Sustainable Defined

The World Conservation Strategy of 1980 has defined the concept of sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet them” (SCOPE, 1990). According to a study on agricultural development by Dover & Talbot for the World Resources Institute, sustainability includes (1) the need to minimize dependence on nonrenewable energy, mineral end chemical resources, (2) to reduce off-farm contamination of air, water and land, (3) must maintain adequate habitats for wildlife, and (4) conserve genetic resources in plant and animal species needed for agriculture. The WRI Study says further that to be sustainable, agricultural systems must be capable of maintaining production over time in the face of ecological, social economic pressures, and that renewable resources must not be depleted by that production (excerption by Sinclair, 1987).

Agriculture and Total Development

During their initial stages of development, the developing countries were facing the most critical plight of their existence namely to feed their people. Through the green revolution some of the developing countries have won the battle which pitted population growth against food production. India and Indonesia are prime examples. But this success in the so-called Malthusian race is now challenged by what Winrock International economist David Seckler calls the second Malthusian race of confronting the increase in labour force with the number of new jobs. Winning the second Malthusian race is paramount to ginning the first (Colmey, 1990).

Losing the second race means increasing the number of jobless people which consequently weaken the domestic market for term produce, including food. In only a few countries can there be sustained agricultural development without growth of a strong domestic market for agricultural products. Until the country can provide enough jobs, thus

enlarging the domestic market for farm products, that country has relatively little opportunity for further agricultural development (Kosher, 1966). Using the entitlement approach of Sen (1981), it is the ability of the different sections of the population to establish command over too! which sets the socio-economic condition for self-sufficient in food for all. It is possible to understand that famines can develop with increased end sustained output in food when development policies stress the value of production rather than employment and income distribution.

Such a situation may become a disincentive to achieve and maintain sustainability of agriculture. To keep the ground of sustainability, an agricultural development strategy in the Third World should seek to increase the purchasing power of the rural people, especially the rural poor, through the creation of employment opportunities in the production sector of labour-intensive wage goods. The increased demand from growth in employment of the poor requires greater supplies of food. The supply of food is, therefore, a critical constraint to sustained growth in employment (Mellor, 1987). Reversely, the provision of employment is a critical constraint to sustained production of food.

In general, capital-intensive strategies of development which concentrate resources in large-scale industries, do not lead to significant increases in employment (Keller, 1987). A recent study indicates that in many Asian countries during the 1970s, a 10% increase in value, added in agriculture led to a 3 - 4% increase in employment (Ahmed cit. Islam, 1989). The Indian experience showed that investments in agriculture generate three times the employment as an equivalent investment in industry (Colmey, 1990).

Agriculture generates employment through its backward linkages with commercial agri-support business like production and distribution of farm inputs and banking of farm credit, and with non-commercial agri-support activities of research and extension. It also forms forward linkages with commercial agri-support business of processing, marketing and distribution of agricultural commodities (Mashef, 1971; Islam, 1989). In this respect, the development of agroindustries dispersed in rural areas is of foremost importance, as these industries tend to be labour-intensive rather than capital-intensive. Hence, more job opportunities for people most in need of help.

In addition to the direct effect of agricultural development on employment, there are indirect offsets. An improved productivity of farming causes increased incomes of landowning farmers. Typically, these farmers spend a large proportion of their new incomes on locally produced non-agricultural goods and services, much as textile products,
household appliances, housing, transportation, educational services, and health services. Production of these goods tends to be far more labour-intensive than in large-scale industries. As a result the rural people are provided with a variety of new, non-agricultural employment opportunities. Taiwan is a good example of a country which used an agricultural-oriented strategy of development to create small-scale manufacturing and industrial enterprises that could compete on the world market (Mellor, 1987).

**Issues in Sustainable Tropical Agriculture**

The term tropical agriculture implies many things. It implies soils which are highly weathered, acid, infertile due to multinutrient stress including toxic accumulation of Al, Fe and Mn, strong erosion, high evapotranspiration rate causing effective rainfall less than an equivalent rainfall in higher latitude climates, subsistence agriculture, swidden agriculture, small-scale farming, resources-poor farmers, and landless peasants. So the issues cover a very wide range of aspects, i.e. biophysical, technological, managerial, social, economical, and political.

