industrial impact, (4) the diffusion, (5) the high-pay off input and (6 induced innovation. A brief statement of each model is as under:

Frontier Model: From the beginning of the civilization expan of the area cultivated or grazed has represented the dominant sour increase in agricultural production. In the earlier phase of the his the discovery of new continents such as North and South America Australia became increasingly important source of food and agr tural raw materials for the development of the metropolitan coun of Western Europe. Later on intensification of land use in vill establishment of new villages agricultural colonization and openin forest or jungle land to cultivation in Europe, Asia and Africa contin the process of increasing agricultural production by the expansiq area cultivated.

In favourable soil conditions such as in the great river basins plains, new villages gradually intensified their system of cultivatio the favourable soil conditions such as in hilly and upland regions areas were opened up to shifting cultivation or nomadic grazing.

The limits of frontier model were quickly realised under the c dition of rapid population growth. Crop yields were low in term output per unit of seed rather than per unit of crop area. Output hectare and per man-hour tended to decline. Up to 1960, there were areas of the world where this model could present an efficient sourd growth. 1960's saw "closing of the frontier" in most areas of South Asia.

Conservation Model: The conservation model of agricultd development evolved series of advances in crop and livestock h bandry. The application of law of diminishing returns to labour capital was introduced. The model also emphasized the evolution sequence of increasingly complex land and labour intensive cropp systems, the production and use of organic manures, and labour-int sive capital formation in form of drainage, irrigation and other phys facilities to more effectively utilize land and water resources. The inp used in this conservation system of farming – land improveme agricultural labour force, physical capital, animal power and pl nutrients – were all largely produced or supplied by the agricultu sector itself.

This model has capable in many parts of the world of sustain rates of growth in agricultural production in the range of 1.0% per y over relatively long period of time. And it was the only approach intensification of agricultural production available to the most world's farmers. The model remains an important source of produ

vity growth in most poor countries and an inspiration to agrarian
ndamentalists and the organic farming movement in developing
untries.

Urban-Industrial Impact Model: Initially the model was
eveloped in Germany by J.H. Von Thuman. He explained geographic
ariations in the intensity of farming system and the productivity of
bour in an industrializing society. Later on, the model was extended
explain the more effective performance of the input and products
arkets linking the agricultural and non-agricultural sectors in regions
aracterised by urban-industrial development than in regions where
e urban economy had not made a transition to the industrial stage.

The rationale of the model was develop in terms of more effective
put and product markets in areas of rapid urban-industrial develop-
ent. It is said that industrial development stimulated agricultural
evelopment by expanding demand for agricultural products, supply-
g industrial inputs needed to improve agricultural productivity and
rawing away surplus labour from agriculture. The empirical tests of
e urban-industrial impact model have repeatedly confirmed that a
rong-non-farm market is an essential pre-requisite for improving
bour productivity and the incomes of the rural population. This
odel appears to be more relevant for rapidly growing less developed
ountries.

Diffusion Model: The spreading out of agricultural products and
imals from the new-world to the old – rubber, maize, potatoes and
assava – and from the old world to the new – wheat, sugar, and
omestic animals was an important by-product of trade during fif-
eenth to the nineteenth century. The diffusion approach is based upon
e empirical observation of substantial differences in land and labour
productivity among farmers and regions. In this view, agricultural
development is considered to be based upon effective dissemination of
technical knowledge and upon narrowing of the productivity differen-
ces among farmers and among regions.

The diffusion model provided the basis of the research and exten-
sion effort in farm management and production economics. It also
helped in providing the intellectual foundation of the research of
agricultural economics and rural sociology as a separate subdisciplines
linking the agriculture and the social sciences. During 1960, the limita-
tion of diffusion model as a basis for the design of agricultural develop-
ment policies became apparent as technical assistance and rural
development programmes based on this model failed to generate either
rapid modernisation of traditional agricultural communities or rapid
growth in agricultural production.

High-Pay Off Input Model: The inadequacy, limitation failure of aforeşaid models led to a new perspective in 1960 and was transforming a traditional agricultural sector into a produ source of economic growth through investment on making modern high-pay off inputs available to farmers in poor countries. This was developed by T.W. Schultz in his book; Transforming Traditio Agriculture. He insisted that farmers in traditional societies remai poor because there were only limited technical and economic op tunities available to them. The new, high-pay off inputs provide th (1) new technical knowledge; (2) new technical inputs and (3) techn of using new inputs effectively.

This model has been accepted with great enthusiasm. New hi productivity grain varieties has been successfully developed in Me and new High-Yielding rice varieties has been developed in the phi pines. These varieties were highly responsive to industrial inputs s as fertilizer and other chemicals and to more effective soil and w management. The high returns associated with these new varieties a the associated technical inputs and managements practices have le rapid diffusion of the new varieties among farmers in a numbe countries in Asia, Africa and Latin-America. India is one of s countries where H-Y-V programmes has been successfully adopted

Induced Innovation Model: The high-pay off model also sho various limitations and was incomplete on various counts. It was complete in the sense that it failed to incorporate fully the mechani where resources are allocated among education, research and ot public and private sector economic activities. It failed to explain h economic conditions induce the development and adoption of an e cient set of technologies for a particular society. Not it attempted explain the process by which input and product-price relationshi induce investment in research in a direction consistent with a natio particular resource endowments.

