Vol XLII
No. 3

ISSN 0019-5014

JULY-
SEPTEMBER
1987

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

Ind. Jn. of Agri. Econ.
Vol. 42, No. 3, July-Sept. 1987

Impact of Agricultural Development on Ecology and Environment

AGRICULTURAL DEVELOPMENT AND ECOLOGY— AN ECONOMIST'S VIEW*

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Merely because man has survived to date with a long history of interaction with nature, it does not mean that the concern over ecological problems at this stage of development is unnecessary or over-played. No doubt, evolution of agriculture itself meant an interference with nature, marking a transition from the earlier stage of hunting and gathering of natural produce. The equilibrium between man and nature was not unduly upset by this globally, but locally it must have been disturbed in many places. Shifting cultivation was a response to local disturbance of this equilibrium as long as there were other places to go to. Technological change no doubt has enabled man to continuously overcome resource scarcities, but the signs of strain on the regenerative capacity of nature caused by the extravagance of man are now emerging more and more conspicuously. They are, for example, increasing instability of our agricultural growth, the alarming rate at which our reservoirs are getting silted up, increasing flood-proneness of many areas, the greater disease vulnerability of crops and, the increasing costs of cultivation in real terms almost all over the world. Though nature could 'take it' all these centuries, we may well have reached a stage now when we cannot take her munificence for granted.

The ecological problems of agricultural development as such cannot be isolated from those of economic development in general. The basic economic aspects of ecological problems are almost the same. Moreover, modern agricultural development has been dependent on industrial development too. Pollution caused by factories producing modern agricultural inputs like fertilisers and pesticides is no less worrisome. The factory that caused the Bhopal disaster was a pesticide producer. Similarly, factories processing agricultural products like sugarcane are also polluters in their own right! Besides, we need not always look upon agricultural developments as the cause, and ecological damage as the effect. The latter, caused either by farmers or by industries, also affects agricultural and rural development. Deforestation caused by industries is a major illustration of this. In view of these interconnections, our discussion of agricultural development in relation to environment would not be in isolation from economic development in general; nor would it be in terms of a unidirectional causation. Our basic purpose,

*Keynote paper.

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Thanks are due to V. M. Rao and H. Ramachandran for their valuable comments on an earlier draft.

however, is not to bring out all the interconnections through a system—or input-output framework; it is mainly to identify and highlight ecological concerns which an economist has to take note of, and also to discuss the problems and dilemmas faced in reconciling agricultural development with these concerns.

Economists have been sharply criticised for their excessive concern with economic growth in a narrow perspective without caring for its sustainability. This has been mainly due to the fact that economists worried about scarcity in a highly restrictive sense as if its relevance was only for the short run. The long-term view could be understood by economists only through discounting the future and by deriving its present value. The present was necessarily at a premium and the long-term at a discount. No other view could pass the test of economic rationality. Moreover, scarcity was incorporated into economic analysis only in a market framework. Valuation of natural resources on site including free environmental resources like air and water, and the impact of economic activity on the state of their scarcity were not, therefore, incorporated into economic analysis (see Dasgupta, 1987). Only the costs of extraction, processing and transport of natural resources were the basis of valuation of their cost to the society in using them. Actually, even pollution amounts to depletion of a natural resource at the cost of other users. Ultimately, the ecological problem in economic terms is basically one of costing the *in situ* natural resources including air and water, the cost of using a unit of resource being the sacrifice imposed on other users, the proximate, distant as well as the future users of the resource. Only such costing can lead to a rational use of resources. Different forms of environmental degradation like deforestation, soil erosion, waterlogging, air and water pollution, noise—all boil down to this basic problem.

It is in this context that economic growth in relation to ecology has to be understood. Instead of taking for granted the alleged dichotomy between ecological concern, on the one hand, and poverty alleviation and economic development, on the other,[1] economics can help us in incorporating the former in our plans and programmes for the latter and seeing that they go together. Frankly, ecology gave a big jolt to economists.[2] While it is not necessary for an economist to become an ecological fundamentalist,[3] he can certainly accommodate the concern over ecology as part of his analytical framework and help in making really 'rational' use of resources— 'rational' from the point of the society as a whole including the interests of future generations.

1. This dichotomy, for example, is implicit in FAO's advice: "Ecological considerations should not always take precedence over those of food production" (FAO, 1981, p. 130).

2. Narinder Singh's "Economics and the Crisis of Ecology" could as well have been titled as "Ecology and Crisis of Economics" (Singh, 1976).

3. Campbell has observed: "Forty years ago, ecology was a respectable field of biological science. In latter years, it has become a religion rather than a science, but it still claims the authority normally accorded to the results of scientific investigation" (see Campbell, 1983, p. 12). While we need not adopt ecology as a religion, there is nevertheless a need for agricultural economists to deal with conservation issues in their analysis.

