II.1 Importance of agriculture in a developing economy.

A striking difference in the economic structure of a developed country from that of a less developed country (LDC) is the predominance of non-agriculture sector in it. The share of agriculture in the national income and the proportion of work force engaged in the farm sector are quite insignificant in a developed country compared to the share of its non-agriculture sector in national income and the proportion of its work force engaged in non-agricultural occupations. In contrast, an LDC is predominantly agricultural. Here not only is the agriculture the chief contributor to the GNP, but the proportion of work force engaged in agriculture is also very high. This difference in the economic structures of these two categories of countries might therefore tempt one to conclude that the key to economic development is rapid expansion of the non-agricultural sectors. In particular, large scale establishment of manufacturing industries may be considered as the quickest way to economic development. It was largely this line of thinking that prompted many of the early development planners to lay excessive emphasis on industrialisation, virtually ignoring the agriculture sector. The strategy of economic development through large scale industrialisation, appealing as it may be, is however unlikely to be very successful, unless the agriculture
sector is given the due attention. Experience has by now demonstrated that attempts at economic development by an LDC through industrialisation is likely to be frustrated without supporting expansion of agricultural production. In fact, the linkages between various sectors are such that economic development of an LDC requires growth of both agricultural and non-agricultural sectors in a balanced manner.

The role of agriculture in economic development is manifold. To quote Johnston and Southworth: "As the largest sector of the economy, at least in the initial stages of development, agriculture is the source of manpower for industrial expansion, it is the source of essential supplies for maintaining a growing industrial population and of exports to be traded for industrial goods and it is the chief potential source of savings for non-agricultural investment". The industrialisation programme of an LDC must therefore be matched by adequate agricultural growth so that the pace of economic development is not restricted due to failure of the agriculture sector to perform its role in economic development. Moreover an expanding agriculture sector can directly promote industrial growth by stimulating demand for output of industries producing agricultural inputs and common consumer goods.

In recent years agricultural growth has assumed new significance in L.D.C.s for yet another reason. With the increasing capital intensity of modern industries, it has become unlikely that even a high rate of industrial growth
would be sufficient to create adequate employment opportunities for the rapidly expanding labour force of LDCs. Hence a solution to the problems of poverty and unemployment in these countries can not be conceived without agricultural growth. Thus, as Gerald M. Meier puts it "The emphasis on agricultural development now is not only for its instrumental value in sustaining expansion elsewhere in the non-agricultural sectors, but for its own absorption of labourers and its own increase of real income among the rural poverty target groups of the small farmers and the landless labourers."

II.2 Sources of agricultural growth, the importance of technological progress.

Having recognised the importance of agricultural growth in economic development, it will be now useful to take an account of the possible sources of agricultural growth. Increase in agricultural production in an economy can come about broadly in two ways viz. (a) through an increase in the land area under cultivation and/or (b) through more productive utilisation of land already under cultivation.

The first source of agricultural growth i.e. increase in the land area under cultivation, may be important for a country where population is sparse and cultivable land is available in abundance. But in a highly populous country like India, the scope for bringing in new land surface under cultivation has by now become fairly limited. Any significant further growth of land area under cultivation can now take
place only at the expense of forests and other non-agricultural land. Such expansion of land area under cultivation will not only involve heavy financial cost but is also likely to have serious consequences for the ecology and environment of the country. Hence expansion of cultivated land surface, as a source of agricultural growth cannot be pressed much further. Growth of agricultural output in a country like India therefore must come primarily from more productive utilisation of the existing cultivated land area.

Given the cultivated land area, increase in the volume of agricultural production in a country can result from a number of factors, such as,

(a) institutional changes in the farm sector,
(b) increase in the cropping intensity of land,
(c) shift in the cropping pattern in favour of crops with higher productivity (in value terms), and
(d) improvement in the technique of cultivation.

These four factors are of course not quite independent of one another. As will be clear from the following discussion, there is a great deal of complementarity among them.

When the institutional arrangements in agriculture are not in shape to provide farmers with the right incentives and opportunities, i.e., when the agriculture sector suffers from such institutional constraints as uneconomic size of land holdings, inequitable tenurial arrangements, indebtedness and lack of access to credit and other inputs on
the part of small farmers, etc., institutional changes become necessary to create favourable conditions for agricultural growth. Measures such as land reforms, then can go a long way to remove obstacles to agricultural growth. But on their own, these measures would raise agricultural productivity only to a certain level. For sustaining agricultural growth in the long run, institutional changes are to be followed up by improvements in the technique of cultivation.

