Chapter - I

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1.1. Introduction

The Indian Agricultural sector provides employment to about 65 per cent of the labour force, accounts for 27 per cent of GDP, contributes 21 per cent of total exports, and raw materials to several industries. The Livestock sector contributes an estimated 8.4 per cent to the country’s GDP and 35.85 per cent of the agricultural output. India is the seventh largest producer of fish in the world and ranks second in the production of inland fish. Fish production has increased from 0.75 million tons in 1950-51 to 5.14 million tons in 1996-97, a cumulative growth rate of 4.2 per cent per annum, which has been the fastest of any item in the food sector, except potatoes, eggs and poultry meat. The future growth in agriculture must come from [G.B. Singh, 2000] viz.,

- new technologies which are not only "cost effective" but also "in conformity" with natural climatic regime of the country;
- technologies relevant to rain-fed areas specifically;
- continued genetic improvements for better seeds and yields;
- data improvements for better research, better results, and sustainable planning;
- bridging the gap between knowledge and practice; and
Judicious land use resource surveys, efficient management practices and sustainable use of natural resources.

A central issue in Agricultural Development is the necessity to increase productivity, employment, and income of poor segments of the agricultural population. Among the rural poor, the small farmers constitute a sizeable portion in the developing countries. Studies by FAO have shown that small farms constitute between 60-70 per cent of total farms in developing countries and contribute around 30-35 per cent to total agricultural output [Randhawa & Sundaram, 1990].

Liberalisation era (1990-91) began in India when over 40 per cent of rural households were landless or near landless, and over 96 per cent of the owned holdings and 68.53 per cent (over 2/3rd ) of owned land belonged to the size groups (marginal, small and semi-medium). The decade of 1981-82 to 1991-92 seems to have witnessed a marked intensification of the marginalisation process - the percentage of small owners increased from 14.70 per cent to 21.75 per cent.

Small farmers emerged as the size group with the largest share of 33.97 per cent in the total land, which has just doubled during this decade. As regards the large farmers, they were 1 per cent of the total owners in 1990-91 but owned nearly 13.83 per cent of the total land. An interesting, but speculative, inference is that the changing position of the large owners represents the other side of the marginalisation process, i.e., the presence, and possibly growing
strength, of a small but dominant and influential group in agriculture. Analytical reports reveal that marginalisation process could gather further momentum in the years ahead to become an explosive source of economic and political turbulence, due to the features of prevailing policy-cum-market environment in the country.

Trend towards a greater casualisation (erratic and low-paid work) of the workforce that was witnessed in the 1980s appears to have continued in the 1990s. Low productivity and inability to absorb the growing labour force make the agricultural sector in India witness to a pervasive process of marginalisation of rural people. This process is likely to get intensified in the coming years, raising formidable problems in achieving sustained development of rural areas and rural people [VM Rao & Hanumappa, 1999].

Both Information Technology, Genetic Engineering and Bio-Technology, which are the "drivers" of globalisation with their complementarities of liberalisation, privatisation and tighter Intellectual Properties Rights, are bound to create new risks of marginalisation and vulnerability. Information Technology is able to produce a penetrating and clinical mapping of the land, encompassing the physical, chemical and biological features, and groundwater resources, and forecast of climatic conditions in a focussed manner, that even small geographical segments - the small farms - can be benefited through the guidance provided by the ways in which natural and human resources can be optimally combined with appropriate technologies, inputs and options to
enhance and diversify agricultural production [KVS2K]. Information Technology will facilitate dissemination of information on development, education, extension, husbandry, marketing, production, and research, to agricultural farmers.

Indian agriculture is characterised by overwhelmingly small holdings due to higher population density and nearly two-third of its population residing in the rural areas coupled with unabated land fragmentation due to the inheritance laws of the country. Nearly 62 per cent of the estimated 142 m ha area is rainfed. Major sources of farm power include both animate (humans and draught animals) as well as inanimate sources such as diesel engines, tractors and electric motors. India’s well-orchestrated Green Revolution began in the mid 60’s. It was ushered in through the adoption of higher and balanced doses of the biological, chemical and mechanical inputs together with the timely intervention of the Government. The latter ensured the availability of the required inputs of high yielding seed varieties, fertilizers, pesticides water and improved power sources and equipment. The Government provided the minimum support price, easy access to procurement markets, rural roads and other infrastructures which helped to trigger the green revolution in selected areas of the country. Resultantly gross food production increased from 50.8 M tons in 1950-51 to 199.3 M tons in 1996-97 and land productivity rose from 0.58 tons/ha/year to more than 2.14 tons/ha/year. Whereas the quantum jump in production and productivity was brought about by a combination of factors, farm mechanization was often at the centre of controversy due to its impact on
employment of human labour in a labour abundant economy. This paper reviews the findings of various researchers on the impact of farm mechanization on agricultural production and productivity, cropping intensity, human labour employment on the farm, subsidiary and non-farm employment as well as gross farm income and net return.

