CHAPTER-3
THEORETICAL FRAMEWORK

3.0 Introduction

Agriculture has been playing a key role in the development and sustenance of human civilization since ages. Until the beginning of the Industrial Revolution, a vast majority of the human population mainly depends on subsistence based agriculture by way of raising crops for self-consumption. However, the development of agricultural techniques over the years, has steadily increased agricultural productivity the world over while the widespread diffusion of these techniques over a time period is often considered an Agricultural Revolution. A remarkable shift in agricultural practices has occurred over the past century in response to new technologies, and the development of world markets. This also has led to technological improvements in agricultural techniques, such as the Heber-Bosch method used for synthesizing ammonium nitrate which makes the traditional practice of recycling nutrients with crop rotation and animal manure less necessary. The famous prediction of Thomas Malthusian theory would have been proved right fairly long ago but for the radical developments such as “Green Revolution” which has enabled the world to produce surpluses of food grains and there by highlights the importance of the agricultural sector to human welfare. This chapter discusses some of these issues.
3.1 Importance of Agriculture

Agriculture is a sector that contributes, to a large extent, to economic growth (T W Schultz). The role of agriculture in economic development from the perspective of poverty reduction and as a supplier of food grains to the ever growing population can in no way be undermined. Infact, its development is a prerequisite for the economic development of any economy.

Early theoretical literature on the role of agriculture in economic development can be traced back to the 18th century in the writings of Physiocrats, who observed that the development of agriculture was of strategic significance to economic development in terms of producing an economic surplus over the cost of production, which they called “the product net” while considering other sectors as sterile class; and the Classical writers also recognized the importance of agriculture to economic development in that technical improvement in agriculture was essential for sparking off development in other sectors of an economy (John Hicks; 1965). In the work titled ‘Wealth of Nations’ Adam Smith, ranks agriculture as highest in terms of wealth creation.

Later in the writings of Neo-classical economists, the role of agricultural sector in the economic development received less attention and had little reference; and it was only after the Keynesian revolution, that the role of agriculture in economic development gained significance. The experiences of developed economies indicate that farm labourers migrating to urban areas help improve their productivity and thereby their incomes, which in turn, create essential conditions for the adoption of new agricultural strategies, which in turn,
contribute to a higher agricultural productivity. It provides additional foreign exchange through increased agriculture exports necessary for development; transfers labour from agriculture to non-agriculture sector as the expanding industrial sector can absorb excess labour from agriculture where there is an excess concentration of manpower; and it also contributes to the capital formation process in the early stages of development. As agriculture requires moderate outlays, it is possible for the agriculture sector to make a net contribution to the capital requirement of infrastructure and industrial expansion besides stimulating industrialization by increasing demand for industrial goods (Bruce. F Johnston and John W Mellor)

In the 21st century, agriculture continues to remain a prime instrument for sustainable development and poverty reduction. According to the World Development Report (WDR 2008), 3 out of every 4 poor people in developing countries live in rural areas – 880 million live on less than $1 a day with most of them depending directly or indirectly on agriculture for their livelihood. Further, agriculture is regarded as a developmental tool for achieving the Millennium Development Goal that aim at halving the share of people suffering from extreme stages of poverty and hunger by 2015. In all economic endeavors, the main focus continues to be on achieving a rapid agricultural development. The GDP in agricultural and allied sector was 1.6 per cent in 2008-09 as compared to 4.6 for 2007-08. Notwithstanding the fact that the share of this sector in GDP has been declining over the years, its role remains critical as the concentration of work force which was around 70 percent in 1951 fell to 67.3 per cent in 1980-81 to 58.4
per cent in 2005, and to 52.1 percent in 2007-08 mainly due to the development of other sectors. Lewis (1979), in his well known article, “Economics with unlimited supply of labour” a two-sector model, observes that with the expansion of the capital sector, surplus labour from the agriculture sector gets observed. It is obvious from the contributions of Lewis and Reins that the mobility of labour from farm to non-farm sector is an essential ingredient of economic transformation as well as development of agriculture. A large agrarian population forms a substantial proportion of the market for producer goods as well as consumer’s goods, which is termed as “Market Contribution”.

