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महाप्रबंधक (सेवानिवृत्त)

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Foreword

The Mango, the most important tropical and subtropical fruits of the world, is called as the king of fruits on account of its nutritive value, taste, attractive fragrance and health promoting qualities. Mango is well adapted to tropical and sub tropical climates. The ideal temperature for mango ranges from 24^0 to 30^0C during the growing season, along with high humidity. A rainfall ranging from 890 to 1,015 mm in a year is considered to be ideal for growing mango. As much as 100 gram of edible portion of the mango contains about 1990 ug of beta-carotene (vitamin A), which is much higher than in other fruits. Mango, both ripe and unripe, is a good source of vitamin C.

Mango accounts for more than one third of total area under fruit crops and about 20 per cent of total fruit production in 2008-09. It is commercially grown in about 83 countries in the world. The total world production during 2010 was estimated at 34,750 thousand MT where India enjoys the top slot (13,056.22 thousand metric ton) followed by China (4,657.42 thousand MT), Thailand (2,222 thousand MT), Mexico (1,925.15 thousand MT). When compared to world average yield (7,202 kg per hectare), India's productivity (7065 kg/ ha in 2010) is low. Brazil ranks first in productivity (12,394 kg per hectare). Uttar Pradesh, Gujarat, Andhra Pradesh, Maharashtra, Bihar, Karnataka, Tamil Nadu and Punjab are major mango producing states.

Producer's share in the consumer price is high when the marketing efficiency is high. Producers' share in consumers' price in channel 1 stood at 28.80 per cent, while it was 34.74 per cent in channel 2 and 33.59 per cent in channel 3. Channels 4 and 5 accounted for 44.05 and 100 per cent respectively. The proportion of expenditure in the price of 1 kg of mango paid by the consumer is 26.17 per cent. About 9.83 per cent goes towards cost of packing, 10.43 per cent towards transportation and 13.57 towards commission and hamali charges, thus leaving 40 per cent of the consumer price towards share of the farmer. It is entirely the producer's surplus as the cost of production is already taken into account.

Average yield of Alphonso mango in Sindhudurg of Maharashtra was 4.5 MT/ ha, which was higher than Kesar mango at Aurangabad (3.46 MT / ha.) during 6 to 14 years. However, the stabilized yield of Alphanso mango during 15 to 35 years was lower at 4.73 MT/ ha as

against Kesar mango 4 .88 MT/ ha. The annual net income earned per hectare was higher (Rs. 55,024 /ha) in Alphanso mango than Kesar mango (Rs 44,773 /ha) during tender age. During adult period kesar mango earned higher net income at Rs 67,993 / ha compared to Alphanso mango (Rs. 53.698/ha). Annual net income accrued by Fazli variety of mango in Malda district, West Bengal was Rs.2,96,000 per hectare followed by Langra at Rs. 2,81,500, Himsagar at Rs.1,87,500 and Laxmanbhog at Rs.1,20,000/ha.

The internal rate of return was more than 15 per cent for all the sample orchards. It is highest at 23.21 per cent in mango orchards of Aurangabad, Maharashtra followed by Chittoor (20.83%), Andhra Pradesh and Sindhudurg (17.66%), Maharashtra. The sensitivity analysis revealed that IRRs are 15.15 per cent and 20.82 per cent for Kesar and Alphanso mangoes respectively.

The indicative cost for establishing mango pulp unit with an installed capacity of 600 metric tons of pulp per annum is about Rs. 35 lakh, while for an aseptic unit the cost is estimated at Rs. 2000 lakh. The length of operation of mango processing units depends on the varieties of mango processed and source of procurement. The average annual operational cost of a 600 MT capacity pulp making unit was estimated to be about Rs. 105.7 lakh. The cost of production per metric ton of pulp mango worked out to Rs. 12,858. The canning units reported gross income of Rs. 122.12 lakh and net income of Rs. 16.42 lakh. The profit margin was arrived at 13.45 per cent in case of canned pulp making units.

Average cost of production per unit and per kg of jelly was worked out to Rs 2.45 lakh and Rs 28.54 respectively. Net income has been arrived at Rs 54,500 per unit and Rs 6.36 per kg. Cost of production constitutes 81.83 per cent of gross income. The ratio of net profit to capital employed (0.64) was encouraging for jelly units that demonstrate efficiency in the use of capital with higher rate of return. However, profit margin (18.16%) in jelly making units needs to be further improved through appropriate management of various costs.

