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THE ROLE OF LOW-COST TECHNOLOGY FOR INCREASING AGRICULTURAL PRODUCTIVITY IN THE ECWA REGION

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The Role of Low-Cost Technology for Increasing Agricultural Productivity in the ECWA Region

Foreword

Growth in output per worker in agriculture is generally recognized as a necessary condition for economic development. This is particularly true in countries of the ECWA region which enjoy favourable man-land ratios. Suitable technology is an important instrument in this respect. But modern technologies borrowed from developed countries are often not adapted to the special circumstances of developing countries. Hence, is the need for appropriate low-cost technology, which is the subject of this paper.

The presentation consists of four sections. The first is an overview of agricultural labour productivity in the ECWA region. The second section considers the basic elements of agricultural labour productivity and the scope for improvement. The third is concerned with the meaning and dimensions of low-cost technologies and the fourth concerns the prospects of low-cost technologies in increasing agricultural labour productivity.

An Overview of Agricultural Labour Productivity

Most countries in the ECWA region enjoy favourable man-land ratios. Thus, comparatively speaking the maximization rule would lead the ECWA countries to maximize output per unit of labour in contrast to countries which have unfavourable man-land ratios (Egypt, India, etc.). Therefore, the concept of agricultural labour productivity is specially significant for the ECWA countries. Furthermore, labour productivity is a direct reflection of agricultural income. Subsequently, improvement of labour productivity should raise agricultural income and contribute to social justice and income equality.

The position of agricultural labour productivity can be assessed by considering productivity levels in selected ECWA countries as given in Table 1 overleaf.

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Table 1

Estimates of Agricultural Labour Productivity in selected Countries of the ECWA Region. Reference Year 1970

Country	Output per cultivated Hectare: US$	Cultivated ha per economically active population in agriculture: ha	Output per economically active population in agriculture: US$
Iraq	116.00	4.40	516
Jordan	61.80	6.80	421
Lebanon	421.20	2.60	1087
S. Arabia	352.80	0.46	161
Syrian AR	61.20	7.00	426
Yemen AR	259.00	0.90	234
Yemen DR	127.00	1.10	143

Sources:

Cultivated area (arable land + permanent crops): FAO 1975 Production Yearbook.

Economically active population in agriculture: FAO 1975 Production Yearbook.

Value added by Agriculture (Current prices): UN Yearbook of National Accounts.

(Converted to US$ using dollar exchange rate reported in UN monthly Bulletin of Statistics, December, 1975, Vol. xxxx,No. 12, PP. 216-219)

As seen, great disparities in productivity levels exist among the various countries. Lebanon is at the top of the continuum, whereas the three countries of the Fertile Crescent (Syria, Jordan, Iraq) lie around the middle of the continuum. The two Yemens are at the extreme end of the continuum.

Generally and apart from labour, the indicated productivity levels are significantly lower than the calculated levels for developed countries. 1/

1/ Estimates based on same method of calculation reported in Table 1 above.

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Thus, the comparative levels for countries enjoying favourable man-land ratios such as USA and Australia are $9313 and $5245 respectively. The level in a country with unfavourable man-land ratio like Japan is $1217.

Broadly speaking, such observed differences in agricultural labour productivity can be attributed to three sources: (a) resource endowments; (b) technical inputs; and (c) human capital.[2/] The first includes not only original land resource endowments, but also internal capital accumulation in the form of land reclamation, livestock inventories and others. Technical inputs comprise the mechanical devices and the biological and chemical materials such as seeds and fertilizers. Human capital includes education, skill, and knowledge obtained from sustained agricultural research.

The gap in agricultural labour productivity among the ECWA countries themselves and in comparison with the developed countries is largely accounted for by differences in technical inputs and human capital, rather than by differences in resource endowment. Lebanon is a good case in point since the agricultural resource endowments of the country are not greater than those of Syria, Jordan, or Iraq.

