CHAPTER - II

REVIEW OF LITERATURE

The literature review provides a theoretical framework which is very useful in executing the research, starting from raising an issue to the final conclusion. Thereby, a comprehensive survey of the earlier work conducted is very much essential in framing the objectives of a present research problem. A brief research findings drawn from a review of literature relevant to this study has been presented in this chapter. The related review of literature concerned with the objectives of the study is presented in the following sections.

2.1 Growth Dimensions

2.2 Cost of cultivation particulars

2.3 FHP and MSP variations

2.4 Profitability measures

2.5 Resource use efficiency analysis

2.1 Growth Dimensions

Rao (1975) discussed the linkage between variability and growth of groundnut crop based on productivity in the 1960s in India and he summarized that since variability in yields per hectare was greater than that of area, productivity-based growth contributed to greater variability in output.

IEMR (1993) compared between the trends of groundnut cultivated area before (mid-sixties) and after the green revolution in India. The study revealed that there was a decline in the cultivation of groundnut from the beginning of the green revolution in the northern states mainly because of the increased emphasis on cereal production, wheat and rice.

Kumara *et al*. (1998) studied the growth rates of area, production and productivity of rice in all the agro-climatic zone of Bihar state of India using time series data from 1959 to 1990 by dividing them into, 1959-68 (period I), 1969-79 (period II) and 1980-90 (period III). They found that the growth rate of yield was positive during green revolution period and negative before green revolution period and state. The growth rate of area was negative in all the zones of the state.

Gupta (1997) showed that India enjoys the distinction of having the largest cultivated area under groundnut cultivation in the world with over 26 million hectares. Also among the agriculture commodities in India, oilseeds form the second largest agricultural commodities after cereals sharing 14 per cent of the country's gross cropped area and accounting for nearly 5 per cent of gross national product and 10 per cent of the value of all agriculture commodities and suggested that groundnut cultivation should be increased under assured irrigation in all the states where yield was not contributing while the area contribution was positive and significant. Thus, he summarised that assured irrigation will not only reduce the variability in production but also sustain the yield.

Jhala (1997) conducted a study upon the consumption trends of edible oil in India and revealed that the area under edible oil in all the Indian states has increased steadily as a result of rising population coupled with rise in incomes and high income elasticity of demand for edible oils.

Patel (1997) examined various factors affecting groundnut acreage in the Gujarat state of India. He observed that despite unfavourable factors like the low level of yield associated with the high degree of instability and poor irrigation facility, the relative area under groundnut increased in Gujarat and also in all the major districts of Saurashtra region except Jamnagar. This was principally due to its relatively high farm harvest price and relatively higher income in it, when compared to other crops. The situation so observed was clearly reflected in the significant positive relationship between income terms of trade and the changes in acreage under groundnut.

Sawant (1997) worked on the yield of groundnut in India and showed that the output growth rate which was 108 per cent in the pre-1981 period exceeded the level of 6 per cent in the post-1981 period. Both area and yield components contributed significantly to the dramatic expansion in output, though the contribution of the former was greater than that of yield component. Expansion in the output of oilseeds continued beyond 1991 with undiminished pace. This outstanding performance of oilseeds must certainly be the result of changed policy environment as reflected in the special programmes undertaken since the Sixth Five Year Plan. He also reported about instability in yield of groundnut in his paper and noted that Uttar Pradesh and

Gujarat were exceptional with high degree of instability and absence of significant positive growth output of oilseeds.

Kamal and Meenu (2000) worked out the compound growth rate for paddy in Punjab using data on area, production, and yield for the three periods *viz*., period I (1970-71 to 1983-84), period II (1984-85 to 1997-98) and overall (1970-71 to 1997-98). Chow-test was applied to test the difference in the growth rate between two time periods. The null hypothesis of no difference between the growth rates was tested against the alternative hypothesis that the growth rates for the two periods were significantly different. Results indicate that the annual compound growth of the area, production and yield of paddy was 6.90, 8.82 and 1.79 per cent, respectively for the whole period. Results of the Chow-test showed that there was a marked difference in the growth rates of area, production and yield between the two periods showing a significant decline in area, production and yield during the second period.

Suhasini (2001) used compound growth rate to analyse the growth in area, production and yield of groundnut during the period 1950-51 to 1998-99 in India, Tamil Nadu and South Arcot district of Tamil Nadu. The growth rates were positive for the whole period for area, production and yield of oilseed crops in India and the Chi-square test confirmed that there was significant difference among the periods in growth rates.

Mathur and Kashyap (2002) worked out CGR analysis for oilseeds in Gujarat during 1970-2000 and revealed that area of oilseeds moved from 23.5 to 27.5 percent. Increase in the share of mustard was from 0.14 to 3.4 percent which was largely responsible for such an increase in oilseeds area. Irrigated cultivation of mustard was found gaining importance in the state over the years. Groundnut, on the other hand was found losing importance, its share is fall from 21 to 18 per cent and was probably being replaced by other *rabi* oilseeds such as castor.

Singh (2002) examined the growth and variability in area, production and productivity of major oilseed crops (groundnut, rapeseed, mustard and sesame) in Gujarat, India during 2002. He also examined the contribution of area, yield, and its interaction effects (area and yield) to increase in production. It was concluded that area was the main factor for the total growth of production of oilseed crops. Yield and interaction effects were secondary.

Vashishtha (2003) studied the issues related to oilseeds in India. He opined that substantial yield gap existed in most of the oilseed crops including groundnut. The author also noted that there is need to identify specific oilseeds in specific areas where yield gap is significant and also investigate the reasons which have prevented exploitation of the potential as well as to identify the price and other factors explicitly for taking appropriate policy measures. He further suggested that there is an emerging need to focus on developing transgenic varieties in the case of certain oilseeds.

