CHAPTER - II

REVIEW OF LITERATURE OF FARM MECHANISATION
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2.1: Introduction:

The present study is intended not only to identify the beneficiaries, the nature and extent of agricultural inputs to improve the productivity, but also to assess the impact of farm machineries. But emphasis has been highlighted on the role of farm Mechanisation as it is one of the most important issues in the aspect of factors of productivity in agriculture. Some of the research issues and studies on farm Mechanisation and productivity differentials are reviewed here to provide the necessary background to the present study. This would help to estimate the extent of farm Mechanisation and its impact on the productivity differentials.

2.2: These Studies can be Classified Under Five Broad Categories:

1) Studies highlighting the main issues on farm Mechanisation.

2) Studies estimating the growth of farm machineries.

3) Studies dealing with the assessment and the contributing factors for the growth of farm machineries.

4) Studies examining the level of adoption of farm machineries.

5) Studies focusing on the economics of farm Mechanisation at different level.
2.2.1: Studies Highlighting the Main Issues of Farm Mechanisation:

Ninth Plan (1997-2002), focuses on the augmentation of resources towards Mechanisation of agriculture, but without large scale replacement of human labour. The objective behind the plan focus is to strengthen the human labour by supplementing the machine labour, which will enhance the agricultural production and productivity.

Sundarayya (1977) analysis that increasing machineries marked by the use of tractors, thresher and tube wells by all sections of peasantry, the traditional means of production including the agricultural livestock—buffaloes and bullocks have greatly reduced.

The adoption of farm machineries has been extremely rapid in the state of Punjab, where more machineries are developed keeping in view of the particular needs of farmers. Where agriculture becomes more mechanized and promoted higher productivity and better quality (Bradhan 1970, Pranab 1970 and Gyanendra Singh 2000).

The Ninth Plan policy laid emphasis on the promotion and popularization of improved agricultural implements, both power operated and animal drawn. They led to the use of farm machinery. The demand for agricultural equipments in respect of farm Mechanisation is estimated at one per cent.

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Singh (1997) states that entrepreneurship, development and promotion of manufacturing capabilities of small industries have helped in quality production and communication of farm equipment.

Binswanger (1978) looks at some of the factors which operate at the micro-level of the farm influencing the adoption of capital intensive machinery in agriculture. Several studies tried to examine the factors in the context of Asian countries pointedly refers to the fact that it is consideration of the cost-efficiency which remains as the major root shift to Mechanisation.

A study on farm Mechanisation in Thailand identifies faster turnover of the ploughing operations during crop seasons, substantial reduction in the operation costs of ploughing per unit of land and the multiplicity of farm operations as the main factors for having promoted the rapid shift to Mechanisation in this region. Due to these aspects there is declining economic importance of the conventional source of energy in agriculture. The cost of maintaining the drought animals has also been rising on account of the limitations of graying lands and the escalating cost of animal feeds. These factors contributes to the shift towards the use of machinery in agriculture Jose (1984).

Hansa and Sharma (1992) points out that the new farm technology revolves around the concept of increasing returns per unit area and per unit time. This necessitates the augmentation of power (Energy input) on farm organizations.
Realizing that the bullock power had its own limitation in ensuring timeliness of operations and precision in the placement of seed and fertilizers, farmers took to Mechanisation has brought about some structural changes in the agricultural set up in Punjab state.

Availability of animal draught power is reducing fast in some regions due to the new popular breeds of cows like Holstein Frison, Red Dane and New Jersey. The male off springs of these cows are not suitable as draught power. Most of the cattle owners either prefer to kill the male calf at a very tender age or sell it far beaf. As a result, availability of animal power has reduced significantly in some regions Thippaiah and Deshpade (2000).

Trends in Mechanisation in India indicated a satisfactory pace of growth in tractors, power tillers, irrigation, pump-sets, levelers and sprayers and dusters. Among the implements wet land peddlers and seed-cum-fertilizer drills recorded highest rates of growth Thippaiah and Deshpade (2000).

At country level (among states) as well as at the state level (across districts) the process of Mechanisation is strong in some regions only. Even going by the availability of equipment only a few states have achieved reasonable rate of growth. Among the lagging regions are eastern Indian states, Madhya Pradesh, Bihar and Rajasthan Thippaiah and Deshpade (2000).
The schemes for promotion of Mechanisation is in the agricultural sector should also incorporate purchase of complementary machinery and implements to make the process more effective. Otherwise purchase of tractors alone may not help to induce the process of Mechanisation (Directorate of agriculture, State Governments).

Kahlon and Gill (1967), reveals that Mechanisation has proved to be the major factor in the implementation of intensive farming, along with the intensive use of yield-increasing technology and multiple cropping. There is a large scope for Mechanisation selected agricultural operations such as seed-bed preparation, sowing, irrigation, plant protection, threshing and transportation.

Sapre (1969) made an attempt to explore whether tractors were really profitable under Indian conditions. It has found that tractors had displaced certain resources but augmented farm production. Resources got replaced because bullocks and farm servants became redundant after characterization. Resources were also saved because of the reduction in the weeding costs, baluta (wages) payments, transport charges and ploughing charges and saving on the depreciation charge on the bullocks retained on the farm because of the prolongation of their working life.

