CHAPTER III

TECHNOLOGICAL CHANGE AND AGRICULTURE

Technological change is a precondition to development. It does not just refer to the use of sophisticated machinery for production, but it is something much more than that. It can be defined as a systematic application of scientific and other organised knowledge to practical task. In search for a relevant technology for traditional societies, generally one refers to the rural economy, where agriculture is a dominant occupation.¹

In Agriculture an increase in yield, resulting from the application of new and modern techniques on farms instead of the existing ones, indicates a technological change. Here, technology means the way a certain thing is done in each of the series of agricultural processes, right from the preparation of the land till the harvesting of the produce. These methods keep on changing, if they do not then it would result in stagnation.

In order to get a clearer relationship between technological change and agriculture, we must first try to find out

as to what is meant by a technological change. According to James Maddox, Technologies in Agriculture are of three types. They are as follows:

(1) One which arises from biological sciences like producing high yielding, scientifically bred varieties of plants and animals, etc.

(2) Second, the Chemical Type which refers to commercial fertilizers, insecticides, fungicides, weed killers, etc.

(3) Third, the work of physicists and engineers; like, for example, the manufacturing of tractors, farm mechanisation and other equipments, which is basically connected with engineering structures and designs.²

According to V.G. Panse, "Technological change in agriculture consists of adoption of farming technique developed through research and is calculated to bring about diversifications and increase in production and greater economic returns to the farmers".³

Technological change has also been defined as the use of new or modern inputs such as fertilizers, high yielding varieties of seeds, tractors, pumps, threshers and harvest

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³ V.G. Panse, "Promotion and Assessment of Technological Changes in Indian Agriculture," Indian Journal of Agricultural Economics, Vol. XXI, January-March 1966, p. 120.
combines, etc. Further, technique refers to the actual mix of input factors whether traditional or modern, or both, which is the function of both technology and relative prices of input factors.  

Theodore Schultz has rightly stated that, the economics of development would be incomplete unless it explained the emergence of new and better production from whatever sources upon agriculture, and also that the economics of agriculture in turn would be incomplete unless it explained that economic behaviour.  

As mentioned earlier Technological Change is an inevitable feature of economic development. The main objective of technological improvement is to control the national forces in such a way as to serve the needs of the human community. This depends on the basic resources available and the level of economic development already attained. In this context we may state that Technological Change does not create many problems in an already industrialised country, where the process of research and development is self-generating; but the same will not be the case for less developed countries.

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where the technological infrastructure is still traditional and primitive.

In the less developed countries the change over from primitive or traditional practices to the more productive improved practices does not take place all by itself, within a short time. Because if this were so, then most countries in the world would have been producing a satisfactory level of agricultural production by now. Instead, we find that only a few countries have made a breakthrough in agriculture to a substantially higher level of production than what they had a few decades before.  

John W. Mellor has given three phases of Agricultural development. They are as follows:

The first phase calls for a situation which provides agricultural development conditions, where agriculture is technologically stagnant. In the first phase, the effect of the pressure of population drives the marginal product of labour to a very low level and thus the marginal productivity is extremely low in the first phase.

The second phase indicates increasing agricultural production with less capital, and labour intensive technology. Under this stage, there is a considerable change in production.

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process which becomes a basic tool of agricultural development policies, in the developing countries. The complementary inputs of technology, education and institutional changes are introduced here in an appropriate proportion, to provide new production possibilities. The result is that the marginal productivity of the various traditional inputs rises substantially, and with it agricultural productivity also increases.

He goes on to say that, technological change in the developing economies generally comes from outside the traditional agriculture. Though it is the individual farm operators who make the decisions, they generally depend directly or indirectly on the government initiative and programmes. For example, agricultural research and extension education programmes are taken up by the government initially which also includes the institutional facilities like supply of inputs, etc. Thus the rate of growth of agricultural production generally depends on the speed and efficiency of the development of these institutions and also the prevailing conditions, where farmers have a higher rate of returns on capital. In such cases, subsidization brings about an optimum use of inputs.

The technological advance in this stage raises incomes of the cultivators and reduces the need to employ more labour. The reasons for this is that, in order to raise the marginal productivity of labour, simple low cost and labour saving devices are used together, with yield increasing technological improvements.
The third phase shows the rising agricultural production where there is a high capital investment and use of labour savings technology on a larger scale.\(^7\)

Technological innovations which is related to agriculture can be conveniently divided into two broad categories: (1) Agro-technical and (2) Biological innovations. Agro-technical innovations refer to mechanization of agriculture, which increases the productivity of labour, whereas Biological innovations involve the introduction of hybrid seeds, cross fertilization, artificial insemination, etc., that is, those innovations which affect the life process of plants and animals.

This broad division highlights acceptance or rejection of a change by the cultivators. The agro-technical innovations influences the entire structure of our rural society that is its institutional structures, the human relationships of cooperations, their reactions, etc., the relationships outside the community and also the political system. On the other hand, biological innovations involves much of the attitudes of the people like their religious beliefs, processes of culture adaption etc.\(^8\)

A change towards improved and better methods of cultiv-

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8 Hulbe, op. cit., p. 35.
atation is very slow mainly because we still pursue the primitive methods of cultivation which is attributed to poverty, ignorance and superstition, etc., likewise for the same reasons the practice of cultivation, in different parts of the country varies from region to region from cultivator to cultivator and among different classes and caste groups.