1.2. Need for the Study

Agricultural technology has been a primary factor contributing to increases in farm productivity in developing countries over the past half-century. Although there is still widespread food insecurity, the situation without current technology development would have been unimaginable.

- New technology can provide additional rural employment, but there are always countervailing pressures to reduce labour input and lower its costs.

- Food prices are demonstrably lower because of technology, but the distribution of benefits between consumers and producers depends on the nature of the local economy and trade patterns.

The adoption of technology requires adequate incentives for producers. Investments in labour or cash will not be made unless there are adequate returns. One of the most important supporting factors is the adequacy of markets for outputs and inputs. Although there is much academic debate regarding the nature and impact of technological change, the important issues for development assistance agencies are related to other uncertainties. These include:
identifying the most effective planning procedures for directing agricultural technology to poverty reduction;

- establishing the role of agriculture in national development strategies;
- deciding the degree to which agricultural investments are appropriate for marginal areas;
- identifying the correct mix of public, private and civil society support to agricultural technology generation;
- and identifying the types of technology that warrant support.

Because agricultural technology addresses multiple, and at times conflicting, objectives, there is a need for careful planning. But there is a trade-off between investment in micro-level technology screening, on the one hand, and support to basic institutional capacities and political responsiveness, on the other. The rhetoric of technological revolutions should be eschewed in favour of consistent attention to building technological capacity in response to changes in the rural economy. One of the most difficult choices is that which faces the appropriate level of (agricultural) support for poverty reduction in marginal areas.

1.3. Motivation for the study

Agriculture has a specialized significance as it can play an important role in improving the socio-economic status of a sizable section of the weaker population. It gives safeguard to the crop failures in the event of natural calamities. In most cases the livestock is the source of cash income for the
subsistence farmers as well as endurance of family purchasing power in the event of unprofitable agriculture due to unforeseen reasons. This immense potential is limited by the traditional and tenure system and subsistence farming practices (traditional technologies) that unfortunately seldom assure, or generate adequate returns which can promote the development of more commercially oriented livestock production systems. If agricultural technologies developed for farmers in developing countries are not transferred in correct (appropriate) manner and adopted accordingly, all the efforts by the researchers who developed new technologies would have been in vain. This is probably why transfer and adoption of new technologies is perhaps one of the most popular written about and controversial topics in developing agriculture (Nell et al 1998). Technology transfer and development is not a new concept, it has been around since mankind discovered things that they did not know before (Finlayson 1995). A farmer is a rational decision maker who normally strives for a better standard of living and seeks ways of adopting new technologies to accomplish this goal (Nell et al 1998).

1.4. Statement of the problem

The extent of commercialization and modernization of agriculture implicitly indicates the stages of the development. Introduction of modern technology expands production, which normally is larger than that required for family consumption and retention for seed purposes. With the spread of
modern technology, the process of monetization and commercialization of agricultural gets accelerated.

Modern agriculture, in the areas where it has been adopted, has had considerable impact on the life and economic activity of the people. The farmers are more receptive to new ideas and willing to take risks. The adoption of technology is also inducing organizational changes. New institutions have been established and agencies have been developed for ensuring services and supplies required by modern agriculture.

The agricultural sector has to grow at a rate much faster than before not only for its own sake but for the sake of the economy as a whole. It has a large potential to contribute to the National Income and provide direct employment and income to the numerically targeted and vulnerable sections of society. The main aim of this study is to analyze the following objectives:

1.5. Objectives

The study is undertaken with the general objective of assessing the contribution of new farm technology to the income and employment potentials of the farmers in the region of Thanjavur district.

- To assess the impact of new agricultural technology on employment of small, medium and large farmers.
- To examine the impact of new agricultural technology on income of the farmers
- To look into the impact of the use of fertilizer on agricultural production.
1.6. Hypotheses

- New agricultural technology introduction to large farmer category is viable than the small and medium farmers.
- There is a significant relationship between level of income and new agricultural technology application.
- Application of chemical fertilizer is more suitable to the new varieties of agricultural seed than the old one.
- There is a positive relationship between level of literary rate and new agricultural technology.

