

THE RELEVANCE OF THE IMPROVEMENT APPROACH TO AGRICULTURAL GROWTH IN ETHIOPIA

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I. INTRODUCTION

Policy makers and donor agencies have so far emphasized the use of modern farm technologies as a sole source of agricultural growth in Ethiopia. However, the cost of modern technologies is so prohibitive that few farmers in limited areas of the country are so far reached. Moreover, it is doubtful whether structural adjustment programmes can contribute to a widespread generation and diffusion of modern farm inputs in the short- and medium-terms. Therefore, it is high time to explore possibilities for identifying approaches that could complement existing strategies of growth.

The purpose of this paper is to suggest a cost-effective model of agricultural growth for Ethiopia. The second section of the paper investigates the relevance of the various models of agricultural development to the Ethiopian conditions and highlights the viability of the improvement approach (the conservation model) during the short- and medium-terms of growth. The third section presents historical evidence from Great Britain and Japan. The fourth section illustrates the viability of the model with reference to improved soil conservation techniques on the basis of empirical studies undertaken by researchers. The final section considers the place of the suggested approach relative to other approaches and draws conclusions relevant to policy formulation.

II. THEORIES OF AGRICULTURAL DEVELOPMENT¹

Following Ruttan (1984), and Hayami and Ruttan (1985), the literature on agricultural development can be characterized according to the following models: (1) the frontier; (2) the urban industrial impact; (3) the diffusion; (4) the high pay-off; (5) the induced innovation; and (6) the conservation. In what follows, we will review only those models which are more relevant to the conditions of Ethiopian agriculture.²

The frontier model (the resource exploitation model) involves an approach to agricultural growth through the expansion of the area cultivated or grazed. The southward movement of population throughout most of Ethiopian history demonstrates the importance of the frontier model in that country. However, there are few remaining areas in Ethiopia today where development along the lines of the frontier model would represent an efficient source of growth. It appears that the frontier is closing, and the cost of keeping it open would be enormous. Such areas where virgin land is available (e.g., Gambella, Metekel, etc.) are without adequate infrastructure and are infested with animal and plant diseases. Experience in the

forced resettlement areas of Ethiopia has demonstrated how costly it is to reclaim land in the so-called "land-abundant" regions.

The importance of the frontier model in Ethiopia is reduced mainly by limitations in physical availability of land in the temperate highlands. However, it is possible that government policies and institutions are contributing factors, as the World Bank noted in its recent country report on Ethiopia:

Longer-term studies suggest that the expansion of the cropped area in Ethiopia came to a halt as long ago as the 1960s. The now limited physical available of land in the temperate highlands and the effects of land degradation have been important explanatory factors. However, the institutions and policies which have prevailed since the land nationalization and land reform in the 1970s have also not favoured the lateral expansion of cultivation. Spontaneous resettlement has been rendered impossible and the precipitate programme of government-directed resettlement launched in 1985, but whose pace has been since greatly reduced, has been insufficient to contribute significantly to cultivated area and output [World Bank 1990: 28].

Besides, the ever-growing population pressure over land may not allow the average size of the operational holding to expand in the highlands where more than 80 per cent of crop production takes place. However, we do not rule out the possibilities of complementing the frontier model with other models in localities where unused land exists.

The high pay-off model, which is also known as "the transformation approach" or "the quick-fix approach", is based upon investment designed to expand the diffusion and adoption of the high-yielding varieties. In Ethiopia, an attempt was made to partially introduce this model (along with the diffusion model) in the Comprehensive Package Project areas, where it had a strong impact, in particular in Chilalo district of Arsi region. However, the large-scale adoption of this model has been constrained by the following factors: (1) the inability of the public and private sector research institutions to produce new and location-specific technical knowledge; (2) the inability of the industrial sector to develop and produce new technical inputs; (3) the weakness of the extension facilities and related institutions to diffuse the new techniques; (4) the inadequacy of the infrastructure to facilitate the diffusion of the new inputs; (5) the inability of peasant farmers to acquire new knowledge and use new inputs effectively; and (6) lack of complementary inputs such as irrigation facilities which are needed to make fertilizers and modern varieties more effective.

In general, the limitations of the high pay-off model are that it does not fully incorporate the mechanisms by which resources are allocated among education, research, and other public and private sector activities. It does not specify the processes by which changes in relative prices induce investment in research in a direction consistent with a nation's resource endowments.