Another conceivable source from which increase in agricultural production can be derived is a shift in the cropping pattern in favour of crops with higher productivity. However, in a technologically stagnant agriculture this source exists more in theory than in reality. First of all, crop productivity is usually specific to soil condition, temperature, humidity and other environmental factors and hence, unrestricted shifting of cultivated area from one crop to another is not feasible. Secondly, given the costs and productivities of competing crops, it is very likely that farmers have already settled down to a more or less optimum allocation of their acreages among different crops. In a period of stagnant technology there may be few reasons to warrant any significant change in their allocation. Technological improvement however, by changing productivity and cost structures of crops, might alter relative profitability of crops dramatically, which in turn would prompt farmers to reallocate their acreages. The case of increase in the share of wheat in total cropped area in India
after the discovery of high yielding wheat varieties, is a glaring instance of happenings in that line.

Another means of having a larger volume of agricultural production from the given land resource of a country is the increase of cropping intensity. In spite of heavy population pressure, in L.D.C.s like India, most parts of agricultural land are put to only one round of cultivation during the course of a year. Hence in these countries considerable agricultural growth can be achieved through the spread of the practice of double or multiple cropping. However adoption of multiple cropping by farmers would require better irrigation facilities to ensure timely and adequate water supply, application of fertilizers to replenish soil nutrients, use of short duration crop varieties to release land early enough, and quicker preparation of land for the next round of cultivation. Thus significant increase in cropping intensity cannot be expected without some improvement in the system and technique of cultivation in these countries.

Sustained growth of agriculture in the long run thus depends ultimately on the improvement of farming technology in the country. The importance of technological change in the context of growth and development of traditional agriculture has been analysed in details by T.W. Schultz in his book "Transforming Traditional Agriculture". According to him the distinguishing character of traditional agriculture, that sets it apart from modern agriculture, is the type of inputs and technology in use and not its cultural
and institutional attributes. Citing various pieces of empirical evidence, Schultz argues that farmers in traditional agriculture do respond to market signals and that they allocate their resources efficiently in a rational manner. He attributes their poverty to the type of inputs and technique of production they use. Transformation of traditional agriculture therefore requires jerking the system off from its low level equilibrium with traditional mode of cultivation by introduction of modern inputs and application of science and technology.

II.3. Technological progress in agriculture: alternative courses.

Technology may be defined as systematic application of knowledge to the practical tasks of production. A particular state of technology is embodied in the manner in which factors of production or inputs are combined to produce output. Technological progress takes place with the enhancement of human knowledge and utilisation of the same in production process through research and practice. It manifests itself in increased efficiency of production process, i.e. "It shifts production relation between inputs and outputs in such ways that either larger output is obtained with given total input of resources or the same output is produced with a smaller amount of inputs". Such shifts of production relation are however not usually neutral towards all factors of production, i.e. while economising the total resource requirement of output,
technical progress might often increase the use of one factor in the production process relative to another factor.

Technological progress in agriculture may proceed along a number of alternative routes. In one extreme form, technological change may be highly capital intensive, labour saving type. Technological progress along this line is marked by large scale mechanisation of production process and replacement of human and animal power by the use of heavy capital equipments. Emphasis is on augmenting productivity per worker than on maximisation of productivity per unit of land. This route of technological advancement of agriculture is appropriate for a country where population is sparse, land and capital are abundant but manual workers are in short supply. But in rural areas of most developing nations where land parcels are small, capital is scarce and labour is abundant, the introduction of heavy mechanical techniques is not only often ill-suited to the physical environment, but also has the effect of creating more rural unemployment. Importation of such machinery can therefore be, as Michael P. Todaro puts it, 'antidevelopmental', since its effective deployment tends to exacerbate the already serious problems of rural poverty and unemployment. In these countries with high population density and small per capita availability of cultivable land, the target of technological change should be augmenting productivity per unit of area under cultivation rather than economising the use of labour. Improvements in agricultural technology to this effect, usually consist in
biological and chemical innovations such as, use of improved seeds, increasing application of fertilizers and pesticides etc. These technological changes are essentially land augmenting in nature and they do not necessitate replacement of labour functions by large-scale mechanization of farming operations.

In actual practice, all technological progress in agriculture need not fall into either of these two courses. The path of technological progress adopted by a country will usually be some combination of the two courses. The type of technological change which the policy-makers have been trying to usher into the Indian agriculture since mid-1960s, is closer to the latter of the two courses discussed above. In our country, human power being available in abundance and capital and land being scarce, the emphasis is on the use of more fertilizers and adoption of better seeds along with irrigation and vigorous plant protection measures, rather than on the use of labour displacing heavy capital equipments.

II.4 Implementation of technological changes in traditional agriculture.