In the long run, as the importance of agriculture to economic development declines, the concentration of surplus capital and labor is transferred to the non-agricultural sector which is termed as “Factor Contributions”. A rapid increase in population and demand for food is made good through a provision of food surplus by the agriculture sector. Thinkers like Barker, Wilson Barsodi and Humphries (1949) are of the view that agriculture is a par excellence fundamental industry. They support the view with due importance given to agriculture as a producer of food, grains, provider of raw materials and a promoter of foreign trade. The most important form in which increased agricultural output and productivity contribute to the overall economic growth in the early stages of development is by ways of providing increased food supplies to an ever increasing population in a context particularly where the demand for agriculture products is high. It has been estimated that about 60 percent of the household consumption is met by agricultural products. The prosperity of the rural economy is also closely linked to
agriculture and allied activities. The agricultural sector has contributed 12.2 per cent of the national potential source of domestic demand at an average growth of over 4.9 per cent over three years (2005-06 to 2007-08); while the agriculture sector has (including allied activities) lent a credible support to the overall growth in GDP, its importance also stems from the raw materials it provides to the industrial sector as agriculture in India has been a major source of supply of raw materials to various important industries of the country. Hence, the development of agriculture is a pre-requisite for the development of these industries. Besides, cotton, jute, textiles, sugar, vanaspati, edible oil, plantation industries (tea, coffee, rubber) and agro-based cottage industries also regularly collect their raw materials directly from agriculture. The classic analysis of Kuznet (1961) identifies important contributions of the agriculture sector to the overall economic growth and development of the less developed countries. Further, the non-agricultural sectors rely on domestic agriculture not only for the food but also for raw materials for the manufacturing sector; this contribution of the agriculture sector is termed as “Product Contribution”. It is important to note here that about 50 percent of the total income generated by the manufacturing sector comes from all these agro-based industries in India. Moreover, agriculture can provide a market for industrial products, as an increase in the agricultural income levels may lead to an expansion of the market for industrial products. As Ragnar Nurkse rightly observes: “there is not a sufficient market for manufacturing goods in a country if two thirds to four fifths of the population are too poor to buy any manufacturing products which reflects low productivity in agriculture”, which means the
expansion of agricultural output and productivity, tends to increase rural income levels, leading to an increased demand for industrial products there through.

Indian agriculture plays a very important role with respect to both the internal and external trade of the country. Agricultural products – silk, tea, coffee, sugar, tobacco, spices, cashew nuts etc. constitute the main items of our exports. The agricultural exports to the total national exports amounted to 44.2 percent in 1960-61. However, it declined sharply to 10.2 percent in 2005-06; but in the year 2007-08 the total exports rose to 12.2 percent. The ‘foreign exchange” contribution, though implicit in its market contribution yet, means, agriculture contributes by earning foreign exchange or by expanding the agriculture import substitutions base.

The prospects of planning in India also depend much on the agricultural sector. A good crop year always provides an impetus to a planned economic development of the country by creating a better business climate for the transport system, with respect to manufacturing industries, internal trade etc. A good crop also brings a good amount of finance to the government for meeting its planned expenditure. Similarly, a bad crop leads to a total depression in business activities of the country, which ultimately leads to the failure of economic planning.

Thus, the agriculture sector plays a very important role in terms of the overall development of the Indian economy. An increasing marketable surplus of agricultural output is very much essential in India for (i) the increasing supply of food grains and raw materials reasonable prices; (ii) widening the domestic market base for industrial products through higher purchasing capacities in the
rural rector; (iii) facilitating inter-sectoral transfers of capital needed for industrial
development along with infra-structural development; (iv) increasing foreign
exchange earnings through increasing the volume of agricultural exports.

3.2 Technology and Agriculture

Achieving the Millennium Development Goal (MDG) of halving the proportion
of people living in absolute poverty by 2015, will require agriculture to play a
major role. Increased agricultural productivity remains perhaps the single most
important determinant of economic growth and poverty reduction, and hence, a
key to achieve the MDGs. Given that improving the efficiency of agricultural
production is a key to pro-poor economic growth, improvements in agricultural
practices or technology is the principal means towards achieving this. Agricultural
technology can affect smallholder incomes, labour opportunities for the poor,
food prices, environmental sustainability, and linkages with the rest of the
economy. It has been a primary factor contributing to increases in farm
productivity in the developing countries over the past half-century. Although
there is still widespread food insecurity, the situation, without the current
technology development, would have been unimaginable. Several technological
aspects play an important role in enhancing agricultural productivity, such as
irrigation, high yielding seeds, fertilizers, insecticides, farm mechanization etc.,
Dhawan (2000)\(^1\) reports that, on an average, a farmer in India obtains about Rs.
14,000 per hectare of irrigated land, whereas, an average farmer earns only about
Rs. 6,000 per hectare of rain-fed land (at constant prices of 1992-93).