Kahlon (1975) conducted a study on the impact of Mechanisation on Punjab agriculture with special reference to characterization. The study aimed at testing the hypothesis related to the impact of tractor Mechanisation on Labour employment, output, productivity, costs and incomes. Comparison of bullock farms with tractor
farms revealed that tractorisation has significantly shifted the production function upward. The results showed that at higher levels of cropping intensity, wheat yields on tractor farms were generally higher than that on the bullock farms. As the farmer gets more skilled in the use of farm machinery, these differences might show up better; it has agreed.

Although animal and human power continue to be the main power sources in agriculture, yet the power driven machines, namely tractors, power-tillers and combine harvesters continue to be in the frontline of farm Mechanisation, where farmers have been provided assistance for owing agricultural machinery Govt. Of India (1998).

Dixit and Bhardwaj (1990) enunciate that in India large number of tractors were introduced in the mid-60, with the introduction of HYVs of seeds to accelerate agricultural production and productivity. To use the HYVs of seeds timely operation of agriculture is essential specially for ploughing, harvesting and preparing the farm for other crops. This factor gives incentive to use tractor in agriculture. But there were two extreme views about the use of tractors in Indian agriculture. The antagonist claimed that the tractorisation would displace the labour hence, it would create unemployment problem in India. So it is not appreciable to use tractors in India, where labour is in abundance. On the other hand, the protagonist said that tractorisation would increase cropping intensity and multiple cropping and, therefore, it would not only substitute the displaced labour but would also create additional
employment in the agricultural sector. That tractorisation displaces the human labour and therefore, the human labour employment is less in the tractor operated farms as compared to the bullock-operated farms in Raipur district of Madhya Pradesh.

The above studies reveal that farm Mechanisation led to increase in production and productivity. However, unfortunately, they indicate that the animal and human labour are being displaced. The studies failed to explain whether the Mechanisation led to generating employment and income through various other avenues.

2.2.2. Studies Estimating the Growth of Farm Machinaries:

Many Agricultural Economists would dispute the inclusion of an indivisible factor of production like tractors, as a component of the new agricultural technology alongside, divisible inputs like new seeds, fertilizers, pesticides and irrigation Diplab (1977).

Farmers of India have adopted improved packages for the modernization of agriculture. India leads in the manufacture of tractors with more than 2.1 lakh tractors sold during 1997-1998. It is also well equipped to manufacture general purpose and specialized agricultural machinery. About 4.5 lakh irrigation pumps, 4.5 lakh plant production equipment and 2.5 lakh threshers are sold every year. Since the introduction of a little over 880 tractors every year during the 1960, the number of indigenously produced tractors were increased to more than 2.10 lakhs in 1996-97 (Census 1997).
The most advanced states in India in the matter of agricultural Mechanisation between 1966 and 1976 are Punjab and Haryana. The number of tractors in Punjab were increased from 10,633 to 63,513 and in Haryana from 4,803 to 27,667. Some available data on the growing use of machinery in several Asian countries depicts that agricultural Mechanisation in such countries involves the use of variety of machines such a tractors, tillers, pump-sets and thresbers which are rapidly gaining ground in these countries Jose (1984).

According to Singh (2000), Punjab state’s agricultural production sector is highly capital intensive and mechanized. It has 7.44 lakh energized tube-wells, 3.87 lakh tractors and 66 thousand combined harvesters.

According to Government of Punjab (1997), about 907 per cent of paddy and 60 per cent of wheat is harvested by combine harvesters in Punjab. It also has the highest consumption of electricity, fertilizers and the highest number of tractors (28 tractors per 1,000 acres) in the country.

Sharma (1998) says, every third farming household in Punjab owns a tractor, and a third of the tractors in India are owned by Punjab farmers. In some villages, the proportion of tractor owners are even higher. Infact, in one village in a southern Punjab district (Bathinda) there were 110 tractors for 960 hectares of land.
Governmental efforts have found expression in a substantial increase in the use of agriculture machines by the farmers. The sale of tractors and power-tillers touched on all high mark during 1996-97 constituting about 2.21 lakh tractors and 11 thousand power-tillers. The same holds good for the other agricultural equipments as well. As a result the power now available at the farms is estimated at 1.10 hp/ha during 1996 as against about only 0.35 hp/ha in the early 70s (India – 1998).

According to Singh, traditionally, threshing has been achieved by bullock trampling which is arduous and take more time. It results in considerable loss and poor quality of grain. This has been gradually replaced by power threshers operated by 5-15 hp engine or electric motor. More than 25 thousand power threshers are introduced every year.

Sidhu (1986) argues that, tractorisation along with the growth of oil engines and electric motors used in agriculture resulted in partially mechanizing major operations, such as water pumping, threshing ploughing and sowing. This has led to proper utilization of inputs like seed, fertilizers and water.