Externality

The ecological concern can be said to have three dimensions: externality, sustainability and equity. An ecologist takes a total or holistic view of a development project or process including negative side-effects and not a partial view. Economists tried to accommodate this concern through the concept of externality, and costs imposed by a project in the form of negative externalities on others were recognised as a component in any worthwhile social cost-benefit analysis. Though admitted in principle, an under-assessment of these costs has been normal, so that we are not even sure whether a project has added to the well-being of the society or damaged it. Similarly, over-assessment of returns is also normal, as side-effects of other projects are not taken note of as illustrated by the under-estimation of siltation rates in river valley projects.

If a hydro-electric or irrigation project submerges vast areas of natural forests, the problem is not a simple one of raising compensatory forests elsewhere, particularly if they contain rich biological specimens which may be lost forever. Alternative area for afforestation may not just be available. Moreover, raising two or three species of trees cannot compensate for the biological diversity that is lost. People displaced by a project can be said to be compensated only if they are really rehabilitated in such a way that in terms of economic well-being they are no worse off than before. In a country where the poor have shown immense capacity for privation and suffering, the valuation of sacrifice imposed on them is always likely to be on the lower side. As observed above, economists are yet to devise a satisfactory approach on the basis of which displaced people can be adequately compensated. There arise some welfare questions. Is it enough to ensure the same stream of nominal income to them which they would have continued to get in the absence of the project? Or have they also to be compensated for being disturbed from their settlement and relocated at a place which was not their choice? Compensation is often considered an administrative problem, arbitrarily decided and clumsily executed. This is at least partly because economists have not yet come up with adequate theoretical work on this issue particularly in the context of a developing country like ours.

The problem of negative externality is more complex in agriculture than in industry. An industrial unit can be compelled to adopt anti-pollution measures and keep emission of pollutants within tolerable limits either through regulatory measures or through penal taxes on pollutants discharged. Such a solution is difficult in the case of farmers polluting the environment through pesticides. In the absence of pesticides, crop losses could be significant, but much of the environmental cost of pesticide use is not borne by the user himself, and there is no easy way of identifying and compensating people who are victims of pesticide use. A direct consequence of this is that pesticides being cheaper than their social cost, there is no stimulus to reduce their use and adopt a safer technology.

Sustainability

The second major ecological concern is about sustainability. In a sense this amounts to taming the economics of discounting the future, but it does not go to the opposite extreme of placing a premium on future use and discounting the present. The concern is simply over the question of whether the present use of resources would so deplete the resource base that the development process dependent on it is not sustainable in future. Such a concern is to prevent a reckless use and promote greater rationality, foresight and responsibility in the use of resources. In the case of exhaustible resources, the problem is more complex, and it is essential that their cost reflects their *in situ* scarcity. In the case of renewable resources, at least the cost of regeneration has to be recovered by their price. Since even this is not done, the rate of their exploitation exceeds the rate of regeneration, leading to depletion of resource base. The problem is caused both because the present use is excessive, and because regeneration is not taken care of, as has been eminently illustrated in our use of forest resources.

Within the sphere of agriculture proper, we have the example of groundwater exploitation for irrigation. Over-exploitation through digging or boring too many wells would bring down the water level to such a level that the expected quantity of irrigation is not any longer available.[4] Such irrigation is hardly combined with proper watershed management to trap run-off water and enable aquifers to get recharged to improve regeneration of water. The problem gets aggravated both ways. Basically, however, the problem arises because the scarcity of groundwater is not reckoned and evaluated in its use, the only cost being considered is one of exploitation. There is no motivation to take into account such scarcity and react to it rationally because the *in situ* resource is considered as free, a common property which every one has a right to exploit but it is nobody's duty to protect and regenerate. It is not considered as a public good to be managed equitably in public interest. Community management which was traditionally exercised in the case of village woodlots, grazing lands and tanks, was hardly to be seen in the case of groundwater exploitation.

Waterlogging in canal irrigated areas is another example of a reckless use of precious resource (water) destroying another precious resource (land) in the process. This takes place sometimes within two or three years of irrigation, indicating the degree of recklessness. Almost invariably, waterlogging is due to excessive use of water for short-term gain and failure to take steps to drain excess water. This may not always be due to the farmers' choice, but also due to indifference of the command area authorities and their failure in enlisting the farmers' co-operation in efficient water management and distribution. In any case, it is hardly an inevitable price to be paid for agricultural development and is quite avoidable. But it continues as a

4. A recent study of Rayalaseema in Andhra Pradesh showed that the drought and falling water-table there could be attributed only to overuse of water and not a climatic change in the form of reduced rainfall. Pumpsets were installed at an explosive rate, and the increase in evaporation and run-off resulting from intensive irrigation caused water shortage (Olsen, 1987).

significant phenomenon[5] due to the under-valuation of our productive resources—land and water. Even if it costs a lot to the society to bring water to the farm, it need not be a scarce resource to the farmer if he is charged nominally on the basis of area irrigated. Unfortunately, even economists concentrated more on the impact of irrigation on productivity of land, rather than on water use efficiency. Is the capital cost of water meters and water saving irrigation modes surely more than the social values of water saved ? Or, could the problem be resolved simply through better organisation and water management without such capital costs ? If so, why has the problem still continued ? Until we adequately explore the economics of alternative ways of ensuring water use efficiency, including institutional alternatives, this problem will continue to haunt us.

