6.1 INTRODUCTION

Maize is one of the most important cereals of the world. Maize is of American origin having been domesticated about 7000 years ago. Maize serves as a basic raw material for the production of starch, oil, protein, alcoholic beverages, food sweeteners and more recently fuel. Maize is high yielding, easy to process, readily digested and costing less than other cereals. It is also a versatile crop, allowing it to grow across a range of agro-ecological zones. Every part of the maize plant has economic value: the grain, leaves, stalk, tassel and cob can all be used to produce a large variety of food and non food products.

Maize is next to rice and wheat in respect of area and production in India. The importance of corn is due to its wide diversity of uses. It is used both as food for human and feed for animals. Corn is nearly directly consumed as feed and as an edible table vegetable. Green cobs are roasted and eaten by people with great interest. Corn is converted in to a variety of foods.

Though maize cultivation occupies a significant position in recent years, it encounters many problems inherent in the field of production and marketing such as notorious fickleness of climate change, monsoon dependence, low productivity, wide fluctuations in price structure and the absence of a well-organized trade network. These aspects called for an in depth study.

The researcher has undertaken the present study with the specific objectives of analyzing area, production and productivity of maize at the world, national, state and district levels, the cost and returns of maize production, the
resource use efficiency and returns to scale, evaluating marketing cost, marketing margin, price spread and marketing efficiency of different channels of distribution. To analyses and interpret both primary and secondary data, appropriate statistical tools such as Cobb Douglas type production function, simple regression equation, compound growth rate, co-efficient of variation, Garrett’s ranking technique, price analysis using multiplicative model, factor analysis, ANNOVA, price spread using concurrent margin method and percentage analysis have been used.

6.2 SUMMARY OF MAJOR FINDINGS

The following are the major findings of the study.

Socio-Economic Characteristics of Sample Maize Cultivators

- 64.20 per cent of the respondents were in the age group of ‘40 to 50’ years.
- 70 per cent of the respondents had literacy up to school level only.
- 98.30 per cent of the respondents were male.
- 62.5 per cent of the sample respondents had ‘4 members’ in their families.
- 57.5 per cent of the sample respondents had utilized ‘2 members’ from their family in maize cultivation process.
- With regard to annual family income of the respondents, 55.8 per cent had ‘Rs.25,000 to 50,000’ annual family income. But only 1.7 per cent had annual family income of ‘Rs.1,00,000’ and above.
With regard to the years of experience of respondents in maize cultivation, the respondents with ‘10 to 15 years’ of experience constituted 55.8 per cent followed by 2.5 per cent respondents having ‘5 to 10 years’ experience.

37.6 per cent of the respondents cultivated ‘Hishell’ variety of maize followed by 30 per cent of the respondents who cultivated ‘Pioneer’ variety of maize.

Only 36.7 per cent of the respondents were getting consultancy services from agricultural department.

47.5 per cent of the respondents used ‘open wells’ as the sources of irrigation followed by 26.7 per cent of the respondents used ‘both open wells and bore wells’ as sources of irrigation.

Maize Production-An Overview

The analysis of country-wise production of maize indicates that United States of America occupied the first place with the 39.29 per cent of world total production followed by China and Brazil which contribute 20.22 per cent and 6.83 per cent respectively. India stood at fifth place with a production of 2.26 per cent. United States of America and China together contributed 59.91 per cent of world maize production.

Analysis of trend, growth and magnitude of variability of maize production indicates that India stood first with the compound growth rate of 6.66 per cent per annum during the study period followed by Brazil with the growth rate of 6.17 per cent per annum and China with
5.44 per cent per annum. It is noted that compound growth rate in India, Brazil and China was more than the World average.

- As far as area under maize cultivation in the world is concerned, United States of America contributed 20.38 per cent of share followed by China with 18.68 per cent. In India it was 5.15 per cent and in Mexico it was 4.61 per cent during the study period.