An example of the meagre role of research and human capital in agricultural development is their share in total agricultural investment in two medium-term plans of Jordan.[1/] In the 1972-75 plan their shares were 4 per cent and 3 per cent respectively, whereas their shares in the 1976-80 plan were 0.5 per cent and 0.3 per cent respectively. Thus as a result of under investment in technology and human capital, most countries of the ECWA region have failed to fully explcit their favourable man-land ratios.

Elements of Agricultural Labour Productivity

The role of technology in increasing agricultural labour productivity should be gauged in relation to two major productivity components. In essence, the growth in output per worker is partitioned between two components: Land area per worker and land productivity, as follows:

$$\frac{Y}{L} = \frac{A}{L} \cdot \frac{Y}{A}$$

2/ Y. Hayami and V. Ruttan, Agricultural Development: An International Perspective, The John Hopkins Press, USA, 1971, P. 86.

1/ ECWA/FAO Joint Agriculture Division, Alternative Strategies for Long-Term Development of Agriculture in East Jordan, Restricted paper, March 1977, Amman, P. 8.

2/ Y. Hayami and V. Ruttan, Op. Cit, P. 115.

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where

Y = Output	Y/L = Labour productivity
L = Labour	A/L = Land area per worker
A = Land area	Y/A = Land productivity

Within this context, agricultural labour productivity can be increased by two different sets of technologies: (a) those that increase output per unit of land, and (b) those that make it possible for a farmer to plant a larger area. The first group includes yield-increasing technologies such as the use of modern inputs comprising new seed varieties and fertilizers. The second is closely linked to mechanization.

The comparative contributions of the two productivity components can be assessed again from Table 1 above. Thus, the lower agricultural labour productivity levels for Iraq, Syrian AR, and Jordan are mainly due to low land productivity manifested in low yield levels. In contrast, the relatively higher labour productivity levels for Lebanon are primarily a function of higher yields and more favourable crop mixes.

For countries like Saudi Arabia, Yemen AR, and Yemen DR, there is scope to increase agricultural labour productivity by stressing technologies which make it possible for the farmer to plant a larger area, mainly through mechanization. The main difficulty in this respect is that such technologies are not scale-neutral and, therefore, are not readily adapted to the special conditions of developing countries. Tractor technology provides a good illustration of this point.

In essence, there is a limited range in tractor technology. Although there are variations in the size and horsepower of tractors, machines of the same size are used in both developed and developing countries. Generally, it appears that the major manufacturers have viewed the market for tractors in developing countries to be an extension of the market in developed countries. There has been no mass-produced product especially designed for circumstances in which capital is relatively scare in comparision with labour.[1/] Consequently, the manufacturers of tractors and farm equipment have exported the same technology as is used by farmers in developed countries.

1/ M. Yudelman, G. Butler, R. Banerji, Technological Change in Agriculture and Employment in Developing Countries, OECD, Paris, 1970, PP. 152-153.

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Often, the market for expensive farm equipment has been restricted to few farmers with large holdings. Overvalued exchange rates, low interest rates, "artifically" high costs of labour, and other policy measures have induced large-scale producers to mechanize extensively, thereby exacerbating the dualism that exists in agriculture. Given the absence of small-scale mechanization technology, the only way of avoiding this technological dualism is the creation of special institutions whereby small farmers can have acess to large-scale mechanized technology.

The other set of technologies affecting agricultural labour productivity are those that increase output per unit of land. Generally, they include modern intermediate inputs such as HYV of seeds and fertilizers. Such technologies are scale-neutral. For instance, the United States, Taiwan, and Egypt reflect approximately similar yields of basic food grains per hectare of 3570 Kgs., 3721 Kgs., and 3940 Kgs., respectively. Such similarities occur regardless of sharp differences in average size of holdings and degree of mechanization among the three countries. By and large, the similarities in land productivity appear to be correlated with the use of modern intermediate inputs, particularly fertilizers as well as other high-energy inputs such as insecticides and herbicides.