\(^1\)
The role of technology in increasing agricultural productivity, particular in the context of developing countries, has been well established. For instance, Green Revolution, has contributed to as much as 50 percent of the yield growth in Asia. Others have observed that one-third of the cereal production world-wide is attributed to the use of fertilizers and related factors of production. Over the last three decades, India has focused on increasing crop yields in order to meet an ever increasing demand for food grains.

Agricultural technologies can be viewed as means by which farmers seek to achieve their production objectives. Such as risk management, quality of life, and environmental stewardship. But for the majority of farmers, who rely on agricultural income, expected profitability is the "sine qua non" - they must earn enough to stay in business. While attempting to produce profitably, farmers may feel constrained by a limited access to essential productive resources such as land, labor, equipment, buildings, and management expertise. Profitable farming calls for using these resources to the extent where the cost of additional resource use is no longer compensated by the value of the resultant gain in output, i.e., increasing it where justified by expected yield gains or reducing input use where the costs exceed the expected benefits (Swinton and Lowenberg-DeBoer, 1998).

A related principle of profitable farming is to balance input use so that no reallocation of inputs can reduce the cost of production. This principle means that in a country where land is costly in relation to capital, farmers acquire enough equipment to plant and harvest crops at the optimal times, thereby maximizing returns to land. In contrast, in a country where capital is more expensive
resource, farmers will extend planting and harvesting periods to economize on equipment, even though this means lower yields per unit of land. Argentine farmers for instance pay much higher interest rates, often depend on custom operators. This principle also implies that new technologies are developed and adopted so as to economize on the use of the scarcest or most costly inputs. \cite{Hayami1985} illustrate the theory of “induced innovation” by way of contrasting land scarce Japanese agriculture that innovated biochemical technologies to boost crop yields (and land productivity) versus labor-scarce, U.S. agriculture that turned to tractor-led mechanical innovations to boost factor productivity.

Two features are likely to compel the adoption of new agricultural technologies. First, considering that they improve the efficiency of input use in mechanized agriculture, they are likely to be adopted first in those places where input use is already relatively efficient. Second, because these technologies use costly capital to automate human information processing, they are most attractive where capital is abundant relative to management labour.

Technology adoption expands faster in land abundant areas where human and financial capitals are available and the use of labor and variable inputs is relatively quite efficient. In areas with a greater population pressure and relatively less land available for agriculture, but ample human and financial capital (e.g. Asia and India), the adoption spreads more slowly unless and until environmental benefits are better documented.
3.3 Agricultural Productivity

To the extent that technology raises agricultural productivity, it should be a major factor in creating positive effects. According to Thirtle et al. (2003) there exists a close relationship between agricultural productivity and poverty. While observing data over the period 1985 to 1993 across 48 developing countries, they find that a 1 per cent improvement in crop yields reduces the proportion of people living below the poverty line. No other sector has demonstrated such a comparably high impact on poverty. Lipton (2001) argues that no other sector other than agriculture offers the same possibilities for creating employment opportunities to lift people out of poverty. Indeed, the adoption of new technologies (such as irrigation, high yielding seeds, agro-chemicals) and the subsequent increases in agricultural productivity in different parts of the world explain, in large part, the regional differences in the reduction of poverty over the last few decades. Nkamleu et al. (2003) Estimate changes in agricultural productivity in respect of 10 countries in the sub-Saharan African countries between 1972 and 1991. They suggest that, whilst efficiency remains constant, it is the technological change which is the main cause behind the total factor productivity increase. A rapid technological change – leading to marked productivity increases - has clearly occurred in parts of the developing world, primarily over the last half century, particularly during the ‘Green Revolution’ (period)- a term originally applied to the spread of dwarf, fertilizer-efficient new varieties of rice and wheat, primarily, though not exclusively, in Asia. Throughout the developing world, an average
cereal yield increased by 2.7 per cent per annum during 1966 -1982 (IFAD, 2001). The performance in South Asia has been especially impressive, in that between the mid-1960s and the mid-1980s, wheat yields increased by 240 per cent and those of rice by 160 per cent (Kerr and Kolavalli, 1999). Increased agricultural productivity holds several positive implications such as:

~ Direct and relatively immediate impact of improved agricultural performance on rural income levels.