- Analysis of trend, growth and magnitude of variability of area under maize cultivation indicates that China stood first with the compound growth rate of 3.99 per cent per annum followed by India with 3.04 per cent per annum and United States of America with 2.09 per cent per annum during the study period. It is interesting to note that co-efficient of variation in maize cultivation area in United States of America, Brazil, China, India and Mexico are greater than the world’s average.

- The analysis of country-wise maize productivity shows that the productivity of major maize producing countries of the world had a fluctuating trend during the study period. The productivity of maize of United States of America occupied first place with an average productivity of 9,402.5 kilograms per hectare followed by China with 5,265 kilograms per hectare. India occupied fifth position with 2,122.6 kilograms per hectare.

- Analysis of trend, growth and magnitude of variability of maize productivity reveals that Brazil recorded the highest compound growth rate of 4.23 per cent per annum followed by India with 3.51 per cent per
annum. For China it was 1.63 per cent per annum and for Mexico it was 1.39 per cent per annum. Interestingly United States recorded a lowest growth rate of 1.16 per cent per annum.

- Analysis of production of maize in India revealed that production ranged between 11,100 thousand tonnes and 21,760 thousand tonnes. The production increased from 11,100 thousand tonnes in 2002-2003 to 14,720 thousand tonnes in 2003-2004 bringing 32.61 per cent increase due to expansion of cultivation area and the prevalence of suitable climatic conditions. It is also noticed that production declines substantially from 19,730 thousand tonnes in 2008-2009 to 16,720 thousand tonnes in 2009-2010 making 15.26 per cent reduction in production.

- The analysis of area under maize cultivation in India showed that there had been a steady increase in area under maize cultivation during the study period.

- Analysis of maize productivity in India indicated that productivity ranged between 1,762 kilograms and 2,527 kilograms per hectare. It is also found that the trend value of productivity of maize in India registered an increasing trend from 1,780 kilograms to 2,466 kilograms.

- The analysis of India’s share in the world area under maize cultivation revealed that it ranged between 4.60 per cent and 5.30 per cent. On an average the area under maize cultivation in India to that of the world stood at 5.16 per cent during the period under study.
The analysis of India’s share in the world production of maize revealed that it ranged between 1.80 per cent and 2.60 per cent during the study period. The analysis of India’s share in the world productivity also revealed that the average productivity in India to that of the world stood at 0.43 times.

The analysis of maize production in Tamil Nadu showed that the production of maize in Tamil Nadu had a fluctuating trend during the period under study. The production of maize in Tamil Nadu was the highest during 2011-2012 and the lowest during 2002-2003. It is interesting to note that the production of maize that stood at 2,41,217 tonnes in 2005-2006 increased to 7,59,112 tonnes in 2006-2007, thereby registering a remarkable annual growth of 214.70 per cent when compared to 2005-2006.

The analysis of area under maize cultivation in Tamil Nadu reveals that the area under maize cultivation in Tamil Nadu ranged from 1,21,057 hectares to 2,86,639 hectares. The area under maize cultivation in Tamil Nadu which stood at 1,21,057 hectares in 2002-2003 had increased to 1,60,159 hectares in 2003-2004, making an annual growth rate of 32.30 per cent when compared to 2002-2003.

The analysis of productivity of maize in Tamil Nadu indicates that the productivity per hectare ranged between 1189 kilograms and 6042 kilograms during the study period. The year 2006-2007 witnessed
222.79 per cent increase in annual growth rate over the previous year 2005-2006.

- The analysis of Tamil Nadu’s share in India reveals that the average percentage share of maize cultivation area in Tamil Nadu to that of India stood at 2.43 per cent, the average percentage share of production stood at 3.49 per cent and the average percentage share of productivity stood at 1.28 times.

- The analysis of district-wise maize production in Tamil Nadu indicates that Dindigul occupied the first place with average production of 1,59,761.7 tonnes per annum followed by Perambalur which produced 86,684.8 tonnes. The analysis of compound growth rate indicates that Theni district stood first with the growth rate of 28.83 per cent per annum during the study period followed by Dindigul district with 22.46 per cent per annum.