However, in Ethiopia, this approach has registered encouraging results in such regions as Arsi and parts of Shewa where the new inputs have gained acceptance

among farmers and where yields are much higher than the rest of the country. Put differently, this approach has made possible an outward shift in the production frontier in limited areas of the country. However, the basis for the widespread application of this model is not yet laid in Ethiopia.

It is the conservation model (the improvement approach) which opens the door to the possibilities for exploiting the full potential of the traditional sector and provides the launching pad for the high pay-off model.

The conservation model of agricultural development, according to Ruttan (1984:39), "evolved from advances in crop and livestock husbandry associated with the English agricultural revolution and the notions of soil exhaustion suggested by the early German chemists and soil scientists. It was reinforced by the application to land of the concept, developed in the English classical school of economics, of diminishing returns to labour and capital." The essence of this model is explained by the "evolution of a sequence of increasingly complex land- and labour-intensive cropping systems, the production and use of organic manures, and labour-intensive capital formation in the form of drainage, irrigation, and other physical facilities to more effectively utilize land and water resources "[Ruttan 1984:39-40].

The strength of this model emanates primarily from the fact that "the inputs used in this conservation system of farming (the plant nutrients, animal power, land improvements, physical capital, and agricultural labour force) were largely produced or supplied by the agricultural sector itself" [Ruttan 1984:40]. The importance of this point in poor countries such as Ethiopia is obvious. As underlined by Ruttan (1984:40), "the Conservation Model remains an important source of productivity growth in most poor countries and an inspiration to agrarian fundamentalists and the organic farming movement in the developed countries."

The major factors which make this model highly relevant to Ethiopian agriculture are: (1) the fact that Ethiopia is unable to make widespread use of existing technological backlog due to, mainly, the high costs of generation and diffusion of new techniques of production; (2) the possibility that the improvement approach involves cost-effective techniques of production and capital formation as it is based upon the use of the relatively abundant resources [e.g., labour for capital formation (see ILO 1982)] and that it could delay the operations of the law of diminishing returns as land is saved through labour intensification; and (3) the fact that soil conservation programmes need special attention as the resource base of the agricultural sector is being depleted at an alarming rate due to the fact that the soil erosion and desertification process continue almost unabated (see Constable and Belshaw 1986: 4; Berhanu Debele 1986).

It can be argued that the conservation model, along the high pay-off model, can make significant contribution to an outward shift in the production possibilities frontier.

III. IMPROVEMENTS IN FARM MANAGEMENT PRACTICES IN GREAT BRITAIN (1750-1850) AND JAPAN (1870-1900)

The historical experience of Great Britain and Japan is important because these countries were able to increase agricultural productivity during the pre-take-off period³ with minimum demand on inputs generated from without the agricultural sector. For example, in Japan "agricultural output has been increased with remarkably small demand on the critically scarce resources of capital and foreign exchange. This was possible because of *increases in the productivity of the existing on-farm resources of labour and land*; and it was done within the framework of the existing small-scale agriculture" [Johnston 1970:58, emphasis added].

It is well-known that the motive force behind the evolutionary change in British agriculture was price incentive. But it is doubtful whether relative prices played a decisive role in Meiji Japan⁴ of 1870-1900, although it was true that a market outlet was needed to absorb that incremental output [Dore 1969: 117].

Most of the innovations which the Japanese government was urging farmers to adopt involved improvements in farm management practices and were highly cost-effective as noted by Dore (1969:117):

Most of the innovations which formed the basis of government urgings did not cost anything. The five "essentials" enumerated in a central government guide to good cultivation issued in 1903 were, for instance, the selection of seed by the saltwater method, the use of narrow oblong seed beds, the use of the seed bed as an ordinary field after transplanting, and the regular planting of rice in rows.

However, two qualifications are in order. First, it is difficult to agree with Dore that the above mentioned innovations "did not cost anything", since improvements in farm management practices often involve an increase in the demand for additional labour. Secondly, the author himself has also pointed out that a great part of the increase in output was attributed to the use of commercial fertilizers, although "year-to-year fluctuations in the market are unlikely to have had any great effect on the volume of production" [Dore 1969: 118].