The available farm power in Indian agriculture was estimated to be low. It was neither desirable nor practical to augment the supply of farm power with human and bullock. Therefore it was recommended, Anonymous (1982) by ministry of Industry that tractor should be promoted especially among the small farmers by reducing state levels and liberalizing terms of credit for purchase of tractors. To form the basis for
formulating programme for sixth five year plan (1980-85), the working group constituted by the Development Council for Automobile Industry (Sept. 1980) estimated the growth in production of tractor to be 15 per cent up to 1984-85. The group also suggested to raise the installed capacity by 72.5 thousand numbers before 1984-85 and by an additional 95.5 numbers by 1989-90. The total tractor production in the country raised to 84.10 thousand numbers during the year 1981-82. During 1983-84, the demand of tractor fell sharply due to restricted credit measures by the Government. Afterwards it was recovered by the increased sales of tractors (Mohan 1986).

Indian farmers have well accepted the tractor technology in agriculture and have shown the tremendous response for tractor use. During five years time (1984-89) the total production of tractors was 4.80 lakh, between 1990 and 1994 the production of tractors increased to 7.38 lakh, further the production has gone up to 12.04 lakh during the period 1995-99. During the years 1996-97, 1997-98, 1998-99 and 1999-2000 the sales of tractors were reported to be 2.22; 2.57; 2.62 and 2.73 lakh numbers respectively. It indicates that there is a huge market for tractors in the country for Mechanisation of agricultural operation and industrialization, (Shahare 2003).

There has been a substantial increase in farm machinery over last three decades. The number of tractors in the country increased from 1.48 lakh in 1972 to 17.13 lakhs in 1995. In a similar way, the number of combined harvesters and
irrigation pump-sets increased from 350 to 11.00 thousand and from 3.16 lakhs to 16.8 lakhs respectively. This phenomenon is not only true for tractors, combined harvesters and pumps but also other machines used for various farm operations. These include power sprayers / dusters, mould board ploughs, disc, ploughs, cultivators, seed drills etc. The growth in number of these implements and machinery is such that the number of power sprayers / dusters increased from 44.8 thousand in 1971-72 to 3.50 lakh in 1995-96. The number of mould board and disc plough increased from 57.3 thousand in 1971-72 to 4.75 in 1995-96. Again the number of disc harrows increased from 55.6 in 1971-72 to 6.00 lakhs in 1995-96 (Sitaram 2001).

The picture of farm Mechanisation in the state of Assam on the contrary was not satisfactory till the Fourth Five Year Plan. However, from the Fourth Plan onwards, agricultural growth rate in the state started picking up with the gradual spread of modern technology strong with the increasing demand for improved seeds fertilizers and other modern inputs, the demand for farm machineries like power tillers, power pumps and other small farm implements also increased in the state. Power tiller registered a significant compound growth rate of 8.27 per cent and power pump 2,946 per cent during the period of 1979-80 to 1991-92. However, the growth rate of Tractor was non-significant (0.89 per cent only) during the same period. There was relatively greater emphasis on farm Mechanisation through power tiller in the state (Sharma 1999).
Nandal (1988) examined the context of Agriculture in Haryana. The process of farm Mechanisation in the Haryana was accelerated as a consequence of progressive adoption of seed-irrigation-fertilizer technology and the system of multiple-cropping by farming community. Stationary operations like irrigation and threshing were preferred to be mechanized using elective and diesel engines. Gradually, the number of tube-wells / pumping sets increased from merely 25.31 thousand in 1996-97 to 3.88 in 1983-84. Similarly the number of threshers increased from 11.00 thousand in 1966-67 to 1.02 lakh in 1982-83. Combine harvester became a technical necessity and their number reached to 10.27 thousands in 1981-82 against zero production in 1966-67 and 79. The number of tractors and power tillers in Haryana state has increased from 4.8 thousand in 1966-67 to 2.80 lakhs in 1983-84 despite steady increase in the prices of tractors and their operational cost.

Pandey, Singh and Suhag (2000) examined the study of mixed farming in Haryana. The post-green revolution era has become the Sinequa-non for improving agricultural production in the state. Use of tractors, pump-sets, electric tube wells and chemical fertilizers has increased manifold so as to increase the agricultural production. The tendency to replace animal power by the tractor has been increasing overtime inspite of the fact that per hectare both initial capital investment and annual operating expenses in case of the bullock power are much lower as compared to that of tractor power. There has been a tremendous increase in the number of tractors in the state from 4.8 thousand in 1966-67 to 1.803 lakh in 1997-98.
The main source of farm power on the Indian farms include human, animals, tractors, power tillers diesel engines and electric motors. The average power availability from all the sources, was roughly 0.45 hp per hectare, against a minimum level of one hp per hectare required for single cropping. With the projected net cropped area of 155 million hectares in the year 2001 the power requirement is estimated to be around 1000 million hp. Umesh’s work (1990) reveals that of the present available power 65 million hp, about 16 million hp (about 25 per cent of the total power available) is obtained by tractors. The number of draught animals is not likely to increase much in the future (Verma 1981).

The number of tractors used during the pre-green revolution increased from 8.55 thousand at the beginning of the 1950s to 54 thousand by the beginning of the green revolution. During that period the number of tractors per lakh hectares grew 5 times from 7 to 34 Mc Guirk and Mundlak (1991) argue that the number of tractors was increasing even before the green revolution. However, the growth of tractor during the post-green revolution era was higher with the number of tractors doubling in the transition period the tripling during the 1970s and 1980s. By 1996-97 the tractors in the country are estimated to be more than 2.04 million.

