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SUSTAINABLE AGRICULTURE*

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After Independenee a key priority for India was attainment of self-sufficiency in foodgrains production and emphasis was, therefore, placed on agricultural development to achieve this aim. During the 1960s, the high yielding varieties of wheat and, to a lesser extent, of paddy enabled significant increases in production and productivity in irrigated areas, ushering in the green revolution. Thus, we could overcome the ship-to mouth situation characterising the food position for many years. Concerted efforts by the farmers, scientists, extension workers, planners and others had led to the achlevement of self-sufficiency in food.

During the last four decades, the country has more than tripled the foodgrains production, from 52 million tonnes to an estimated 176 m. t. this year. However, it is to be noted that the People's Republic of China has achieved noticeably better output and yields.

Further, our agricultural growth has created disparities not only between regions but aiso with respect to production and productivity of different crops/crop groups (cereals, pulses and oilseeds) as also between various sections of the farming community.

Since the country's population has been growing at 2.2 percent per annum and per capita income has also risen, the demand for foodgrains shows a noticeable upward trend. The per capita consumption of rice has risen from 158.9 gms. to 217.3 gms. per day between 1951 and 1989. However, per capita wheat consumption has risen at a higher rate—from

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60.7 gms. per day in 1951 to 157 gms. in 1989. But it is a matter of concern that the availability of pulses has fallen sharply to 40 gms. per day in 1989 from 60 gms. in 1951. In terms of total calories, against an intake of 2,694 per capita per day at the global level and 2,484 calories in Asia, our intake is only about 2,204 calories. This gap in nutritional requirement is to be filled through a balanced diet. The planners & administrators feel that for ensuring adequate availability of food and other agricultural commodities there has to be a substantial step-up in production during the coming years, particularly since achieving a better quality of life will create additional demand pressures.

However, the country cannot afford to lose sight of the basic necessity of not only increasing the output and quality of food and non-food crops, but also of sustaining their levels along a rising growth locus. And, more importantly, the resource base in agriculture should continue to be restored. conserved and upgraded. The questions arise—what should he done to have sustainable agriculture in the long-run? And what has been thei n the past? To take the second question first, we may examine the adverse impact of our otherwise well-conceived endeavours, in general.

In our efforts to increase the foodgrains output, land and soil resources have been subject to great stress and inappropriate land use has resulted in soil degradation—soil erosion, salinity and alkalinity, shifting cultivation, and nutrient losses. Nearly 170 m ha area is affected by these maladies. It is also estimated that 6,000 million tonnes of soil containing about 8.4 mt of plant nutrients are lost annually through erosion. Salt-affected and waterlogged areas account for approximately 7 mha and 5 mha, respectively, which means that valuable land with irrigation potential is lost.

With emphasis on quick results that have the certainty of being achieved, regions of difficult resource and production conditions have been neglected leading to inter-regional imbalances. During 1962/65 to 1980/83, the share in incremental value of output for the North West region is estimated at 53% of India's total, with annual value productivity growth of 3.3%. This has been accompanied by the problems of resource depletion (e.g. of groundwater) and the increasing rate of land degradation (e.g. salinity) in this prosperous region. Conversely, the Eastern region's share in the incremental value of output is put at 7.65% only, with production growth rate of a mere 0.07%. Degraded soils, ill-drained fields, shifting cultivation, and salinity constitute serious causes of low or declining productivity, and raise serious concerns regarding sustainable agriculture.

Sustainability as an issue of inter-generational equity involves restoration and conservation of resources. The somewhat exploitive approach for enhancing foodgrains production under favourable conditions has not provided much support to the resource conditions for growth. This has obviously resulted in inter-regional and inter-generational equity problems—in terms of welfare considerations and sustainability.

Added to the above set of issues is the 'externality' dimension in land and water development added by the inexorable and lopsided pace of industrial and urban development which has led to a sizeable reduction in fertile lands and deterioration in the quality of water. In other words, agricultural development experience over the past 40 years exhibits little, or at best only limited, concern for the above issues confronting long-term sustainability and economic viability of Indian agriculture.

Agro-Climatic Regional Planning (ACRP) Approach for Sustainable Agriculture

One could list features of agricultural development with sustainability as follows:

First, development must be relevant to, and in tune with, the resources available both in the short and long run perspectives. The causal relationship must be *from resources to development* and not vice versa.