These limitations led Yujiro Hayami and V.W. Ruttan to devel a model of agricultural development in which technical change treated as endogenous rather than an exogenous factor to the develo ment process.[14]

The productivity levels of the farmers in most advanced countri are high which reflects the level of technical progress achieved by the countries. These levels are not available in most low-productivit countries. They can be made available by investing on agricultur research needed to develop technologies appropriate to the countrie natural and institutional environment and by investing on physical an

institutional infrastructure needed to realise the new production potential opened up by technological advances.

It has been historically proved that technology has been developed to facilitate the substitution of relatively abundant (hence cheap) factors for relatively scarce (hence expensive) factors of production. The constrains imposed on agricultural development by an inelastic supply of land have been removed by the development of High-yielding crop varieties designed to facilitate the substitution of fertiliser for land. Similarly, the constraints imposed by an inelastic supply of labour in most advanced countries have been removed by technical advances leading to the substitution of animal and mechanical power for manpower.

Developing countries which are incapable of evolving technical and institutional innovations in agriculture suffers two major constraints on its development of productive agriculture. One is that they are unable to take advantage of advances in biological and chemical technologies suited to labour-intensive agricultural systems. And second is that their size of farming is small and hence the imported technology will not work productively. The imported technology will be useful only under conditions of large-scale agricultural organisation.

During the last two decades number of developing countries have begun to establish to institutional capacity to generate technical changes based upon national and regional resource endowments. A new system of international crop and animal research institutes has also emerged which became both important source of new knowledge and technology and increasingly effective communication links among the developing national research systems.

The lag in shifting from a natural-resource-based to science-based system of agriculture continues to be a source of national differences in land and labour productivity. Lags in the development and application of knowledge is also an important source of differences in regional productivity within the countries. In countries like India differential rates of technical change have been an important source of the widening disparities in the rate of growth of total agricultural output, in land and labour productivity and in incomes and wage rates among regions. Hence, productivity differences in agriculture are increasingly a function of investments in science and industrial capacity and in the education of rural people sector than of natural resource endowments.

The effects of education on productivity are particularly important during periods in which a nation's agricultural research system begins to introduce new technology. In a condition of static technology, the

gains from education to be realised are few in rural areas. Rural peop who lived for generations with the same resources and with the sam technology have learned from long experience what their efforts can g out of the resources available to them. The skill which the childre acquire from their parents are worthwhile. Formal schooling has litt economic value in agricultural production.

This situation changes as soon as the new technical opportuniti are available. Technical changes need the acquisition of new husband skill; acquisition from non-traditional sources of additional resourc such as new-chemicals, new-equipment new-seed and new-skills i dealing with both natural resources and input and product mark institution linking agriculture with the non-agricultural sector. Th process by which new knowledge can alter the rate and direction technical change in agriculture are, however, substantially greater tha the knowledge of the processes by which resources are brought to be on the process of institutional innovation and transfer. Yet, the need f viable institutions to support more rapid agricultural growth and rur development is more compelling to-day than a decade ago.

AGRICULTURE AND ECONOMIC DEVELOPMENT

A close contact between agriculture and economic developme has been discussed in the previous two parts – "Place of Agriculture I Development Economics: A Historical Perspective" and "A Brief Not on Models of Agricultural Development". While the first part deal with the gradual changing attitude of the economists in viewing th role of agriculture in economic development, the second part explains in brief, the stages of the penetration of agriculture in the developmen process in various farms of models.

The importance of agriculture in the economic development o any country, developed or developing, is born out of the fact that it i the oldest and the most basic of all human professions and is the primary sector of the economy which not only provides the basic in gredients necessary for the existence of mankind but also provides the basic raw materials for the development of important and essential industries which when transformed into finished products serve as basic necessities and comforts of human race. In a preponderantly agrarian economy like India, agriculture plays a most strategic role in maintaining the high rate of economic growth. Basically, agricultural production must be increased to keep pace with population growth. When economy moves towards industrialisation, the urbanisation also expands quickly. This may then be expected to bring with it rising per capita demand for food, based on the increasingly high per capita incomes.

In addition to supplying food, agriculture also provides many raw materials to our most important industries. The fate of our textiles, silk, wool, leather, sugar, tobacco, edible oil, food processing, brew and many more crucially affected by the supply of raw materials produced in agricultural sector. Hence, the pace of advance in a wide range of consumer goods manufactures is eventually be affected by the pace of agricultural development.

Moreover, agriculture also generates exports surpluses in order to earn foreign exchanges. These foreign exchange are used to finance the import of capital goods and certain kinds of industrial raw materials.

However, agriculture is not only a supplier of goods for domestic and export needs but is also a supplier of production factors such as labour and capital. A rapidly growing industrial sector necessarily require some labour force which the rural sector provides abundantly. Moreover, in one form or other, agriculture is called upon to save and hence it finances a significant part of the investment for an expanding industrial, transport and other sectors.