Sustainability of economic development is a much more basic concern than that of externality. The former subsumes the latter concern, since the former is interpreted not merely in the narrow context of sustainability of a particular development project, but in the broader context of the total development process—and of human life itself. Thus, a factory polluting water threatens the sustainability of economic activity downstream which is dependent on the presence of unpolluted water. A factory making excessive use of forest produce without caring for regeneration threatens through its deforestation the sustainability of not only the factory itself, but also of agriculture and rievr valley projects. Economists' concept of externality usually applied to pollution does not fully comprehend the significance of the concern over sustainability of the total development process and human life. Even if a paper and pulp mill satisfactorily controls pollution, the depletion of forest resources that it causes would still continue.

The concept of user costs goes a step ahead in comprehending this concern. It is defined as, "the present value of all future sacrifices (including foregone use, higher extraction costs, increased environmental costs) associated with the use of a particular unit of an *in situ* resource" (Howe, 1979, p. 78). The concept of user costs is helpful in making rational decisions involving inter-temporal allocation of resources, since it conveys inter-temporal opportunity cost. But this concept cannot do away with discounting the future, since the cost is derived in terms of present value. The rate of discount has to be socially optimal and cannot be mechanically identified with the long-term rate of interest on bonds and securities. A value judgement is inevitably involved in the choice of discount rate. Nevertheless, some objectivity and fairness to the interests of future generations can be imparted to this choice if the rate of regeneration is taken into account wherever possible. Colin Clark pointed out how "discounting can lead to the economic desirability of over-exploitation and ultimate destruction of a fishery if the discount

5. Waterlogged area as a proportion of total irrigated area is not negligible. In Karnataka, taking major irrigation projects (excluding Upper Krishna, where the problem was negligible), this proportion turned out to be 7·0 per cent between 1982-83 and 1984-85. But in some projects, it was substantial, being 30·3 per cent in Kabini and 21·6 per cent in Hemavathi, though both are relatively new projects (irrigation was started there since 1974 and 1982 respectively). Calculated on the basis of information in Prasad and Malhotra (1986).

rate is sufficiently above the natural reproduction rate of the fish stock.[6] In any case, even if a choice of a lower than market rate of interest is made, the environmental implications of a project would have to be independently considered.

A direct and immediate consequence of not ensuring sustainability in project planning is that the process of depletion may soon go beyond control. The cost of regeneration of a resource increases with the level of depletion. Ultimately, the cost can be so high as to make regeneration non-viable or impossible.[7] The process of resource depletion also increases the cost of production activity based on the resource. That is how the economic impact of ignoring sustainability is felt even in the time-span of a given generation itself. This affects the development process by increasing the capital or input requirements for producing a unit of output. Thus, the process of soil erosion can perhaps be compensated by the use of complex chemical fertilisers, but only at an increasing cost. Crop yields in India being lower than in other countries and also lower than in our own demonstration plots could be more due to careless ploughing without water and soil conservation measures than due to low rates of fertiliser use. In such a setting, even the response of crop yields of fertilisers could be low, resulting in high cost. The process of increasing cost even in real terms has already affected Indian agriculture, quite independently of inflation. At a micro level, in the example above regarding over-exploitation of groundwater, the cost of irrigation sharply increases, and returns too drop.[8] This has been evident at the macro level also. We have only to compare the phenomenal increase in agricultural inputs in real terms (area irrigated, fertilisers used, etc.) with the 'Hindu' rate of growth in agricultural output. An analysis of the disaggregated tables in the National Accounts Statistics showed that in India, in terms of constant (1970-71) prices, the annual use of inputs (excluding labour) as a proportion of the value of agricultural output increased from 19.7 per cent in 1970-71 to 23.6 per cent in 1981-82. This was not a matter of choice of years, since the trend was steadily upward. In terms of current prices, the increase was sharper still, from 19.7 per cent in 1970-71 to 28.6 per cent in 1981-82, reflecting a greater increase in the cost of inputs than in the prices of output (see Nadkarni, 1987, pp. 52-54). This is not a question merely of deterioration in the terms of trade. Even the cost of inputs like organic manure has sharply increased on account of the deterioration of our natural resource base.

Evidently, we have concentrated more on supplying market inputs than on improving their productivity which is possible only if the natural resource

6. See Clark (1973), as quoted by Howe (1979, pp. 159-160).

7. Rao and Chandrakant (1984) have drawn attention to how investment in tank irrigation has become uneconomical, the cost of irrigation per hectare from this source being much higher than in the case of canal and well. One wonders how this source, which for centuries has sustained agricultural development in many areas of South India, has now become un-economical and whether it is not due to deforestation and indifferent land management resulting in excessive siltation.