The pattern of technological change in both Britain and Japan during the periods under review was characterized mainly by an improvement in farm management practices. In Britain, in particular, almost no new physical inputs were sought from outside the agricultural sector and increases in production were possible by improving the way resources were used. "The essential features of the new techniques of production which characterized the agrarian revolution on the light soils of England were constant tillage, new crop rotations, and a closer association of crops and stock" [Deane 1967:37]. Similarly, in Japan the production of silk and silk fabrics, which accounted for 42 per cent of total merchandise exports from 1868-1930, were produced "almost entirely with indigenous resources" [Johnston and Kilby 1975: 211].

Farm management improvements also took the form of improvement in farm tools. In Britain and other West European countries, "technological changes when it appeared, first took the form not of mechanization but of a switch from lower into higher working capacity hand tools" [Collins 1969: 79]. Similarly, in Japan, simple mechanical innovations were important both in easing labour bottlenecks and in permitting certain operations to be performed efficiently [Johnston and Kilby 1975: 209].

Land improvement activities were also important in both Britain and Japan. In the latter case, for example, small-scale projects aimed at improving water control by realigning paddy fields and irrigation channels and providing drainage for individual fields were initiated in late 19th century [Johnston and Kilby 1975: 207]. Japan has remained a classic example of countries tailoring foreign technologies to their own conditions. The technology that emerged in Japan was a "combination of indigenous know-how and very selective borrowing from the west" [Johnston 1970: 61; Johnston and Kilby 1975:191].⁵

In both Japan and Great Britain, the legitimization and mobilization of indigenous knowledge constituted the basis of technological progress. The case of Japan, as documented by Dore (1969), will be discussed below.

In Japan, the technological development after 1870 was preceded by a tradition of gradual improvements in farming practices. The pre-1870 period saw "considerable innovation in agriculture, slow cumulative changes, evolved and actively preached by men who deliberately recorded and experimented in the conscious hope of making useful innovations. It was, moreover, a literate and articulate concern" [Dore 1969:96]. Then, if there had been gradual improvement before 1870, what was the role of the Meiji Restoration? The state "limited its activity to certain strategic measures that helped to create a favourable environment" [Johnston 1970: 62]. The Meiji Restoration greatly intensified and diffused the insights and knowledge of a class of literate and progressive farmers. The state facilitated the further development and diffusion of available best farm practices "by opening up new sources of technical knowledge and by making the innovator one of the heroes of the new society" [Dore 1969:96]. The state went to the extent of recruiting the best farmers as instructors in agricultural colleges:

In the 1880s the Ministry of Agriculture and Commerce instructed all prefectural governments to encourage the establishment of [such] societies, and a year later 100 leader farmers were invited to Tokyo to consider measures for improving the nation's agriculture. Some of these farmers were appointed as instructors at the newly established Komaba Agricultural College and others were employed as "itinerant instructors" to tour the country and meet with groups of farmers and demonstrate improved farming techniques [Johnston 1970:61].

As the Japanese leaders recognized the limitations of western technologies, they turned their attention toward the traditional sector. As Dore (1969:99) pointed out, "The useful new crops were quickly assimilated: the new methods often proved

unsuitable. After 1880 the emphasis turned back somewhat to more traditional concerns -- improvement within the framework of Japanese agriculture -- by developing new strains of traditional crops, and by diffusing more widely the best practices of particular regions".

In the agricultural congress of 1881, an official of the Ministry of Agriculture talked of the danger of leaping ahead to the new while neglecting what is good in the old. The congress itself was duped as a congress of 'old farmers' assembled together for the purpose of exchanging information about traditional practices in their regions [Dore 1969:99]. Intimate knowledge of the best of traditional methods became the starting point for research in the earlier period of the development of Japanese agriculture [Johnston and Kilby 1975:209; Johnston 1970:61].

The best practices were diffused in different ways, including the exhibition methods, the promotion of agricultural schools and colleges, the removal of restrictions on the inter-regional movement of new techniques, and the promotion of extension activities. Among the relevant functions of extension activities, one interesting method was "to keep an eye open for inventions and improvements which the Minister might reward with prizes and honours" [Dore 1969:100].

The diffusion of the best practice in Japanese agriculture was also facilitated by laying down directives at the communal levels. The individual farm household was pressurized to follow these directives. In this way, "a few energetic 'old farmers' with traditionally supported authority could alter the farming practices of whole villages" [Dore 1969: 105]. Lazy farmers were encouraged to work harder. Wastage of time and resources was avoided. "Holidays, for instance, are fixed for the whole village, and on every week day, bells ring out to mark the hours at which the farmers should go to their fields, the hours at which they make a luncheon break, the hour to come home" [Dore 1969:106-107].

