so far as alleviation of rural poverty reduces the encroachment on the fragile resource base and poverty alleviation in general enables savings for investment in resource rehabilitation. As long as poverty is also a cause of resource degradation, it will be extremely difficult to escape the vicious circle of environmental decay and further impoverishment. The way out may have to include not only more deliberate policies in family planning, more attention to the role of women in development and higher priority for increased enrolment in primary and secondary schools [Birdsall *et al.* (1993)], but even a redistribution of assets in favour of the rural poor and de-emphasis of public expenditure that does not directly benefit the poor nor help to sustain the resource base for future economic growth. This is undoubtedly the biggest challenge imposed by the environment-agriculture-poverty linkage.

Market-oriented Agricultural Price and Trade Policies

Price and trade policies have often tended to discriminate against agriculture in developing countries. Overvalued currencies, low procurement prices, taxation of agricultural exports etc. have kept producer prices low in favour of consumers and/or public revenue. The impact on resource conservation is not generally clear and needs further research. The direct effect of low output prices may have been to discourage a more rapid growth of production and thus also to discourage the overuse of common property land or the expansion of water use for irrigation. But the indirect effect via depressed farm incomes and reduce purchasing power for improved technologies may have caused the reverse, i.e. neglect of investment in resource conservation, more cutting of bush and reduction of fallows. Damage of the environment may also have been the undesirable side effect of input specific pricing policies such as tax exemptions and subsidies on agro-chemicals (pesticides, fertilisers) or the non application of user charges for irrigation water. They have

often encouraged the excessive use of such inputs or resources.

Many governments, including Pakistan, have started to revise such policies as part of overall structural adjustment programmes or as part of a deliberate environmental policy. Emphasis is being put on the importance to avoid misleading signals from price distorting policy interventions on output and input markets and to choose other sources of government revenue (e.g. direct taxation on income and property) and other ways of channelling any intended support for the urban and rural poor, including direct investment in rural infrastructure and natural resources. The effect is expected to be more targeted poverty alleviation as well as a more efficient use of inputs and resources.

While these are encouraging signs, much remains to be done toward an institutional and policy framework in which individuals and communities receive the right market signals in combination with a legal framework regulating access to common property resources, so as to ensure that people are sufficiently motivated and capable of adopting more sustainable techniques on a large scale.

Investment

Resource rehabilitation and introduction of more sustainable production systems require considerable investment in agricultural research, resource rehabilitation and infrastructure for rural development. In view of the need to feed an additional three billion people by the year 2020 while, at the same time, safeguarding the environment, the investment requirements are considerable. This need contrasts sharply with recent observations of a slowing growth or even a decline of investment in agriculture in many developing countries. International assistance to agriculture has also stagnated or even declined in real terms over the last years [Puetz, von Braun *et al.* (1992); FAO (1990a)]. Such insufficient investment today might show its negative impacts on food supplies and environment only with some delay, possibly by the end of the century and thereafter. Adoption of environmentally friendly technology would require an even greater investment, particularly in research. Investment in agricultural research is known to have an extremely high pay-off [Ruttan (1982)].

Incentives for Environmentally Friendly Research and Investment

Any rural society can follow multiple paths of technological change for its agricultural development. The decisions on which technologies, input levels and production systems to adopt are finally made by the farmers, depending on their resource endowments, skills and preferences and on the expected impact of the chosen package on their income and well-being. Farmers in resource-rich regions will choose different techniques than those in resource-poor regions. High labour

costs will favour demand for labour saving technologies, high land prices lead to demand for land saving inputs allowing higher yields, especially for crops with relatively high market prices. Thus changes in relative factor cost and relative product prices tend to induce demand for specific types of innovations.

Hayami and Ruttan (1971) have first elaborated the induced innovation theory to explain agricultural technical change as a function mainly of relative prices in a number of countries. The important implication of this is that speed and effectiveness of the inducement process depend very much on the adaptability of private and public research institutions. Close participation of farmers and extension staff in setting research priorities and testing innovations facilitates the practical usefulness and profitability of new technologies. Another essential lesson from the induced innovation theory is that government price policy cannot only be judged according to its immediate effects on production and income but also according to its indirect impacts on the direction ("bias") of technical change. Price distortions will thus lead to distorted innovations and thus aggravate any allocational inefficiencies even further, e.g. lowering of a product price may cause a neglect of research on the respective commodity and low or no charges on irrigation water may lead to a neglect of research on water-saving technologies.