Second, resource use must be expansionary and growth-oriented, through use optimization. There should be a systems approach under which all crops, livestock and related activities are integrated to maximise output/employment subject to the condition that resource levels are not depleted. The complementarity between activities, resource use and technologies must be exploited.

Third, since farming system is resource-based and resources are region-specific, strategies should be relevant to the regional conditions of resources and production. This would give rise to designing of *regionally differentiated strategies* if they were to be relevant and realistic.

Finally, problem solutions and operational strategies, besides being location-specific, should be evolved on the basis of *participatory planning*, leading to local solutions. This is extremely important for motivating local people and agencies to work towards sustainable agriculture.

Given this paradigm of sustainable agriculture, one could see *strong correspondence between these axioms and the goals of agro-climatic regional planning* which is done at a decentralised levels; such planning is resource-oriented and its objective is integrated development of a region

with emphasis on resource conservation. Thus, it could well be called agro-climatic regional planning for sustainable agriculture.

Thrust Areas of ACRP

The Planning Commission initiated work on Agro-climatic Regional Planning (ACRP) in 1988, dividing the country into 15 zones, with Vice Chancellor of a State Agricultural University (SAU) in the zone acting as Chairman. The Director of the Agro-economic Research Centre in the region usually works as the Secretary of the Zonal Planning Team (ZPT). The uəqt Member (Agriculture) in the Planning Commission—Prof. Yoginder K. Alagh—was the moving spirit behind the project and he ably developed the ideas and provided excellent leadership until end 1989.

Agro-climatic Regional Planning is a departure ftom the earlier exercises of macro and sectoral planning. It starts from assessment of basic resources such as land and water, their quality and quantum of availability and potential for improvements and, based on this, development plans are drawn up which require spatially disaggregated approach. State and national plans are then prepared by aggregation, Notably, the focus of ACRP is on developing regionally-differentiated, location-specific development strategies which seek to maximize the use of land and water resources and to reduce inter-regional imbalances through investment and development efforts. In addition, it may be noted that the strategies are based on inter-related activities such as crops, livestock, horticulture and forestry as a conscious effort of *farming systems analysis*. It helps towards satisfying the productive efficiency criterion as the key to agricultural development.

In essence, sustainability considerations are implicit in ACRP. Sustainability as a macro concept has no meaningful import except as a general policy guide. For making it practical, the ACRP fits the bill through its stress on regionally differentiated strategies which are oriented towards achieving a balance between productivity improvement and resource conservation strategy at spatially disaggregated levels.

The work under the ACRP has not only contributed towards evolving more appropriate resource-use strategics but also towards identifyng projects of local/regional relevance and importance. Based on the zonal profiles and an assessment of growth problems and opportunities made by the Zonal Planning Teams, strategies for each sub-zone have been prepared and these provide technical inputs for drawing up agricultural schemes for the State under the VIII Five Year Plan. Interactive linkages between ZPTs and State Planning/Development agencies, and in the

process involvement of State Agricultural Universities and Non.Governmental Organisations, have served the ACRP approach in identifying development interventions which are basically relevant to regional needs and potential and acceptable to planners who believe in agricultural development in a sustainable framework.

Under this approach, a *district level exercise* is now being initiated to develop district level strategies using ACRP as the focus. Initially, two districts are being taken up in each Agro-climatic Zone for this purpose.

The other aspects of the ACRP work worth noting are a set of special studies on land and water resource management, livestock and fodder development, pasture development, critical area (e.g. desert) development strategy, fishery development with emphasis on inland and brackish water fisheries, horticultural production and agro-processing. Models for ACRP have been tested at the sub-regional as well as State levels. As a supportive system, an Information System has been built at Agricultural Regional Planning Unit (ARPU), Ahmedabad, to service the needs of ZPTs, the Planning Commission and other agencies.

ACRP exercises have made a significant contribution in identifying thrust areas for the VIII and longer term Plans which otherwise may have escaped attention or masked in macro level planning. It is not that the problems are new as they have often been discussed in national forums. But what is important is the perspective of such problems and the freshness in perceiving them in the context of ground truth and their socio-economic ramifications. Thus, the concept of watershed is not new but its design with resource upgradation and sustainability acquires a new and very relevant dimension. Wasteland development is not merely adding to the existing stock of land but comprises the strategy for utilization of such restored lands for arid horticulture, silvi-pasture, silvi-agronomy and other uses. Similarly, livestock development with fodder and health care support is integrated with overall resource utilization.