8. For example, as revealed by Deshpande *et al.* (1985).

base of agricultural development is sustained and improved.[9] Some attention is no doubt, being given to improving the natural resource base in dryland development and watershed management through soil and water conservation measures but we have still a long way to go. It was, for example, estimated that till 1982, only about four to five per cent of the total erosion-prone areas of Kerala were treated by soil conservation measures due mainly to paucity of funds (Government of Kerala, 1984, p. 126). No wonder, we hear about droughts in Kerala more and more frequently. Things may not be much better elsewhere. In the country as a whole, 175 million hectares are estimated to be erosion-prone out of the total geographical area of 329 million hectares (Government of India, 1985 *a*, p. 17). Only 29.4 million hectares, *i.e.*, 9 per cent of erosion-prone area, were covered by conservation measures upto the end of the Sixth Plan (Government of India, 1985 *b*, p. 11). Since paucity of funds was cited as the main reason (in the Kerala Report), it only indicates a low priority given to this problem.

An important aspect of sustainability is stability. If growth is highly unstable, or is tending to be more unstable, its sustainability is at stake. Even in the context of traditional agriculture, a positive association between growth and instability was pointed out (Sen, 1967). Sen advanced a 'tentative speculation' attributing this to growth taking place as a result of extension of cultivation to marginal lands and use of inputs like fertilisers rather than improvement in skills. The question assumed further significance when growth was taking place (since the mid-sixties) more as a result of increasing yields per hectare than through extension of area. An early study of Maharashtra showed that a negative association emerged when growth was mostly through irrigation, the rainfed crops having low growth and high instability (Nadkarni, 1971). A subsequent study of Karnataka showed, however, that a positive association emerged again in the context of growth in yields being promoted mainly in rainfed crops. Coarse cereals and pulses showed above average performance in this State more through promotion of high-yielding varieties (HYVs) suitable in rainfed crops than through irrigation. This reduced the disparity in the levels of agricultural development as between crops and regions, but was also associated with increased instability on the whole (Nadkarni and Deshpande, 1982 and 1983). The same study also showed however that such a positive association was not universal, though a leading one. There were also districts known for drought-proneness and high variability in rainfall, showing significant growth in yields, yet having lower than average instability. This was a hopeful sign, for it showed that instability need not be an inevitable price for growth. Soil and water conservation programmes, promotion of crop varieties that combined high yields with resistance to pests and droughts, improvement in skills, and judicious decision-making to minimise risks helped in reducing instability even while promoting growth.

9. Rao and Deshpande, (1986, esp. p. A-103) have attributed the increasing costs to a tendency to concentrate inputs in only a few areas and inefficiency in their use. This explanation is quite consistent with our explanation above.

Ecology and the Poor

The third dimension of ecological concern is about the class character of agents perpetrating ecological damage and that of the victims of the damage. The concern arises out of the well-founded fear that while the gains of development projects are pocketed by the propertied elite, the ecological costs are borne by the unorganised poor. The issue is linked both with externality and sustainability. We have two patterns here, one being more dominant than the other.

In the first and the dominant pattern, the agents of damage are the propertied and affluent, usually the big industries. Guided by the profit motive, they make reckless use of resources—water, air, forests and land, and in the process ruin the very life-support systems of the poor. There are reasons for expecting that the main and also the direct victims of environmental degradation are invariably the poor. It is they who live nearest to and depend directly on the natural environment, and are farther than the rich from the built, protected or processed environment, whether they are tribals, farm labour, fishermen or slum dwellers. Their life is dependent on what is cheap or free, which the natural environment provides. When they are deprived of this source because of degradation, their poverty increases whatever may happen to their cash incomes. Any poverty alleviation programme which ignores this dependence of the poor on what nature can freely provide, is likely to become abortive. A bank loan can easily be given to the poor to purchase a cow, but if care is not taken to increase the fodder resources in the village or to improve the productivity and management of grazing lands, the cow can lead him to bankruptcy. Depletion of fuel wood and water makes the life of rural women all the more miserable making them trudge for miles, and can also keep the children away from schools since they too have to help in this. The impact of deforestation on tribals and artisans dependent on raw material like bamboo is an old story, though by no means a past and bygone story.

Though it might appear that environmental deterioration in the form of air and water pollution hurts all, even here it is the poor who suffer more. Air pollution pushes the poor into the polluted low rent areas, while the rich can move out for locations of cleaner air. The evidence of ecological impact on the poor has been eloquently documented in both the Citizens' Reports on the State of India's Environment (Centre for Science and Environment 1982 and esp. 1985, pp. 362-376). When the rich start using natural resources used also by the poor, the latter cannot just compete but lose in an unequal battle.