The submission of the individual to the will of the community was facilitated by the Japanese "tradition of paternalistic patron-client relations between landlord and tenant which permitted the 'old farmer' type of landlord to exert a guiding control [Dore 1969:120] over the local people.

The improvement approach, which was adopted in Japan and Britain to varying degrees, was basically land-saving and resource-conserving. In Japan (1878-1917), for example, "gains in productivity were more important than new land in achieving output increases, and suggests that land-saving technological innovations were of great importance" [Ohkawa and Rosovsky 1964:47]. Therefore, a brief review of the implications of such a land-saving technology for labour use is in order.

Land-augmenting technologies are normally labour-intensive. The rate of expansion of the labour supply was one of the sources of agricultural growth in Britain and Japan along with the rate of expansion of new investment and technical progress. The increase in demand for labour in the British agriculture, though less

both proportionately and absolutely than the increase in the total working population, was lucidly described by Johnston and Kilby (1975:88) as follows:

Contemporary historians no longer stress the role of the enclosure movement in making available an abundant supply of cheap labour for the growing manufacturing industries. The newer system of farming, and the land reclamation, hedging, building of farm roads, and other improvements that accompanied enclosures all demanded considerable labour, and it is also pointed out that the work-force engaged in agriculture, forestry, and fishing increased (from 1.7 to 2.1 million between the first census in 1801 and the census of 1851). But this increase was much less, both proportionately and absolutely, than the increase in the total working population.

The increase in demand for labour, in particular, during peak seasons was met in different ways, including the full utilization of the local labour pool and extensive use of the labour of migrant workers. The local labour pool was more fully utilized by mobilizing the labour of local tradesmen, workers in domestic industry and wives and children of agricultural workers. In addition, workers were provided with incentives to work faster and longer hours [Collins 1969:76]. Other means at the farmers' disposal included earlier cutting at the yellow-ripe stage of maturity to add perhaps a week to the front end of the harvest, and staggered sowing to phase out the ripening process [Collins 1969:76-77].

Finally, the question of the relevance of the British and Japanese experience to Ethiopia could be raised. Ethiopia, unlike Britain of the 18th and 19th centuries has, in principle, a technological backlog from which to draw. But, in reality, Ethiopia is unable to make use of the backlog due to the high cost of transfer and inappropriateness of foreign technologies. Japan overcame problems of inappropriateness by adopting western technologies to her own needs and, above all, by legitimizing and developing indigenous techniques of production and resource conservation. Ethiopia, on the other hand, unduly relies on "foreign sources of technology instead of conscious utilization and promotion of indigenous technology and lacks the capability to identify, transfer and adopt technologies that are appropriate to the country's needs" [PDRE 1989:12]. Ethiopia, like Japan of the 19th century, has not yet fully exploited the energies and creativity of the rural population. However, it is doubtful whether today's Ethiopia has favourable cultural heritage (e.g., tradition of literate farmers) that contributed to the success of Japan in fully exploiting the underutilized resources. In Ethiopia, "there has not been a scientific tradition at the grass-roots level" [PDRE 1989:7]. It is possible that cultural values and norms limit the extent to which scientific and technological advances are introduced and diffused throughout the agricultural sector.

It can be admitted that the improvement approach alone may not bring about sustainable agricultural growth. Both Britain in mid-19th century, and Japan, right from the beginning of agricultural change in late 19th century, had adopted other approaches along side the improvement (conservation) approach. In the long-run the improvement approach is bound to give way to other approaches.

In any case, there are lessons that could be drawn from the case of Japan and Great Britain. Some of these lessons are:

- that it is possible to increase agricultural output with small demand on the critically scarce resources of capital and foreign exchange by increasing the productivity of the existing on-farm resources of labour and land;
- that the state (as in Meiji Japan) should limit its activities to certain strategic measures that help to create a favourable environment;
- that during the initial period of growth prices (as in the case of Japan) may not have much effect on the volume of production, although their importance tend to increase over time and that non-price incentives (e.g., improving the social status of the best farmers) may play positive roles in motivating farmers to adopt innovations;
- that the indigenous knowledge systems of the rural population should be incorporated into rural development programmes, specially that intimate knowledge of the best of traditional methods could become the starting point for research in the earlier period of agricultural development; and
- that peasant agriculture has the capacity for absorbing redundant labour as new techniques are introduced (although there may be an upper limit imposed on its absorptive capacity).