ACRP strategies are finding their reflection in VIII Plan documents of the various States, and this integration is significant in making the ACRP a timely, relevant and practical exercise. The strategies are based on the need for maximum efficiency in resource use in the long term setting of sustainable agriculture. It has reversed the process from 'development plans and needed resource support' to *resource endowment with strategies for optimum use.*

Development strategies with the above focus have been worked out by the ZPTs for all 15 Agro-climatic Zones (ACZs) and 73 sub-zones. ARPU/ZPTs have also prepared Statewise development strategies and VIII Plan programmes for majority of the States using ACRP as the basis.

A wide range of issues and approaches to implementation have been brought out in these exercises. In the following paragraphs two case illustrations are provided which serve the twin purposes of showing the output of the ACRP exercise and of demonstrating how long-term considerations of sustainable agriculture form an integral part of ACRP.

Case Studies

(i) *Himalayan Region with Low Level of Development and Large Problem-soil Areas (Zone 2)*

This Eastern Himalayan Zone represents a diversified region in terms of geographical and climatic conditions. The altitude ranges from about 100 m to 5,000 m and the climate, from tropical to Alpine. Large river basins, a considerable forest area and barren lands leave a relatively small area for cultivation. The natural endowments of land, water and the prevailing ecological balance need to be used with great care for sustainable agriculture.

This large zone of 8 States and 3 districts of West Bengal having geographical area of 27.5 million ha, with density of 125 persons/sq. km., has just 18.7% cropped area, and nearly 77% area in the hills. Nearly 44% area has a slope of over 600 m. Farming systems include both settled farming and shifiting cultivation. Because of steep slopes, erosion of soil is heavy and degradation very rapid. In plains, frequent and flash foods usually affect nearly 11% of the population and render large areas flood-prone. Sustenance agriculture with high cereal-based (96%) cropping characterises this region. Non-descript livestock of low productivity puts heavy pressure on land (3.2 animals/ha of cropped area). On the other hand, climatic conditions favour development of high value horticulture and tea.

Sustainable agricultural development of this region needs appropriate corrective measures as under:

— Land use considering the slope; better land management/control of shifting cultivation
— Increase in the irrigation potential
— Evolution of suitable genotypes for high elevation and low temperatures; developing crop varieties suitable for low photo period, and short duration (late planting) paddy variety for flood-prone areas
— Organisation of production and marketing complexes in view of the transportation constraints, and

— Adoption of farming system in an integrated manner for crops and livestock; supporting activities of sericulture and agro-processing to promote income and employment.

The rationale to be followed in this region for growing crops and for sustained productivity of land should be—crop husbandry upto 10% slope; land having 10 to 30% slope to be used for horticulture/fodder development; and all lands above 30% slope to be brought under tree cover, Jhum (shifting) cultivation needs to be restricted and permanent settlement encouraged by setting up production complexes demonstrating farming system packages.

Obviously, this zone is too diverse to be amenable to a single set of measures. The most abundant natural resource, i.e. rainfall cannot be harnessed and often poses a natural hazard. Land tenure system is age-old and not compatible with modern agriculture. Maintaining fragile eco balance and appropriate land use system are probably the two most important considerations for sustainable agriculture in this zone.

(*ii*) *Arid Zone* (*Zone 14*)

This zone (Western Dry Region) is a classic example of an area which needs restoration of natural resources and at the same time maximisation of agricultural output.

The nine districts of western Rajasthan having a geographical area of 17.6 million ha and population density of 58 persons per sq. km., account for 44.5% of net sown area, 1.6% of forest, 4.3% of grasslands and 26.3% of culturable waste. Very low rainfall (395 mm), high inter-year variability, high inter-seasonal instability and uncertainty of commencement and recedence of rainfall make crop husbandry an uncertain economic activity. A livestock population of around 19 million heads, comprising about 14 million of sheep and goats in almost equal proportion, puts heavy pressure on land—2.36 animals/ha of gross cultivated area, leaving a large deficiency (92 lakh tonnes/annum) in fodder.

The eco-system is fragile and climate harsh for both people and animals. Any further degradation of the ecological system would be disastrous. The livestock and crop systems shall have to play a mutually complementary role. Desertification hazards are very high and nearly 75% of the area has sand and sand dunes, leaving only a limited scope for success of crop husbandry. Even livestock cannot provide employment to large segments of the population unless tbe carrying capacity of land is enhanced. This calls for measures to stabilise sand dunes, afforestation. silvi-pastoral system, pasture development, and arid horticulture

development.