The second pattern is where the agents of ecological damage are the poor themselves. The rural poor stealing firewood from the forests more for sale than for their own use, unregulated grazing and extension of area under cultivation at the expense of forests and pastures, are cited as the major forms of ecological damage generally attributed to the rural poor. The three forms are inter-related. The root cause of the former two is the scarcity of

domestic fuel and fodder, which in turn is due to the absence of an institutional arrangement to deal with the scarcity and overcome it that would involve people's consent and participation and ensure regulated use and regeneration of resources. A biomass budget prepared for Karnataka showed that of the estimated 112 lakh tonnes of domestic fuel required, agricultural wastes met 46.2 per cent, dung met 4.4 per cent, fuel wood depots of the Forest Department met 4.2 per cent and the deficit was met from forests through over-exploitation, *i.e.*, at a rate above their regeneration capacity (Gadgil and Sinha, 1986, pp. 24-25). Agricultural wastes have traditionally met the needs mainly of the poor; it is the relatively richer classes who purchase fuel wood, and the poor make a living by fetching the same from forests on head loads. Unfortunately, even the supply of agricultural wastes is stagnant, mainly due to the fact that HYVs, which have less straw contents have significantly replaced traditional varieties and traditional crop patterns. Residues of traditional crops, particularly stalks of *tur* and other pulses, were a rich source of free fuel for the poor, the area under which has been declining.

The same phenomenon has affected fodder too. The biomass budget for fodder in Karnataka showed a grave scarcity, the demand unfulfilled from cultivation being 71 per cent (Gadgil and Sinha, 1986, pp. 24 and 27). The State has much more livestock population than its resources could permit, with a large proportion being under-fed and left to take care of themselves through free grazing. But this grazing has not been really free, even apart from the costs imposed on forests through over-exploitation. This has increased the cost of protection of farms by way of expenses incurred on fencing and even discouraged double cropping.[10] There is also a cost in terms of loss of dung and energy in the process of free grazing. Yet, the vicious circle of scarcity of fodder and free grazing has been difficult to break, made worse by the fact that the traditional institutional arrangements for taking care of common property resources (CPRs) like pastures broke down and much of this land was privatised and brought under cultivation.[11] Basically, the loss of land under CPRs, made it difficult to have rotational grazing and regeneration when very little land was left for grazing or none at all.[12] We may also incidentally note that a large proportion of our livestock are

10. Since the fodder supply is generally comfortable in the wet season, the livestock are tied and stall-fed in this season. Moreover, since more remunerative crops are grown in this season, the farmers are extra vigilant and take care to fence the fields where necessary. These fences however cannot generally last throughout the year. Even where the moisture retained in the soil was enough to raise a second crop like groundnut after taking paddy in the first season, uncontrolled grazing came in the way. The farmers themselves told this to the author in the course of field work in Shimoga district of Karnataka.

11. "The area of CPRs has declined mainly because more and more land has been given to private ownership. Under land reform programmes and other welfare schemes, considerable area of CPRs has been converted into private property and has been distributed to individuals. Besides, the unchecked illegal grabbing of CPR lands for private use has reduced the area of CPRs" (Jodha, 1985, p. 268).

12. Area under pastures and other grazing lands declined in India from 14 million hectares in 1960-61 to 12 million hectares in 1980-81 (Government of India, 1985 *a*). The loss in area may not look substantial, but it has also been accompanied with a significant decline in the productivity of area that has remained.

possessed by the well-to-do and not by the poor, and the latter cannot be considered as an obstacle in evolving proper institutional arrangements for regulating free grazing.

Extension of area under cultivation has been the most significant factor behind the decline in forest area (apart from the decline of tree cover in areas designated as forest areas, due to industrial demand). Once the forest areas are grazed and depleted of trees, either they are left barren and are uncared for, or they come under the plough. It may be recalled that extension of cultivated area was the main source of increase in agricultural production at least upto the mid-sixties. Much of this occurred at the expense of forests. Of the total area lost to forests between 1951-52 and 1975-76, *i.e.*, out of 4.14 million hectares, 2.51 million hectares were lost due to extension of cultivation alone (Tiwari, 1986, pp. 141-142). All this, however, could not have occurred only due to 'encroachment' on the initiative of the poor. Failure of the non-agricultural sector in providing adequate employment opportunities and relieving the pressure on land, and failure also in imposing ceilings on large holdings and obtaining adequate surplus area for redistribution, led the politicians to seek an easy way out—to meet the land hunger at the expense of forests and other CPRs. Though the importance of extension of cultivation as a source of growth of production has declined, its socio-political significance in meeting land hunger has hardly declined even now. Even hill slopes have not been spared in this process, adding considerably to the problems of soil erosion.[13]

The interesting point to note here is that these 'gifts' to the poor did not come at the expense of the rich, but of the poor themselves. The decline of CPRs and forests hit the poor themselves the hardest, by diminishing their fuel and fodder resources, and decreasing the productivity of agriculture. If we can think of a curve showing the marginal cost imposed on the society thus by successive acres of forest land brought under cultivation, it would surely be rising sharply. Even if a curve showing the marginal benefit derived by these successive acres were to be constant, the marginal cost curve would have crossed the benefit curve long ago, being far above it now.