- As far as district-wise area under maize cultivation in Tamil Nadu is concerned, Perambalur occupied first place with an average area of 43,789.9 hectares per annum followed by Dindigul with 37,983.4 hectares per annum. The area under maize cultivation during the period under study experienced considerable variation of 42.42 per cent in Coimbatore followed by Theni where it was 34.00 per cent, in Perambalur 28.09 per cent, in Erode 26.17 per cent and in Dindigul it was 12.60 per cent. It is noted that co-efficient of variation of area under
maize cultivation in the above maize producing districts is greater than Tamil Nadu.

➢ The analysis of district-wise productivity in Tamil Nadu showed that the productivity of maize in Erode occupied first place with an average productivity of 4742.8 kilograms per hectare followed by Theni. Dindigul occupied the third place, Coimbatore occupied the fourth place and Perambalur occupied fifth place in productivity.

➢ The analysis of area under maize cultivation in Dindigul district showed that it ranged between 31,125 hectares and 48,142 hectares. The area under maize cultivation in Dindigul district which stood at 40,321 hectares in 2007-08 had increased to 48,142 hectares in 2008-09, making an annual growth rate of 19.40 per cent when compared to 2007-08.

➢ The analysis of maize production in Dindigul district showed that the production of maize in Dindigul district had a fluctuating trend during the study period. The production of maize in Dindigul district was the highest during 2008-09 and lowest during 2005-06. It is interesting to note that the production of maize that stood at 41,940 tonnes in 2005-06 increased to 1,48,387 tonnes in 2006-07 there by registering a remarkable annual growth of 253.81 per cent when compared to 2005-06.

➢ Analysis of maize productivity in Dindigul district indicated that productivity ranged between 1,224 kilograms per hectare and 6,528
kilograms per hectare. It is also found that the trend value of productivity of maize in Dindigul district registered an increasing trend from 1,259 kilograms to 6,751 kilograms.

- The analysis of Dindigul district’s share in Tamil Nadu area under maize cultivation revealed that it ranged between 14.5 per cent and 25.7 per cent. On an average the area under maize cultivation in Dindigul district to that of Tamil Nadu stood at 20.3 per cent during the period under study.

- The analysis of Dindigul district’s share in Tamil Nadu production of maize revealed that it ranged between 15.2 per cent and 32.1 per cent during the study period. The analysis of Dindigul district’s share in Tamil Nadu productivity also revealed that the average productivity in Dindigul district to that of Tamil Nadu stood at 1.2 times.

**Cost and Returns Analysis**

The cost and returns analysis was made with the help of the primary data collected from the sample respondents who were classified as marginal, small and medium.

- The analysis of factor motivating the maize cultivation showed that suitability ranks first followed by minimum cost, better revenue and easy marketing.

- The cost analysis indicated that the total operational cost was Rs.13321.32, Rs.12,662.45 and 11,897.12 per acre for marginal, small and medium farmers respectively. The operational cost accounted for
69.31 per cent in the case of marginal farmers, 67.27 per cent in the case of small farmers and 65.36 per cent of the total cost in the case of medium farmers.

- Fixed cost contributing to the total cost was 30.69 per cent in the case of marginal farmers, 32.73 per cent in the case of small farmers and 34.64 per cent in the case of medium farmers.

- The variable cost was more than the fixed cost in all the cases of farmers.

- Cost of hired labour was the major component with 28.24 per cent in case of marginal farmers, 29.72 per cent in the case of small farmers and 31.25 per cent of the total variable cost in the case of medium farmers.

- Among the fixed cost components, the rental value of owned land constituted the major share of 16.65 per cent in the case of marginal farmers, 17.00 per cent in the case of small farmers and 16.48 per cent in the case of medium farmers.