Equally important for the inducement of innovations is the overall environmental policy framework. Rules and regulations, incentives and disincentives can serve to replace the missing markets in cases where externalities occur which the individual will not normally take into account. The public sector, must, through property rights, land use planning, taxes and subsidies protect public goods such as long-term soil fertility, bio-diversity, water resources and the overall equilibrium of the agro-ecosystem. This framework will encourage demand for technologies which maximize the benefits for the farmers within such constraints and thus induce respective innovations. This is the message of the theory of "induced innovation" applied to the externality problem [Runge (1986)]. Again, it is important that research organisations are sufficiently staffed and endowed and that there management is enabled to react to the evolving needs by flexible adaptation of research priorities and methodologies.

8. CONCLUSIONS

Pakistan like many developing countries is confronted with an extremely difficult task of embarking on a technology path for agricultural and rural development, which gives high priority to environmentally friendly technologies without sacrificing growth of production and incomes for the rural population. To find production systems and practices which allow an acceptable growth without unacceptable environmental damage is not impossible to achieve in many situations.

New breakthroughs in agricultural technology do exist or can be adapted

which combine productivity growth with minimum ecological damage. In the interest of the environment these technologies must allow sustainable intensification, i.e. increase input use per unit of scarce resource, but combine external inputs as far as possible with locally produced inputs and by-products of a diversified production system. The aim must be to use available natural resources as efficiently as possible. Promising technologies include improved land management methods, water saving and drainage technologies, recycling of animal waste and by-products of agricultural industries, integrated pest management (IPM) and integrated plant nutrition management (IPNS), all of which can combine agricultural income growth with improved resource management.

In spite of such promises the fact remains that the implementation of a more sustainable path of agricultural and rural development requires substantial public investment and often a deliberate political will to depart from past policies and procedures. The efforts and costs involved compete with public expenditures that are dictated by multiple political pressures and in particular by the immediate survival needs of masses of low income people. Thus as long as poverty prevails and where complementarity between production growth and environment protection can only be achieved through investment, societies may be inclined to give preference for production over protection.

Since poverty alleviation is an important precondition for resource protection, governments may have to thoroughly review existing patterns of asset distribution and consider a fundamental revision of policies so as to give high priority to poverty alleviation, and this not only in the interest of immediate social welfare but also of environment protection for future food security.

Empirical evidence shows that many particularly fragile ecosystems with unreliable agro-climatic conditions such as the *Barani* and rangelands in Balochistan and Sindh province of Pakistan suffer from population pressure and acute poverty. In promoting agricultural growth parallel to resource protection, these areas deserve priority attention. Where the limits of the agricultural carrying capacity are reached, the potential for diversification of incomes through off-farm employment in place of resource-demanding agricultural growth should also be developed.

Large-scale adoption of more sustainable techniques rests on a favourable institutional framework through a minimum of price distortions and absence of price discrimination against agriculture in combination with rules and regulations which would attach proper value to scarce resources and give incentives through internalisation of external costs. Pakistan like many other governments has already started to revise agricultural price and trade policies and remove the bias against the farm sector as part of overall structural adjustment. This may well lead to more efficient resource use and thus help to reduce the pressure on the environment.

Public awareness of the intricate relationship between environmental protection and socio-economic development, political will and investment capital are three key ingredients for implementing sustainable agricultural and rural development (SARD) programmes. Broad farmer participation, based on perceived benefits, is another crucial precondition to protection and rehabilitation of natural resources.

REFERENCES

Amir, P., M. Y. Chaudhri and M. H. Nasir (eds) (1992) Proceedings of National Conference on Agricultural Sustainability and Natural Resource Management. Islamabad: Ministry of Food, Agriculture and Cooperatives.

Aslam, M. (1992) Green Revolution–A Resurgence. *Pakistan Journal of Agricultural Economics* 1: 2 89–98.

Attaviroz, J. P. (1991) Soil Erosion and Land Degradation in the Northern Thai Uplands. *Contour* 3:1 3–7.

Birdsall, N., D. Ross and R. Sabot (1993) Underinvestment in Education: How much Growth has Pakistan Foregone? Distinguished Lecture at Ninth Annual General Meeting of the Pakistan Society of Development Economists, Islamabad, January.