FAO (2004) stated that India is a world leader in groundnut farming with 8 million hectare of cultivated area in the year 2003. It showed that groundnut cultivation had increased from 6.8 million hectare in 1980-81 to 8 million hectare in the year 2002-03. Groundnut was grown mostly in five states namely Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra and together they account for 90 per cent of the crop’s total area. Gujarat and Andhra Pradesh states shared about 28 and 24 per cent of the total groundnut area, respectively in the country. At the same time, the cultivated area in Gujarat was found declined from 2.1 million hectare to 1.8 million hectare between 1980-81 and 1996-97.

Patel (2004) conducted a study on food and non-food grain crops, including oilseeds, in the Gujarat state of India. He reported that the entire period of 1949-96, when divided into pre-green revolution period *i.e.*, 1949-68 and post-green revolution period i.e., 1968-96, the performance was better in the pre as compared to the post-green revolution period due to relatively better growth rate of crop acreage. He also noticed higher growth rate for various non-food grain crops as compared to food grain crops and found that it was mainly due to the overall shift in crop pattern from food grain crops to non-food grain crops.

Bindukumar (2006) studied the changes in redgram economy of Karnataka and study period was divided in to three sub periods Pre-WTO (1985-86 to 1994-95), Post-WTO (1995-96 to 2004-05) and Overall Period (1985-86 to 2004-05). The results of the study revealed that growth in area was almost constant in both Pre-WTO and Post-WTO period *i.e.*, 2.80 per cent per annum. In Pre-WTO period the performance of redgram crop was poor both in production and productivity which showed negative trend (-3.21% and -5.85% respectively), whereas in Post-WTO period production grew at the rate of 8.33 per cent and productivity at the rate of 5.50 per cent which was impressive. The growth in area, production and productivity for overall period, in Karnataka was not at all encouraging (0.52, 0.59 and 0.06 per cent, respectively).

Patel (2006) in Gujarat was observed that over the period revealed consistent variations for instance area under groundnut substantially increased with about 22 per cent in the first decade, i.e. TE 1963 but consistently declined thereafter and it was 16.57 per cent in TE 2001.

Sandesh *et al.* (2006) in their study on growth and instability analysis of major oilseeds in selected states of India revealed that among the selected major oilseeds growing states, the production of total oilseeds showed significant positive growth in Karnataka, Madhya Pradesh and Maharashtra (3.07, 8.57 and 4.74 per cent, respectively) during (1971-72 to 2002-03), and all other states showed positive growth during the same period except Uttar Pradesh. India as whole showed a significant positive growth in area, production and productivity (1.65, 3.66 and 1.98 per cent) during the same period and was due to the implementation of Technology Mission on Oilseeds.

Sharma *et al*. (2007) in their study on oilseed crops in India noticed that the oilseeds acreage increased significantly during the 1980s and early 1990s mainly because of price supported various oilseeds development programmes launched by the government of India. However, during 1990s area under oilseeds remained constant at about 25 million hectare and later it declined in early 2000s.

Singh Jitendra (2007) noted that there has been more than five times increased in oilseeds production during the period from 1950 to 2005 in India. He further observed that India ranks first in production of groundnut in the world and the fourth largest vegetable oil economy in the world next to U.S., China and Brazil.

Gudmewad *et al*. (2008) examined the trends in area, production and productivity of oilseed crops grown in Nanded district, Marathwada region, Maharashtra, India, over a period of 22 years from 1980-81 to 2001-02 to study the variability in different oilseed crops over the period. The period of 22 years was divided into two parts: the 1st period covered 1980-81 to 1990-91, and the 2nd period covered 1991-92 to 2001-02. Linear and compound growth rates were worked out to determine the trends in area, production and productivity over the years under study. Coefficients of variation were worked out for all crops and sub-periods to determine the relative development and fluctuations. The productivity of *kharif* and *rabi* sunflower showed a significant growth in Nanded district. The growth rates of production and productivity of total oilseeds in Nanded district were significant. In general, productivity and production trends for major oilseed crops were not encouraging even during the post-globalization period, *i.e.* after 1991. Hence, it can be concluded that the impact of globalization was not observed during the study period in Nanded district.

Kumar *et al.* (2010) examined historical data for 1949-2006 and reported that cotton and groundnut showed fluctuations in output, a consequence of inter-annual yield fluctuations. Sharp decline in yield levels was observed during drought years. After 1988, yield fluctuations in groundnut have become severe. Thus, yields of crops having a substantial rainfed component were found highly vulnerable to droughts. Rainfall was the major source of moisture for crop cultivation in Gujarat and developments promoting assured irrigation can be a major force in conditioning the growth and variations in crop production across the crops and also across the regions.

Chand *et al*. (2011) estimated the instability and regional variations in Indian agriculture to measure year-to-year fluctuations in output and variations in productivity across Indian states in major agricultural commodities. The study showed that for groundnut, during 1951 to 2007, the instability in acreage has decreased from 9.52 to 5.85 per cent but production instability has doubled from 14.07 to 29.81 per cent in the same period due to similar trend of higher instability in the groundnut yield. Instability in production across crops was found to depend significantly on the irrigation coverage of a crop which was around 17 per cent in groundnut. The major cause of increase in instability and its high level in groundnut yield was the occurrence of frequent droughts during the period 1994-95 to 2008-09. They also concluded that the instability in agricultural production raises the risk in farm production, affecting farmers' incomes and their decisions for investments to adopt new technologies. It also affects price stability and vulnerability to market swings.