India Info line Sector Report (2001) however states that a drop in agricultural output has had a negative impact on the demand for tractors. Tractor sales fell by about 10-12 per cent in April-Sept.2000 as a drought swept through the states of
Rajasthan, Gujarat and Madhya Pradesh in April and May (Business Recorder, 2000).
Similarly, sales in the key agrarian states of Punjab and Haryana in 2000 was affected
as farmers were forced to offload their stocks due to distress sales as the procurement
of paddy, by the government was slow as there was due to shortage of storage space
(Business Recorder, 2000).

During 1970s and 1980s, tractors were mostly concentrated in the north and north-west states like Punjab, Haryana and UP account for nearly 50 per cent of the entire tractor sales. Punjab alone accounts for 26 per cent. The main reason was comparatively larger land holdings and the affluence of the farmers in these states (Money line, 2000).

The review clearly reveals that there is a fast growth of machine power in the country. However, the growth is not uniform as it is concentrated in few states only. Therefore, there is a necessity to spread the same in all the regions of the country. Hence, in this study an effort will be made to understand the growth of machine power in the state of Karnataka.

2.2.3. Studies Dealing With the Assessment and the Contributing Factors for the Growth of Farm Machineries:

Empirical evidence proves beyond any doubt that farm Mechanisation has substantially contributed to the success of the new technology not only in India but all over the world (Desai 1973). The issue today is not whether, but rather what
machines should be used? (US Government 1967). The question is also as to how to modernize the vast number of small and marginal farms? Besides electric pumps used for irrigation, the use of tractors, power tillers, thresher and harvesters have become quite common and in several areas in India, they are responsible for yield and income variations between the different groups of farmers and regions. Ways and means will have to be found to halt the growth in disparity in this regard and to modernize farms.

Agricultural development in Punjab is closely associated with the changes in the level and structure of agricultural employment. It reflects the composite effect of market forces and technical factors influencing demand for human labour in the state’s farm. In late 1960s and early 1970s the introduction of modern production technology for wheat and rice unleashed the forces of change that influenced productivity, production and employment. Increase in production was accompanied by greater labour absorption in the process through increase in cropping intensity and use of fertilizers, expansion in irrigated area and higher land productivity (Grewal and Kahlon 1974, Raj Krishna 1974, Raju 1976 and Bislaiah 1978).

Seed-irrigation-fertilizer technology necessitated Mechanisation of farm operations through introduction of tractors and tractor-operated thresher in a big way in the late 1970s, in order to realize higher returns through precision farming and vertical expansion of land area. Tractorisation of farm operation led to a fall in labour intensity. Yet, total agricultural employment on mechanized farms did not decline due to increase in cropping intensity, labour-intensive shifts in crop-mix and higher

Labour-saving technology, particularly, the use of four-wheel tractors for land preparation was introduced to Thai agriculture long before the introduction of the modern rice varieties (Siamwalla 1987). However most of them were used for land preparation of upland crops, especially for preparing new land for cultivation. The market for tractor contractor service was widespread in the central plains (Wattanutchariya 1983). A power tiller originally imported from Japan spread rapidly during the early 60s. The power tillers were modified later by Thai manufacturers to suit local conditions. The locally produced power tiller rapidly spread the irrigated areas of the central plains. The increase in the cropping intensity of paddy in the irrigated environment and the low interest rate of agricultural credit were the major factors that contributed to the widespread adoption of power tillers (Onchan 1983). In the central plains, the adoption of power tillers was 100 per cent by 1998 in all production environments.

Mechanisation leads to direct yield increase only in exceptional cases such as the application of seeds, pesticides or fertilizers. Higher levels of Mechanisation usually substituted for labour or where they are already in use for animals. It is in direct contract to the net contributor view, which assumes that higher levels of Mechanisation and in particular tractors directly lead to yield increases on other output gains, regardless of the economic environment in which they are introduced.
Such a view usually stems from a confusion of the direct effects of Mechanisation with the indirect productivity effects arising from the factors saving made possible in the view of Binswanger (1984).

Sen (1970) absorbs that some increase in farmer investment in machineries may well be associated with the shift to multiple cropping and new technology. But given the uneven distribution of irrigated acreage among the state of Punjab, the new technology will also be uneven and farm Mechanisation may, however, be limited to those states which have a large proportion of irrigated acreage. The extent of Mechanisation and the rate of increase of investment in capital equipment vary from state to state and this difference may persist because of regional differences in factor endowment.