1.7. Theoretical framework

**Increasing agricultural productivity is central to reducing poverty – Technology’s Role**

Mellor’s model of agricultural development is yet another significant contribution to agricultural economics. This model is a basic explanation of agricultural transformation from his traditional character to modernization. Although not strictly cast in the Schultzian framework, it is an orderly exercise of agricultural dynamics. Prof. J.W. Mellor’s model entitled “The Economics of Agricultural Development” came in 1966, two years after Schulz’s ‘Transforming Traditional Agriculture’ was published. Even though in some respect Mellor agrees with Schultz but comparatively his approach is more pragmatic and extensive in nature. Mellor explains systematically the evolution of agriculture form primitive technology to modern agricultural technology.
Mellor believed that along the time path, agriculture undergoes some changes which initiate its transition from tradition to modernity.

Mellor believes that at any point of time, agriculture of an economy may be found to be one of the following three phases:

(i) Traditional agriculture.

(ii) Technologically dynamic agriculture with low capital / labour intensive technology.

(iii) Technologically dynamic agriculture with high capital / labour saving technology.

Mellor suggested following steps to smoothening as also to the rapid agricultural growth during this phase:

- Strengthening institutional environment
- Encouragement to research
- Supply of new improved physical inputs
- Setting of institutions to service agricultural production
- Spread of education

Boserup is one of those economists who have made fundamental contribution to the explanation of the process of agricultural development. Boserup’s work assumed importance for the reason that it stoutly refuted the Malthusian view on the relationship between agricultural development and human population—besides, of course bringing in focus the alternative explanation of agricultural transformation. Distinctly her explanation brings out
rising population as a stimulant for agricultural development rather than as a handicap culminating in the emergence of a situation wherein cruel hand of nature forces equilibrium by reducing the human population to existing food supply.

In her analysis, she attempts to inquire into the causes of agricultural development. She attributes agricultural development to a compelling situation arising on account of fast rising population in an economy. The development of patterns and techniques of cultivation are governed by the rate of population growth. In support of her assertion she examines agricultural development in some African and Latin American Countries.

Malthus constructed his treatise of population on the following two postulates:

(i) food is necessary to the existence of man, and

(ii) passion between the sexes is inevitable.

The two postulates were further used to deduce the third one namely “the power of population is indefinitely greater than the power in earth to produce subsistence for them”.

He believed in some kind of equilibrium between population and food supply. If any time food supply increases more than the population growth, then, according to Malthus population will increase and a new equilibrium will be restored between population and food supply. On the other hand, if population growth of an economy is already beyond the means of subsistence,
it brings untold human sufferings and through positive checks, population will come down to reach an equilibrium level with food supply.

Both these aspects of Malthusian theory of population have been refuted by Boserup. She refutes first point of the theory by saying, “Few observers would like to suggest that the tremendous increase in the rates of population growth witnessed throughout the underdeveloped world in the two post war decades could be explained as a result of changes in the conditions for food production. It is reasonably clear that the population explosion is a change in basic conditions which must be regarded as autonomous in the sense that the explanation is to be sought not in the improved conditions for food production but in medical inventions and some other factors which the student of agricultural development would regard as independent variables.

Boserup refutes the second part of the Malthusian theory in a more emphatic and direct manner. According to her, “whenever, there is population pressure or not population does not go down. It rather leads to various technical and other changes which result in agricultural growth and increase in food supply. The technological changes in agriculture need not be considered autonomous in relation to population.

**Stages of agricultural development**

- the forest fallow stage
- bush fallow
- short fallow
Boserup’s theory and present day underdeveloped Economics

Though Prof. Boserup substantiates her assertions taking examples relating to primitive agriculture, she maintains that her theory is valid even in the modern times for underdeveloped economics with underdeveloped industrial sector. In this connection, she writes, “The modest increase in output per man hour which can be obtained by the use of industrial products or scientific methods in such communities may not be sufficient to pay for the very scare resources of skilled labour and foreign exchange which they absorb”. It seems somewhat unrealistic, therefore, to assume that a revolution of agricultural techniques by means of modern industrial and scientific methods will take place in the near future in countries which have not yet reached the stages of urban industrialization (as a result of growing populaton)”.