Acharya *et al.* (2012) studied the growth in area, production and productivity of major crops in Karnataka and the growth in area under oilseeds and commercial crops was found negative and insignificant. The production of oilseeds and commercial crops registered insignificant positive growth. Productivity of oilseeds recorded moderately positive growth during 2012.

Madhusudhana (2013) discussed the groundnut area, production and productivity at national level (India), state level (Andhra Pradesh State) as well as district level (Anantapuram district). Results revealed that the area, production and productivity of groundnut crop showed positive trends at national level, state level and district level during 1996-2000 to 2001-2008.

Pangayarselvi *et al.* (2015) conducted a study on growth dimensions of maize crop in Tamil Nadu, India. Findings revealed that the percentage of growth in maize crop was higher during post-liberalization period with production in the lead followed by consumption, area and productivity. The rise in production was mainly due to the increase in area levels and not due to rise in productivity levels. The fluctuations in growth dimensions were found to be lowin terms of area during Post-Green Revolution (2.09 %), but high during Post-Liberalization (15.38 %) and Overall Periods (16.16 %).

2.2 Cost of cultivation particulars

CACP (1971-2015) of different crops reveal that the farmers have either realised very little profit or suffered huge losses in cultivating most of the investigated crops in India. In order to find out whether cost is increasing faster than Value of Product (VOP), CACP analysis measure the rate of increase in cost of cultivation and values of output. The results show that cost of cultivation of crops has been increasing over the years because of rise in wage rate of labour, input prices and other managerial costs.

Pandey (1979) examined impact of irrigation development on groundnut cultivation and he examined whether irrigation is the key to increasing agricultural output per hectare and per unit of farm labour in developing nations. The demand for irrigation water generated by modern agricultural techniques is different from those that arise from traditional methods of cultivation. He was of the opinion that the irrigation systems built for the older technologies of traditional farming are not usually suitable for modern and high-output agriculture.

Nina (1988) reported that the cost of cultivation of major oilseed crops including rapeseed, mustard and groundnut increased in India at a compound rate of 8.81 per cent per annum, as against 6 per cent per annum increase in general price level during the period 1951-52 to 1980-81 in the country.

Shanmugam (2003) in his analysis concluded that Tamil Nadu ranked second in terms productivity of groundnut after Punjab according to the estimates in 1997-98. In this connection he measured the farm specific technical efficiency of raising major principal crops including groundnut. He used the cost of cultivation scheme's data for the year 1990-91 to 1992-93. The results indicated land and labour inputs as the significant determinants of output of almost all the crops in the state. He noted that observed outputs of all studied principal crops are less than their respective potential outputs due to technical inefficiency. Farms having a high proportion of family members with above middle school education are more efficient in raising groundnut.

Bhalla and Singh (2009) stated that the situation with respect to rate of increase in cost and VOP has changed during 1991-92 to 2006-07 in India. During 2006-07 the ratio became less than one or marginally above one in crops like paddy, wheat, groundnut, sugarcane and cotton. Gram was the only crop where the farmers have realised a profit margin of 25-37 per cent over cost C_2 and C_3 because of increased value of output realised by the farmers. They have concluded that over the whole period, it appears that the steep rise in the cost of cultivation is one of the main reasons for the low profit margin or loss in crop cultivation.

Anonymous (2011) studied per acre cost and returns and economies of groundnut production in India. The per acre total cost of cultivation was Rs. 4670.00 and output yield was 8 to 10 quintals per acre. In rupee terms, net returns per acre and net profit were Rs. 10500.00 and 5830.00, respectively. The study revealed that seed and fertilizers cost around 58 per cent to total cost per acre and cost on human labours was also very high.

Narayanamoorthy (2013) calculated the profitability over C_2 in six different crops in India *viz*., paddy, wheat, gram, groundnut, sugarcane and cotton for seven different years during 1975-76 and 2006-07 using cost of cultivation survey data. He did not found a clear cut trend in the profitability in groundnut cultivation, as it varied substantially from year to year. Out of total seven years, he observed that farmers were getting a small profit in five years. While using cost C_3 for profit calculation, farmers have incurred losses in four out of seven time points. Moreover, losses found in more number of times during the post-1990s as compared to the pre-1990s situation. This could be because of the import of low value edible oils from other countries during post-1990s.

Narayanamoorthy *et al*. (2014) revealed in his study that due to fast increase in the cost of cultivation, the profitability of the crops has been severely hit mostly during the agrarian crisis period (1995-96 to 2010-11) in India.

Ganga Devi *et al*. (2016) revealed that crop wise instability index varied from 5.82 (Gram) to 14.43 (Tur) at Anand in Gujarat. The high growth rate and low instability of MSP was the good sign for farmers in all the crops selected for the study. They also stated that the growth rate of FHP in all the food grain crops was found positive and highly significant. This showed that the FHP for Paddy, Jowar, Maize, Bajra, Tur, Wheat, and Gram haven risen significantly over a decade. Where, for Jowar and Gram FHP was found to be highest (11.03 per cent) and lowest (5.57 per cent) growth rate among all the crops, respectively. The high growth rate and low instability for FHP was the good sign for farmers in all the crops.

2.3 FHP and MSP variations

Acharya and Agarwal (1980) worked out the linear growth in farm harvest prices of important oilseeds during the year 1960-61 to 1975-76 for the state of Rajasthan. The period of study was divided into two sub-periods *viz.*, 1960-61 to 1969-70 and 1970-71 to 1975-76. The study revealed that during the first period, the increase in farm harvest prices of oilseeds ranged between 7.79 per cent and 8.70 per cent per annum. It was found to be higher for groundnut and minimum for rapeseed and mustard. At the same time, the linear growth for all the individual oilseed crops as well as for oilseed as a group was negative during the period 1970-71 to 1975-76. Thus, the prices of oilseed crops recorded an increase before 1970 and declined thereafter.