It is important to point out that the economies which are generally attributed to yield - increasing technologies are essentially financial economies of scale rather than technical economies. Small farmers suffer from being able to purchase only small quantities of inputs and sell small quantities of output at a time. They are often undercapitalized in storage capacity and have to sell their produce at harvest time when prices are low. But apart from these financial economies, yield-increasing technologies are scale-neutral. It makes little difference to total output of modern agriculture whether farmers are large or small.

Given the above framework, the prospects for agricultural technology transfers from developed countries to the ECWA region can be generally ascertained. The scope for technologies that make it possible for a farmer to plant a larger area is limited. First, the technologies are not scale neutral and not readily adapted to local

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conditions. Second, the countries of the region already have favourable man-land ratios which limits the scope for further improvements in terms of enlarging the area planted per worker. Thus, the core of potential labour productivity increases rests in raising land productivity.

Since they are scale-neutral, the use of modern intermediate inputs should be readily transferable from developed to developing countries. However, the determining force in the application of such inputs concerns relative input-output prices. For instance, the HYV of rice respond to fertilizer to the order of 5 to 10 Kgs. of rice per Kg. of fertilizer. Given this technical parameter, the rice-to-fertilizer price ratio becomes the crucial factor for the adoption of HYVs. At price ratios approaching 1:1, the HYVs are widely adopted. At lower ratios, the new technologies would be resisted. Thus, future levels of input prices should be a major factor determining the transfer of this technology. Present projections show unfavourable trends in factor price relationships, particularly in view of the recent spiralling of fertilizers' prices. This raises the question of the availability of intermediate technology and the appropriateness of international transfer of low-cost technologies, and/or the endogenous development of such technologies.

Meaning and Dimensions of Low-Cost Technologies

The transfer of technologies from developed countries to the ECWA region is constrained by two forces. Technologies enabling farmers to plant a larger area are generally inappropriate since they are not scale neutral. On the other hand, scale-neutral modern inputs are becoming less attractive due to unfavourable input-output relative prices. These are the reasons for the growing interest in low-cost technologies either developed endogenously or transferred from developing countries to other developing countries.

The terms"Low-Cost" technology, intermediate technology, appropriate technology, and "soft" technology are often used inter-changeably. More precisely, intermediate technology refers to technologies half-way between traditional and modern technology. Appropriate

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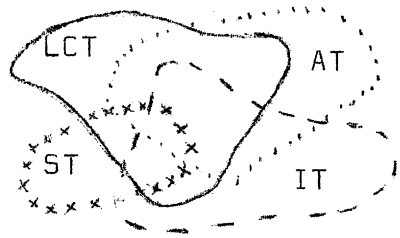
technology stresses the adaptation of technology to the social and cultural environment. Soft technology emphasizes the adequation of technology to society, i.e., the ecological relationship with nature. These various concepts can be viewed as a set of over lapping areas summarized graphically as follows: 1/



LCT = Low-cost technology
AT = Appropriate technology
IT = Intermediate technology
ST = Soft technology

The dimensions of low-cost technologies encompass three major aspects which are of direct concern to policy makers:

1. Identifying needs for low-cost technology

The first major step in the development of low-cost technology is the identification of market needs and their translation into effective demand. Generally, the need for appropriate technology tends to be identified in macro-economic rather than micro-economic terms, e.g., employment generation, import substitution, public health, and rural development. The translation of identified needs into effective demand is very crucial. For instance, the solar pump developed in West Africa is technologically well adapted to local conditions, but its price is very high relative to prevailing income levels. Therefore, its application is considered only in the framework of a much broader public programme for infrastructural development.