Historically the stages of agricultural development as enunciated by Boserup may not occur simultaneously in all the countries of the world. Differential levels of development will certainly affect, though to some extent only, the experience of evolution of agricultural transformation of the underdeveloped countries, yet the sequential order of occurrence of different stages of development will remain the same. Boserup, therefore, is right in asserting that her explanation of agricultural development is valid for the present day underdeveloped agrarian economics of the world.
Production is a process whereby certain goods and or services are used to create goods and or services of a different nature. Production is the name given to the process of conversion of certain inputs into a consumable form. Farm production likewise refers to the producing of food, fibre and livestock by using several different kinds of inputs. Land is used by the farmers as a factory which helps them produce the desired crop. To this manufacturing plan (land) labour and capital are added to cultivate plant and harvest the crop. When considered necessary, fertilizer is also added by the farmers. Water may either be provided by rainfall or by artificial irrigation methods. Application of all these inputs results in the desired crops (output). The crops so produced are, in turn, consumed by the population, fed to animals which produce meat, milk, eggs and many other livestock and poultry products through complex biological processes.

Agricultural production economics is, thus, concerned with the quantitative relationships which are basic to production processes in agriculture. These relationships take the form of input-output patterns, and the various types of interactions among the individuals inputs themselves and among the products which contribute to the output. It is also concerned with levels of factor costs and product prices and with the nature of production patterns which allow the attainment of certain desired optima, like profit
maximization or cost minimization."\(^1\) The subject matter of production economics covers all agricultural problems that fall under the scope of resource allocation and marginal productivity analysis. The farmer as a production economist is hence concerned with any phenomena which have a bearing on economic efficiency in the use of agricultural resources.

We have seen that there are three main factors of production, viz., land, labour and capital at the disposal of the farmer. It is the job of the farmer to use these three inputs in combination on the farm. In doing so, the farmers have to perform two distinct functions. In the first place, he has to act as entrepreneur or proprietor of the farm business and is responsible for farming the general policy or plan on which his business and his system of farming is based. In the second place, he has to act as chief executive or farm manager and is responsible for the administration of the plan. Both these functions of the farmer are concerned with the fundamental problem of ascertaining and adopting the optimum combination of land, labour and capital at the disposal of the farmer. Under any given set of circumstances, the optimum combination is that which will enable the farmer to obtain the maximum financial output for the minimum financial input from his farm as a whole.

Agriculture plays a unique role in reducing poverty. Partly this reflects the sheer number of poor people engaged in it. Around 75 per cent of those surviving on less than US$1 a day - the internationally agreed definition of

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absolute poverty – live in rural areas (IFAD, 2001) and agriculture is an important source of livelihood. It is estimated that 70 per cent of sub-Saharan Africa's labour force and 67 per cent of South Asia's, work in agriculture (Maxwell, 2001). But the argument in favour of agriculture as the poverty-alleviating sector par excellence rests on more than population statistics. Improvements in agricultural productivity have a powerful knock-on effect to the rest of the economy by: creating jobs in neighbouring sectors such as food processing and input supply as well as directly in farming; increasing the supply of affordable food; and stimulating and supporting wider economic growth and development.

To the extent that technology raises agricultural productivity, it should be the major factor in creating these positive effects. Thirtle et al (2003) explored the relationship between agricultural productivity and poverty. They drew on observations between 1985 and 1993 in 48 developing countries and found that a 1 per cent improvement in crop yields reduced the proportion of people living on less than US$1 per day by between 0.6 and 1.2 per cent.

No other sector has demonstrated such a comparably high impact on poverty. Thus, Lipton (2001) argues that no other sector than agriculture offers the same possibilities to create employment and lift people out of poverty. Indeed, the adoption of new technologies and 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) calculate changes in agricultural productivity in 10 countries in sub-Saharan African countries between 1972 and 1999. In contrast with significant progress in Asia, Nkamleu *et al* found that, on an average, total factor productivity decreased in that period by 0.2 per cent annually. They suggest that, whilst efficiency was constant, technological change was the main cause of the failure of total factor productivity to increase.

**How widespread has the adoption of new technology been?**

Technological change in agriculture began at least 10,000 years ago, when the first cultivators selected wild plants and experimented with different growing environments. From those early beginnings, the technical performance of agriculture in the great civilizations remained roughly equivalent for centuries until the middle of the nineteenth century, where, principally in Europe and North America, the introduction of new machinery and sources of power (Grigg, 1974), the rediscovery of Mendel’s experiments leading to the development of scientific plant breeding, and the development of artificial fertilisers, resulted in rapid increases in agriculture productivity.