Sharma and Singh (1987) worked on product price variations in the Ludhiana district of Punjab state and revealed that the rate of increase in price was higher in gram (10.02%), followed by desi cotton (8.46%), groundnut (8.03%) and rapeseed and mustard (8.01%) during the period 1960-61 to 1983-84.

Patel (1988) revealed higher magnitude of instability was observed in wholesale prices of pulses (CV % 31.42), followed by oilseeds (CV % 18 to 23) during the period 1970-71 to 1980-81 in the state of Gujarat.

Bhatt and Shiyani (1989) revealed that the wholesale prices of groundnut in Amreli regulated market of Gujarat state had increased at a linear growth rate of 2.67 per cent per annum during 1970-71 to 1987-88.

Kuchhadiya *et al.* (1989) studied variability in farm-harvest prices of various crops in Saurashtra region of Gujarat state during 1960-61 to 1986-87. They concluded that oilseeds have shown higher instability in farm-harvest prices than cereals.

Kag (1994) examined coefficient of variation (CV %) in order to know the variability in prices and arrivals of mustard in five selected markets of Banaskantha district of Gujarat during 1983-84 to 1992-93. The result of the study revealed that variability in arrivals ranged from 107.75 to 135.84 per cent (CV %) among the different selected markets while instability in prices did not show much variation among the different markets (30.06 to 32.05 CV %).

Shah and Patel (2003) concluded that the MSP per quintal of groundnut consistently increased from Rs.140 in 1975-76 to Rs.1500 in 2003-04 with significant average compound growth rate of 8.06 per cent per annum. The coefficient of variation about the trend for MSP of groundnut worked out to 0.73. The FHP per quintal of groundnut has increased from Rs. 78.09 in 1970-71 to Rs. 711 in 2001-02 with significant average compound growth rate of 7.22 per cent per annum. Almost it was found that MSP and FHP were positively co-related i.e. when MSP moved up, FHP also moved up. It was also observed that the gaps between FHP and MSP were noticeable in Gujarat during the study period. This clearly indicated that FHP always remained significantly higher than MSP for groundnut in Gujarat. Further, on an average, the compound growth rate per annum has almost remained same for both MSP and FHP during the 1970-71 to 2001-02. Thus, it may be concluded that increase in MSP results in increase of FHP during the period under study. It was also found that the MSP and FHP were highly (0.98) correlated during 1970-71 to 2001-02. The MSP and FHP of groundnut had shown positive significant trend during the 1980-81 to 1999-2000 in Gujarat. MSP and FHP negatively and insignificantly related with area under groundnut while MSP and FHP are positively but insignificantly related with production and yield of groundnut during the period 1980- 81 to 1999-2000 in Gujarat.

Acharya *et al.* (2007) conducted a study on all the major food crops of India and showed that minimum support price (MSP) is being used as a form of market intervention on the part of the states and also as one of the supportive measures to agricultural producers.

Anonymous (2010) suggested that the government of India should announce the minimum support price (MSP) for crops at 50 per cent more than the actual cost of production (Cost C_3) and minimum support prices should be announced every year for various crops and they should be linked with the wholesale price index so as to protect the farmers from the possible inflationary pressure.

Narayanamoorthy and Suresh (2013) concluded that for the Indian farmers, the main issue is of bridging the gap between ever-increasing costs of inputs (labour, fertilizers, pesticides and seeds) and lower incomes for the produce. To mitigate the ongoing uproar in the farming horizon, a reasonable profit margin is the need of the hour. And this can be achieved only by fixing the price of crops in tune with their cost of cultivation.

Ganga Devi *et al*. (2016) made an attempt to see the effect of MSP and FHP on area of major food grain crops in Gujarat. The results revealed that the compound Growth rate of MSP and FHP for all the crops were found positive and statistically significant. Further it was observed that there was no significant impact of MSP and FHP on area of major food grain crops except bajra crop for which the regression coefficient was found to be negative and statistically significant. They observed that the positive and highly significant growth rate was found of MSP for all the crops. This showed that the MSP for Paddy, Jowar, Maize, Bajra, Tur, Wheat, and Gram has risen significantly over the past decade where the highest growth rate was found for Tur crop (10.98 %) and lowest growth rate was found for Gram (4.83 %) among all the selected crops and the result of the instability index was found lower for all the crops. The results also revealed that growth rate of MSP was found higher as compared to FHP of Paddy, Maize, Bajra, Tur and Wheat crops. Whereas, in case of Jowar and Gram crop the growth rate of FHP was found higher as compared to MSP. In case of area the growth rate was found higher as compared to MSP and FHP in Wheat and Gram crop. Whereas, the growth rate of area as compared to MSP and FHP was found lower in Paddy and Maize. The negative growth rate of area was found in case of Jowar, Bajra and Tur crops.

2.4 Profitability measures

CACP (1971-2015) analysis for groundnut crop concluded that Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka are the major Groundnut cultivating states in India. These states together accounted for about 81 per cent of its total area in 2007-08 and Gujarat alone accounted close to 30 per cent of area. Therefore, Gujarat became the obvious choice for studying the profitability in Groundnut. In fact, the losses are found more number of times during the post-1990s as compared to pre-1990s situation. This could be because of the import of low value edible oils from other countries during post-1990s.