- The cost concept analysis showed that Cost A1 was maximum at Rs.14617.04 in the case of marginal farmers and the minimum of Rs.13402.50 in the case of medium farmers. Cost A2 remained the same because no land was leased for maize cultivation. Cost B1 ranged from Rs.15,202.50 per acre in the case of medium farmers to Rs. 16,021.04 per acre in the case of marginal farmers. Cost B2 ranged from Rs.18,202.50 per acre in the case of medium farmers to Rs.19,221.04 per acre in the case of marginal farmers.
The cost analysis also reveals that Cost C1 registered the maximum at Rs.16,994.95 per acre in the case of marginal farmers and the minimum of Rs.15,339.64 in the case of medium farmers. Cost C2 was maximum at Rs.20,194.95 in the case of marginal farmers and the minimum of Rs.18,339.64 in the case of medium farmers.

The cost of production in the case of marginal farmers was Rs.8.74 per kilogram which was higher than that of small and medium farmers which were Rs. 8.42 and 8.06 respectively.

The analysis of average annual productivity of maize in the study area revealed that the productivity of maize per hectare ranged from 2199.51 kilograms in the case of marginal farmers to 2257.79 kilograms in the case of medium farmers.

The gross returns worked out were Rs.20587.45 per acre in the case of marginal farmers, Rs.21080.48 per acre in the case of small farmers and it was Rs.21403.86 per acre in the case of medium farmers.

Net income was the highest in the case of medium farmers at Rs.3064.22 and the lowest at Rs.392.50 in the case of marginal farmers. Investment income was maximum at Rs.7,864.22 for the medium farmers and minimum at Rs.4,996.50 for the marginal farmers.

The net profit ratio indicates that the producers’ margin was 6.64 per cent of gross returns in the case of marginal farmers, 10.70 per cent in the case of small farmers and it was 14.96 per cent in the case of medium farmers during the study period.
The cost and returns analysis showed positive results to the effect that cultivation of maize was profitable.

The functional analysis indicated that in case of marginal farmers, the yield of maize was significantly influenced by the level of human labour, cost of manure and cost of irrigation. One per cent increase in the level of labour used, keeping all other factors constant, would increase the yield by 0.562 per cent from its mean level.

The functional analysis also indicated that in case of small farmers the co-efficient of cost of irrigation was 0.689 and it was significant at one per cent level, indicating that one per cent increase in cost of irrigation would increase the output of maize by 0.689 per cent from mean level.

In case of medium farmers, the variable cost of manure is one of the important inputs contributing to the yield of maize. Its co-efficient was 0.851 and it was significant at one per cent level, indicating that one per cent increase in cost of manure would increase the output of maize by 0.851 per cent from its mean level.

The analysis of resource-use efficiency indicated that in the case of marginal farmers, every rupee additionally spent on cost of irrigation and cost of manure would yield Rs.2.58 and Rs.2.22 worth of output respectively, in the case of small farmers, every rupee additionally spent on cost of manure and cost of irrigation would yield Rs.10.55 and 8.11 worth of output respectively and in the case of medium farmers, every
rupee additionally spent on cost of manure and cost of irrigation would yield Rs.17.89 and Rs.5.87 worth of output respectively.

- The analysis of the returns to scale reveals that the sum of the production elasticities were 1.455 for marginal farmers, 1.257 for small farmers and 1.527 for medium farmers in Dindigul district.

**Marketing of Maize**

The majority of the maize cultivators prefer to sell their produce to the village traders because the village traders operate in the interior areas close to them. They assemble the produce purchased from the cultivators and pass it on to the commission agents. Usually, commission agent purchases the produce either directly from the cultivators or from the village traders and sells to the wholesalers. Maize cultivators having more stock of maize and good holding capacity directly contact the wholesalers and sell their maize. The wholesalers do not hold maize stock for a long duration. They transport the stock to the industrial consumers.

- Identified marketing channels presently available for different group of respondent cultivators of maize in Dindigul district of Tamil Nadu are given below.