Rapid technological change – leading to marked productivity increases - has clearly occurred in parts of the developing world, primarily over the last half century. This was particularly apparent during the **Green Revolution** - a term originally applied to the spread of short-straw, fertiliser-efficient new
varieties of rice and wheat, primarily, though not exclusively, in Asia. Throughout the developing world, average cereal yields increased by 2.7 per cent per annum between 1966 and 1982 (IFAD, 2001). Performance in South Asia was especially impressive, where, 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). Gains from new technology have also occurred in other crops and regions, thanks in large measure to investments in agricultural research and extension. Since the mid 1980s progress in the rates of productivity increases achieved has slowed - the annual rate of increase in developing country cereal yields falling to an average of 1.7 per cent (IFAD, 2001). While some commentators point to reduction in external assistance to developing country agriculture as a cause of this (Pinstrup-Andersen et al., 1997), a slow-down in productivity gains is almost certainly attributable - in part at least - to the Green Revolution ‘running out of steam,’ having achieved the easy gains under relatively favourable conditions in its early phases. The spread of new technologies has been impressive, particularly improved “modern varieties” (MVs) of grains. By 1990 MVs represented an estimated 74 per cent of rice, 70 per cent of wheat and 57 per cent of the maize grown in the developing world (Byerlee, 1994). Although these figures reflected in part the Green Revolution package of seed, fertiliser and irrigation, a substantial proportion of these MVs are grown with low or no external inputs (Byerlee and Lopez-Pereira, 1994). But the story is not just confined to cereals, or to the
development of yield maximizing varieties. New technologies have also been
developed for non-cereals, and many MVs have been developed principally for
their resistance to pests and diseases. For example, improved cassava varieties
have spread rapidly in parts of West Africa (Nweke et al., 2002) and research
undertaken in Nigeria in the 1970s was fundamental to the development of
cassava resistant to mosaic virus in Uganda nearly two decades later (Otimum-
Nape et al., 2000). New disease-resistant bean varieties have been extensively
adopted by most small-scale farmers in western Kenya (David et al., 2002).
New varieties of potato, sweet potato, pearl millet, sorghum, groundnut, pigeon
pea, soybean, chickpea, lentil, durum wheat and barley have also increased the
yields, particularly of resource-poor farmers. Advances in crop management
technology have also occurred but these are often less visible and tend to be
under-reported compared to the spread of new varieties, but these too have
made significant contributions to increased agricultural productivity. For
example, agroforestry research has led to the widespread adoption of improved
fallows in eastern Zambia, making an important contribution to soil fertility
and increased yields (Franzel et al., 2002). The adoption of reduced-tillage
practices in Brazil has increased productivity on more than 500,000 hectares
(Landers, 2001). Significant advances have also been made in the management
of tillage, crop establishment and weed control in many areas of Asia (Hobbs
et al., 2000).
What influences the adoption of new technology by farmers?

A range of factors appears to have been critical in determining the rate at which farmers have innovated new ideas and so been able to raise productivity for the benefit of growth and the pace of poverty reduction.

Secure output markets

Farmers will innovate to increase subsistence production, but as innovation generally implies some type of investment (in cash, labour or learning) the chances of farmers investing and innovating are greatly enhanced by the existence of secure markets. As evidence shows, it is difficult to overestimate the importance of reliable output markets as an incentive to new technology adoption. Dorward et al. (2004) argue that a key feature of many successful early Green Revolution environments was government’s role in stabilising output prices, a function which has been progressively dismantled in Africa where innovation has been limited. Wiggins’ (2000) survey of African case studies found a number of success stories that contradict the general pessimism about African agriculture, but virtually every one was associated with well functioning output markets. In Malawi, Orr and Orr (2002) argue that unreliable maize markets lock many farmers into inefficiently producing as much of their own grain needs as possible, rather than innovating with new crops in which they may well have a comparative advantage.

Effective input supply systems, including credit

While there is danger in relying too heavily on “technology on the shelf”, effective input supply systems are essential, particularly when
technological change or advance depends on purchased inputs. Inadequate formal seed supply systems have been shown to dampen, or even preclude the diffusion of new crop varieties (Tripp, 2001). Increasing fertiliser use has long been plagued by difficulties in providing the right products in affordable pack sizes (Omamo and Mose, 2001). Establishing the systems to provide those inputs is, however, one of the major challenges for many technologies, and not merely the conventional seed-and-chemical technologies. Delivery of tissue culture banana plantlets in Africa requires the development of a network of intermediary nurseries (Wambugu and Kiome, 2001). Nurseries are also crucial for the spread of many agroforestry technologies, and efforts at encouraging farmer groups to take on this role have largely failed (Bohringer and Ayuk, 2003). The delivery of veterinary technologies depends largely on the delivery role of the private sector (Leonard, 1993). But an operational system of input provision is often ineffective in the absence of effective credit systems. Previous experiences with state-subsidised credit provision has received much justified criticism (Adams and Vogel, 1990) and new approaches are being considered, including linking input supply and output procurement (Dorward et al., 1998).