~ Impact of cheaper food availability for both urban and rural poor;

~ An increase in agriculture’s contribution to growth and the generation of economic opportunist in the non-farm sector; and

~ An improvements in agriculture’s fundamental role in terms of stimulating and sustaining economic transition, as countries (and poor people’s livelihoods) drift away from being primarily agricultural economies towards a broader base of manufacturing and services.

~ Improvements in Foreign Exchange potential.

~ Diversification of agriculture. In essence, diversifying into commercial crops/commodities that can increase agricultural income levels, reduce risks of crop failures and earn foreign exchange.

Further, diversification can be so designed as to help poverty alleviation, employment generation and environmental conservation. Diversification in
agriculture can be tried across sub-sectors as well as within each sub-sector. In Indian agriculture, diversification has occurred across sub-sectors, viz. cropping pattern, livestock rearing, and forestry along with logging and fishing as well as within each of these sectors. Several studies such as Jha et al. show that there have been significant structural changes in the livestock and fisheries sectors of the economy. With regards to many commodities, the production basket remains concentrated over the years. Changes in the percent of gross cropped area also suggest a move towards specialization. There has been a significant increase in the percent of gross cropped area under fruits and vegetables. The micro-level evidences suggest that certain crops are more remunerative given the resource endowments and institutional framework.

Gains from new technology have also occurred in respect of other crops and regions, increased investments in agricultural research and extension. Since the mid 1980s growth rate of productivity levels achieved have slowed down - the annual rate of increase in a developing country cereal yields falling to an average of 1.7 per cent (IFAD, 2001). Some of the negative implications of these technologies include a) excessive use of agrochemicals affective soil health; b) excessive irrigation – leading to soil erosion, salinization of soils; etc.

Among various technological aspects discussed above, at the micro level, it is the application of fertilizers that has received the maximum attention relative to other factors. For instance, irrigation facilities are operated by forces beyond
the influence of individual farmers. Further, it has been well established that the usage of fertilizer has a greater influence over productivity levels.

3.4 Agriculture Subsidies

Subsidy, derived from the Latin word ‘subsidium’, implies coming to assistance indirectly. Subsidy is a fiscal tool for ensuring and maximizing social welfare of the society. Subsidy in simple terms means a monetary assistance extended by the state, or a public body etc to keep down the price of a particular commodity or service. According to the joint economic committee of v.s congress 1972, “subsidy is a government assistance for which no equivalent compensation is revived in returns but the assistance is conditioned on a particular performance by the recipients.”

However, the beneficial potential of subsidies is at its best when it is transparent, well targeted, and suitably designed for the practical implementation. Like indirect taxes, subsidies can alter the relative prices and budgetary constraints and thereby affect decisions concerning production, consumption and allocation of resources. The Oxford English Dictionary defines subsidy as “money granted by State, public body etc to keep up the prices at stationary state”. Subsidies, through creating a wedge between consumer prices and producer costs, can lead to changes in demand/ supply decisions. Subsidies are often aimed at: inducing higher consumption/ production; offsetting market imperfections including internalisation of externalities; achievement of social policy objectives including redistribution of income, population control, etc
Economic implications of subsidies can be broadly grouped into allocative effects: these relate to the sectoral allocation of resources. Subsidies help draw more resources towards the subsidized sector. Redistributive effects: generally depend upon the elasticity of demand of the relevant group for the subsidized good as well as the elasticity of supply of the same good and the mode of administering subsidy. For instance, agricultural input subsidies. Fiscal effects: subsidies have obvious fiscal effects since a large chunk of subsidies emanates from the budgetary allocations. They can directly increase fiscal deficit, example, and fertilizer subsidy.

Subsidies may also lead to perverse or unintended economic effects. They might result in an inefficient resource allocation if imposed on a competitive market or where market imperfections do not justify a subsidy, by way of diverting financial resources away from areas where their marginal productivity would be higher. Subsidies have a tendency to self-perpetuate. They can create vested interests besides taking on political hues. In addition, it is difficult to control the resultant incidence of subsidies since their effects are transmitted through the market, mechanism which often exhibits imperfections other than those addressed by subsidies.