The matter of sustainability of tropical agriculture, therefore, must be tackled holistically through a systemic approach. Some pertinent interlinked constraints show up immediately which require integrated strategies to alleviate. For instance, for resources-poor farmers swidden agriculture is the best choice of managing marginal soils in the humid tropics for food crops. The elevation of the economic status of those farmers to be able to put in more advanced technology is a prerequisite for transforming swidden agriculture into permanent agriculture. But this effort will be right away confronted by the subeconomic size of the farms and the limited access to local market due to poor transportation facilities and/or low purchasing power of the local population. The commercialization of subsistence agriculture needs the political willingness of the executive institutions of the country to adhere in their policies to the concept of equitable distribution of opportunities for growth and development rather than favouring the concept of total growth which can be easiest achieved through supporting, or by taking- .18.. with, big capital enterprises.

In many oases the objective of agricultural development, particularly in developing countries, is not so much the welfare of the farmers ma it i– the creation of a surplus for national development, which has often been equated with urban-elite development (Roling, 1984). A shift in national priorities towards equitable opportunities for development of the
urban-rich mod the rural-poor encompasses political dimensions that ought not to be underestimated. The consistent development of such opportunities requires that small farmers develop their own effective lobbies, increasing their capacity to make claims. Strategies intended to assist small farmers depend just as much on the creation of appropriate opportunities as on the delivery of appropriate technology (Roling, 1984).

Governments must foster the establishment of a strong political bargaining position of the rural-poor for counteracting exploitive forces and conflicting pressures of large-scale industries and urban-based interests. This is especially true in Indonesia where farmers often are facing impelled conversion of their crop lends into non-agricultural uses. A strong bargaining platform may be built by mobilizing small farmers within homogeneous target categories into groups. As Sethi (1983) said, development is not a politically neutral task.

Those social, economical and political constraints are institutional problems, so that institutional changes are needed to mitigate them. The task is far from simple as it may involve the restructuring of laws and rules, the reformulation of perceptions and concepts, end the reinterpret-. attain of tradition. It is hard to imagine a sustainable tropical agriculture has been established where institutional adjustments have not been made.

**Appropriate Tropical Land Management**

In general sense, management is concerned with the process of decision-making. Its function is one of continuous decision-making and of choosing between alternatives. Management for production consists of choosing between alternative uses of resources and of operating production so as to achieve maximum net returns (Sri Ram, 1962). Technology, according to the definition of Lawless, is “the ensemble of practices by which one uses available resources in order to achieve certain valued ends” (Roling, 1984). Thus management for production is essentially the application of a chosen technology to resources as to obtain certain benefits.

A land management scheme is called appropriate if it applies a technology which fulfills the following requirements: (1) technically possible, (2) environmentally sound, (3) economically feasible, (4) socially desirable, (5) administratively manageable, and (6) politically acceptable. Technology performs on the combination and interaction of four components: (1) Hardware of appliances which embodies facilities, and (2) Software, comprising (a) person embodied technology or humanware of skill which
expresses abilities, (b) document embodied technology or informware of information which expresses facts, and (a) institution embodied technology or organware of organization which expresses framework.

In the context of the Symposium theme, requirements 1 and 2 for, appropriateness of technology and components 1 and 2b of technology call for international cooperation in research and in the establishment of data banks operating on a unified information system. Component 1 also suggests that a multilateral technical assistance be organized among cooperating countries. Components 2a and 2c imply the necessity of the arrangement of agrotechnology transfer. The transfer should have the primary aim of integrating new crop, products, and practices into existing farming systems to make them more productive (Anon., 1985). Component 2a also indicates the eminence of education, training, and extension to farmers as an essential part of the agrotechnology transfer. Component 2o in conjunction with requirements 3 through 6 signify that lend cannot be managed for sustainable use and benefit where the agri-milieu is not providing the opportunity to carry it out. As Dudal (1982) had said, growth in agricultural production in the developing countries will, in addition to technical inputs, require a transformation in institutions and social relations. It will mean an effort to create an effective framework of policies and services encouraging and ensuring growth in production with equity in the distribution of income, wealth, and services.

Appropriateness of lend management schemes he spatial and temporal dimensions as both agroecosystem and agri-milieus vary with location and change with time. On account of small farmers and delicate soil systems, however, the stipulation for land management in the tropics is what Barwood (1984) called the regenerative agriculture goal. It is an agriculture which possesses an intrinsic mechanism of building and maintaining its productivity upon a cyclic farming system. It is contrasted with industrialized farming systems which are dependent on large inputs of fertilizers and pesticides from industry, and in which the potential for maximum yield is inevitably associated with a risk due to ecosystem instability (Vogtmann, 1984).