**Supporting infrastructure – particularly irrigation**

The presence of supporting infrastructure is fundamental to effective innovation on new technology and was a major factor in Asia’s successful Green Revolution. Roads are critical to supporting input and output marketing
(Dorward et al., 2004), but the expansion of irrigation probably constituted the most important element of supportive investment. The expansion of irrigation in developing countries has been greatest where attaining increasing agricultural output through land expansion has been difficult and so gains are made by intensification. Thus, both South and East Asia have a much higher use of irrigated land compared to Africa (Table 1). By 2030, it is projected that about 80 per cent of future production gains will be made from intensification (in part dependent on irrigation) with a much smaller proportion through land expansion (de Haen et al., 2003).

**Risk and vulnerability**

The relationship between risk and technology use is a perennial theme. It can work in two directions. First, the adoption of agricultural technology can make a limited contribution to reducing the vulnerability of the poorest. Examples include the adoption of drought resistant varieties that reduce the risk of crop failure because of drought. The use of irrigation can enable double cropping and lengthen the growing season, thereby smoothing production and consumption, and mitigating the impact of price volatility. Second, there can be trade offs between growth through agricultural technologies and risk since taking up new agricultural technology is, in itself, risky. Whilst improved productivity through agricultural technology can lead to increased incomes, adoption is associated with capital and transactions costs that poor people may not be able to afford. Furthermore, poor farmers struggle to control production
uncertainties. Whilst there are some instances of very poor people investing in quite risky technology (e.g. cotton farming in much of South India), on the whole, because poor people are risk averse, they tend to benefit less than others from agricultural technologies and stick to low risk, low return activities.

But have the poor benefited from new agricultural technology?

For many the key question remains: to what extent, and in what circumstances, have poor people benefited from new agricultural technologies or have the benefits been confined to the better off? Assessing this “distributional” impact of new technology is difficult, as the uptake of innovations is inevitably skewed with the better-off usually being “early adopters.” Propositions regarding distributional impact should therefore be carefully specified, and any assessment of ultimate impact should not be based on the adoption pattern seen in the early years after technology release (Rogers, 1994).

Among the most useful (but rarest) assessments impact of technology’s on poverty are those that follow farming communities’ experiences over a longer-term period (Lanjouw and Stern, 1998; Hazell and Ramasamy, 1991). These studies tend to show that the poor have benefited from new technologies, principally through increased employment opportunities and higher wage rates.

On the other side, a review by Freebairn (1995) of over 300 other studies related to the Green Revolution revealed a general increase in
inequality **between regions** as a result of technology upgrade. This conclusion however, requires qualification. First, it is inevitable that technological advance will lead to an adopting area becoming relatively better off compared with a non-adopting area. This simply underlines the importance of balancing investment in technology generation between marginal and favoured environments. Secondly, the review itself identified the difficulties in separating the impact of technological change from concomitant changes in population, policies or land tenure.

Rigg (1989), identified a similar issue: many negative assessments of the poverty impact of the early Green Revolution are examples of ‘guilt by association’ – the technology was seen as responsible for increasing inequality which was primarily the result of other factors including: farm concentration, urban migration, and so on, which accompanied technology dissemination. Most of the evidence about the poverty reducing effect of agricultural technology comes from Asia. In Africa there are far fewer examples of where agricultural technology has benefited poor people. However, evidence from Zimbabwe reveals a post-independence Green Revolution amongst smallholders which had a very significant impact on poverty. This was achieved through the introduction of hybrid maize, expanded access to credit, guaranteed prices and marketing subsidies. The outcome was a doubling of maize production between 1980 and 1986 (Eicher, 1995).
How does new agricultural technology benefit the poor?

A number of factors influence the extent to which the poor benefit from changes in agricultural productivity through the adoption of new technology. These are discussed below, beginning with the two most important factors – impact on employment and food prices.