CACP (1971-2015) reports showed that the profitability of cotton crop has been declining in India over the years. During the mid-seventies and mid-eighties farmers were able to reap 20-29 per cent of profit margin over cost C_2. But this setting changed thereafter. In fact, farmers have suffered heavy losses amounting to Rs.3459/ha in 2001-02 and Rs.1799/ha in 2006-07 over cost C_2. If cost C_3 is taken into account then this amount of loss gets increased from Rs. 3966 to Rs. 5183/ha during 2001-02 and 2006-07, respectively. The information on cost of cultivation and VOP of different years also indicate that the farmers have suffered heavy losses during post-1990s as compared to the situation of pre-1990s. A steep rise in the cost of cultivation over the rate of increase in the value of production during post-1990s appeared to be the main reason for the huge loss suffered by the cotton farmers in Maharashtra State. This increased loss from the cotton cultivation might be the main reason for the high proportion of farmers' suicides in Maharashtra.

Krishna (1996) defined the profitability analysis in detail. According to the researcher, it is a rate expressing profit as a percentage of total aspects or sales or any other variable to represent assets or sales. What should be used in the numerator and the denominator to compute the profit rate depends upon the objective for which it is being measured.

Gaddi *et al*. (2002) showed that profitability ratio of bullock labour on small farms and human labour on large farms in Karnataka were optimally used and use of rest of the inputs differed from their optimum level. They suggested that the need for reallocation of expenditure among different inputs based on the profitability ratio.

Sen and Bhatia (2004) in their study attempted to find out the trends in profitability of different crops utilizing the data from cost of cultivation survey on six important crops of India. They found that a tremendous development and spectacular growth have been observed in agriculture during the past five decades, 1949-50 to 1999-2000. However, there has not been any spectacular modification in the technology since 1980s, leading to a continuous deceleration in the rates of growth of both production and productivity of most crops in recent years which in turn complicate farm profits.

Sikander and Sandeep (2004) examined the profitability of paddy, maize and wheat crops grown in Himachal Pradesh for the year 2001-2002. In this study, different cost concepts of Cost A, Cost B and Cost C were calculated. As regard to

Cost C, paddy incurred highest cost (Rs. 20835) followed by maize (Rs. 18709) and wheat (Rs. 17102) per hectare. For all the other crops, the highest share of cost was occupied by labour. In respect of gross returns per hectare, cost component was highest on paddy crop followed by wheat and maize. The study further found that net returns were positive on paddy crop as compared to the wheat and maize crop where net return was negative. The negative return was due to low yield. However, net profit per quintal was negative for all three crops.

Ardeshna *et al*. (2008) concluded that all the input variables included in the model explained about 79 per cent variation in income from groundnut in Saurashtra region of Gujarat. The elasticities of area under the crop (0.18) and human labour (0.42) were found statistically significant at 1 per cent level of significance whereas the elasticities of other included variables were found positive but non-significant. This revealed that only area and human labour have contributed positively and significantly to income from groundnut.

Dev and Rao (2010) analyzed the issue of profitability in India utilizing temporal data on paddy and wheat crops. They found that the agricultural price policies are effective in enabling the farmers to obtain sufficient profits to promote investment, technology and productivity and thereby to productivity.

Varghese (2011) in his study on Indian groundnut exports revealed that the profitability of the crop is more or less dependent upon the better utilization of resources and manpower. He further suggested that it is worthwhile to increase production capacity and use advanced technology to cut down cost of production and wage cost in order to increase profitability, not only against the investment, but also for investors return points of view.

Ani *et al*. (2013) found that the mean gross margin per hectare of groundnut was N 1,897.86 per month while the profitability test shows that it is profitable when $t= 6.87$ and $P \leq 0.01$). They concluded that the key variables that influence profitability are hired labour, cost of seed, agrochemical and cost of fertilizer.

2.5 Resource use efficiency analysis

Seeta Prabhu (1985) studied the productivities of fertilizers along with other inputs within the Cobb-Douglas production function framework in the world. The results indicated that the ratio of marginal value productivity of fertilizers, manures and irrigation to their unit cost were substantially higher than unity, implying thereby sub-optimal use of these inputs.

Patel *et al.* (1986) made an attempt to assess the resource productivity using Cobb-Douglas production function in Kheda district of Gujarat. The ratio of marginal value productivity to marginal cost of bullock labour, irrigation, seed, manures and fertilizers indicated excessive use of these inputs.

Hossain *et al.* (1987) studied resource allocation efficiency under irrigated farming in Bangladesh. They found that coefficients of human labour, animal power and triple super phosphate were positive which indicated a logically consistence relationship between output and these inputs. The negative signs of coefficients of seed, manures, urea and potash revealed the excessive use of these inputs.

Reddy (1989) in his study on the efficiency of fertilizer use in groundnut Vayalpad block of Chittoor district, Andhra Pradesh indicated that efficiency of use of fertilizers on sample farms was quite low and fertilizers need to be judiciously combined with other complementary inputs such as credit, improved seed, improved implements, irrigation, insecticides and technical knowhow. The groundnut growers also need to be enlightened on proper time of application and dose of fertilizers as well as efficient methods of fertilizer application.

Wani *et al*. (1993) conducted a study in Jammu and Kashmir on resource use efficiency and factor productivity in apple with adopting Cobb-Douglas production function. The study revealed that the fertilizer was most rationally used which turned out to be positively significant whereas, the most irrationally used input was plant protection. The pooled result of production function analysis showed positive and significant results in fertilizer, plant protection as well as human labour too. Respective regression coefficient was 0.257, 0.754 and 0.621. It means that one per cent increase in the use of fertilizer, plant protection and human labour would resulted increasing 0.257, 0.754 and 0.621 per cent increase in apple production.

Chandrashekhar *et al*. (1996) have examined resource use efficiency in groundnut production under rainfed conditions in Challakere taluka of Karnataka. The data on the cultivation of groundnut crop of 1991 *kharif* season were collected from 100 groundnut growing farmers. The Cobb-Douglas type production function was used. The production function analysis revealed that land, farm yard manure and seed in the case of small farmers contributed significantly to the production. The returns to scale were near constant for all the categories of farmers.