Selection of an appropriate course of technological change marks merely the beginning of the process of technological transformation of a traditional agriculture. Implementation of transfer of technology in reality is a multidimensional problem involving participation of a number of groups and institutions of the society such as, the
agricultural scientists, research institutes, the extension workers, agencies engaged in distribution of farm inputs and marketing of farm products, financial institutions, planners and policy makers and of course, the farmers.

The new technique of cultivation which is to replace the traditional mode of farming, can be developed indegenuously through research or it can be imported from abroad. To save the time and research efforts required to develop the new technology indegenuously, an L.D.C. may choose to import technology from abroad. But this does not eliminate the necessity of agricultural research in the country. As Mellor has pointed out, 'most innovations in agricultural technology are suited to some narrow range of conditions. Differences in climate, soil, elevation and other factors often cause innovations which are highly productive in one environment, to be unproductive in new conditions. Consequently research works need to be continued for trial and adoption of innovations in different sets of farming conditions which the cultivators face'. Thus it is the responsibility of the agricultural scientists and research institutes to present the new technology to the farmers in a form which is suitable for their local conditions. Once the new technology has been presented to the farmers in this directly applicable form, it becomes necessary to arrange for adequate supply and proper distribution of inputs of new technology. If an organised system for this function does not already exist, it would be
necessary to develop agencies which could organise adequate and timely supply of inputs to farmers through outlets which are easily accessible to them. Extension service assumes great importance in the process of transfer of agricultural technology in an L.D.C. Besides educating farmers on the new technology and helping them with technical advice at various stages of cultivation process, the people in the extension service are to monitor the performance of the new technology in the field and provide the feedback to the agricultural researchers about the problems encountered while actually implementing the new practices, so that future research can concentrate on elimination of these problems. With the adoption of new technology, farmers demand for finance is likely to go up, because the improved practices (in water management, plant protection, fertilization etc.) usually require higher investment in farming. Hence the success of a programme of modernization of agricultural technology, will depend to a great extent on the support of the financial institutions. Large scale adoption of new technology cannot be expected, unless the financial institutions come up with increased supply of agricultural credit on easy terms. With the spread of improved methods of cultivation, the volume of agricultural production can be reasonably assumed to increase rapidly. Agricultural marketing agencies must therefore adjust suitably to cope with the increased flow of farm output into the markets. Storage facilities in the economy must improve and expand. Government must come up with a
positive price policy so that farmer's incentives are not adversely affected by a possible price slump of farm products following their increased production with the spread of new technology.

II.5. Need for continuous research and improvement in implementation of innovations.

Finally, it is worth mentioning that the problem of agricultural growth does not end at replacement of traditional method of cultivation by a set of modernised farm practices. To sustain long term agricultural growth it is necessary to continuously improve even upon the new technology. This requires mainly two things, (a) continuation of agricultural research and (b) better implementation of agricultural innovations. To elaborate this point we make use of two quotations:

"........ it is important to dispel the illusion that the Green Revolution is a once for all technical breakthrough........ On the contrary, in order to sustain, it there would have to be continuous research ...... Apart from the longer term research on plant protection and diversified breeding to reduce the risks of large scale crop failure through disease and infestation, there are at least three fields of research of immediate economic importance. First, research is needed to adapt the new high yielding varieties to diversified local conditions. Second, research is needed to make the new varieties more appealing to the consumer's tastes. Third, in order to obtain the full benefit from the
Green Revolution, more intensive use of land and multiple cropping is necessary. It has been suggested that in order to recover the overhead cost of elaborate irrigation facilities when required, four or five crops may have to be grown annually on a given piece of land. This makes it especially important to diversify the crops. Research to widen the scope of Green Revolution to other crops is an important condition for maintaining its momentum." (Hla Myint)

"Viewing the matter from a perspective of the gap between potential productivity shown by research and actual performance of different crops on the farmer's fields, one cannot fail to observe that the gaps range between 30 per cent to 300 per cent..... Thus even with the available production technology and given cropping pattern in different agro-climatic zones of the country there is tremendous potentiality for increasing productivity through the application of additional inputs and the better management of resource use" (S.S. Johl)

Hence technological transformation of agriculture cannot be just an once for all affair. It has to be a continuous process of sustained research in various branches of agricultural science, followed up by relentless adaptation of innovations in farmers' fields.

Notes and references :-


6. A detailed and comprehensive discussion on the practical problems of transfer of agricultural technology in developing countries is available in Isaac Arnon's "Modernisation of Agriculture in Developing Countries - Resources, Policies and Problems" Second Edition 1987, John Wiley and sons, Chichester, New York...... etc


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