Besides, all this area may not really have gone to the poor. For example, there have been allegations in Karnataka that most of the forest area was encroached upon by rich farmers and coffee planters, and not by the landless labour, because landless labour just did not have the political power to defy forest authorities and get their encroachments regularised. The illegal confiscation of common property lands was also by the influential people in the villages, and this was possible only because of relaxation of restrictions by the State on such activity (Jodha, 1985, p. 275). If this is true, the area lost to forests due to encroachments would be under the first pattern described above, since even here, the agents of degradation are basi-

13. Ninan (1986) observed in the course of his field investigation for the study of economics of tapioca cultivation that the cultivation of this crop on hill slopes adversely affected productivity of paddy down the hills. Cultivation of root crops like potato and tapioca at the expense of forests has had many adverse side-effects.

cally the rich themselves. It is populism more than poverty alleviation which has led to ecological degradation.

The discussion in this section leads to the conclusion that we cannot take for granted that we can ignore ecological degradation in the interest of poverty alleviation. Any project evaluation must include not only ecological costs, but these costs should also be given further weightage in terms of distributional implications. That is, project benefits and costs should be weighed in terms of social values given to welfare or income gains/losses accruing to different economic classes involved. Obviously, welfare or income loss to the poor cannot be taken as being offset by the income gain to the rich, even if the latter far exceeds the former. The project has necessarily to have built-in safeguards to prevent welfare loss to the former, or to compensate adequately for the same if such losses are inevitable. It is a challenging task for any project evaluator to do justice to this need, and at the same time be careful enough not to miss a development opportunity. The dilemma could particularly become difficult, where gains of a development strategy or project are expected to make a significant impact in terms of removing hunger and reducing poverty in the larger economy, whereas its losses are either borne by the local poor or passed on to future generations. Since agricultural production is expected to remove hunger and reduce poverty, such a dilemma could be relevant to certain development strategies adopted here, and needs to be probed into.

Agricultural Development vs. Ecology ?

There is a fairly strong empirical support now to the contention that agricultural development, at least in India, has contributed to the reduction of rural poverty. Significantly, agricultural development is taken here as measured in terms of net domestic product generated from agriculture per rural person at constant prices, and not just in terms of availability of food (see Ahluwalia, 1978, p. 39; and Dharm Narain's work as presented by Mellor and Desai, 1986, p. 3). Dharm Narain's work also showed that a rise in the price of foodgrains can wipe out the effect of improvement in agricultural income on poverty. An increase in foodgrain production can prevent prices from rising, unless they are artificially jacked up. Thus, agricultural development, in so far as it improves the purchasing power of the poor, has a powerful influence on reducing poverty. Though poverty has hardly disappeared,[14] its level even in terms of brute hunger would have been immensely higher in the absence of breakthroughs in foodgrain output achieved by HYVs. Politically also, agricultural development, through a substantial improvement in foodgrains production, has made the nation self-reliant in a very important sphere, and has helped us to consolidate our Inde-

14. This could be partly attributed to the increase in per capita agricultural income itself not being significant enough. "There was very little growth to percolate." The higher incidence of poverty in some regions was also associated with lower rates of increase in agricultural incomes per capita and low rate of increase in the production of coarse cereals consumed by the poor (see Parthasarathy, 1987, p. 5).

pendence. It appears, therefore, that the gains of agricultural development, even in terms of distributional considerations, have been significant enough to justify the emphasis placed on quick ways of increasing production. One could take a stand (as did Kusum Nair, 1983) that instead of a strategy based on modern inputs, if more emphasis was placed on an alternative strategy of relying on traditional labour intensive practices to improve productivity like using more organic manure including compost of human excreta, it would have been more effective in removing hunger and poverty and also in realising higher yields. It is also claimed that traditional practices are environmentally sound too, besides ensuring high yields.[15]

But, could we take for granted that whatever was traditional and old was ecologically sound ? Is it not possible to identify conflict areas between agricultural development and ecology and avoid the ecological costs, yet making use of both traditional wisdom and modern science in a synergetic fashion ? That is, instead of thinking of selecting either the traditional or the 'modern' in mutually exclusive terms, the strategy could be one of eco-development, which combines resource development with growth of income and removal of poverty on a sustainable basis.

Just as there was a lot that was environmentally sound in old practices, there was a lot which was unsound too. We have to identify and rediscover old practices which were based on the principle of sustainability, and discard or modify practices which could not care for this principle either because of scarcity created by the larger economy or because of the inequity of the rural social structure. Free grazing of livestock, cultivation of hill slopes regardless of soil conservation, heavy lopping of forest trees for manuring private gardens, setting fire to forests to generate grass for grazing cattle and protect them from carnivores, these and other such old practices had created quite a headache to conservationists even in the past. Similarly, the old feudal and semi-feudal institutions were hardly more environmentally oriented than peasant capitalism or even capitalist farming. Land tenure on short-term lease under absentee landlords, for example, did not enable a tenant to have a long-term stake in land or in planting trees there. Similarly, small and fragmented holdings were not conducive to proper land and water management which required a larger area as a unit of development and needed co-operation of all farmers. But such a co-operation was a problem in a highly unequal society. These problems still remain as obstacles to eco-development, and have to be solved as part of any strategy of agricultural development.