The large firms employ a large number of workers i.e, 700. The small firms on the other hands employ only 256 workers. The small firms produce 860 tons of mango pulp per unit whereas the large firms produce 5,995 tons. Total revenue generated, on an average, varies

from Rs. 161.25 lakh for small firms to Rs. 1361.6 lakh for large firms. Net revenue available for small firms was Rs. 11.25 lakh and Rs. 40.93 lakh for large firms. Thus, it is evident that the processing firms are profitable.

The operating ratio ranges for small and large firms were 0.76 and 0.82 respectively. This signifies that for every rupee of gross income a substantial portion of operation cost is incurred. The fixed ratio was 0.17 for small firms and 0.13 for medium firms. The gross ratio stood at 0.93 for small firms and 0.97 for large firms. This reveals that a large portion of gross income is utilized for meeting the total expenses and small firms are more efficient than other size class of firms.

The capital turnover ratio worked out at 0.81 for small firms and 0.91 for large firms revealing that every rupee investment by small firms generates gross income of 81 paisa. This measure reveals that large firms are more efficient than the small firms. The rate of return on investment gives a better picture of efficiency. The value of rate of return on investment varies from 0.027 for large firms to 0.056 for small firms revealing that every rupee of capital investment generates a net return of 3 paisa and 6 paisa. This measure shows that small firms are more efficient than large firms.

The IRR of small firms (19.31%) is the highest followed by that of large firms (17.5%). and medium firms (13.87%). The investment in mango processing plant has least payback period for small firms (5 Years) followed by that of large firms (6 years) and medium firms (7 years). The shorter payback period for mango processing plants provides an important opportunity for an entrepreneur.

The breakeven point for small firms (Rs 113.54 lakh) is the lowest followed by medium firms (Rs 380.97 lakh) and the large firms (Rs 1138.85 lakh) respectively. The BEP in physical terms for small firms with 605.52 tons is the least followed by medium and large firms with production of 1746.82 tons and 5014.25 tons respectively.

The average annual maintenance cost of mango orchard up to plucking stage comes to Rs 62,700 lakh per hectare as per the current package of practices. However, loan actually availed by the farmers was at Rs 35,920 per hectare. The banks assessed the loan requirement at Rs 600 per tree for meeting maintenance expenses and accordingly sanctioned KCC limit of Rs 60,000 per hectare. The

remaining portion of the maintenance cost was met out of own funds and/or by availing credit from the traders-cum- middlemen and input dealers. The apathy of farmers towards bank loan is primarily due to the fact that alternative options for arranging maintenance expenses are in practice in the district. The input agents provide inputs on credit and collect their dues in harvesting season. But traders-cum-middlemen, who normally lift the produce through their local agents, are continued to be the primary source of finance of the farmers.

The traders-cum-middlemen provide advance ranging up to 20-30 per cent of the anticipated production at the door steps of the farmers, during October to January, without going through elaborate documentation. Farmers reported no interest was charged till settlement of yearly account in June. However, interest is charged @ 2 per cent per month on the outstanding balance, if any, of the advance after boxes are settled around June.

Lack of availability of genuine planting material, improper orchard management, non adherence to application of recommended doses of plant growth regulators at the appropriate stages of fruit growth, dearth of training and awareness creation on various cultivation practices for producing good quality mango, dearth of proper infrastructure in terms of facilities for handling the produce, poor transport and storage facilities are some of the problems faced by the mango farmers. Concerted efforts need to be stepped up to intensify export promotion efforts. These include: (i) strengthening infrastructure base, (ii) efficient post harvest management, (iii) better improved packaging, (iv) excluding new markets, (v) improving cold storage and transportation logistics (vi) developing India brand mangoes and campaigning abroad about the quality, (vii) promoting an efficient export marketing network to optimize our export, (vii) setting up of more quality control laboratories in the Export Processing Zones and (viii) exploring new export destinations.