An agricultural input subsidy is a governmental subsidy paid to farmers and agro based units for supplementing their incomes, manage the supply of agricultural commodities, and influence the aggregate cost and supply of such commodities.
The broad argument that input subsidies can lead to relatively higher incomes, reduced poverty and improved food security is based on specific claims with respect to a wide range of objectives. Most of these objectives have either an economic efficiency rationale underlying them or concerned with reallocating income to a particular constituency (for reasons of social equity or political patronage). The main economic objectives include: 1) Stimulate agricultural production; 2) Compensate for high costs of transport from port or factory to farms that raise costs of inputs; 3) Improve soil quality and combat soil degradation (in the case of fertilizers); 4) Offset high costs of supplying inputs when markets have low volumes and economies of scale in logistics cannot be availed of; 5) Make inputs affordable to farmers who cannot buy them, owing to poverty, lack of access to credit, and inability to insure against crop losses; and 6) Learning - to allow farmers to try out novel inputs mixes and become familiar with their potential advantages.

Disadvantages and potential dangers associated with input subsidies; Arguments against subsidies include the following: 1) Subsidies may prove to be ineffective in terms of improving the use of inputs and increased yields. There of it is not always the case that the volume of inputs applied is prices sensitive; 2) Heavy subsidies on inputs potentially distort the relative costs of factors, leading to an inefficient allocation of inputs, with the subsidized inputs substituted for other factors. This applies particularly where inputs happen to be substitutes, rather than the cases where they are complementary. The most often cited case for agriculture subsidy is that of farm machinery, where capital grants and tax
exemptions for tractors and harvesters lead farmers to use machinery for displacing day labourers — in places where there are many landless labourers looking for working; 3) Subsidies intended to benefit specified groups of farmers, or to stimulate the production of particular crops, may prove to be less effective as leakages occur frequently For example, when farm profits rise, landlords may be able to raise land rents and thus effectively appropriate the real value of subsidy. The degree of this leakage depends on the extent to which farmers rent out rather than own lands (or have otherwise secured land rights), and the extent to which the price of land is bid up; 4) When subsidized inputs dominate the supply of a particular input, then subsidies may become closely linked to government budgetary cycles or to electoral cycles with pronounced swings in availability with the effect that supplies, whether or not subsidized, may not be regular, reliable and timely; 5) All these apart, the main objection to subsidies has been that they involve a high social cost.

3.5 Fertilizer subsidy

The Indian fertilizer industry has come a long way since its early days of post independence era. India today is one of the largest producers and consumers of fertilizers in the world. India’s production of nutrients (N and P2O5) reached to 15.96 million tonnes in 2006-07 from 38.7 thousand tonnes in 1951-52. Similarly, the consumption of fertilizers (NPK) has also grown from 65.6 thousand tonnes in 1951-52 to nearly 22.57 million tonnes by 2007-08. The Indian Fertilizer industry, given its strategic importance in achieving self-sufficiency in food grains production in the country, has, for decades, been under the government control.
With the objective for providing fertilizers to farmers at affordable price and ensuring adequate returns on investments to entrepreneurs, a fertilizer policy was envisaged for providing fertilizers to farmers at subsidized prices. In order to achieve this objective, the government introduced the Retention Price cum Subsidy scheme (RPS), a cost-plus approach, for nitrogenous fertilizers, in November 1977 and was extended to complex fertilizers in February 1979. Under the RPS, the retail price of fertilizers was fixed and was uniform throughout the country and the difference between the retention price (adjusted for freight and dealer’s margin) and the price at which the fertilizers were sold to the farmers was paid back to the manufacturer as subsidy. However, the consumption of chemical fertilizers was not free from criticisms that it fostered inefficiency leading to a huge financial burden on the exchequer. Estimates of fertilizer subsidy as per the central government budgets over the years in the post-reforms era show that fertilizer subsidy has increased significantly. The total subsidies have increased from Rs. 12158 crore in 1990-91 to Rs. 129243 crore in 2008-09, an increase close to 10.6 times. The fertilizer subsidy has increased from Rs. 4389 crore in 1990-91 to Rs. 75,849 crore in 2008-09 representing an increase of over 17 times. As a percentage of GDP, this represents an increase from 0.85 percent in 1990-91 to 1.52 percent in 2008-09.