Causes of the Slow Progress of Technological Development in India

History tells us that India, which once had a glorious past, is now one of the most backward and poor nations of the world.

India is an agricultural country. According to the first all-India Census, about 65 per cent of the population were dependent on agriculture for their occupation, which is more or less the same today. The Technological development is also more or less the same today as it was in the past.

We can say that there are two major causes for the slow progress of agriculture in India, that is, firstly, the neglect of Indian agriculture under the British rule, and secondly, the lack of interest and initiative on the part of the Indian farmer himself.

When we come to the first cause, it is a bit difficult to form a conclusion as to whether agriculture really deteriorated or prospered during the British rule as is evident from the following argument/discussion.
From time immemorial, there were three departments of Administration in India. They were: (1) The Department of War, or Plunder of exterior and (2) The Department of Finance, or Plunder of Interior, and (3) The Public Works Department which was largely concerned with the maintenance of irrigation facilities. During the British Regime, the first two were maintained extensively, but the last was neglected.9

Agriculture in our country which was maintained at a huge public cost before the British rule, decayed owing to lack of repair and maintenance under their administration. At the same time the business of the Indian manufactures was destroyed by the British tariffs and with the capital which flowed into England, led her to become a capitalist class, especially when the British manufacturers managed to close down the East India Company in 1813. A different form of exploitation emerged, where India was depended on for raw materials only, and simultaneously she became a ready market for the British goods, because of which the cultivators switched over from production of food crops to cash crops. This made the country more prone to famine.

On the other hand, it is also true that famines were an indirect booster for technological development. For example, the Muslim kings of the country not only controlled the prices

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and prohibited the export of grain during periods of distress, but also made attempts to improve and extend cultivation as a means of preventing the recurrence of famines and the restoration of property to the famine-stricken population, after the scarcity period was over. Later attempts to use scientific methods and techniques in Indian agriculture were carried on to some extent by the Court of Directors of the East India Company, around 1788, through the Government of India. The growing realisation of agricultural improvement was also observed in 1891 by the Government of India, by freeing the Agricultural Department from duties of collection of statistics and records and allowing it to concentrate only on agricultural development. But this movement was extremely slow.10

The second cause of hindrance in agricultural development and technological progress is that the farmers themselves are not prepared to come forward and take up the initiative or interest, to develop their farms. The cultivators can be classified into two groups. The first group comprises of those cultivators who grow enough food for their own requirements, for at least half the year (using the traditional methods) and when they need money for food for the other half of the year, they can easily get it from the moneylenders. The other group comprises of the agricultural labourers, who

when times are good can always look forward to employment and when times are bad, can always appeal to the Government of relief work. This is true in most areas even today.\textsuperscript{11}

In both the cases given above, we find that the cultivators do not take their responsibility seriously, because of which it is said that the biggest obstacles to the innovations in India, often arises more from the social factors within the organisation rather than from the absence of the technological know-how and equipment.

Many times we hear that the rate of technological progress in India has been very slow. The main reason for this can be the lack of desire and incentive to produce more. The frequent failures of rains or, that the people being superstitious, easily lose heart and feel helpless against fate, are some of the reasons as to why they are not prepared to adopt new methods. A Committee appointed by the UNO for measuring the development of the underdeveloped countries also supports this statement.

Butani has rightly come to the conclusion that “if the well springs of India’s development efforts seem now to be drying up, the explanation must in large part be traced to the inability or unwillingness to reform the social and economic structure of the country”.\textsuperscript{12}

\textsuperscript{11} Ibid., p. 47.

In the traditional pattern of cultivation we find that the technique of cultivation is passed on from one generation to another with little or no change at all. What is needed for progress is the introduction of different techniques of cultivation which are an improvement over the previous ones. Education of farmers in the new techniques may be considered as one of the important aspects of technological change.

According to Smt. G.B. Saha, "Technological change or innovation means the use of new inputs and techniques or the ideas leading to an outward shift of the production possibilities. Inputs in agriculture refer to fertilizer, seeds, insecticides, mechanisation, etc. One input cannot be used as a substitute for another. They all have to be applied in a certain proportion together, in such a way that the final result may be more effective.

These techniques are the outcome of a series of experiments and research, or in other words are a result of a careful and diligent search for technique, material and practices. As, it is the farmer who has to make the decision as to the acceptance and use of these techniques it is he who must learn and adopt these techniques to make this farm more productive. Similarly a more effective diffusion of technological change in the rural areas can take place on a larger scale, through education, extension and demonstration programmes in the field.
Relevant, Appropriate or Intermediate Technology

As far as the acceptance of the new technology is concerned there is a great deal of uncertainty. A farmer knows the results of the old methods, but as he is not sure of the results of the new methods he lacks confidence in undertaking the same. All farmers in a region do not exactly follow the same methods and practices, as a result of which some are more productive, some less and some are average. For an all round development we do need a technology, but not necessarily the technology of the West which is capital intensive. What we need is a technology more suited to the conditions prevailing in our country, where though there is an abundance of manpower, there is still a scarcity of capital resources. There is also a technology, midway between our traditional technology and the capital intensive technology prevalent in the West. Such a technology is termed as Intermediate Technology or Labour Intensive technology with a capital investment which a country concerned can afford.