Punjab experience appears to be unique. The labour to land ratio on the farms in Punjab, for instance, is one of the lowest in India. For the undivided state of Punjab in 1964-65, the ratio was approximately 6 agricultural workers to 100 acres of cropped land. This is on the supply side of farm labour. On the demand side, close to half of Punjab’s gross cropped area is irrigated – the highest proportion of irrigated to cropped land for any state of India. The cropping intensity in Punjab is also one of the highest for the undivided Punjab again, it was 132 in 1964-65. There may be a pressing need, therefore to supplement human labour and draught animals by capital equipment. Further, the number of operational farms of large size is quite considerable. Farm size is not only determinant of Mechanisation, however, soil
conditions and fragmentation may effectively limit the scope for Mechanisation. In this respect, too the Punjab case is different from the rest of the country. Decades of sustained land consolidation have developed a farm-layout that is suitable for the profitable use of farm machineries.

Agriculture in modern economy benefits from the equipment, which industry produces. Heavy input of outside energy-oil engines, tractors, electric motors or electric energy transformed to nitrogen fertilizers multiplies the effect of human effort; it replaces the draught animal, thus increasing in the area available for human food. Mechanisation increase production and productivity, import of tractors and farm equipment results in the expenditure of foreign currency. Immediate promotion in the field of agriculture so as to enable it to play its role better in national economy, seems to be the task of high priority. Economic development would strongly benefit from investment in agricultural Mechanisation. Costly equipment must be put into maximum use, given the average farm size in India, individual ownership and use of tractors would be an exception in the phase of Mechanisation.

Byerlee and Sidhu (1991) review the technical change and wheat productivity in the 1970s and 1980s revealed a number of interesting trends — green revolution has been consolidated through further intensification in the use of modern labour — saving inputs especially fertilizers and herbicides. Use of those inputs continued to increase strongly even after full adoption of HYVs. However, the use of tractors, has expanded even more rapidly in this period. Labour-saving technologies have reversed the trend
toward higher labour inputs in wheat production that was observed when the new wheat technology was first introduced.

Venkatappiah (1972), in his inaugural address spoke about the progress in respect of farm implement and machinery during the plan period. As far as the Government is concerned, the establishment of 16 research-cum testing and training centers, 15 agricultural implement workshops in the districts selected under DARP wings at the Gram Sewak training centers, 40 workshops and 2 tractor testing and training centers is a milestone. An important development of the recent past has been the exemption of the tractor and power tiller industry from the licensing provisions of the Industries (Development and Regulation) Act 1959. Agro-Industries corporations have been set up, practically, in all the states. They distribute agricultural machinery and implement as well as other allied equipment on a system of hire purchase basis.

Tractors are used for a number of operations but its attachments are either not available or very costly. There is, therefore a need for more R & D efforts to manufacture cheap tractor implements, like tractors could be put to multiple uses. Alternatively Farmer’s Co-operatives or Agro-Industries Corporations or similar agencies should maintain a pool of implements and hire out to farmers. However, the latter proposal is beset with a number is required by all the farmers during a particular time period.
Tractor owning farmers are also found to be maintaining bullocks either because of irregular and inadequate supply of electricity / diesel or non-availability of adequate service facilities. The State Government should, therefore ensure continuous supply of electricity and desired quantities of diesel to farmer. Besides, either state should provide adequate service facilities through its own agencies or help entrepreneur to set up adequate number of small workshops in the vicinity of villages.

In 1982, the Sibsagar district Assam report points out that the modified improved implements which could be considered as intermediate technology by and large found favour with the cultivators who realized the advantages in terms of labour – saving, labour efficiency and productivity. The report attributes a stress on provision of repair facilities for the implements either in the village or within reasonable distance.

Recognising the importance of farm machinery Government of India undertook imports of farm machinery in the First Five Year Plan. A tractor testing station was started at Nagpur. Simultaneously for promoting the proper use of farm machinery Government of India established “Agricultural Machinery Utilisation Training Center”, in 1955 at Budni in Raisen district, M.P. The tractor testing station started at Nagpur was shifted and amalgamated with Budni Centre. The Budni Centre was renamed “Tractor Training and Testing Station”. In 1983 the station was upgraded and renamed Central Farm Machinery Training and Testing Institute.
The farmers’ interest, increase in yield levels and the government’s effort both at the state and central level led to the growth and development of farm Mechanisation in the country. Therefore, an effort is made in the present study, to understand the extent of the adoption of the same in the state of Karnataka and Mandya district.

2.2.4. Studies Examining the Level of the Adoption of Farm Machineries:

Adoption of the new agricultural technology in India seems to have been accompanied by increased farmer investment in forms of capital equipment such as diesel pumps, electric pumps, threshers, tractors and the like. The most pronounced increase in this respect has taken place in Punjab and to a smaller extent in Haryana and Western Uttar Pradesh. Increase in investment in farm mechanism seems on the whole to be less in the rice-growing areas than in the wheat belt. If the current tempo of farm Mechanisation in Punjab is any guide, farm Mechanisation may be extensive in all regions in the near future.

Hanumantha (1975) observes the impact of farm Mechanisation — particularly tractorisation on output and employment. Since tractor power is employed for ploughing, threshing and transportation etc., i.e., jobs hitherto performed by human and bullock labour, there would be some displacement of labour. However, it has been contended that the use of tractors on farms would facilitate quality, ploughing and multiple cropping (cropping intensity) by timely operations and thereby raise yield per planted acre “Whereas the impact of tractor use, in the first instance is the
technological displacement of the part of the existing labour observes Raw, some new employment could be generated for inter cultural, harvesting, etc, through its secondary effects. The latter effect could be significant in regions experiencing technological changes in developing countries, as there is a growing demand for agricultural commodities and hence an incentive for farmers to expand agricultural output in such regions. The impact of tractorisation on farm employment in such regions depends upon the extent to which its labour substituting effect is compensated by its land augmenting effect.