The land use pattern should give priority to pasture development and grazing lands, because raising livestock is the main economic activity of this arid region. A large forest area to check ecological degradation, expansion of soil cover to check soil erosion, and increased production of top feed trees for livestock should assume priority.

Some of the programmes appropriate for sustainable agriculture are indicated below:

- Improving production of grasses in pasture lands through seeding (aerial as well as manual) so as to cover about 2 lakh ha. This should increase productivity of grasses from 4 qtls/ha to about 10 qtls/ha. It will also help to conserve and maintain the limited arable area.
- Raising productivity of cows through better breeding technology, covering about 1.62 lakh cows. The milk yield should increase from about 1,000 lit/animal to 1,500 lit/animal.
- Enhancing productivity of sheep for fine quality wool by reducing mortality and increasing the cross-bred population.
- Increasing forest area by planting time-tested Khejri trees (about 10 million) to augment fuelwood and fodder supplies, and check soil erosion.
- Putting larger area under arid fruit production.
- Using saline water for irrigation through conjunctive use of ground and surface irrigation. The use of water saving devices like sprinklers and drip systems has to be increased (about 4000 sets).

Summary and Suggestions Based on ACRP Work

The above two studies clearly show that agricultural growth in a sustainable framework can be achieved through appropriate combination of a two-pronged strategy, i e. productivity improvement and resource conservation. The important consideration is that the strategies have to be specific to the region's potential and problems, and should strike an appropriate balance between the objective of maximization of short run output and fulfilment of the long term goal of sustainability in the sense that posterity is not poorer in terms of the resources they inherit from the present generation.

As a part of the Agro-climatic Regional Planning exercise, four broad strategies have been identified for the country for achieving these objectives :

1. Productivity improvement of existing crop/non-crop sectors

2. Cropping pattern changes/diversification
3. Resource conservation/management
4. Farming Systems approach, i.e. integrated development of crop and non-crop enterprises.

A summary view of the strategies under the third category and their relevance to various zones/sub-zones is given below :

SUGGESTIONS FOR SUSTAINING AGRICULTURAL GROWTH THROUGH RESOURCE CONSERVATION IN DIFFERENT ZONES OF INDIA

Strategy	*Applicable to*	
	Zone	*Sub-zones*
(i) *Related to land*		
— Soil Conservation	1	(2)(3)
	2	(2)(3)
	7	(1)(2)(3)
	8	(3)(4)(5)
	14	all
	15	all
—Correction of problem soils (Usar, Pokhali, Chaur, Tal, Acidic)	2	(4)(5)
	4	(5)(6)
	5	(2)(3)
	7	(1)(2)
	11	(2)(3)
	12	(1)(2)
—Wasteland Development	8	(2)(8)(10)(13)
	11	(3)(4)(6)
	13	(5)
—Rational land use in ecologically fragile regions	1	all
	2	(1)(2)(3)
	7	(5)
	8	(2)(3)(6)
	12	(1)(4)
	15	all
(ii) *Related to water*		
—Water management/drainage	3	(3)(4)
	4	(3)
	5	(2)(3)
	6	(2)(3)
	11	(1)(2)
	13	(2)
—Minor irrigation (tank development)	7	(1)(2)(5)
	11	(2)(4)(6)
—Ground water development	3	(1)(4)
	4	(1)(2)
	7	(1)(2)(5)
	8	(3)(7)(8)(9)(10)

—Controling mining of ground water	6	(2)(3)
	13	(4)
—Rain water harvesting	7	all
	8	(3)(4)(5)(6)
	10	(1)(2)(3)
—Flood control	2	(4)(5)
	3	(1)(2)
	4	(5)(6)
	5	(1)
	6	(2)

Need for Increased Awareness about Environment in General

While specific policies and programmes suggested above—directly or by implication—would contribute significantly towards attaining sustainable agriculture, greater awareness about environment is of paramount importance, especially in the long-run context. Increased consciousness will have to be fostered at all levels—the village, block/mandal, district, State and the nation, as well as at the regional and global levels.

