Models of Agricultural Development

Any attempt to value a meaningful perspective on the process of agricultural development must abandon the view of agriculture in premodern and traditional societies as being essentially static. Historically, the problem of agricultural development is not one of transferring a static agricultural sector into a modern dynamic sector but one of accelerating the rate of growth in agricultural output and productivity consistent with the growth of other sectors in a modernizing economy. Similarly, a theory of agricultural development should provide insight into the dynamics of agricultural growth (that is, in to the changing sources of growth), in economies ranging from those in which output is growing at a rate of 1 percent or less to those in which agricultural output is growing at an annual rate of 4% or more.

Agricultural development can be represented by five general models:

The frontier model
The conservation model
The urban-industrial model
The diffusion model
The high-payoff model

The Frontier Model

Throughout most of history, expansion of the area cultivated or grazed has represented the main way of increasing agricultural production. The most dramatic example in Western history was the opening up of the new confinements, North and South America and Australia, to European settlement during the 18th and 19th centuries. With the advent of cheap transport during the latter half of the 19th century, the countries of the newly opened continents became increasingly important sources of food and agricultural raw materials for the metropolitan countries of Western Europe.

In earlier times, similar processes had proceeded, though at a less dramatic pace, in the peasant and village economies of Europe, Asia and Africa. The first millennium AD saw the agricultural colonization of Europe north of the Alps, the Chinese settlement of the lands of

south of the Yangtze, and the Bantu occupation of Africa south of the tropical forest belts. Intensification of land use in existing villages was followed by pioneer settlement, the establishment of new villages, and the opening up of forest or jungle land to cultivation. In Western Europe there was a series of successive changes from Neolithic forest fallow to systems of shifting cultivation on bush land and grassland followed first by short fallow systems and in recent years by annual cropping.

According to Von Thuenen, the frontier model is based on the assumption that land is physically infinite had it not been for transportation costs and problem of accessibility. In his model, transport cost and accessibility play a crucial role in determining the land rent and the agricultural frontier, and thereby land area under cultivation. In this approach, land is assumed to be homogeneous, and differ only by the location as measured by distance from a center (Village). Thus, land is assumed physically infinite. There is, however, scarcity of good land that is land close to the center (land with low distance cost). Where soil conditions were favorable, as in the great river basins and plains, the new villages gradually intensified their systems of cultivation, Where soil resources were poor, as in many of the hill and upland areas, new areas was opened up to shifting cultivation or to nomadic grazing. Under conditions of rapid population growth, the limits to the frontier model were often quickly reached. Crop yields typically were low, measured in terms of output per unit of seed rather than in output per unit of crop area. Output per hectare and per person hour tended to decline, except in the delta areas such as those in Egypt and South Asia and the wet rice areas of East Asia. In many areas the result was the worsening of the wretched conditions of the peasantry.

There are relatively few remaining areas of the world where development along the lines of the frontier model will represent on efficient source of growth during the last quarter of the 20th century. The 1960s and 1970s saw the “closing of the frontier” in most area of South East Asia. In Latin America and Africa, the opening up of new lands await, the development of technologies for the control of pests (such as the tsetse fly in Africa) and diseases or for the release and maintenance of productivity in problem soils. This century can be seen as the transition from a period when most of the increases in world agricultural production occurred as a result of expansion in areas cultivated to a period when most of the increase in crop and animal

production will come from increases in the frequency and intensity of cultivation. In the future, growth in agricultural production must come from changes in land use that make it possible to crop a given area of land more frequently and more intensively and hence to increase the output per unit area and per unit of time.

The Frontier Model-Ethiopian context

In the Ethiopian case, given the subsistence agriculture dominated by cereal - producers who produce 80% of total agricultural output, given the primitive and unchanging technology, the means to increase output has been observed to be through increasing the size of farmland. This ensures that "with traditional agricultural technologies, farm production is almost completely dependent upon the natural resource available". This justifies the application of the frontier theory in Ethiopia wherein agricultural production among the smallholders is almost completely dependent up on the available natural resource (land mainly). The land expansion approach is also stated and used in practice implicitly by the investment policy of Ethiopia. As mentioned above, the farming system applied by the small holders in Ethiopia has primitive and unchanging technological base that implies the practice of extensive farming system. Thus, the structure of the economy, the farming system used among the small holders as well as the investment proclamations for the large scale commercial farmers are based on the notion of frontier agricultural development model.