Thus, we have strong historical evidence showing the importance of the conservation model during the initial period of agricultural development.

IV. POTENTIALS OF THE IMPROVEMENT APPROACH IN ETHIOPIA: THE CASE OF SOIL, WATER CONSERVATION AND RELATED PRACTICES

It is possible that substantial increases in agricultural production could be attained in the short-run through improvements in farm management efficiency (see, for example, Tamirie Hawando 1989:266).

The possibility that agricultural production can significantly be increased without the use of the high-yielding varieties and commercial fertilizers but with improvements in farm management efficiency can be illustrated with Tamire Hawando's findings in Hararghe Highlands of east Ethiopia where, according to him, the soil is severely eroded [Tamirie Hawando 1989:266-272].

The effect of soil and water conservation on yield can be cited as an example. Before illustrating the advantages of soil and water conservation for crop yield, we will point out that the extra cost involved is essentially limited to labour cost. The basic activities involved in soil and water conservation (in land improvement) are largely labour-using. The essence of these activities consists of: (1) checking run-off during torrential rainfall; (2) allowing the rain water to infiltrate into the soil profile to be stored for further use by crops; and (3) utilizing the crop residue as mulch and source of organic matter to enhance the conservation of soil moisture and to check

soil erosion [Tamirie Hawando 1989: 266-267]. The significance of simple, agronomic soil conservation techniques is discussed by Wood (1990).

The advantages of land improvement for crop yield increases can be illustrated at two levels, i.e., at the research level and on farmers' fields. The research level results were as follows:

The five year average maize grain yields under tied ridges were compared to the grain yield of maize with no tied ridges (flat land). The yield increment for maize grain under tied ridges over the control was 16.5 quintals/hectare (an advantage of 579.3 Birr/ha.). With no nitrogen fertilizer, i.e. using the conservation practice only, maize yield increment over the control was 12.4 quintals per hectare... Similar results have been documented for sorghum also [Tamirie Hawando 1989:267].

Similarly, the five-year average incremental sorghum grain yields observed in four locations on farmers' fields with soil bunds over those with no bunds ranged from 8.26 q/ha. to 20.8 q/ha. "In monetary terms, the farmers with soil bunds received an additional income ranging from Birr 329.8 to Birr 832.4 per hectare" [Tamirie Hawando 1989:268].

Similar findings were also reported by other studies. For example, Yohannes Gebre Michael (1990:51) reported that the average barley yield for three seasons was raised from 9.4 q/ha. to 13.8 q/ha. as a result of improvements in soil conservation techniques introduced in Northern Shewa.

Food availability can also be increased by making simple improvements in traditional storages facilities. In one study, it was estimated that "the elimination of both pre-harvest and post-harvest food losses could feed some 3.6 million hungry people" for one year [Yemane Kidane and Yilma Habteyes 1989:426].

Other methods of improving farm management efficiency are the following: the use of improved farm tools; improvements in the working capacity of draft animals; improved methods of crop cultivation (better ways of seed selection, tilling the land, planting and harvesting); the development of small-scale irrigation projects; improved uses of manures; and the use of better animal feeds. The major cost component of most of these techniques is household labour, the opportunity cost of which may approach zero.

V. TOWARDS A MODEL OF AGRICULTURAL GROWTH FOR ETHIOPIA

The improvement approach alone cannot be relied upon as the source of agricultural growth. Other approaches should also be considered if significant and sustainable growth in per capita output is to be realized. One approach is, of course, the transformation approach (the high pay-off model) which, though costly, is capable of ensuring long-term growth in per capita agricultural output. Another approach is the removal of possible X-inefficiency [Leibenstein 1966] in peasant agriculture. The

underlying assumption of the latter approach is that all farmers are not equally competent in maximizing output per unit of physical input even if they are homogeneous with respect to access to physical resources. Put differently, some farmers operate within the production possibilities frontier. In that case, output per head can be increased through a movement towards the frontier. This approach involves no use of new techniques of production; what it requires is the full utilization of existing resources or improvements in how available resources are used. A movement towards the frontier involves essentially increased *effort* on the part of the farmer. The major opportunity cost of such a movement, in a rural setting where wage labour rarely exists, is the farmer's leisure time and it can be assumed that, in the context of rural Ethiopia, leisure (excluding social and cultural obligations) is an inferior good within a limited range of per capita income.