Fertilizer use choices at the farm level involve a very complex process. To start with the question whether to use fertilizer or not, then follows the decision of which crop to fertilize and at what quantities. The capital constraints and other factors often influence decisions on fertilizer usage. Since fertilizer consumption
is a function of a host of factors, many times interacting with each other, it is very
difficult to isolate and quantify the effects of each on fertilizer consumption.
While scrutinizing the influence of price on fertilizer consumption, it becomes
evident that it is, to an extent, price-sensitive.

The farmgate price of fertilizers, determined by the MoF, remained
balance-of-payments crisis and a need to borrow from the IMF, the government
announced an increase of 30 percent in the issue price of urea, amounting to it to
Rs 3,060/ton. The selling price of urea was subsequently reduced in August 1992
by 10 percent to Rs 2,760/ton, but increased again in June 1994 by 20 percent, to
Rs 3,320/ton; by 10 percent in February 1997 to Rs 3,660/ton; by 10 percent in
January 1999, to Rs 4,000/ton; by 15 percent in February 2000 to Rs 4,600/ton;
by 5 percent in February 2002 to Rs 4,830/ton; and, finally, by 10 percent in
February 2010 to Rs 5,310/ton.

An important consideration in determining fertilizer use is the potential
profitability of its application. Profitability of fertilizer use is indicated by
economic return. While the extent of economic returns is determined by crop
prices, fertilizer prices and crop response to fertilizers applied. 1971-72, 19759-
76 to 1979-80, 1982-83 to 1985-86 and 1988-89 to 1990-91 the price of N had
decreased. (D. K. Mittal 1994) consequently, these years witnessed a higher
increase in the consumption of nitrogen. Whenever there was a sharp increase in its price in terms of output prices, the growth in
terms of consumption slowed down or prices of fertilizes, procurement price/market price of food grains and efficiency in fertilizer use ultimately determined the gross financial returns from investment in fertilizers. An improvement in the gross financial returns on every rupee invested in fertilizers encouraged consumption. For example, return from very rupee invested improved markedly in 1983-84 and 1988-89 as compared to 1990-91. As a result, the consumption of N improved substantially during these years. During the years when return from investment in fertilizers declined, the growth in the consumption of nutrients also slowed down, though this pattern was at times modified by various non-price factors including promotional efforts undertaken by various governmental and non-governmental agencies. This pattern is broadly discernible in respect of all types of fertilizers by the way of computation of returns from investment in respect of each type of fertilizer separately. However, this, may pose problems when a blend of different types of fertilizers is used on a particular land for a single crop. In general, the cost benefit ratio of fertilizer use with respect of irrigated lands are in 1:2:3 for wheat and for 1:2:5 price. The farmers in the rain fed areas have an added risk. To cover this risk adequately, the prices of fertilizers should be so fixed as to yield a cost-benefit ratio in the region of 1:3 to 1:3, 5 so as to provide for a low risk bearing capacity of Indian farmers.

A study on the impact of price increase on fertilizer demand conducted by CACP observes that for one major paddy growing state, it has been estimated that between 1979-80 and 1980-81 when fertilizer prices went up by 38 percent, the consumption of plant nutrients went up by 6.7 percent in respect of large farms
but declined by 8.3 percent in respect of small farms. When bulk of fertilizers is used by non-small farmers, the overall impact of a price increase on fertilizer consumption would be small. Even the smaller holders may not cut fertilizers consumption if covered by adequate credit availability. Their response to a price rise in the very short run may differ from the medium to long run responses. Thus the exact magnitude of the price elasticity of fertilizer demand may not be as high as observed by Parikh.

Chapter summary

From the foregoing analysis the following aspects become crystal clear;

~ Agricultural development is the basic pre condition for sectoral diversification and development of the economy.

~ Role of technology, be it irrigation facilities, HYV seeds, artificial plant nutrients, is of paramount importance to agricultural development and it would continue to remain the same.

~ Consumption of fertilizers at farm level is subjected to individual farmer’s decisions which in turn are influenced by several aspects such as price of fertilizers, conditions of soil moisture, and prices of farm produce.

~ To ensure a proper replacement of plant nutrients year after year, it is essential to use chemical 1 fertilizers and to ensure the required supplements, fertilizer pricing policy should be designed in such a manner as to encourage fertiliser use.