As few studies available for suicides, distress and anguish that was created in the state of Karnataka were due to the cause of, loss of crops due to inferior quality of inputs and their non-availability on time has been one of the recent phenomenon Rao and Goppalappa (2004). Moreover, adoption of new technology with inadequate knowledge, expertise and state support creates uncertainty in yield or productivity loss due to farmers expectations about the income flow and leaves them under financial stress mounting credit burden, debt trap and consequent financial, non-availability and interlocked input-credit product markets, failure of extension services to provide counsel on farm technology, on the problems faced and immediate steps to be taken by them, add to farmer miseries.

There are few farmers’ suicides available on the first but of suicides that rocked Karnataka and Andhra Pradesh a few years back was very high (Assadi 1998, Revathi 1998 and Vasavi 1999). The issues that featured in this debate included the
failure of technology, lack of support to the inputs, failure of market, ecological crisis and the absence of support mechanism. Among these the failure of technology and lack of support system were the most important. As Vasavi puts it rightly "the state has promoted a model of agriculture in the region that draws primarily on the model of agriculture developed for wet regions for commercial cultivations. The rainfed areas did not receive the appropriate technical support. In addition the cash component in the cost of cultivation has increased substantially. This is probably deepened the crisis.

There are reports of suicides by farmers because of their inability to return loans. More than one thousand farmers have committed suicides during the last five years or so (Iyar and Maniclal 2000). Distress sale of farm machinery, tractors and even land are being reported in the state of Punjab.

Farmers in Punjab have made huge investments in farm machinery. The state has 4.34 lakh tractors (CMIE 2002:7), 1.45 lakh seed-drills, 3.25 lakh threshers, 7,300 combine harvesters and more than 9 lakh tube wells. The total investments in farm machinery is at least worth Rs. 8,000 crores (Sidhu 2002). The tractor population of the state constitutes about 25 per cent of all tractors in the country. Each tractor is being used for at least 1000 hours. More than 9 lakh tube wells are being supplied electricity by the state government free of cost.
Abercrombie (1973) in his review of the experience of tractorisation in Latin America notices that tractor – use is largely concentrated in Argentina, Brazil and Mexico and has benefited agricultural production in those countries. He observes, however, that the direct effect of tractorization on crop yields per hectare has been small or much more importance in raising yields has been the use of other inputs such as improved seeds, fertilizers and water control. The overall effect of tractorisation has been to displace labour to the count of 3 workers/tractors.

Deepak (2001), observes that with the progressive adoption of new HYVs and scientific methods of farming, the demand for farm implements and machinery has increased considerably. The adoption of improved seed-irrigation-fertilizer technology and system of multiple cropping has stimulated the demand for seasonal labour which in turn seems to have precipitated into use in seasonal wages. This obviously has made the investments in farm implements and machinery by the farmers more attractive. Infact, any use of mechanized power in place of human / animal power of agricultural operations are performed by varieties of machines. But in India progress of farm Mechanisation is confined to some operations by particular machines, such as tractors which are mainly used for preparatory, tillage and transport, power operated pumps used for lifting water for irrigation purposes, power operated sprayers, dusters, harvesters and threshers. However, among the developments in Indian agriculture the introduction of power-driven machines on a sizable scale has not received serious attention.
In India the farmers have increasingly realized the advantages of farm mechanisation such as timeliness, efficiency and quality of operations. As a result there has been considerable increase in the adoption of improved farm implements and machinery over the last three decades. This is evident from the fact that the number of tractors in the country increased from 1.48 lakhs during 1972 to 17.13 lakhs during 1995. Similarly, the number of combine harvesters and irrigation pumps are estimated to have grown from 350 to 11,000 and 3.16 lakhs to 16.80 lakhs, respectively, during the period 1972 and 1995. The passage of time is not only marked with phenomenal increase in the number of tractors, combine harvesters and irrigation pumps but also in the number of other machines such as cultivators, planters, threshers, sprayers, dusters etc. Thus increasing mechanisation as evidenced by a rising demand for tractors, tillers, threshers, pump sets etc., is one of the directions in which transformation of Indian agriculture is taking place.

The adoption of short – duration HYVs of real crops and increasing use of inputs such as seeds, fertilizers, irrigation, pesticides and those that can be ascribed to new techniques of production, have played a significant role in this achievement. It is to be noted that the adoption of any farm tool and equipments by farmers greatly depend on the socio-economic conditions of the local farmers and agro-climatic conditions of the region. This is symptomatic of the fact that a number of improved farm implements designed and developed at various research centers do not reach the farmers due to non-popularization and lack of suitability of these implements to local conditions and therefore, they lie in the premises of these research organizations.
Majority of the farms in India are small and it is the general feeling that neither can they afford to purchase the huge and costly agricultural implements and machinery nor can they afford its economic use, individually at their farms with the result, many of them continue to rely upon manual and bullock power drawn traditional implements.