As to the explanatory power and the relevance of the model to the Ethiopian case, it is possible to see the matter from another angle. In principle, the approach is recommended to farm unused land so that increasing production is by increasing the gross catchment area of overall cultivation. In practice, however, such unused land in Ethiopia is pertaining to marginal areas along gorges and mountains, located out of commonly required infrastructures with many human and animal diseases. This makes such locations mainly inaccessible, exposed for erosion and/or reserved as forest for conservation purposes. Such conditions in turn may lead to conflicts with the environmental protection and conservation objectives of the country since the government is exercising conservation based agricultural development strategy. On the other hand, it will entail huge/extra costs for preparatory and infrastructural works before the main investment, to retain

competitiveness during operation and for additional overhead expenditures to sustain related extra duties.

At the other observation, the legalized model as policy instrument for the country can be related to the nature of the resources. In this respect, as many development thinkers conclude, none of developing countries are absolutely deficient of the required resources for their development but they are owners of under developed resources. These resources are underdeveloped due to various inhibitions such as their inaccessibility, lack of technical knowledge, non-availability of capital and the small extent of markets. Thus, the available resource in Ethiopia has to be evaluated in light of such perspective since the' new lands' recommended for cultivation are not free of the inhibitions.

According to the model and from the large-scale commercial farming point of view, therefore, there should be available free land resource sufficiently and favorably enough to all the demands of the investors. However, the free land may not be endless and favorably available at the commonly expected cost and technology. This is because uncultivated land usually is of lesser quality &/or more costly to develop than the currently farmed. Much of currently uncultivated land needs irrigation, drainage, stone or tree removal, or other investment before it can be farmed profitably. This is practically true for Ethiopia and hence investors will lose competitive power as they went out of the center to uncultivated areas.

Specially, the possibility of applying frontier approach at the high lands of Ethiopia is closed many years ago. At the highlands, there is very high population pressure, overgrazing, and the land has been under cultivation for long period. Even the relatively land abundant regions do not have such abundant and accessible free land for all kinds of farming needs, given the existing farming system. In addition, all such areas are not absolutely free in that some are commonly under use for farming practices other than cultivation. For instance, the Afar, Benshangul, Gambella and some parts of Southern Regions 'free land' areas are used for either grazing or covered by forests. In short, the free land potential is also to be evaluated from long term perspective of development issue such as with questions of environmental problems and sustainability in agricultural development. Moreover, the actual free land potential has to be known by undertaking up-to-date land resource inventory along with indicating the trends and

changes in the demand for land before arriving at conclusions on the time and places of importance of the model for Ethiopia.

In general, this option (applying frontier model as policy framework in Ethiopia) has a very limited and short time possibility so that it can't be taken as a means to develop/modernize the sector for long run and countrywide purpose. Therefore, frontier approach is not a priority policy option since the Ethiopian farmers' and farming practices are of such natural trends. In addition, this approach in theory and the practice in Ethiopia is the real source of deforestation, degradation, over grazing, erosion, etc. which is also against the conservation based development strategy and need in the country.

The conservation Model

The conservation model of agricultural development evolved from the advances in crop and livestock husbandry associated with the English agricultural revolution and the concepts of soil exhaustion suggested by the early German chemists and soil scientists. The conservation Model is concerned with the application of the laws of diminishing returns to agricultural sector with the assumptions that: land for agricultural production is scarce and becoming more so, Soil exhaustion is possible and action to prevent decreases in yields or to increase land productivity will have only slow effect at best. Thus, "as land scarcity increases, poorer land is used causing the marginal productivity of labour and land to decrease. To prevent these declines, high priority is attached to maintaining soil productivity at its present level or attempting to return the soil to its 'original' presumably more productive level" in the extreme conservation model.

The conservation Model with Ethiopian context

To evaluate the relevance of the model in Ethiopia, it is helpful to assess the ground that justifies the application of the model. According to the 'Ethiopian Highlands Reclamation Study', the ecological and economic loses of land degradation and soil loses are proved to be tremendous. In 1983, degradation was estimated to cost Ethiopia for about 600 million birr per annum, which was found to be equal to 14% of the contribution of agriculture to GDP of the time. In terms of lose of cereal production, it was expected to amount about 120,000 tons annually in the early 1980's (FAO, 1986, 7-8). As a result, conservation model was and is still a practical response to

such alarming rate of loses. In effect, policies favoring the control/conservation measures have started to be practiced in Ethiopia since late 1980's and are getting further emphasis at present.