Aswathareddy *et al*. (1997) studied resource use efficiency in groundnut production under rainfed conditions in Challakere taluk of Karnataka. The study revealed that land and farmyard manure in the case of small farmers and farmyard manure in the case of large farmers contributed significantly to production. The average mean technical efficiency indices of small and large farm groups were 0.679 and 0.646, respectively showing that small farmer groups were achieving yield levels which were more efficient than the large farmer groups.

Patil *et al.* (1997) studied the resource use efficiency in groundnut production in Dharwad district during 1994-95. The results indicated that the regression coefficient with respect to seeds was highly significant in all categories of farms. The regression coefficients with respect to expenditure on plant nutrients and labour charges were significant except for large farmers. But expenditure of plant protection chemicals which was positive in all categories of farms but significantly only in case of large farms. The ratio of marginal value product to factor cost was greater than for all the inputs in groundnut production indicating scope to increase the use of those resources.

Kumar and Arora (1999) examined the resource use efficiency of chilli in their study on economic issue in vegetable production in hilly region of Uttar Pradesh and established the relationship between dependent variables and explanatory variables, following Cobb-Douglas type of production function. Prior to estimation of function, the zero order correlation matrices was estimated using OLS technique after converting function into log linear form. To test the significances, ‘t’ test was used while to examine the resource use efficiency, MVPs of inputs were compared with their respective marginal factor costs and concluded that the co-efficient of multiple determinants (R^2) was 0.318 indicating in the model. The regression co-efficient of human labour and expenditure of chemical fertilizers turned out to be positive and had statistically significant impact on the yield of chilli. In case of seed plant protection chemicals, positive but non significant influence was noticed whereas excess utilization of bullock power and FYM were found due to negative regression coefficient.

Singh and Vashist (1999) adopted Cobb-Douglas production function to study the input-output relationship for the study of production and marketing system of vegetables in Himachal Pradesh during the year 1997-98. The results of step-wise regression analysis showed that labour charges, investment on manures and fertilizers contributed significantly, to variation in the yield of cauliflower and explaining 55 per cent variation. In case of tomato, labour, investment on manures and fertilizers were significantly affected the yield of tomato. For instance, one per cent increase in labour charges were expected to increase the yield on an average by about 1.65 per cent and manure and fertilizers by 0.05 per cent, other variables being constant. The values of returns to scale were 1.87 and 1.85, indicating that the farmers were operating in the first zone of production in tomato and cauliflower, respectively.

Kale and Sale (2000) analyzed the resource use efficiency of sugarcane cultivation in the Thane district of Konkan region in Maharashtra state and remarked that the human labour, bullock labour and number of irrigations had significant influence on the value of output. The MVP-MC ratio showed efficient utilization of resources which was greater than unity for land, denoting higher efficiency while fertilizers had negative impact showing the need for reduction in their usage.

Velavan and Balakrishanan (2000) examined the components of cost of cultivation for groundnut in the Salem district of Tamil Nadu and revealed that there was a possibility to increase the irrigated groundnut production in Tamil Nadu by increased use of human labour, machine labour, bullock labour and by increasing application of nutrients. Similarly for rainfed groundnut, there was a possibility of increasing production by increased use of human labour, nutrients and other costs. Further, the analysis showed that withdrawal of machine and bullock labour will make the groundnut production profitable in the study area as the study showed that there was an over use of these two inputs. The ratio of marginal value product to marginal cost for nutrients was comparatively higher than other inputs in the irrigated condition. It also revealed that there was more scope for increasing the production by increasing the application of nutrients in irrigated condition. In the rainfed situation, marginal value product to marginal cost ratio indicated that there was a scope for increasing the production by increasing the application of plant protection chemicals, gypsum and bio-fertilizers. Thereby, it was found necessary to educate the farmers through proper extension activities to use scientific methods of production in order to achieve the potential output.

Wadhwani and Bhogal (2001) in western region of Uttar Pradesh measured resource use efficiency in production of potato using Cobb-Douglas production function taking per hectare yield as dependent variable. It was found that the co-efficient of multiple determinations (R^2) was 0.63 indicating that around 63 per cent of variation in production was explained by the variables included in the model. The cost of farm yard manure, expenditure on chemical fertilizers, plant protection and irrigation had a positive and significant influence on increasing the yield per hectare. The values of regression co-efficients ranged from -1.1237 for land to 0.2931 for irrigation.

Guledgudda *et al*. (2002) studied the resource use efficiency of banana crop in northern Karnataka. They employed Cobb-Douglas type of production, where banana yield was taken as dependent variable and land, labour, farmyard manure, bullock labour, fertilizers, and plant protection chemicals as independent variables. The study showed that land, labour and plant protection chemicals significantly influenced the production of banana as indicated by their significant regression coefficients of 0.672, 0.472 and 0.172, respectively in the study area.

Wadhwani and Bhogal (2003) studied the economics of production, post-harvest management and price behaviour of cole crops (cauliflower and cabbage) in western U.P during 1997-98 using Cobb-Douglas production function. The coefficient of multiple determinants (R^2) of the cauliflower and cabbage indicated that 33 and 36 per cent variability, respectively in production of these two crops was explained by the variables included in the model. The variables like human labour and FYM, exerted positive and significant influence on the yield of both the crops.

Shanmugam (2003) examined the resource use efficiency for groundnut in Tamil Nadu and indicated that the land and labour inputs were significant determents of output of almost all the crops in Tamil Nadu. The returns to scale parameters for production of almost all crops were close to one (constant returns to scale). There were considerable evidences that the observed outputs of all principal crops selected for the study were less than their respective potential outputs due to technical inefficiency. The average technical efficiency values of rising rice, irrigated groundnut and rainfed groundnut was below 60 per cent, indicating that they could cut input resources up to 40 per cent without any production loss. Thus there is possibility at farms to increase the outputs of crops and thereby farm income through better use of available resources, given the state of technology.