2. Information mechanisms for low-cost technologies

This aspect depicts the software of low-cost technology comprising information, education, training and managerial assistance. The biggest problem with low-cost technology lies not in the creation of knowledge or its transfer but rather in its diffusion and application. Market heterogeneity requires that different means have to be devised

1/ OECD Development Centre, Low-Cost Technology - An Enquiry Into Outstanding Policy Issues, Paris 1975, p. 11.

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to reach each segment of this market. Thus, there is strong need for a technology extension service. This approach requires great effort and must be backed by a deep understanding of the social mechanisms of innovation. The "delivery system" of low-cost technology addressed to the rural poor is comparatively more important than the technology itself.[1/] Developing more adequate agricultural tools may be far from simple, but the most difficult problem lies in the social processes which lead to a community's adoption or rejection of an innovation.

3. Competitiveness of Low-Cost technology

To be successful, low-cost technology must be economically, socially and technically competitive with other types of technology, modern or traditional. Commercial viability is necessary but not enough. Social acceptability is often a decisive factor. A good illustration is provided by the rainwater collection system developed by IRFED for African countries.[2/] Their plastic sheets covering traditional roofs may be technically appropriate, but are not competitive with the tin roof. The latter is not only technically simpler, but socially much more prestigious.

Prospects of Low-Cost Technologies

The prospects of low-cost technologies in countries of the ECWA region should be conceived within the context of the two components of agricultural labour productivity. As indicated previously, advanced agricultural machinery and equipment are not well-suited to local conditions. For instance, American machines designed for large farms and high labour costs, or Japenese machines designed for small holdings with high income are generally unsuited to the typical small, low-income farms in the ECWA region. The former are too expensive, and the latter too complex to operate and maintain.

However, there are examples of low-cost mechanization technologies tuned to low-volume agricultural production. For instance, the "jeepney" (a simplified version of the jeep) is now manufactured in several parts of the Philippines. Another example is the Ford Motor Company's "Developing Nations Tractor" and its small multi-purpose transport

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1/ Ibid., P. 67.

2/ Ibid., P. 55.

vehicle now marketed in South-east Asia. Another example is the power tiller developed in 1972 by the International Rice Research Institute (RRI).

It is important to note two important aspects of such low-cost mechanization technologies: first, mechanization of this type does not generally displace labour. Second, apart from the multinational corporations and certain regional institutions such as the IRRI, most of the low-cost mechanization technologies are developed by individual innovators who often lackformal education. For instance, a motorized low-lift pump was developed by a farmer-mechanic in Vietnam in 1963 and was subsequently owned, less than four years later, by 43 per cent of the country's farmers.

It is surprising that the local engineering community has generally failed to develop similar appropriate technologies. The lessons for the ECWA region are two-fold: first, that reliance on the transfer of intermediate technologies developed abroad may not be a very effective solution. Instead, major effort should be put on initiating endogenously a process of innovation and self-sustaining growth. Second, intra-regional cooperation is very much needed in setting up regional research centres for the development of such technologies.

Concerning the second component of agricultural labour productivity, i.e., yield-increasing technologies, there seems to be more room for imaginative application of low-cost or intermediate technologies, particularly in the LDC of the ECWA region. For instance, chemical fertilizers can to some extent be substituted by organic fertilizers. The costly HYV fertilizer technology could be replaced by a simple seed-inoculant approach which would also overcome the severe transportation and distribution constraints of fertilizer that are most binding to the smaller farmer. Nitrogen fixation in the plant would also overcome the transportation and distribution constraints of fertilizer.

The scope for low-cost and yield-increasing technologies is wide open and requires larger investment in research, extension, and human capital. It also calls for significant changes in agricultural research policy which is presently centered on emulating high-cost

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sophisticated technologies developed in industrialized countries. Green manuring can replace large quantities of fertilizer and is well tuned to conditions of West Asia. Relay planting of the type practiced in Taiwan is also suited for certain ECWA countries, particularly in connection with irrigated agriculture. Here again, intra-regional cooperation is of great importance.