In the current socio-economic development policy of Ethiopia, the development strategy of agricultural sector emphasizes that the development effort should be in line with a guiding principle of conservation based agricultural development strategy. As a result, Conservation Model has explicit legal and policy bases of application in the country. The fact that conservation and environmental issue is being implemented at an authority level is showing the importance given to it Ethiopia. The question of sustainability is mire emphatically and explicitly stated aspect of the model in the current policy papers of the country although economic results could not prove the same.

In general, after considering ADLI as priority task in the macro development strategy in current Ethiopia, there are few new inclusions in relation to agricultural development efforts in the policy frame works ensuring the application of conservation model (including the issues of sustainable agriculture and environmental protection). One is the establishment of Environmental Protection Authority, with relevant regional and zonal offices, that formulates and implements rules and regulations regarding the use of the lands, water and natural resources of the country. The other is a recent regulation to control the uses of agricultural chemicals impacts on the control of various diseases, insects, weeds and vegetable pests which will in turn contribute a lot to the sustainability of agriculture. The third one is pertaining to Ethiopia being signatory of international convention on environmental protection which strengthens efforts to control the existing and potential environmental degradation. Though it is not directly related to conservation model, there is also a fourth very recent attention as to improving the pastoral farming system, which is practically at a premature stage to give any comment on it. Similarly, although it is at an implant level, the current issue and practices of Poverty Reduction Strategy following the international focus, is being practiced by independent office in Ethiopia. As a result, it can be deducted that this is a fifth new policy framework that has influence on the agricultural sector and conservation strategy of the country.

The Urban-Industrial impact model

According to the conservation model, locational variations in agricultural development were related primarily to differences in environmental factors. Whereas the urban-industrial model stands in sharp contrast to conservation model by interpreting the geographical differences in the level and rate of economic development primarily in terms of the level and rate of urban-industrial development. This model relates agricultural productivity and development with the distance from & development effects of urban/ industrial areas. It is derived from the Recardio's theory of rent and John Von Thuenen's spatial model. Von Thuenen hypothesized that the determinant factor of productivity and development in agriculture to be the distance and cost of transporting agricultural products to the urban market, i.e. bulky and perishables tend to be near urban and industrial areas while the less perishables tend to be produced far away on lower cost land. In addition, Ruttan (1988) gave conclusions on how industrial development stimulates agricultural development by expanding demand for farm products, supplying the industrial inputs needed to improve agricultural productivity and drawing away surplus labour from agriculture.

Initially, the urban-industrial impact model was formulated by von Thunen in Germany to explain geographical variations in the intensity of farming systems and in the productivity of labour in an industrialized society. In the US it was extended to explain the better performance of the inputs and product markets, which link the agricultural and non-agricultural sectors, in regions characterized by rapid urban-industrial development than in regions where the urban economy had not made a transition to the industrial stage. In the 1950s, interest in the urban-industrial impact model reflected a concern with the failure of agricultural resource development and price policies adopted in the 1930s to remove the persistent regional disparities in agricultural productivity and rural incomes. The rationale for this model was developed in terms of more effective factor and product markets in areas of rapid urban-industrial development. Industrial development stimulated agricultural development by expanding the demand for farm products by supplying the industrial inputs needed to improve agricultural productivity, and by drawing away surplus labour from rural areas. The empirical tests of the model have repeatedly confirmed the importance of a strong non farm labour market as a stimulus to higher labour productivity in agriculture.

Urban Industrial Impact Model with Ethiopian context

This model can be said partially practiced in Ethiopia when the first effort was made to develop the economy in 1945 when the ten-year program of industrial development was prepared. At that initial stage of the policy practice, industrial development was believed to change and develop the whole economy, while the remaining sectors were considered to change and develop as a result of the industrialization. Thus, it is said partial for that spatial factor (urbanization by its merit) was not stated explicitly. By implication, the model has also been partially exercised in the subsequent few urban as well as industrial development policy, planning practices and budgetary allocations of the country. Although, all policies, plans and strategies on paper say a lot about the importance of agricultural sector, the practices were far from the promises. As a result, the agricultural sector of Ethiopia did not get the right share in budgetary allocation as much as its contribution and expected role to play in the development of the whole economy. By this analysis, the spirit of industrial fundamentalism and urban industrial impact models is not eroded although both the industrial as well as agricultural sectors couldn't show any transformations since long in the country.