The following illustrates how the three approaches can be combined to bring about a take-off into sustained growth. Assuming that two competitive products, coffee and maize, are produced, the original production possibilities frontier is depicted by P_0P_0 (Figure 1). Phase I of development involves a movement towards the frontier along line AB. Phase II involves a modest shift in the frontier resulting from the widespread implementation of the improvement approach. The third phase signifies a period of take-off into sustainable growth in per capita agricultural output on the basis of the transformation approach (the high pay-off model).

Each phase of productivity growth corresponds to different phases in patterns of resource use. The transition from phase I to phase III is characterized by development in patterns of resource intensification (Figure 2). Labour intensive techniques are employed throughout the first and the second phases of development. It is in the third phase that capital intensive techniques are used.

In each phase of development, emphasis is placed on different policy instruments. During the first two phases, the state should limit its activities to certain strategic measures (e.g., provision of infrastructure) that help to create a favourable environment. It is in the third phase that price incentives play a critical role. During this phase market imperfections are removed and inter-sectoral commodity flows become important.

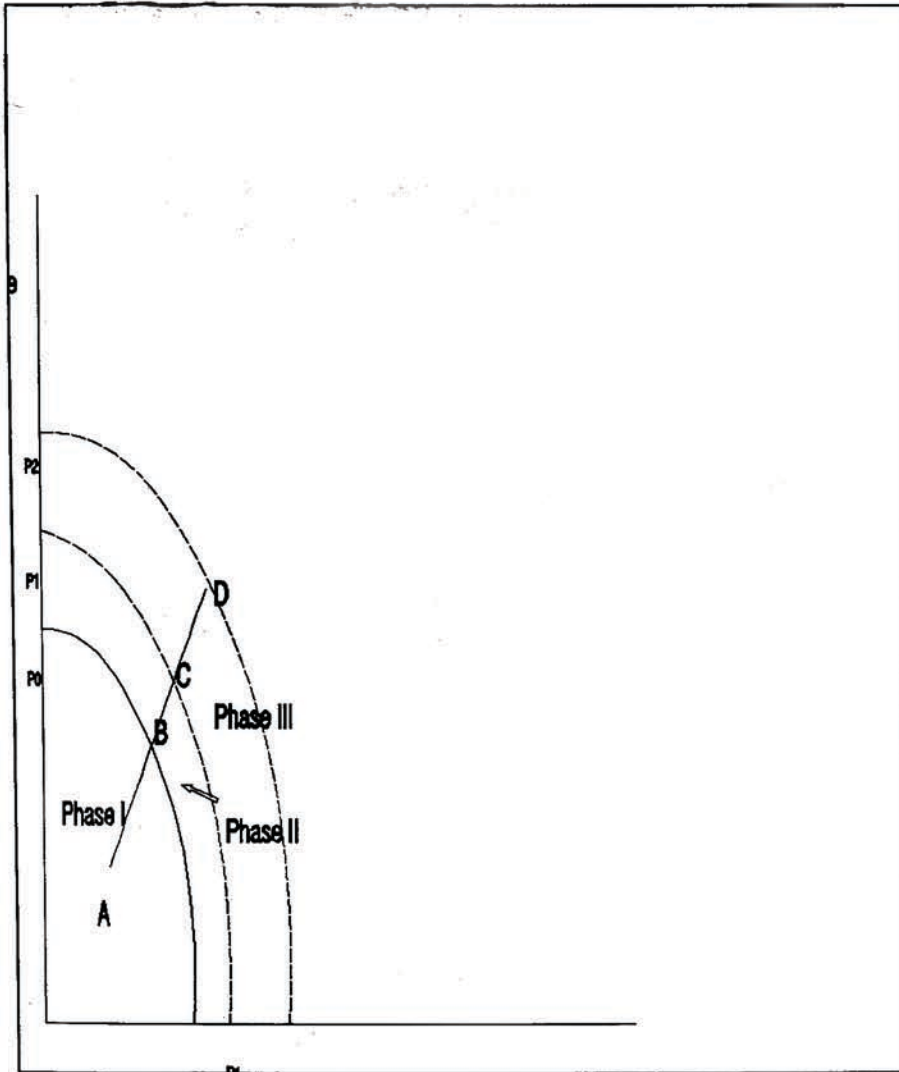


Figure 1: Phases in Productivity Growth: Illustration with Production Possibility Frontier