In brief the crucial significance of the agricultural sector in the economic development is that it constitutes an important source of supply of goods, manpower, capital and saving as well as of earning foreign exchange.

These contributions can be summed-up under four broad headings:

(i)   Agriculture production contribution,

(ii)   Agriculture market contribution,

(iii) Agriculture factor contribution, and

(iv)   Agriculture foreign exchange contribution.

Production Contribution: The growth of product within the agricultural sector itself is the first and the basic contribution to economic development. An increase in the net output of agriculture represents a rise in the product of the country since the latter is the sum of the increase in the net products of several sectors. Hence, agriculture product not only keeps a growing population alive but also keeps alive the other sectors and so the nation as a whole. This is quite obvious that if agricultural output — food and raw material — does not keep pace with the rate of population and industrial growth, the nutritional level of the growing population and the expansion of the most of consumer-goods industries both will adversely be effected. The nutritional level either will be lowered or will be maintained by increasing food imports. Similarly, the expansion of the consumer-goods industries will also be possible on importing strategic raw materials. Spending meager foreign

exchange reserves on food and raw material would mean hamper
the imports of most important capital goods and technology whic
crucial but in short supply in the initial stages of economic deve
ment. Poor agricultural performance in terms of output, thus, decl
the macro-dimensions of growth rate.

The slow growth of agricultural output, amidst high rate
population growth and industrialisation process, generates inflation
pressures. Aggregate demand for farm output increases on two fro
It increases because of population growth and because of rising of
capita income. Since all developing countries show relatively high
come elasticity of demand for food, most part of the increased inco
has been spent on food and other essential consumption goods. On
basis of the growth of population, income and income elasticity for
increase in the demand for food can be measured as[16]

$$Gr = Pr + (YED)Yr$$

Where   Gr = the rate of growth of food demand.
         Pr = the rate of growth of population
         Yr = the rate of growth of per capita income
         YED = Income elasticity of demand for food

If suppose "Pr" is 2.5 per cent, "Yr" 3.5 per cent and "YED" is
then "Gr" will be 4.25 per cent. If YED is higher than .5, say .9, then Gr v
be 5.6 per cent. Thus, to keep pace with the growing demand for fo
agriculture production must increase by 4.25 per cent or 5.6 per c
respectively. According to NSS, YED IN INDIA is 0.8 Keeping this inco
elasticity and possibilities of increase in population and per capita co
sumer expenditure in view, Planning Commission has estimated th
demand for agricultural commodities is likely to increase at the rate
4.7 per cent per annum. Accordingly, the nation can remain self-relia
in agriculture only if agricultural output rises at least at the rate of 5 p
cent per annum. If domestic food production is not growing by the
rates and imports are also limited by foreign exchange constraints, bo
the absolute and relative price of food will tend to rise. Such inflatio
ary pressure is more burdensome to those poor nations who spe
more than 50 per cent of the income on food. This leads to the co
clusion that increasing food and raw material output is crucial
achieve a sustained multi-dimensional rate of growth.

Simon Kuznets[17] examines the product contribution of agricultu
in terms of its share to the growth of total net or gross product and to t
growth of product per capita. Algebraic notation of it is given as under:

Pa = output of agricultural sector (Sector A)

Pb = output of all other sector (Non Agricultural Sector B)

P = Total output $Pa + Pb$

Δp = Increment in total output

ra = Rate of growth of Pa

rb = Rate of growth of Pb, so that

$p_a1 = p_a o (1 + ra)$, the subscripts are referring to time

$p_b1 = P_b o (8 + rb)$

Then $\Delta p = P_{ara} + P_{brb}$

The equation for the share of agricultural output in the growth of total output is therefore:

$$r = \frac{Pa\ ra}{\Delta P} = \frac{1}{1 + \left(\dfrac{Pb}{Pa} \times \dfrac{rb}{ra} \right)}$$

Kuznets pointed out that the product contribution to the economic growth of a country will be higher, if: (1) the share of agriculture in country's labour force is larger and (2) the ratio of product per worker in agriculture in relation to non-agricultural sector is also higher. When economic growth moves towards industrialisation the share of agriculture in the labour force decreases and hence there will be a continuous decrease in the proportional contribution of agriculture to economic growth.

Several important conclusions in regard to the contribution of agriculture to net-outpuut have been drawn by Kuznets Firstly, "so long as the rate of growth of the non-agricultural sector is higher than that of agriculture, all other conditions being equal, the proportional contribution of agriculture to the growth of total product will decline".[18] Indian economy proves it well. A study indicated: "A point to be noted from the point of view of structural changes is that contribution of agriculture to the growth is still very large, in spite of its low growth related to other sectors. Out of over 5 per cent of total growth during the eighties, 1 per cent point has come from agriculture, a little over 0.9 percentage point has come from registered manufacturing and 0.4 percentage point share come from unregistered manufacturing. Thus, the manufacturing, registered and unregistered together, share for the first time during the eighties, increased their contribution to growth to 1.36 percentage points which is more than the contribution of agriculture".[19] Since the contribution of non-agricultural sector to total growth is higher than the agricultural sector, the share of agriculture to Gross as