Technology, and the Transfer of Technology

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The transfer of technology is now a very important aspect of the development effort in any underdeveloped country. It is the subject of discussion in various United Nations and other forums. It has also been studied by the Pugwash Conference on Science and World Affairs, which has brought out a Code of Conduct for the International Transfer of Technology.

Technology is transferred from one country to another in the course of new investment on development projects. This could take the form of private, foreign or local investment, and public investment with or without foreign financial assistance. Foreign assistance could take the form of either bi-lateral or multi-lateral aid, the former from a foreign government, the latter from the World Bank, the Asian Development Bank or some UN Agency. It should be noted that "only official Development Assistance should be designated as AID. The flow of private capital and official credits undertaken for commercial reasons have no more the character of AID when they flow to developing countries than when they flow between developed countries". [1] The multi-national or trans-national corporation is wellknown in the field of private foreign investment.

From earliest historical times, in every civilization, technologies evolved empirically as a result of man's interaction with Nature, in his immediate environment. These technologies enabled man to meet his essential needs. Sciences were developed, independantly of technology, as a result of man's enquiry into Nature in many of these early civilizations. Both Science and Technology were "transferred" from place to place as a result of exploration and the movement of people, which was greatly helped by the discovery and invention of the magnetic compass. There was continuity in the development of sciences like Astronomy and Mathematics down the ages, although this knowledge was generally the privilege of the leisured classes and the priesthood.

After a general transfer of knowledge from the East to the West, the Rennaisance in Europe was sparked off by a combination of fortuitous circumstances. Thereafter there was rapid development of both Science and Technology in Europe, but once again, independant of each other. The growth of technology was stimulated by commerce and trade, and by early colonial expansion, catalysed by the spirit of pioneering and by the protestant ethic, after the Reformation. Thereafter the Industrial Revolution was precipitated in Europe, starting in England in the 18th century. The Industrial Revolution more or less coincided with the emergence of the capitalist system of production. This resulted in the evolution of the factory system of production in industry with a concentration of capital in the form of technology, and a division of labour. This in turn eventually led to the growth of a centralised, large-scale manufacturing, distribution and marketing, system, which then became synonymous with industrial development and modernisation in industry. Modern industry was at first confined to urban centres, whilst the small-scale, traditional industry which it replaced, from which in a sense it grew, remained in the so-called traditional sector. Today, this sector has altogether disappeared in the advanced countries, but sustains a majority of the population in developing countries, where incipient modern sectors are also to be found, usually as a result of transfer of technology from the developed world.

In the United States, the industrial revolution took place in the 19th century, and was characterised by the extensive mechanisation of agriculture. As in Europe, the application of scientific technique to the deliberate development of technology was to come later and the early transformation of technology was empirical. Today, modern agricultural development is based on scientific research. This has resulted in the intensification of inputs to achieve increased productivity and increased outputs. This modern agricultural technology is also being transferred to developing countries, and is sometimes imposed on the traditional agricultural sectors of these countries.

In the construction sector too, modern technology is transferred to developing countries. In Sri Lanka, heavy construction equipment was first used during the restoration of ancient irrigation works, before World War Two and this work of piece-meal restoration gathered much momentum after the war. The use of heavy earthmoving and other equipment, enables engineers to dam any river. This has led to a new approach to the *design* of irrigation and multi-purpose projects. This approach may be described as one based on a centralised, large-scale system, which is in marked contrast to some of the ancient irrigation works which could be described as being based on dispersed, interdependant, small-scale systems.

It is thus seen that since the time of the Industrial Revolution in the West, large-scale centralized systems for production, manufacturing, storage, distribution etc., have become increasingly popular in developed world countries. These systems have replaced existing dispersed small-scale systems almost completely in those countries. There is a tendency to imitate the

large-scale centralised systems of the developed countries in the developing countries and this is promoted by a transfer of technology. It may be argued, however, that it is only an accident of history that efficient, small-scale, de-centralised production and commercial, systems have seldom emerged which could compete with the large-scale centralised systems, although in recent times there appears to be some development in this direction, e.g. some large multi-national corporations are known to be dispersing their investments in a large number of smaller production factories in various parts of the world.

An interesting aspect of this evolution of systems, is a comparison of the eco-systems in which each of these man-made systems has evolved. Very broadly, eco-systems in the temperate regions of the earth tend to be large-scale and of limited variety and diversity. On the other hand, in the tropical regions especially in the humid tropics, eco-systems show a splendid variety and diversity, and an intricate basis of inter-dependance. For example, there are extensive areas covered by deciduous forests and also by coniferous forests in the temperate lands; in each of these large-scale systems there are comparatively few individual species of flora and fauna. In contrast, in the tropical forests there are a very large number of species in a small area. (This is well known in our country in the Sinharaja Rain Forest, for example). It would appear therefore that the dispersed, interdependant small-scale system evolved naturally in the eco-system of the tropics, whereas the corresponding eco-system in the temperate regions had inevitably to give rise ultimately to centralised largescale systems. Therefore, there seems to be a built-in contradiction in the transfer of technology from the developed world countries to the developing countries. The cause of this contradiction has been described in the statement, "Technology is like genetic material—it carries with it the code of the society which conceived it". Instead of "society", we could read "eco-system" in this statement.

In a developing country like Sri Lanka, these two systems, the modern or recent, centralised, large-scale, on the one hand, and the traditional dispersed, small-scale system on the other, should not be considered as alternatives. Rather they should be used as complementary systems that support, rather than compete with each other. The proportions in which the two systems should be used will depend on the particular context, and each case should be treated on its own merits.
In particular, each project should be viewed in terms of the factors of production in that sector.