  **Channel I:** Cultivators – Village Traders - Commission Agents – Wholesalers – Industrial Consumers

  **Channel II:** Cultivators – Commission Agents – Wholesalers – Industrial Consumers
Channel III: Cultivators – Wholesalers – Industrial Consumers

- In the study area, the analysis of marketable surplus of maize showed that the percentage of marketable surplus to the total quantity of maize produced by the marginal farmers worked out 98.57 per cent. However in case of small and medium farmers, the marketable surplus is 100 per cent.

- The analysis of storing practices among sample cultivators revealed that the small farmers stored 23.67 per cent of the marketable surplus and Medium farmers stored 76.43 per cent of the marketable surplus. Out of 75 medium farmers who stored maize, 32 stored maize for a period of 30 to 60 days, 29 stored 60 to 90 days, 10 stored up to 30 days and only 4 stored for a period of above 90 days.

- The percentage of storage loss in the quantity of maize stored by the small farmers was 4.60 per cent and in case of medium farmers it was 4.69 per cent.

- The percentage of marketed surplus to the marketable surplus was 98.91 per cent for small farmers, 96.42 per cent for medium farmers and 100 per cent for marginal farmers.

- The analysis of cost incurred by the cultivators in marketing of maize revealed that the cost incurred by the farmers in marketing of one quintal of maize was Rs. 89 in Channel I, Rs. 100 in Channel II and Rs. 112 in Channel III. The analysis also revealed that the total
marketing cost incurred by the farmer in marketing of maize was the minimum in Channel I while compared with the total marketing cost of other channels. The cost of preparation to market was found to be almost equal per cent in all channels.

- The total marketing cost incurred by the village trader was Rs.16.90 per quintal of maize. Among the different components of marketing cost incurred, transportation cost and loading and unloading cost had a major share of 41.43 per cent followed by establishment and administration cost which was 34.91 per cent. These two costs put together constituted 76.34 per cent of the total marketing cost incurred by the village traders.

- The total marketing cost incurred by the commission agent was Rs.42.60 per quintal of maize. Among the different items of marketing costs, establishment and administrative cost was the largest, accounting for 24.82 per cent of the total marketing cost followed by both transportation cost and commission charges with 23.46 per cent each.

- The total marketing cost incurred by the wholesaler was 72.60 per quintal of maize when they purchase from commission agent. Establishment and administrative cost constituted a major share accounting for 28.40 per cent of the total marketing cost, followed by transportation cost with 17.91 per cent and commission charge with 16.53 per cent. The total marketing cost incurred by the wholesaler in direct purchase was Rs.91.90 per quintal of maize.
Price – spread analysis in the domestic market revealed that farmer’s share in the price paid by consumer is estimated to be around 76 per cent in all the three channels in the study area. It implies that there is not much difference in the net price received by the farmer whatever may be the type of channel he chooses to market his produce. It is observed that the farmer’s share is the maximum in channel III, which is 77.00 per cent in the price paid by consumers. The net share of the farmer is found to be the lowest in Channel I which is 76.03 per cent because of more intermediaries involved in Channel I.

The overview of channels with their price spread reveals that the farmer’s price was the maximum in Channel III with Rs.948 per quintal of maize followed by Rs. 943 per quintal in Channel II. The price spread in Channel I was the highest with Rs. 295.10 among all channels because of the existence of more number of marketing intermediaries and more marketing cost. The price spread in Channel III is the lowest with Rs. 283.10 per quintal because of lesser marketing cost and higher farmer’s price. The marketing margin was the maximum in Channel III with Rs.79.20 per quintal of maize followed by Rs. 74 per quintal of maize in Channel I.

The marketing efficiency analysis using Shepherd’s method reveals that among all channels, Channel III is seen to be the most efficient. The efficiency index for Channel III is the maximum with 5.04, followed by
Channel II with 4.72. The marketing efficiency in Channel III is better than that in the remaining channels because of lesser marketing cost.