In fact, different packages were exercised to improve the agricultural sector at the end of the imperial period but the result was neither nationwide nor sustainable. The inability to transform the agricultural sector of the imperial regime was related to 1) the weaknesses of the model to capture the real condition of the country 2) the very devastating drought which affected Northern Ethiopia that eroded the very marginal effects of development efforts of the time and 3) the international effect of the oil crisis in the middle East that had also negative impact in the overall economic activities of the country. In fact, the average result of the overall policy was successful in initiating the development of industrial sector had it not been for the combined effect of the oil shock and drought which resulted in slow down of the economy that led to eventual collapse of the regime.

The Diffusion Model

In the diffusion model, agricultural development is assumed to be based on devoting considerable resources to a)'' increasing the flow of information to farmers about new agricultural technology and new institutional arrangements and b) teaching tradition bound

farmers how to make more economically rational management decisions about the uses of resources they have access to". Moreover, it is an approach recommended from observed variations of land and labour productivities among farmers and regions as evidenced empirically. The route to agricultural development in this model was viewed to be through more effective dissemination of technical knowledge and a narrowing of the productivity difference among farmers and among regions using extension workers.

This model provided the major intellectual foundation of much of the research and extension effort in farm management and production economics since the emergence, during the latter years of the 19th century, of agricultural economics and rural sociology as separate sub-disciplines linking the agricultural sciences and the social sciences. The developments that led to the establishment of active programs of farm management research and extension occurred at a time when experiment station research was making only a modest contribution to agricultural productivity growth. Empirical findings have indicated that the location specific nature of agricultural technology had become a great limiting factor of the diffusion of much agricultural technology. Hence, in any area, "agriculture usually requires much local adaptation of farming practices." A further contribution to the effective diffusion of known technology was provided by the research of rural sociologists on the diffusion process. Models that emphasized the relationship between diffusion rates and the personality characteristics and educational accomplishments of farm operators were developed.

The limitations of the diffusion model as a foundation for the design of agricultural development policies become increasingly apparent as technical assistance and community development programs, based explicitly or implicitly on the diffusion model, failed to generate either rapid modernization of traditional farms and communities or rapid growth in agricultural output. More specifically the limitations in the diffusion model are indicated to be first, they noted, in line with Schultz's argument, that traditional farmers have good knowledge of available traditional technology and are effective allocators of their resources. Hence, extension efforts devoted to trying to teach these farmers as how to improve the allocation of their traditional resources are wastage. Secondly, there has often been little new agricultural technology available in LDCs that would be productive if diffused. Third, extension personnel have often not been well trained and

thus they have not been able to successfully transfer to farmers the available useful knowledge. Fourthly, these extension agents have generally lacked detailed personal knowledge of agricultural and social conditions in the areas they were supposed to improve, as they have often been outsiders, government appoints from urban or other parts of the nation.

The Diffusion Model with Ethiopian context

The practice in Ethiopia has proved similar condition with the preceding worldwide experiences. Although the initial efforts of extension activities on disseminating and demonstrating fertilizer application, partially improved seeds cultivation and new farming practices have shown good results, it could not be sustained. The effort to acquaint farmers with new farming practices has not registered significant result event at the beginning. The reason for all is that, on the one hand, per head income of farmers is not so much enabling to go beyond the common expenses. On the other hand, the prices of inputs are continuously increasing so that limiting further diffusion among the smallholder farmers of Ethiopia. Moreover, the contribution of communication system such as newspapers, magazines, radio and television etc., which are commonly recommended in theories by the model, are almost irrelevant to the Ethiopian farmers at the rural areas where there is no the network of or access to such systems and most of the farmers are illiterate.

However, for the Ethiopian case, the diffusion model has relatively better importance, wider bases for practices as well as strong sides for applications as compared to others. In fact, currently in Ethiopia, there is a new extension demonstration and training program of this model type. This program could change production and productivity level although the result is not significant and could not be sustained. As to the extension agents, the workers are recruited from the localities where they are supposed to be assigned so that they know sufficiently their areas/societies of their assignment which is one of the bottlenecks of diffusion otherwise.