Sidhu (1986), makes it clear that the area under HYV is an important constraint for the adoption of improved implements and machinery in agricultural sector. The area under HYV is higher in the high-income mechanized states like Punjab, Haryana and T.N. as compared to the low-income states where the use of agricultural implements and machinery is in the rudimentary stage. Agricultural wages were much higher in the Mechanisation states than the overall wages of India.

Mechanisation, is visualized as a process of slow, well considered and orderly adoption of machines will all its complementary effects on demand for other inputs, and in the process of demand for labour. Machines substitutes for labour in the performance of certain farm operations at a given level of output, yet it enhances the capability to perform these operations more intensively and more number of times and necessitates some other operations which otherwise will not be performed. Mechanical power use may thus have some complementary effects on labour-employment at the farm-firm level. On a farm-firm level, if mechanical power use substitutes for labour, it does so mostly at an advanced phase on the expansion path.
Adoption of implements and machinery by dry land farming ryots will go a long way in increasing the agricultural production Bhimaiah (1982)

Increase in the levels of Mechanisation has been a decrease in the level of human labour employment not only on per cropped hectare basis but also per net sown hectare basis too. This indicates the labour displacement effect of Mechanisation. It is important to note that the labour displacement effect was such that even the increase in cropping intensity due to Mechanisation could not neutralize the effect.

Though there is a lot of scope for tractorisation in Indian agriculture, the progress achieved in this front has been very slow. This was due to various problems at different levels among Indian farmers. Changing attitude among Indian cultivators and aggressive structures have undoubtedly encouraged cultivators to adopt advanced technology viz., HYVs, fertilizers, pesticides and farm implements.

2.2.5. Studies Focusing on the Economics of Farm Mechanisation at Different Levels:

The traditional tools and implements relied mostly on human and animal power. Improved hand tools and bullock drawn implements, although, help in reducing drudgery in farm operation they do not necessarily help in completing the operations on time.
Though tractors and farm machines have made a positive contribution to agricultural production, the extent of the use of mechanical power in agriculture is much below the ideal. As of 1996, the net cultivated area in the country stood at 142 million hectares, of which 53.5 million was irrigated. Even if it is assumed that tractors are used only in irrigated areas, there were 38 tractors per 1,000 hectares. This translated into 1.41 HP/ha. of mechanized power as compared to 2 to 5 HP/ha. for developed countries. Studies have shown that the utilization of tractor capacity is rather poor in a farm size groups. The overall utilization of the available operational tractor capacity is 47 per cent, varying from about 43 per cent on small farm to about 52 per cent on large farms. Thus, the capacity utilization seems increasing with the farm size (Venugopal 2004)

Implementes are generally called improved because of their superiority to traditional implements in terms of better performance, reduction in drudgery, increase timeless of operations and reduction in the cost of operation. The implements have not been adopted widely, would have been expected owing to various technical, economic, institutional or other factors. Ray (1993) found that the constraints for non-adoption of agricultural implements and machinery in most of the states were small farm size, low adoption of HYV seed, low percentage of area under irrigation, poor cropping intensity, higher wage rates and poor holding size.

The investment in farm machinery showed a direct relationship with farm size. It was highest on large holdings and lowest on small holdings in all the zones. The
large holdings made greater investments in tractor and tractor drawn implements whereas the small and medium-sized holdings invested more in irrigation structures. The threshers and maize-shelters were common items of investment and all types of holdings had invested in these items (Bal Singh and Bal 1973, Chandra 1973), states that though the small farmer is able to make the same per acre expenditure as the large farmers on size - neutral inputs such as seeds, fertilizers, pesticides etc., his investment in machinery is constrained by farm-size. A study in Krishnagiri block, Tamilnadu, showed little difference between wetland and dry land farmers with respect to investment pattern (Padmanabhan 1992).

Pratap (1992) and Satish (1992) have analysed the farm Mechanisation of the Rajasthan state. Different categories of farmers have been assessed on the basis of their land holdings. The farmers owing less than 1 hectare land are classified as marginal farmers, those having between 1 and 2 hectares as small farmers and all the farmers owing more than 2 hectares are categorized as large farmers.

The marginal farmers are poor cultivators and their earnings are meager. They could not afford costly crop inputs, tools and equipments. Human and animal power are the prime sources of energy on their farms. These farmers are continued to use wooden plough for land preparation, seedling and inter cultural operations. Human power is used for seedling, weeding, harvesting, threshing and shelling of crops.
The small farmers are very enthusiastic and adoptive. Small farmers are mainly used human and animal power sources and sometimes hire tractors for ploughing operations. Many small farmers in Rajasthan own electric or oil engine pump-sets for irrigation of crops. Harvesting is done manually using traditional and improved sickles. The crop is threshed manually or by treading it with animals. Some of the small farmers have own threshers. They are looking for a prosperous future.