The impact on employment

Employment on the farms of others is of critical importance to the livelihoods of the poor. This is not just true for the classically landless, employment is also a vitally important way for many farmers to supplement their incomes. The impact of new technology on labour markets – specifically its impact on the demand for labour and wage rates - is of great importance to the poor. Most evidence on this issue comes from the Asian Green Revolution experience and, while often technology-specific, a number of general principles emerge with respect to the impact of new technology on the demand for labour and wage rates.

In terms of the impact on the demand for labour:

- the adoption of high yielding rice and wheat varieties generally increased demand for labour due to the higher harvesting and threshing requirements associated with their greater yields
- the majority of additional labour used was hired rather than family labour (Lipton and Longhurst, 1989). This is particularly important for the poorest.
Increased labour demand was the greatest when new varieties were introduced into high potential areas and often associated with an increase in cropping intensity. The impact was less pronounced in low potential areas. (David and Otsuka, 1994; Lipton and Longhurst, 1989).

The impact on wage rates is more difficult to determine because there are numerous causal, and on occasion counteracting, factors. Some conclusions can be drawn though, including that:

- Generally wages appear to have increased (IFPRI, 2002)
- Labour saving technology has probably dampened the rate of wage increases, although this does not mean that wages have fallen because of the adoption of new technology. Lipton and Longhurst (1989), show that while a doubling of yields increased wages by 40 per cent early in the Green Revolution, a similar yield increase 20 years later resulted in only a 10-15 per cent increase in wages due to mechanisation. Bautista (1997) describes disappointing increases in the demand for agricultural labour in the Philippines, explained in part by subsidised farm mechanisation.
- In some cases, e.g. herbicide adoption in rice systems (Naylor, 1994), the introduction of labour-saving technology has been a response to rising rural wage rates caused by growth in non-farm wage rates.
- Even where wage increases have been modest, the adoption of new technology has frequently increased the number of employment days, and on occasion, facilitated the introduction of contracts for casual labourers (Leaf, 1983).
Food prices

For the poor, the price of food is critically important given the relatively larger proportion of their income generally spent on it. A relative lowering of food prices – particularly of staples - allows the poor to eat more and possibly better which has a positive impact on nutrition, health and food security. But cheaper food also releases income which can be spent on other goods and services with immediate positive benefits to the poor such as improved shelter or access to key services such as health and education. This release of income also creates demand for goods and services which can have a powerful multiplier effect on the wider economy. In many developing countries - and for the developing world as a whole - increases in the production of staple foods have comfortably outstripped population growth since the mid-1960s when the Green Revolution began to be adopted widely. Only in Sub-Saharan Africa have food supplies grown slower than population during the last thirty years.

Given this significant increase in per capita supply, and the relatively low elasticity of demand for basic foods, the real world market prices of the major traded grains have steadily fallen since the early 1950s. At the individual country level, increased production of food grains can have a dramatic effect on prices. This is of great benefit to the poor, both in urban and rural areas, where many people buy, as well as grow their own food (De Janvry and Sadoulet, 2002; Jayne et al., 1999). But increasing production can also be a double-edged sword if it reduces prices to the extent that producer incomes fall.
However, where productivity increases due to technology match or even outpace the corresponding fall in prices, both net consumers and net producers can benefit. Bangladesh provides an excellent example of this. Between 1980 and 2000, production of rice and wheat increased from below 15 to over 25.7 million tonnes, increasing per capita availability over the same period from 425 to 510 grams per day, despite population increasing over the same period from 90 to 191 million people. Real wholesale prices in Dhaka markets of rice and wheat have consequently fallen dramatically, with the price of rice falling from just over Taka 20 to around Taka 11 per kg in two decades. But despite declining market prices, farmers have successfully increased their production, yields and incomes - rice yields have risen from an average of 2 tonnes to over 3.4 tonnes per hectare by the early 2000s – through the use of new varieties, fertiliser and, above all an expansion of irrigation. These improvements have allowed farmers to cut their unit costs of production and so offset the impact of falling prices on their incomes. It also appears that smaller farmers have not been excluded from this technology.

**Nutrition and food utilization**

There are numerous examples of how agricultural technology has benefited the nutritional status of poor households. These include:

- improved varieties with increased vitamin content that contribute to the reduction of human disease;
- post-harvest fortification of crops to reduce vitamin deficiencies;
➢ longer cropping seasons to regulate food supply and reduce the number of months that households go hungry; and

➢ improved storage and processing to extend the shelf-life of food and reduce waste.