The High-pay off input Model

The inability of models constructed based on geographic size; physical features as well as sectorial baisedness to explain and catch the development problems of agricultural sector have led to conceiving of and shifting to other alternatives. Among such alternatives, application of

technological or industrially produced inputs to the agricultural sector was recommended specifically to improve the failures of conservation, urban industrial impact, industrial fundamentalism and diffusion models. According to this new conception, transformation of traditional agriculture was believed to be undertaken by investments aimed at increasing the availability and supply of modern high pay off inputs to farming activities. In this model the notion of Peasants of poor countries are assumed to be efficient, rational resource allocators within their farming system except to the lack of technical and economic opportunities are taken for granted. Proponents of the High-pay-off-input model argue that peasants in developing countries remained poor because there were only limited technical and economic opportunities to which they could respond. The supply of new technological inputs and the availability of such opportunities, therefore, could enable the traditional farmers to make uses of the chances and overcome their poverty. According to Schultz, new high pay off inputs is the capacities of

1) Public and private sectors research institutions to produce new technical knowledge
2) The industrial sector to develop, produce and market new technical inputs and
3) Farmers to acquire new knowledge and use new inputs efficiently.

Based on these facts, it was hypothesized that investment in agricultural technology development and human capacity building could enable to produce more productive technologies and productive farming people. This in turn could lead to generate new technologies, adopt the available ones to the economies of poor countries and overcome the problems of inappropriateness of the inputs produced by the 'body of knowledge' in advanced countries. In addition, such investments would improve the availability and prices of modern agricultural inputs which could be determinant to growth of the agricultural sectors of poor countries.

The model is also said to be incomplete theory of agricultural development in that the mechanism by which resources could be allocated among non marketed/non traded, public goods such as education, research and the like was not included. Moreover, the model "doesn't explain how economic conditions induce the development and adoption of an efficient set of technologies for a particular society.

High-Payoff Inputs Model with Ethiopian context

Although this model is criticized for the problems of inapplicability at the micro level, it is implicitly applied in Ethiopia. For instance, the institution for Rural Technology is trying to produce and introduce new inputs and equipment designed for improved agricultural production and productivity but practically unable to be fully effective. The main reason is that some of the materials produced entail a large amount of money as compared to the financial background of the farmers.

The Rural Technology centers (started since long during the then Dergue regime and functional still) have dimensions of diffusion model as well. In fact, the dissemination of materials produced/installed at demonstration level also failed mostly because of the activities being without the participation of peasants from the very beginning. That is, it was out of the knowledge and interest of the 'beneficiaries' from the outset. However, at all the costs, the trials did give lessons that have and would have commutative effect in the long run.

The Indian Green Revolution Experience

Beginning in the 1950s there was an increasing preoccupation with the problem of feeding a rapidly growing world population. The goal of increasing per capita income was to be matched by rising per capita food production through the green revolution, largely funded by the international donor community and engineered by the international Agricultural Research Centres (IARCs). In essence it focused on three interrelated actions: breeding programmes for staple cereals that produced early maturing, day-length insensitive and high-yielding varieties (HYVs); the organization and distribution of packages of high pay off inputs, such as fertilizers, pesticides and water regulation and implementation of these technical innovations in the most favorable agroclimatic regions and for those classes of farmers with the best expectations of realizing the potential yields.

The green revolution development strategy has relatively been successful in India and some other Asian countries. Nevertheless, much of Indian green revolution success was accompanied by several problems such as inequity, instability and sustainability problems particularly. For instance, while produces have widely adopted the new HYVs irrespective of farm size and

tenure, factors such as soil quality, access to irrigation water, and other bio-physical-agroclimatic conditions have been formidable barriers to adoption. Farmers without access to the better endowed environments have tended not to benefit from the new technologies, which partly accounts for the relative lack of impact of the green revolution. But even under favorable conditions in Asia or Latin America, a significant gap persists between performance on the agricultural research station and in the farmer's field.

Intensive monocropping with genotypically similar varieties has also led to increasing incidence of pest, disease and weed problems, sometimes aggravated by pesticide use. There are now signs of diminishing returns to the HYVis and high pay-off inputs in intensive production. Perhaps, more important, the experience on less well-endowed farms suggests there are real limits to replicating the successes of current green revolution technologies and packages in more marginal agricultural areas. The problems, moreover, have not only been due to inappropriate technologies but to the nature of the accompanying national agricultural policies. These have tended to be short-term in nature, focusing exclusively on output growth and ignoring both the small farmer and the continuing degradation of the resource base. Credit, tenure and marketing arrangements have tended to favor the adoption of the new technologies by larger rather than smaller farmers, while uniform pricing structures and standardized criteria for support services have encouraged in appropriate cropping patterns and their associated technologies. In these and many other respects such policies are diametrically at odds with the goal of sustainable development.