In the less developed countries like the Asian countries, there are only ruins which stand out as evidence of the past prosperity which no longer exists. Whereas in the developed countries science has been progressing by leaps and bounds, due to which the technology gap between the developed and less developed countries have been growing wider and wider.

This gap can be reduced, by making it possible for the less developed countries also to achieve a fairly rapid rise
In productivity with the use of simple and inexpensive technological improvement in agriculture. Though some problems may arise like, for example, that even this simple technology can be a costly process for these countries, or as to what will be the attitude of the farmers towards acceptance of these new methods, etc., but the fact remains that the technology cannot be simply transferred from developed to underdeveloped countries in its original form.

From the Research Institute of Agriculture Machinery at Prague-chadev, Czechoslovakia, D. Hutla, who has made a special study of the requirements of an agricultural community, has emphasised that the special agro-technical conditions of developing countries should be taken into account for evolving appropriate technology in such areas. Many important crops grown in the developing countries like rice and sorghum are not grown in Europe on a large scale so as to lead to a development of reliable machinery and implements for these crops. Tools which are used in temperate climate are also not always suitable to the tropical conditions. As climatic variations necessitate the use of different kinds of implements such implements will have to be innovated, in the developing countries itself taking into account the local conditions prevalent.13

Mr. E.F. Schumacher, when he was invited as a consultant by the Planning Commission, suggested the introduction of Intermediate Technology, to match the socio-economic environment of the rural areas. The same was also strongly supported by the late Dr. D.R. Gadgil and Jai Prakash Narayan and other eminent economists and social workers. In the studies on adoption of technology, it has been indicated, that the innovation should be 'need oriented'. Attention should be directed to solve the problem of the immediate needs of the cultivators, so that if the innovations satisfy his needs, he will adopt them easily. This calls for establishing a closer relationship between the cultivator, the extension worker and the researcher. While delivering his 1973 David Livingstone Lecture, His Excellency Prof. R.K. Gardiner, Executive Secretary of the U.N. Economics Commission for Africa observed in the African context, that there was a strong need now to search for appropriate technologies in agriculture. He stated, "Too much expensive equipment has been imported only to remain idle or to be used well short of full capacity". What Gardiner has said of Africa, is also very much true of what we are experiencing in many parts of our country today.

Appropriate technology has much significance for the development of backward areas of Africa, India and other Asian countries. An example of appropriate technology can be

14 Ibid., pp. 260-261.
given as follows: Fertilizer is scarce and thereby costly for the common farmer in these countries. Losses can be minimized if the appropriate type of fertilizer is used for a particular agro-chemical condition, in the correct dose under the right situation and in the proper manner. This is the only for one single operation. There are so many different stages and operations in agriculture that we find ourselves in a situation where the most efficient technological achievements can fail to satisfy the needs of each and every locality and of each and every crop and the individual cultivators. Therefore, the problem of the choice of technology and that too of appropriate technology, has emerged significantly in the developing world. The evolution of appropriate technology and the measurement of its appropriation are two distinct problems. The former is the task for science and technology and the latter for the economic theoreticians to work out. The goal of appropriate technology is to harness research and development for the economic welfare of the economically backward areas, without creating additional burden on the national resources. In other words, what is needed in these countries is a technologically feasible structure at the socially acceptable and economically sustainable stage. 15

As the economy develops due to technological progress,

15 Ibid., pp. 15-16.
the manpower shifts from agriculture to manufacturing industries, and it becomes possible for the population to be fed from the labour of a smaller and smaller number of men engaged in it. The labour thus released, moves from agriculture into other occupations. This is more so important in a country like India which has a very large agricultural population and due to which she is facing the problem of large scale underemployment.

As the new technology, recommended in the Green Revolution Programme in India is characterised by frequent applications of water, fertilizers, insecticides, weeding, double cropping, bigger crops, larger volume of transportation, marketing, food processing, etc. The farm technology here is also more labour demanding and this would relieve the problem of under and unemployment in the rural areas, and simultaneously bring about a modernisation of agriculture and increase in the production of foodgrains. 16

In countries where there is no surplus labour, improvement in agriculture and industry go hand in hand, but in countries with surplus labour like India, development of manufacturing industries should be given equal priorities as is given to agriculture, so that people displaced in agriculture should at least in the short run, be able to get immediate alternative employment.

Finally, in conclusion we may state that, generally one does not consider any difference between the two concepts of intermediate and appropriate technology but in order to remove confusion, if any, by Intermediate Technology is meant the minaturisation of machines or the adoption of micro-machines, which yield production at a cost, which is not very different from the employment of rudimentary and traditional methods of production. Appropriate technology on the other hand, entails the use of a technology taking primarily into consideration its own circumstances, the resources available, objective, capacity and intellectual skills, etc. 17