**Options of Production System**

On account of the low productivity of the major soils of the tropics one may assume it logical to encourage high-input farming. It is aimed at the elimination of soil constraints by applications of high doses of fertilizers and soil amendments to make the
soil fit for growing high yielding and high demanding crop varieties. But high-input technologies put small farmers under a high degree of control of commercial delivery systems of production inputs. As small farmers do not possess the needed power, ability or opportunity to take the necessary counter-measures whenever the situation demands correction, their farming systems will never become self-contained.

Where soil and water constraints are not easily overcome at low cost, the applicability of high-input technologies diminishes as in the case of the marginal soils of the tropic. (Sanchez & Salinas, 1981). In addition, an attempt to eliminate all soil constraint, in a multi stress soil will mean a too strong intervention in the physics, chemistry and biology of the soil, which may lead to the deterioration of soil productivity. Thus by small farming standards, high-input technology is environmentally unsound, economically unfeasible, and socially undesirable.

Many research efforts in the tropics are now directed towards developing low-input soil management technology. It does not attempt to eliminate the use of purchased input but rather attempts to maximize the efficiency of its use through a series of practices (Sanchez & Salinas, 1981).

The objectives are (1) increased yields without the necessary absolute dependence on high-input technologies, (2) improved soil productivity, the sustainability of which can be achieved through practices compatible with small farm operations, and (3) introduction of appropriate technologies to open up appropriate opportunities to small farmers for produce diversification and for producing higher-priced commodities (Notohadiprawiro, 1989).

Field trials conducted throughout Indonesia indicate that for sustained agricultural production it is essential to incorporate the following practices into the cropping systems (Notohadiprawiro, 1989):

1. *Maintain year-round crop cover.* It will shade and protect the soil from strong insolation and the impact of rain-drop. This minimizes soil evaporation, daily fluctuation of soil temperature, erosion and leaching. It also provides farmers with more harvest which in turn increases farm productivity and income.

2. *Increase and maintain soil fertility.* This practice interacts with the first mentioned practice. By applying well balanced fertilization with P as the key nutrient, a vigorous crop growth securing high yield will be promoted. This, in turn, increases the availability of crop residues which will do good to the following third practice.
3. *Return crop residues.* Maintaining the level of soil organic matter is essential.

4. *Apply soil and water conservation measures.* If the three previously mentioned practices are considered not sufficient because of particular lend conditions, other complementary practices such as contour planting, strip cropping and terracing should be used.

5. *Reduce village inputs.* If some mechanized land preparation is to be done, it may best be carried out with disc plough and disc harrow and at the same time it should receive the benefit of the addition of a basal dressing with rock phosphate. By disc ploughing and harrowing soil disturbance can be kept to a minimum and topsoil inversion can be avoided. The basal dressing may be complemented with green manure. Pilot trials conducted on an Ultisol in Southeast Sulawesi suggested a basal dressing of 750 kg rock phosphate and 6t leguminous green manure per ha is sufficient (Sastrosoedardjo, 1983).

6. *Introduce crops rotations.* Research and testing carried out in Indonesia during the last five years have shown that the introduced cropping pattern with a relay-intercrop system of corn + upland rice + cassava + groundnut-cowpea (or rice bean) gave consistent results in 10 different sites. The productivity and economic potential were higher compared with the farmers' existing cropping patterns (Ismail, 1984).

**Research and development network**

Most of the less developed countries (LDC) are found in the tropics and subtropics. At present 72% of the world population lives in these countries. It is predicted that when the stable population is reached in the year 2110, the proportion will increase to 87%. In the LDCs each unit of agricultural land has to support more people. The ratio of people per hectare presently cultivated is 4.0 in the LDCs, while it is only 1.8 in the developed countries. The average world figure is 3.0 (Dudal, 1982). This means that most people have to live with less land of low productivity in the LDCs of the tropics.

It is therefore imperative to find suitable ways to mitigate this untenable situation. For this purpose, the setting up of a research and development network to improve the supporting capacity of tropical agriculture is urgent. As a network is a structure which connects interrelated resources to form a common system, the network should operate on benchmark sites for easy transfer of experience and findings to similar situations.
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