In India, oneness of man and his external world (environment, in currcnt terminology) used to be an integral part of prevailing ethos and culture, and embedded in religious consciousness. But historical factors weakened the understanding, and discontinuity occurred in this symbolic bond between mankind and nature. Hence, the need has arisen to restore the original consciousness and to build upon it. During recent years, a fair amount of work has been done in India to create awareness about the harm caused to the environment and the ways in which the damage could be checked and steps taken to conserve our natural resources. However. these afforts have fallen far short of what needs to be done.

A *World Charter for Nature* was signed by Member States of the United Nations in October, 1982. India is a signatory to the Charter; Dr. M. S. Swaminathan—an internationally renowned scientist—in his address said that India's approach to conservation, management and utilisation of natural resources for sustainable development should be based on the World Charter.

The Planning Commission has highlighted the importance of environment and sustained development in the formulation of the Eighth Five Year Plan A Steering Group for Environment, Forests, Wildlife and Wasteland Development, constituted earlier by the Commission, was of the opinion that the exercise of building a Charter for Nature ought to be initiated at the level of the village itself to be realistic and useful.

Without such realism characterising national planning, talk of a World Charter for Nature will have little meaning. Therefore, the Steering Group set up a Task Force under Dr. S. N. Dwivedi—a leading expert on fisheries and coastal areas management—to prepare a Resource Book. The Task Force recently came out with a very good publication—Charter for Nature; which provides resource material and an overview of basic components like air, water, soil, plant genetic resources, forests, animal genetic resources, fish germplasm, and marine environment to help the teachers guide school children in preparing a village level charter. Such exercises at the grassroots level are bound to foster consciousness in school children and others about nature and the need for conservation and long-term sustainability.

In developing school curricula as well as concepts of environment education for adults, we need ideas and examples based on our own conditions at local, regional and national levels. Since the programmes of environmental awareness and formal education in this field are rather recent in the developing countries, many of the coneepts have been borrowed wholesale from the Western countries. The desirability of indianisation of concepts and communication techniques, and basing these on local patterns and structure of resource endowment and utilisation, can hardly be overstressed.

Although compaigns by government and many non-governmental agencies (NGOs) have succeeded in creating noticeable public awareness on environmental issues, it appears that the public perception is related more to negative aspects, that is awareness about what has gone wrong and the damage caused to the eco-system, and less to positive aspects, i.e. what can be done to correct the situation through curative and preventive measures. So, what is required is an action-oriented environmental movement; otherwise, surface awareness and prophesies of doom, besides lacking social relevance, can lead to despondency and an apathetic attitude towards the whole issue.

Also, educational and informative programmes should be based on a fuller understanding of the various components of our environment, their inter-relationships, the delicate, overall balance in nature, and how nature sustains life. Life and environment have to be seen as inter-dependent. Relating environmental issues to the day-to-day life alone can carry the message home and impart realism. Conservation should become a way of life, ingrained in personal habits and values of conduct and ethics.

In creating awareness about environment, we ought to work towards recovering our past values and heritage, and exploit the mythic conscio-

usness of people in relation to conservation of nature. In India's old legends, fables, and stories, for example, rivers, forests mountains and even animals are treated as sacred and their preservation considered holy. The revival of these values would serve as modes of awareness and technologies of communication of information which should, of course, be updated in the light of latest scientific knowledge, prevailing resource conditions and long-term requirements of a sound eco-system.

Awareness based on such broad-based understanding of the issues can be expected to lead to a reversal of the process of reduction of the ecosphere (natural environment) and of expansion in inappropriate ways of the technosphere (the technological environment); the extent of shrinkage of the former is making it increasingly difficult to maintain a balance of natural resources that can sustain development.

The significance of awareness of environmental depredation was brought into sharp focus at a recent conference of non-governmental organisations held under the auspices of the Economic and Social Commission for Asia and Pacific (ESCAP) of the United Nations at Bangkok. There, leading international scientists and activists deliberated on a "code of conduct for human beings in their attitude towards nature and natural resources." At the end of the conference, a statement was adopted, the preamble of which read : "Aware that the development and environment are inextricably linked, and that decisions about development and environment cannot be separated, decision making processes must take into consideration the needs of future generations". The statement listed five action points for national governments in the the region, of which timely access to reliable environmental data and training in communicating such knowledge and information on a national and regional (South-South and South-North) basis constituted a key item.

The objective now is to instill further in people a sense of responsibility towards nature so that future generations do not suffer. As the motto of the Germany's Greens Party sums up "We have only borrowed the earth from our children".