Wadhwani and Bhogal (2003) made an attempt to measure the resource use efficiency in production of potato in Uttar Pradesh by using Cobb-Douglas production function. Their results showed that the coefficient of multiple determinations (R^2) was 0.33 indicating that 33 per cent of variation in potato production was explained by the variable included in the model. The cost of FYM, chemical fertilizers, plant protection and irrigation had positive and significant influence on increasing per hectare potato yield. The value of regression coefficient ranged from -1.1237 for land to 0.2931 for irrigation.

Singh and Kumar (2004) worked out resource use efficiency of brinjal in Madhya Pradesh during 1994-95 and result revealed that all the variables include in Cobb-Douglas production function *viz.*, rental value of own land, human labour, irrigation, manure, fertilizer and plant protection had a significant influence on increasing the gross value of produce. In case of potato the regression co-efficient for irrigation was - 0.9876 indicating excessive use of irrigation water by the farmers. Human labour (0.8695), plant protection (0.5375) and manure and fertilizers (0.2949) were other variables, which exerted positive and significant influence on gross value of produce. The value of co-efficient of multiple determinations (R^2) was about 0.88. This indicates that 88 per cent of variation in gross value of produce in case of brinjal and potato was explained by the variables included in the function.

Kale *et al.* (2005) analyzed the resource use efficiency of chilli cultivation in Thane district of Maharashtra and marked that the human labour, bullock labour and number of irrigations were significant influenced on the value of output. The MVP-MC ratio shows efficient utilization of resources which was greater than unity for land variable, denoting higher efficiency while fertilizers had negative impact showing reduction in its use.

Kumar and Alagumani (2005) examined the resource use efficiency of paddy in Tamil Nadu. The results revealed that marginal value productivity of manure, water and plant protection were found to be greater than marginal input cost in all the researches. This indicated that there is a possibility to enhance the yield by increasing the use of these inputs in the study area.

Shivannavar (2005) studied on economic analysis of production and marketing of papaya in north Karnataka. He used the Modified Cobb-Douglas type of Production function that the seed, farm yard manure, fertilizer, labour and machine power significantly influenced the production of papaya in study area as indicated by their significant regression coefficient of plant protection chemicals was non-significant in the study area. The inputs such as land, seed, farm yard manure, fertilizer, plant protection chemical, labour and machine power together have explained nearly 90 per cent of yield in papaya. The input variables included in the production function contributed substantially in the production of papaya as indicated that by the higher values of coefficient of multiple determinations (R^2). The estimated R^2 for the study area was 0.91. The returns to scale was 1.05 which indicated that there is an increasing returns to scale and the ‘F’ value is 139.41. It is worth nothing that the elasticity of production of plant protection chemicals was negative (-0.042). This clearly indicated that the yield of papaya declined with the increase in doses of plant protection chemicals.

Visawadia *et al*. (2005) analyzed the resource use efficiency of Bt-cotton and hybrid cotton in Saurashtra region of Gujarat state. The findings of the study indicated that chemical fertilizers, farming labour, irrigation, other paid out cost and cropped area were positive and highly significant while the hired labour was positive and highly significant in case of Bt-cotton. In the hybrid cotton seed, chemical fertilizer, human labour, irrigation, other paid out cost and cropped area were positively and highly significant at 1 per cent level of significance. Seed played a negative and non-significant role in Bt-cotton indicating the overuse of Bt-cotton seed. This was due to non-adoption of the recommended practices by the farmers. Large incidence of pests like bollworms reduced production by hybrid cotton.

Talathi *et al*. (2006) used cobb-Douglas production function to study the resource use efficiency in banana production in Sindhudurg district. The results indicated that in mixed cropping, planting material and fertilizers were significant, while in case of sole cropping, planting material, male labour, fertilizer and irrigation charges were statistically significant. The ratio of MVP to FC for chemical fertilizers in mixed cropping and planting material, female labour and plant protection in sole cropping were less than one indicating excess utilization of these resources.

Hanumantharaya (2007) conducted a study on a comparative economic analysis of tissue culture banana production in Karnataka. The results of the sucker propagated banana indicated that the regression coefficient of sucker (0.13) was not significant. The regression coefficients of plant protection chemicals and bullock labour were non-significant. The regression coefficients of plant protection chemicals and bullock labour were non-significant. The regression coefficient of human labour (0.078) was significant at 1 per cent level whereas the R^2 value was 0.86. The returns to scale was 0.625. The results of the banana tissue culture indicated that the regression coefficient of plantlets was (0.091) significant at 5 per cent level. The estimated coefficient of FYM and fertilizers was (-0.042) and it was non-significant. The regression coefficients of human labour, bullock labour and plant protection chemicals were significant at 1 per cent level. The value of R^2 was 0.46 with o.37 returns to scale.

Pawar and Pawar (2007) examined the marginal productivity and economic efficiency of resource use in JKCH-666 cotton production in Parbhani district. Results revealed that the regression coefficients of manure (0.141) and hired human labour (0.172) were highly significant at 1 per cent level while regression coefficients of phosphorus (0.062), area of JKCH-666 cotton (0.184) and bullock labour (0.142) were positive and statistically significant at 5 per cent level. Thus, it was inferred that these resources were underutilized and there was scope to increase them in the cotton production. The ratios of MVP to price with respect to above resources were higher than unity.