Most of the large farmers are economically sound. They have enough money to invest in land development, creation of irrigation facilities, purchase of modern crop inputs and farm implements. A number of large farmers have own tractor seed-cum-fertilizer drills, sprayers and dusters, power threshers, electrified open or tube wells. Most of the farm works on the large farms are mechanized except harvesting which is still being carried out manually or by hired labourers. Large farmers are also rented their machines to other farmers on hire basis.

Jaganathan (1994) analyses the farm size and productivity of the farmers of Tirpur block of Coimbatore district in Tamilnadu for the agricultural year 1991-92. Land is the major productive asset for agricultural development. The structure and distribution of land holding pattern normally determine the level of income and the pattern of income distribution. The changes in the structure of land holdings would result in the changes in the cropping pattern, pattern of use of the modern farm inputs and the level of productivity. The size of the farm and the access to the modern farm inputs determine the level of adoption of the modern farm technology. The interaction
between farm size and adoption of farm technology could be seen in terms of productivity. A number of earlier studies revealed the inter relationship between the farm size and productivity.

The selected villages formed the first strata and the farmer respondents formed the second strata. The farmers were classified into small (below 5 acres) medium (between 5 & 10 acres) and large (above 10 acres). The small (45.83 per cent), medium (32.49 per cent) and large 21.68 per cent farmers owned 21.62 per cent, 37 per cent and 41.38 per cent of the total net cultivated area of the sample households i.e., 78.32 per cent of small and medium sample farms owned 58.62 per cent of the total cultivated area, whereas 21.68 per cent of large farmers owned 41.38 per cent of the total net area sown. The estimated value of Gini-ratio was 0.58. It shows that there was unequal distribution of land holding in the sample farms.

Irrigation was a major limiting factor in agricultural production in general in the study area. Open wells and minor irrigation sources are the source of irrigation in the study area. The average net cultivated and irrigated area increase with the increased farm size but the percentage of gross cropped area under irrigation declined along with the increased farm size. The determining factor for farm efficiency is the cropping intensity. There was inverse relationship between cropping intensity and farm size.
Giriappa and Govindaraju (1981) in their study took two blocks, Modakurichio and Kodumudi in Erode taluk of Coimbatore (new periyar) district and Bhadravathi taluk of Shimoga district. This study finds that for commercial crops tractorization seems to be a good alternative for bullock power. These crops which have a high output price like turmeric seem to fare better than crops like sugarcane which have a near stationary price.

It has been shown by the study that though there may be regional differences in power requirements, that obtainable in Bhadravathi indicate that increased farm power need not result in increased productivity. In a high tractor intensity region, the rate of replacement of biological power seems to be high and economically efficient. Paddy seems to withstand the competitiveness of commercial crops in both the regions. In Bhadravathi, sugarcane demands more power but the yield is low. The increased power use has been the result of increased mechanical power. This contented with low productivity shows that tractor power is being inefficiently utilized there. If considered along with non-farm use, tractor power may perform better in terms of economics. But in places where large tractor power is required and where the yield level is not correspondingly high use of tractors for farm operation possesses sense criticisms.

In a developing country like India, a compromise should be arrived at between full employment and high productivity. From this angle, bullocks would seem to dominate, the scene for a very long time to come. For commercial crops, tractor
power seems to be more advantageous. Also, farm and non-farm usage commercialization aspect are dealt still further.

The national commission on Agriculture (1976) has suggested the horsepower per hectare should cross 0.5 level to increase crop productivity. And the major possibility seems to be through mechanical power, which would be largely as stationary power (diesel and electric pump-sets) though there is scope for better use of biological power also. Tractor power for selected crops (mostly commercial) and operations (hard ploughing and transportation) may be encouraged and custom services may also improve the efficiency of farms. It looks on the one hand that tractor power is necessary for increased farm productivity but on the other hand, tractor power does not seem to perform to the expected satisfactory level on farm activities. This is a point in Indian agriculture like many other dualisms, unless one prefers to make a shift with tractorization in its completeness (farm to non-farm uses) towards a higher rate of commercialization. It is a question of appropriateness in choice, application and goal realization with which the Indian farmers is confronted.

The vast review of the literature reveals that though there is a lot of scope for tractorization in Indian agriculture, the progress achieved in this front has been very slow. This was due to various problems at different levels among Indian farmers. Changing attitude among Indian cultivators and aggressive structures has undoubtedly
encouraged cultivators to adopt advanced technology viz., HYVs, fertilizers, pesticides and farm implements.

The farm Mechanisation led to increase in production and productivity. However, unfortunately, they indicate that the animal and human labour are being displaced. The studies failed to explain whether the Mechanisation led to generating employment and income through various other avenues.

There is a fast growth of machine power in the country. However, the growth is not uniform as it is concentrated in few states only. Therefore, there is a necessity to spread the same in all the regions of the country. Hence, in this study an effort will be made to understand the growth of machine power in the state of Karnataka.

The farmers’ interest in increasing the yield levels and the government’s effort to increase farm Mechanisation, both at the state and central level led to the growth and development of farm Mechanisation in the country. Therefore, an effort is made in the present study, to understand the extent of the adoption of the same in the state of Karnataka and Mandya district. A detailed methodology adopted to take up the study has been presented in the 3rd chapter.