The main reason why the old practices even to the extent that they were sound are being replaced by the new strategy based on modern inputs from the market, is that commercialisation is the driving force behind agricultural development now. The rise of cash economy in most of the rural transactions and the gradual replacement of subsistence agriculture by com-

15. See, for example, the claim, that peasant farming in traditional agriculture gave as much importance to yields as to the conservation and enrichment of soil fertility in a long-term perspective (Krishna Murti, 1986, p. 525).

mercial agriculture have changed rural attitudes towards resource use and their management, making them more individualistic and less communitarian. Maximisation decisions take place at the household level, and hardly at the community level. The promotion of HYVs increased the importance of private control over resources. Such a trend was not favourable for environmental care, since it needed a communitarian ethos. Commercialisation also tends to discourage the decision-maker in taking a total view of his production particularly if positive externalities and by-products are enjoyed by others outside the market framework. For example, while making a choice regarding HYV vis-a-vis traditional varieties, the decision-maker may concentrate only on the cash income expected and requirements of self-consumption, disregarding the by-products in the form of straw and stalks which he was giving away free to others. Separate fodder crops may be raised on a commercial basis, but not as a free good. Secondly, the rise of individualism also reoriented attitudes to short-term from long-term interests. Technologies which made high short-term gains possible were preferred to those which mainly promoted long-term sustainability. Thirdly, commercialisation of labour too was a part of this process, taking place through expropriation of tenants and increased use of hired labour. In the old societies, availability of cheap or almost free labour commandeered by feudal lords made labour intensive practices economical right up to the point of zero marginal product. Even if productivity per unit of land could be stepped up thereby, such intensity of labour use could no longer be possible in a commercialised setting. Today, even small farms have to hire labour, which is economical because the marginal product of labour itself was shifted up through the use of modern inputs. But even environmentally sound old practices of high labour intensity could not be continued where the immediate marginal return to the farmer fell short of the wage rate, even if the marginal return to the society or even to the farmer himself in the long run was higher.

This indeed is the crux of the economic problem in dealing with environmental issues. In a commercialised setting, how do we encourage resource use practices that involve lower personal and immediate return than the cost involved, though social and/or long-term return could be higher; and discourage practices that involve lower personal costs compared to returns, though social and/or long-term costs may be higher? The problem is the same in soil erosion, free grazing, waterlogging and over-exploitation of forests. If the forces of commercialisation could be compared to a horse, the solution to the problem is neither to kill it and go back to old days, an impossible romanticist dream, nor to ride it untrammelled. The horse has to be tamed and kept well within control to see that it goes in socially desirable directions. Commercialisation does meet a social purpose, by advancing the forces of production and making it possible to have more goods than before even for the poor. No country has been able to ban or eliminate it, even in the socialist block. It could, however, be controlled and directed to some extent, depending on political will.

First of all, policy makers at least need to have a total view of development. That is, at some stage at least they should go beyond sectoral perspectives and take a look at side-effects, positive and negative, and implications of sectoral developments for resource demand. For example, a rural development strategy could have a major shortcoming if it promotes, on the one hand, activities which reduce the supply of fodder (*e.g.*, HYVs and extension of cultivation at the expense of CPRs), and on the other hand, activities which increase the demand for the same (*e.g.*, giving more loans for livestock rearing). Obviously, a total view is not simply one of aggregating sectoral outlays and matching them with financial resources. It is one of identifying real resource effects and constraints in terms of an inter-sectoral perspective and incorporating all the three dimensions of environmental concerns discussed above. Once this is done, the next stage is to tame and bend commercial and private decisions to accord with social preferences.

This could be done through a combination of economic, institutional and technological measures and innovations. An economic solution within the market framework is to equalise private costs with social costs through taxes, and private returns with social returns through subsidies. Unfortunately, not much attention is given to this possibility in India in the field of agriculture. These economic incentives have to be decided with care, taking into account the fact that economic decisions at the micro level of private producers take place in terms of values at the margin. For example, even if a lump sum water charge based on acreage reflects social cost at the required level of water use, water can nevertheless be wasted since the marginal cost of water to the user here is zero. Penal taxes can be levied on lands that are left in erosion-prone or eroded state. Even if land is scarce from the point of view of society, it may not appear so for large holdings which tend to leave large part of their land mis- or under-utilised (Nadkarni and Deshpande, 1979; Nadkarni, 1985, pp. 172-176).

Economic incentives have to be in a proper institutional setting to ensure the achievement of the objectives. For example, soil and water conservation measures as a part of watershed management cannot be achieved merely through cash subsidies to individual farmers. The state itself and co-operatives of farmers would have to tackle this job on a cost and benefit sharing basis. Preventing farmers from free grazing in areas demarcated for generation of fodder and fuel trees would have to ensure first that there is in the meanwhile some alternative area for them for grazing their livestock, and secondly a fair and equitable share in the benefits of tree growing in lands on which they have had traditional rights of use.