- Secular trend analysis of the prices that prevailed at the Udumalpet market over the years showed that there had been a significant increase in the price of maize. The annual average price of maize per quintal had increased at the rate of Rs.176.96 per annum.

- The indices of cyclical variation in the prices of maize in Udumalpet market reached the maximum of 1.22 in 1996-97 and it started declining until 2004-05 and again it started increasing and reached the peak level of 1.03 in 2009-10.

- The indices of irregular variation for the price of maize at Udumalpet market ranged from 0.83 to 1.10.

- Analysis of seasonal variations of maize price in different months of a year showed that the lower prices prevailed from January to February. This was due to heavy arrivals and post harvest glut in the market. The lower prices in the months of October imply that the growers sold their produce after storing for some time. The highest price index between June and September was due to off-season shrinkage of arrivals and the pre-harvest scarcity.

- The analysis of problems in maize cultivation showed that unfavourable climatic condition ranks first followed by high cost of inputs and the power shortage as other problems. With regard to marketing, some of the important problems for the cultivators in marketing of maize are
immediate post harvest sales, malpractices of middlemen and clutches of village money lenders cum traders in order of ranks.

6.3 SUGGESTIONS

- Steps may be initiated to undertake large scale production of value added products using maize as the main ingredient.
- Organically produced farm products are preferred throughout the world today. Maize, being an important food crop both for the human being and the cattle may be produced only with organic inputs and methods of cultivation. Such practices will help in maintaining and preserving the soil structure, environmental friendly and it is cost effective also.
- With the constant demand for maize in various sectors, large scale availability of this crop is becoming essential to sustain such sectors. Therefore, the productivity level can be enhanced through various improved methods of cultivation such as innovative practices, judicial uses of inputs, integrated pest management and so on.
- Export potential for maize from India may be explored so that the demand for the product can be sustained which in turn will ensure a support price during all the seasons.
- Modern farm equipments, machineries and tools may be used in farming which will reduce the large scale demand for labourers since the shortage of adequate skilled and unskilled labours is a major problem in farming today.
• Regulated markets exclusively for maize can be established so that the farmers can sell their produce at the correct ruling price, avoid exploitation; get certified seeds and other quality inputs.

• Liberal financial assistance without much cumbersome procedures to the maize cultivators through commercial banks and co-operative societies may be provided to enable them to store the produce till the rise in price and avoid the immediate post harvest sales. Such advances to the farmers will help them to set themselves free from the clutches of the local moneylenders and the traders.

• The farmers must be provided with information regarding all aspects of maize cultivation and marketing like innovative cultivation method, integrated pest management system, supply and demand, current price, market trend, value addition details and the like through all the media from which the farmers can access information and the extension service departments.

• Godowns and warehouses must be established in the production centres. so that the cultivators can stock their produce to sell it at a remunerative price at the appropriate time.

• Power shortage and the consequent problems in irrigation are acute in farming. To overcome this, effective irrigation practices using modern techniques like sprinkler and drip irrigation methods can be followed which will ensure judicious supply of water to crops. Solar power systems to generate electricity can be tried on co-operative basis using the subsidies offered by the governments.
6.4 CONCLUSION

The cultivation of maize has started increasing in the recent years. The water requirement for this crop is very less. This has encouraged many farmers to convert many areas of paddy, ragi crop into maize cultivation. In India, maize is emerging as third most important crop after rice and wheat. Maize has its significance as a source of a large number of industrial products besides its uses as human food and animal feed. The present study has brought into focus various issues relating to production and marketing. If the policy implications suggested are implemented properly, it will help to increase the levels of production and productivity in maize cultivation.

Scope for future study

The researcher suggests the following areas for future research.

- Economic of Maize Production
- Cost and Return Analysis of Maize and its Value Added Products.
- Problems and Prospects of Maize Trade – A study under changing economic scenario.