Access to land and other resources

The extent to which agricultural technology can benefit poor people clearly relates to existing inequalities in land and access to other resources. There are various explanations that are couched in terms of the allocation of land and other resources of why poor people stay poor. There is concern that technologies may exasperate inequality in access to productive resources. One major criticism of the early Green Revolution was the fact that early adopters tended to be larger (richer) farmers. (Indeed, a large proportion of subsidies for Indian farmers continue to go to richer farmers (Gulati & Narayanan, 2003)). These farmers were able to take greater risks and gain economies of scale from applying new technologies to larger land holdings. Evidence suggests that, subsequently, smaller farmers caught up and, in some cases, took better advantage of the new technology (Lanjouw and Stern, 1998; Hazell and Ramasamy, 1991). Nevertheless, it is widely accepted that, initially at least, technology is an unlikely way to overcome major inequalities in access to basic resources, especially land.
**Gender issues**

Gender-related effects of technology change are often important in determining the impact of adoption on poverty. Technology generation has tended to favour crops traditionally grown by men, who frequently have greater access to labour, markets, credit and other inputs than women to a degree that may impact negatively on the intra-household distribution of income and consumption (Doss, 2001). Addressing these challenges goes well beyond technology design, as maledominated societal rules and norms, and a complex household environment of ‘joint decisions, multiple objectives and mutual dependence’ (Bonnard and Scherr, 1994) make it difficult to target, or predict the gender-related outcomes of technology development. Simply targeting technology to women’s crops is not necessarily the answer. (von Braun and Webb, 1989).

**Sustainability issues**

Whilst new technologies are important for poverty reduction, if not carefully managed, they can create additional demand on resources which may simply not be sustainable in future. The most obvious example of this is water, for example the lowering of water tables and loss of aquifier water, but other resources, including biodiversity and chemicals, are also discussed here.

**Irrigation and water resources**

The area of irrigated farmland has tripled since 1950 (Smil, 2000). The expansion has not been evenly distributed, with much greater increases in
irrigation in South and East Asia. Irrigation has, undoubtedly, been a central component in poverty-reducing agricultural growth. But poorly managed irrigation has led to falling water tables, salinisation and other problems.

*Salinisation*

Rosegrant et al. (2002) review evidence of salinisation. They argue that on a global scale there are about 20-30 million hectares of irrigated land that are severely affected by salinity. Furthermore, an additional 60-80 million hectares are affected to some extent by waterlogging and salinity. Some salinisation would have happened even without new technology but some have been encouraged by unsustainable subsidisation of irrigation.

*Chemicals*

The indiscriminate use of chemicals has also caused problems; Rola and Pingali (1993) showed that pesticide use on rice in the Philippines results in negative economic benefits if human health costs are included in the analysis.

*Biodiversity*

Technological advance is often blamed for the loss of biodiversity, but the issues here are complex. Agricultural expansion generally has caused habitat destruction and, at the local level, productivity increases can attract new farmers to the agricultural frontier by making farming more profitable. But yield increases achieved through new technology have curbed deforestation and the cultivation of marginal lands. If world crop yields had remained at their
1960 levels, another 800 million hectares of land (equivalent to the Amazon River basin) would have had to be brought into cultivation to meet current demand (Ausbel, 1996). Modern crop varieties have frequently displaced many local varieties. But the relationship of these changes to overall genetic diversity is difficult to unravel. Recent work shows that the uptake of wheat has not lowered genetic diversity (Smale, 1997) as farmers often adopt a new crop variety and grow it alongside their traditional varieties.

1.8. Limitation of the study

This is a micro level study and generalization of the findings for the whole region is not feasible.

Personal interview method is followed for data collection. The data collected was for the agricultural year 2009. The answers given by the farmers may not be accurate and adequate since they do not usually keep a proper record of costs and returns in cultivation of crops. Since the respondents rely on their memory and reply to the questionnaire may be biased. Even then all efforts have been taken to minimize the error by cross checking the information.

1.9. Chapter Scheme

The whole thesis is divided into seven chapters, where in

Chapter I deals with the introduction, need for the study, motivation for the study, objectives, hypotheses, theoretical framework of the study, limitations and chapter schemes.
Chapter II brings out an account the review of literature.

Chapter III presents the profile of the study area and methods and material.

Chapter IV deals with the general description in Tamil Nadu of the study.

Chapter V presents Analysis and discussion – I.

Chapter VI deals with the Analysis and discussion – II.

Chapter VII gives the summary and conclusion. It also offers some suggestions and further research.