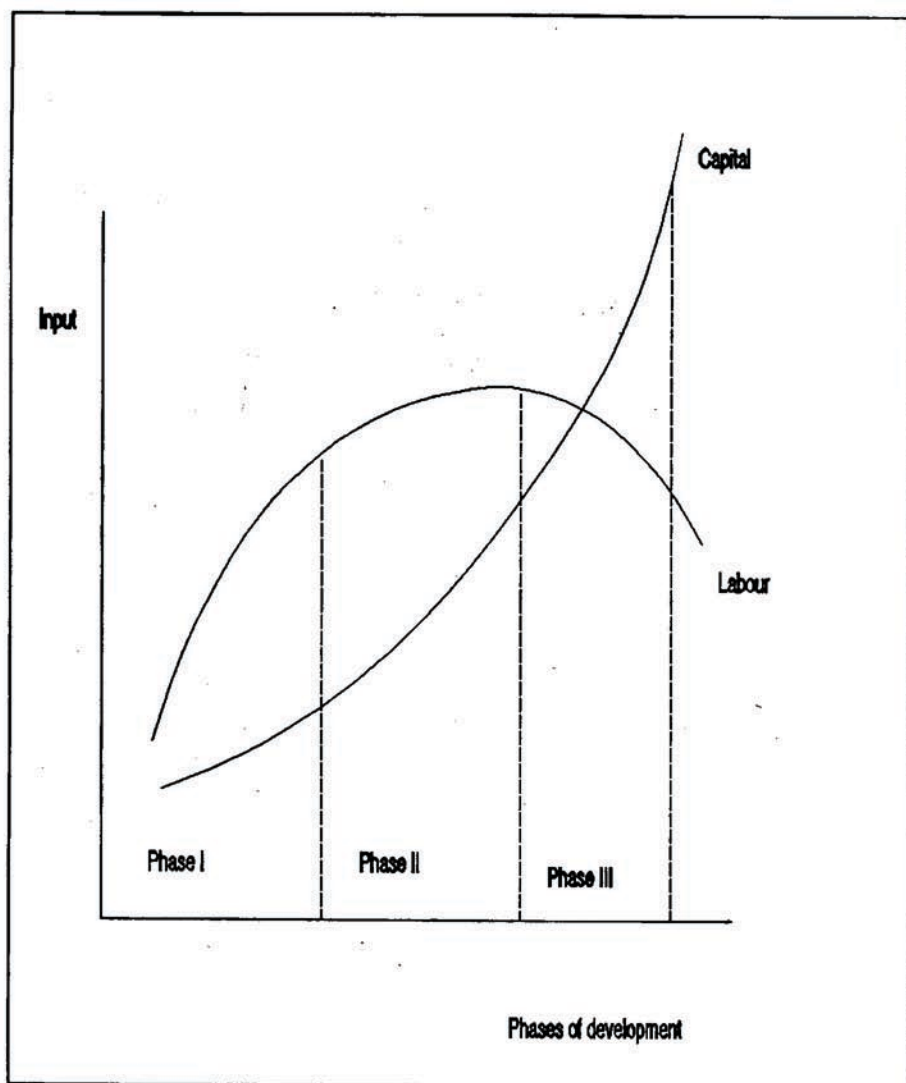


Figure 2: Phases in the Development of Intensification

NOTES

1. The framework of this section is drawn from Ruttan (1984: 38-46) and Hayami and Ruttan (1985:41-59).
2. Regarding the other models, the interested reader can refer to Ruttan (1984: 38-46) and Hayami and Ruttan (1985:41-59).
3. The periods under review are: 1750-1850 in Great Britain and 1870-1900 in Japan. In the former case, most of the innovations that spread during the period 1759-1850 had already emerged earlier.
4. "Meiji Japan" refers to the period of the restoration of the Meiji dynasty in Japan. The Meiji dynasty made important institutional reforms which created conducive situations for technological change in agriculture.
5. Though the thrust of this paper is the importance of the improvement (incremental) approach in agricultural development, it should be noted that Japan had adopted the high pay-off model as early as the last quarter of the nineteenth century. The latter model later became widespread, and, finally, displaced the former as agricultural productivity increased.

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