All solutions cannot and need not be within a market framework. For example, dangerous pesticides which are banned in other countries can be banned here as well, instead of discouraging their use through higher prices. Institutions have to be evolved, drawing from the past as well as suited to the present, which ensure that public goods needed for community welfare and for the sustenance of the poor are managed and allowed to develop. Insti-

tutional innovations are particularly necessary in preserving genetic diversity. The risk of traditional varieties becoming almost extinct is always inherent in any promotion of HYVs. Gene banks may not give the expected results and face grave risks of loss.[16] We have also to explore the possibilities of *in situ* conservation of genes, which would require a planned and cautious promotion of HYVs in a way that some area at least continues to be under different traditional varieties under expert supervision.[17] Otherwise, we may be foreclosing future opportunities of evolving new varieties.

Technological breakthroughs in environmentally sound directions have been taking place in resisting pests and fertilising soils. Economic incentives may have a role in inducing farmers in adoptiag them, but it is more likely that these breakthroughs may actually reduce even private costs provided that we constantly learn from the farmers' own innovations and experiences and do not allow multinationals to monopolise here. For example, a change from mono-cropping to a cropping system and rotations that involve some nitrogen fixing crops have traditionally achieved this objective. Even nitrogen fixing fodder trees can be planted in fields in a way that conserve moisture too. For rediscovering desirable traditional practices that are growth promoting as well as cost and risk reducing, scientific research and a proper institutional back up would be needed. Technological advance even in agriculture need not be purely exogenous. Since environmental degradation and improvement are not purely physical processes but also socio-economic in nature, it is necessary to identify and promote socio-economic institutions and incentives that favour right technologies and reject undesirable ones. This can reduce the gap between social and private costs/returns and economic development can be placed on a sound footing. This will depend however on whether human/ecological concerns ride over the forces of commercialisation, or on the contrary, we allow these forces themselves to ride over human concerns. Economists can play an important role by showing how the society can increase its capacity to ride over these forces consistent with human concerns.

In the course of this paper so far, several research issues and areas have been identified in the context of specific examples which need further attention of agricultural economists. We can briefly recapture them in general terms now: The problem of pricing *in situ* natural resources, particularly land and water, and planning their optimal and equitable use; principles for paying

16. Even in developed countries, "from half to two-thirds of accession brought in over several decades have been lost. Enormous losses of valuable material have taken place in past collections and are continuing. The principal causes are the lack of organisation and continuity in research programmes, contamination in the case of cross-breeding species, and the lack of resources (staff, funds and facilities) to enable effective conservation to be achieved." Power failures and equipment breakdown at gene banks have also been contributing factors. "In some cases even the log books were lost, leaving genetists to wonder exactly what they were missing" (Mooney, 1983, p. 76).

17. "Very tiny plots of land and very little money would be required to work with villagers and individual farmers to turn them into farmer/curators protecting local land-races. The costs could be a small portion of the costs of transporting and preserving seed overseas (in gene banks) .... We do not propose the farmer/curator system as an alternative to gene banks for land-races, but as an addition. Governments are not good at saving for eternity" (Mooney, 1983, pp. 168-169).

compensation and giving incentives where negative and positive side-effects respectively are expected; principles for selection of a proper rate of discounting the future; planning development strategies with a total rather than a partial or sectoral perspective and incorporating the three dimensions of environmental concern discussed above; developing techniques of appraisal of alternative projects, technologies and institutions for rural development that reflect the human/environmental concerns; identifying and rediscovering desirable traditional practices and assessing their present relevance; identifying socio-economic incentives and other measures which satisfy these concerns. These general issues could be applied to particular problems like degradation of land, both cultivated and uncultivated, which could well be considered as the single most important form of environmental degradation in India deserving more attention than even air and water pollution. Agricultural economists have not given adequate attention to it as they have given to economics of crop production. The role of property rights and land tenure systems in soil erosion, the nature of institutional and economic constraints in reversing land degradation and social economics of alternative land use and technologies are some of the critical areas of research which need our urgent attention.

There are indeed limits to what economic analysis or economists can do. Value judgements are always inherent in project formulations and appraisals which are a political job. Similarly, all dilemmas of decision-making cannot be resolved in terms only of economic analysis. Rival interest groups cannot always settle issues equitably; nor can the state be taken for granted as an impartial arbiter. Often populist measures may be taken to appease the poor, which bring no long run benefits to them. In environment issues particularly, the future generations are not here today to plead their case. Yet, there have been people's movements in many countries including India in favour of human/environmental concerns. They are a source of optimism as they can provide the needed political counterweights against unbridled commercialism. In this context, the state has been increasingly expecting economists to show how it could tame the forces of commercialisation consistent with these concerns without curbing economic advance. In spite of their limitations, economists will thus continue to have an important role to play. Economics has been a dynamic science which has shown its capacity to address itself to new issues and problems, though the new issues and problems are also becoming more and more complex.

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