FAO (Food and Agriculture Organization of the United Nations) (1990) Mid-term Review of FAO Inter-country Programme for the Development and Application of Integrated Pest Control in Rice in South and South East Asia. Rome, Italy. (Mission Report.)

FAO (Food and Agriculture Organization of the United Nations) (1990a) External Assistance to Agriculture: Trends, Policies, and Impact. Rome.

de Haen, H. (1991) Environmental Consequences of Agricultural Growth. In DSE (ed) *Agricultural Sustainability, Growth and Poverty Alleviation: Issues and Policies*. Proceedings of an IFPRI Seminar, Feldafung (Germany). 31–48

Hayami, Y., and V. W. Ruttan (1971) Agricultural Development: An International Perspective. Baltimore and London.

Khattak, R. A. (1992) Soil Sustainability. In P. Amir *et al.* (eds) *op cit.*, pp. 42–44

Malik, Dm. (1992) Resource Management and Development Activities for Increasing Crop Production. National Conference in P. Amit al *op cit.*

Pakistan, Government of (1991) Report of the FAO-PCCC Regional Workshop on Integrated Pest Management in Cotton, Karachi: Ministry of Food, Agriculture and Cooperatives.

Pakistan, Government of (1992) Report of the National Commission on Agriculture. Islamabad: Ministry of Food, Agriculture and Cooperatives.

Puetz, P., J. von Braun, R. Hopkins, D. Madani and R. Pandya-Lorch (1992)

Underrated Agriculture, Increasing Need but Declining Aid for Agriculture in Low-Income Countries. Washington, D.C.: International Food Policy Research Institute.

Runge, C. F. (1986) Induced Innovation in Agriculture and Environmental Quality. In T. Phipps, P. Crosson and K. Price (eds) *Agriculture and the Environment.* Washington, D.C.

Ruttan, V. W. (1982) *Agricultural Research Policy.* Minneapolis: University of Minnesota Press.

UNEP/IRIC (1991) Global Assessment of Soil Degradation, a Global Perspective. (Unpublished Draft Report.)

Young, M. (ed) (1991) Towards Sustainable Agricultural Development. (Published in Association with the Organization for Economic Cooperation and Development (OECD). London and New York.

Comments on "Agricultural Development and Environmental Protection: Some Key Issues of Potential Relevance to Pakistan"

Professor de Haen's lecture is very interesting and it is quite comprehensive in terms of its coverage of environmental issues. The conception of the environment problem as the balance between the short-term benefits derived from the productive use of resources and the long-term benefits from the preservation of their ecological and other functions is rather useful in prioritising environment protection programmes. It helps in isolating the areas where environment protection is complementary to growth from the areas where there is a trade-off between the two.

The main focus of the lecture has been on the population growth-poverty–environmental degradation nexus. It is argued that the growth of population has accentuated the poverty problem and, consequently, marginal lands have to be cultivated which leads to deforestation. Accordingly, Professor de Haen argues that the environment situation would improve if poverty is alleviated and that is possible via an increase in productivity through technical change. While the development of technology is absolutely necessary for the eradication of poverty and improving the environment, two issues need to be kept in view. First, land augmenting technologies, in general, have been fertiliser and pesticide using technologies and these inputs tend to worsen the problems of the environment. Second, since the improvement in the environment is a function of the alleviation of poverty in the rural areas, these efforts may not be confined just to the promotion of agricultural productivity; the increase in the production of the manufacturing and other activities in the rural areas would also help in resolving the problem.

He has also argued for the development of environment-friendly technologies. As a matter of fact, he has argued that a number of such technologies already exist. For example, farmyard manure and agricultural by-products may be used instead of fertiliser to increase the productivity of land. He has argued that this technology is more cost-effective and is also more environment friendly. However, one wonders why farmers are not using a cost-effective and environment friendly technique of production. Is Professor de Haen assuming non-rational behaviour on the part of the farmers or some distortions which create a wedge between social and private profitability? If there are such distortions, they need to be identified and policy measures need to be suggested to remove these distortions. If, on the other hand, the farmers are not motivated and organised, then the necessary institutional arrangements to disseminate technology need to be developed. However, Professor

de Haen has not made any attempt to point out the factors causing the failure of the farmer to use the cost-effective and environment-friendly technologies.