In any economy, and especially in a developing economy,employment is available in 3 sectors of production which may be called the primary, the secondary and the tertiary sectors. In the primary sector actual production takes place from agricultural and mining activities. In the secondary sector, there is a processing and manufacture of goods, and in the tertiary sector there is the commercial activity associated with the handling and distribution of goods and the provision of services. In each sector of production, there are also three levels of employment called the blue collar level, the white collar level and the management level. The relative numbers of people employed in the primary, secondary and tertiary sectors, and at the three levels of skills, is an indication of the stage of development of the economy. In a developed country, comparatively few people are engaged in primary production. Furthermore, in the primary sector, because of high productive capacities of technologies used, there are comparatively few blue collar workers. In a poor developing country like Sri Lanka, on the other hand, more people are employed in the primary sector, and more people are employed at the blue collar level when traditional technologies are used.

Capital, Labour and Land are generally described as the primary factors of production, where land refers to resources. In engineering planning, it is usual to refer to Money, Men, Materials, Machines, Methods and Management. We can define Technology as consisting of Materials, Machines, Methods and Management, and identify factors of production, as Capital, Labour and Technology. We may further subdivide technology into two components,technological hardware consisting of materials and machines, and technological software consisting of methods or techniques, and management.

At any stage of development, there will be a certain mix of capital, labour and technology in any given sector of the economy. When development is deliberately accelerated, the "natural" mix of capital, labour and technology is deliberately changed, in order to force production. It is in this context that the transfer of technology should be viewed.

In the Sri Lanka situation, technology is often transferred to set up new productive capabilities, for example in the corporation sector. When a new factory, is set up in this manner, a number of skilled personnel (the factor Labour) together with a certain amount of Capital is brought into the country along with the technology proper, (both hardware and software) that has to be installed. The intention in such cases is to replace that imported labour and capital after some time with local resources. In practice, another aspect of the mix of factors exists. Before the new factory was set up, there would have been some local productive capacity in the traditional sector, however primitive, which produced the same goods, or equivalent goods, or goods of a lower quality to that which the new factory will produce. It is important to consider the impact of the new investment on the existing industries in the traditional sector. Furthermore, if the National Planners are aware of the existence of such an equivalent traditional industry, it is their bounden duty to examine the capabilities of the traditional industry, and the possibility of upgrading it before bringing in the transferred technology,

lock, stock and barrel. This applies no less to the agricultural sector as to the industrial sector.

In practice we know that this has not been done in the industrial sector in many instances. The State Hardware Corporation was set up with a transfer of technology to produce some 46 different products ranging from mammoties and other agricultural implements to tower bolts, hinges and other building accessories, all of which were being manufactured by artisans in the traditional sector at the time, inspite of competition from high quality mass-produced imports. The plywood complex was set up at Salawa to produce various treated timber products like tea chests and chipboard, without reference to the productive capacities of existing saw mills and carpentry workshops in the country, and so on.

In the agricultural sector too, transfer of technology is now a regular part of development planning and various technology packages have come in to Sri Lanka under so-called Aid Programmes. Special mention may be made of the technology of the Green Revolution which has now been described as a maximum input—maximum output technology. In otner words, high-yielding varieties (of rice, wheat, maize, etc.) were developed which needed high-inputs of fertilizer, pesticide, etc. which inputs are freely available in developed countries but are scarce resources in developing countries. What the developing world needs are *optimum* input *optimum* output technologies which will be appropriate to our factor endowments.

It is thus seen that "appropriate technology" in the broadest meaning of the expression stands for an optimum technology, a technology which makes optimum use of available resources. Such a technology in a developing country may often be an "intermediate technology", being less complex, capital-intensive and large-scale than other existing technologies, (in developed world countries) and less labour-intensive than some previously used primitive technology. However it should be noted that an intermediate technology is not necessarily an appropriate technology, in the above defined sense of being an optimum technology, making optimum use of available resources.

The expression intermediate technology was originally popularised by the late Dr. E. F. Schumacher who set up the Intermediate Technology Development Group in London in 1965. The concept of intermediate technology has been given various attributes, including roots in the philosophy of Gandhi and Ananda Coomaraswamy, and religious sanction from Buddhism (*vide* chapter on Buddhist Economics in Schumacher's classic, "Small is Beautiful"). Not surprisingly, some intermediate technologies are now being made to measure in developed world countries for developing countries, and transferred like any other technology.

Meanwhile, the development effort in developing countries often flounders on the question of choice of technology. The image of developed world societies always looms large before decision-makers who "choose technology" for planning, design and construction of projects in developing countries. In such a situation, choice of intermediate technology is difficult and designing an appropriate technology becomes well-nigh impossible. It is therefore necessary to counter the psychological effect of the developed world image, before getting down to the task of designing appropriate technologies, and choosing transferred technologies, in Sri Lanka.

REFERENCES

1. Partners in Development. Report of the Commission on International Development (1969) Praeger Publishers.

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Another important element of science and technology policy is international co-operation in scientific research, including the transfer of research findings to industry. Specialization and co-operation in research, with a clear sharing of scientific labour at the international level, is one of the preconditions for the development of science and technology at the national level. This international co-operation should start with the definition of priority fields for collaboration, the preparation of a programme of action, and the choice of the most effective modes of co-operation. These latter might include the exchange of information and scientists, joint research projects, and mutual assistance in training scientific personnel and in construction of scientific facilities.

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