Ardeshna *et al*. (2008) in their study concluded that in groundnut crop human labour(-25.72 man days/ha) and nitrogen (-2.26 kg/ha) were found under-utilized, whereas bullock labour, phosphorous, potash and other working capital were found over-utilised in Saurashtra region of Gujarat. The results indicated that the need to divert more funds towards nitrogen fertilizer and human labour from the inputs over-utilized.

Rathod (2008) studied an economic analysis of production and marketing of chilli in Anand district of Middle Gujarat. The result of the coefficient of multiple determinations (R^2) indicates that all of seven variables (seedling, bullock labour charges, human labour, cost of fertilizers, manures, insecticide and irrigation) have explained 93 per cent variation in total output of chilli. The regression coefficient of seedlings, irrigation, human labour and fertilizers turned out to be positive and statistically significant implying positive and significant impact on yield of chilli. The inputs such as manures, insecticides and bullock labour were found to be negatively non-significant which shows that they did not contributed any role to increase in the output level.

Taru *et al.* (2008) studied economic efficiency of resource use in groundnut production in Adamawa State of Nigeria. The results indicated that the Cobb-Douglas function gave the best fit. The R^2 was highly significant at one per cent level with the value of 0.784 per cent. This implies that around 78 per cent of the total variation in groundnut yield were explained by influence of all the explanatory variables (farm inputs) in the regression equation. Three out of the eight independent variables were significant at one per cent level, these were farm size, seed and labour input positively affected the groundnut production indicating that more the farm size, quantity of seed and labour used, the more output would be produced. Economic efficiency of resources used showed that the seed and labour were underutilized, while fertilizer and agrochemicals were over overutilized.

Kunte *et al.* (2009) studied the resource use efficiency and returns to scale in the command area of Penganga irrigation project. A sample of 310 farmers was scientifically chosen during the agricultural year 2004-05. The study was confined to three foodgrains and four cash crops. The ratio of marginal value product to factor cost for some resources was found to be more than one, indicating the operation of increasing factors returns. In general for cash crops, the study suggests to increase the use of resources *viz*. bullock labour, seeds and irrigation so as to increase the production of the cultivated cash crops in Indian agriculture.

Khatri *et al*. (2011) examined the resource use efficiency of important vegetables in Chorayasi taluka of South Gujarat. They have found that nitrogen, potassium fertilizers and other working capital were the important resource variables positively influencing the crop output. The comparision of marginal value products of resource inputs with their per unit prices indicated optimum use of resource variables such as nitrogen, potassium and other working capital in the production of brinjal crop, while cropped area, bullock labour, nitrogen and potassium optimally used in the case of cauliflower crop.

Patil and khobarkar (2013) studied production and resource use efficiency in wheat of Amravati division of Vidharbha region of Maharashtra state and used the double log type Cobb-Douglas production function. The result explained that seed rate, human labour, machine labour, bullock labour and nitrogen fertilizers had the elasticity of 0.46, 0.03, 0.14, 0.12, and 0.07 respectively, which was positive and statistically significant indicated that increase in these inputs will significantly affect wheat yield. The value of MVP in respect of seed rate (6.88) , machine labour (2.15), bullock labour (1.87), nitrogen (1.19) were more than unity level, indicating if expenses made on these resources, then it will gives profitable returns. The average allocative efficiency was 86 per cent.

Gamanagatti *et al*. (2013) used Cobb-Douglas production function to study resource use efficiency in Bt-cotton cultivation in northern transitional zone of Karnataka. The results revealed that all the inputs (land, seed, farmyard manure and human labour, fertilizer) were under-utilized in small farmers whereas, medium and large farmers over utilized the bullock labour. There was an increasing returns to scale in small farmers (1.04) whereas decreasing returns to scale for medium (0.90) and large farmers (0.94).

Zekeri and Tijjani (2013) conducted a study to measure the resource use efficiency in groundnut production in Jigawa State of Nigeria. They have found that among the variables, seed, hired labour and pesticide use in the groundnut production were significant while fertilizer, family labour and farm size were not significant. The returns to scale were 1.77. For resource use efficiency, seeds, family labour and hired labour were under-utilized, while fertilizers and pesticides were over-utilized.

Mane *et al*. (2014) used Cobb-Douglas production function to study resource use efficiency in groundnut production in Hingoli district of Maharashtra. They have observed that regression coefficients of area under groundnut was 0.382, followed by that of hired human labour (0.229), nitrogen (0.041) and irrigation (0.220) which were positively significant at 5 per cent level. Regression coefficient of phosphorous was found significant at one per cent level. On the contrary, the regression coefficients of family human labour, bullock labour, machine labour, potash and plant protection were negative and non-significant. Marginal product of area under groundnut was 11.20 quintals, followed by that of hired human labour (0.063q), nitrogen (0.023q) and phosphorous (0.28q) and so on. MVP to price ratio with respect to area under groundnut was 2.34, followed by that of phosphorous (6.71), nitrogen (95.28) and hired human labour (2.63).

Singh *et al*. (2014) conducted study on resource use efficiency in production of groundnut in Rajasthan. They found that among the all factors of production seed, fertilizers, irrigation and human labour observed as key factors in production of groundnut with 78 per cent R^2 value which showed that the factors involved in production have great role in increasing the production of groundnut. The key factors such as seed, fertilizers, irrigation and human labour with coefficient of 0.35, 0.23, 0.36 and 0.62, respectively indicated the increase on these variables have great scope. Additonal unit of each respective factors added about Rs. 141, Rs. 41, Rs. 632 and Rs. 40 to the value of marginal productivity in groundnut crop in the year 2014.

In general, human labour, fertilizer, seed and farm yard manure were the important resources for the crop production. These resources were positively significantly affect the crop production. It implies that these resources were efficiently used in the production process.