The development of environment-friendly technologies necessitates the diversion of more resources to agricultural research. Previous experience suggests that left to the developing countries such research activity would be less than optimal. In any case, it needs to be examined whether such technologies should be developed through research carried out in each country or through a joint global action on this front. It needs also to be assessed if the developing countries have the requisite resources and capability to develop such technologies. Moreover, would it be cost-effective to develop such technologies in the developed world and then to transfer these to the developing countries is another issue which also needs to be examined. Unfortunately, Professor de Haen has not discussed these issues.

He has rightly pointed out the need for institutional change for the acceptance of the policies aimed at resource protection. However, the form in which this should be developed has not been discussed.

The impact of pesticide and fertiliser use on agricultural production has been widely discussed but its impact on the farmers, related activities and the user of the output has not been adequately examined in the study. For example, the use of excessive pesticides has been quite harmful to cotton pickers. Similarly, the standing water in paddy farms contaminated with fertilisers and pesticides leads to dermitology problems for the farmers. Moreover, such contamination leads to loss of potential fish. The indiscriminate spray of pesticides, especially on vegetables and fruits, badly affect the consumers of these fruits and vegetables.

No doubt, withdrawal of subsidies from the use of agricultural inputs such as fertilisers and pesticides can help in avoiding the wasteful use of these inputs and in improving the environment. However, the higher input prices may lower the level of output by reducing the input use below the judicious level which may then lead to even higher levels of poverty. This, in turn may lead to the farming of marginal lands thus worsening environmental problems. Therefore, Structural Adjustment Programmes of the IMF and World Bank need to be reviewed as they aim at just improving the efficiency at the cost of ignoring equity considerations altogether. While the subsidisation of inputs may not be an optimal policy to combat the poverty problem, the withdrawal of subsidies without a policy package to help the poor would not be very helpful either.

A. R. Kemal

Pakistan Institute of
Development Economics,
Islamabad.

Comments on "Agricultural Development and Environmental Protection: Some Key Issues of Potential Relevance to Pakistan"

Dr de Haen is to be congratulated on his succinct and comprehensive exposition of what I shall refer to as the first principles of the interrelationships among growth, sustainability, and poverty alleviation in developing economies. As he correctly points out, no individual or institution contemplating these interrelationships can ignore that:

(a) In many developing countries, agricultural production goals cannot take second stage to environmental concerns, and such trade-offs should not be viewed as automatic;
(b) the solutions will involve combinations of new and existing policies, technologies, and institutional arrangements;
(c) the relative weights on these key ingredients will, in many cases, diverge from historical tendencies that focused disproportionately on technical change, and increasingly stress policy change and institutional innovation;
(d) the ecozone specificity of the problems and solutions will be paramount; and
(e) farmers and rural communities will continue to be the prime movers of the success, or failure, to reach growth and poverty alleviation objectives without compromising the natural resource base.

Once these first principles are firmly in our grasp, I feel the urgent need to take the next step, and identify and experiment with potentially successful combinations of policies, technologies, and institutional arrangements. We may find that theory and first principles do not always indicate the proper modifications of present production and distribution systems, but at this stage, we must begin let experience (even recently gained) be our guide as to what works, and what does not. This will require carefully and comprehensively designed efforts to achieve sustainability, growth, and poverty alleviation goals, and solid empirical evidence from which to judge success in terms of each of these goals.

First principles, by their very nature, can only speak in general terms about the lag structure of the interrelationships they propose, or the depletion rates of key natural and human resources. My reading of the Pakistan situation, with dramatic

increases in population and natural resource degradation, and stagnant (at best) total factor productivity in agriculture, suggests that there is an urgent need to take action. In my view, Pakistan does not have the luxury of waiting for development to solve its population growth problem, for institutional "evolution" to internalise externalities partially responsible for promoting degradation, or for biotechnology to generate a new set of environmentally appropriate "silver bullets". If policies, technologies and institutional arrangements capable of reversing these ominous population, degradation, and productivity trends are not identified and enacted, Pakistan may (within a decade) find itself with insufficient rural production to feed and employ its people, and insufficient income to sustain livelihoods via imports.

Therefore, Pakistan must take the lead among developing countries in addressing these issues. Indeed, I hope Pakistan will provide important lessons for those of us in the international community grappling with these issues.

Stephen A. Vosti

International Food Policy
Research Institute,
Washington, D.C.,
USA.