The study recommends growth and sustainability of small firms, proper forward and backward linkages, exploring contract farming, enhancement of domestic consumption through campaigns and product diversification, formation of cooperative society, adoption of quality standards, technology favoring the market and promotion of cluster approach. All these call for the support and nurturing by government to help technology up-gradation, adopt Hazard Analysis

Critical Control Point (HACCP), ensure geographical identity and uprooting the senile and unproductive orchards and availability of genuine planting material of the required quantity. The study also suggests that to get rid of alternative bearing , the crop production can be regulated to a certain extent through pruning immediately after harvest coupled with adequate manuring, judicious irrigation and effective plant protection measures. The appropriate package of practice may be popularized by the DoH of the selected districts of the states. The setting up of pack houses with washing, waxing, packing, commissioning of vapour heat treatment plant (VHPT) to sort out the problem of fruit fly and availability of institutional credit are some of the major recommendations. There is a need to streamline data on credit flow to mango separately for various activities, especially in the AEZs, review and monitor the progress and identify various issues confronted by the stake holders in AEZs at the state/ district levels together with corrective actions. The Self Help Groups (SHGs) / Farmers Clubs of mango farmers in selected districts of Maharashtra could organize mango festivals with the help of their counter parts in other districts. The mango farmers can be taken on study tours to other places for awareness and skill upgradation.

I am sure the findings and recommendations of the study will be useful to the mango growers, processors, research organizations, packers, exporters, financial institutions, development authorities, academicians, planners, policy makers, and implementing agencies.

Dr K.G.Karmakar)

Managing Director

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The Author

Abbreviations

Ac	:	Acreage
AMC	:	Agricultural Marketing Committee
AEZ	:	Agri-Export Zone
APEDA	:	Agricultural and Processed Food Products Export Development Authority
APITCO	:	Andhra Pradesh Industrial and Technical Consultancy Service
AP	:	Andhra Pradesh
BCR	:	Benefit Cost Ratio
CFTRI	:	Central Food Technological Research Institute
CRC	:	Correlation Coefficient
CA	:	Commission Agent
CAGR	:	Compound Annual Growth Rate
CP&L	:	Cost of Petti and Labour
C&H	:	Commission and Hamali
DoH	:	Department of Horticulture
DoES	:	Department of Economics and Statistics
DDM	:	District Development Manager
DF	:	Degree of Freedom
ETTS	:	Effective Technology Transfer System
FFA	:	Federation of Farmers' Association
FTP	:	Farm to Plate
FAO	:	Food and Agriculture Organization
HCPMA	:	Horticultural Crops Planting Material Authority
HACCP	:	Hazard Analysis Critical Control Point
HA	:	Hectare
IRR	:	Internal Rate of Return
IARI	:	Indian Agricultural Research Institute
KCC	:	Kisan Credit Card
Kg	:	Kilogam
LDM	:	Lead Development Manager

ME	:	Marketing Efficiency
MH	:	Maharashtra
MT	:	Metric Tonne
MM	:	Marketing Margin
ME	:	Marketing Efficiency
MP	:	Madhya Pradesh
MACS	:	Mutually Aided Cooperative Society
NHM	:	National Horticulture Mission
NHB	:	National Horticulture Board
NPW	:	Net Present Worth
NABARD	:	National Bank for Agriculture and Rural Development
PCB	:	Pollution Control Board
PL	:	Price Coefficient
PHC	:	Post Harvest Contract
PC &L	:	Production Cost and Labour
SCMS	:	Supply Chain Management System
SHGs	:	Self Help Groups
TO	:	Transport Operator
USA	:	United States of America
UAE	:	United Arab Emirates
UK	:	United Kingdom
UP	:	Uttar Pradesh
UCTs	:	Up Country Traders
VHTP	:	Vapour Heat Treatment Plant
VT	:	Village Traders
WC	:	Working Capital

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Executive Summary

The Mango is called "the king of fruits" on account of its nutritive value, taste, attractive fragrance and health promoting qualities. It is cultivated world over, especially in the South and South-East Asian countries, African countries, tropical Australia, and the USA. Mango is well adapted to tropical and sub tropical climates. The ideal temperature for mango ranges from 24^0 C to 30^0 C along with high humidity with a rainfall ranging from 890 to 1,015 mm per year. As much as 100 gram of edible portion of the mango contains about 1990 ug of beta-carotene (vitamin A). Mango is a very good source of vitamin C.

A total sample of 186 respondents was selected from three states, of which Andhra Pradesh had 75 respondents (40.33%) per cent followed by Maharashtra covering 59 respondents (31.72%) and West Bengal 52 respondents (27.95%). Category wise the study covered 92 mango growers (49.47%), 33 mango processors (17.75%), 29 Traders/ Exporters (15.59%), 7 banks (3.76%), 10 Nursery owners (5.37%) and 15 others (8.06%).

Major Findings

The world production of mango during 2010 was estimated at 34,750 thousand MT where India enjoys the top slot (13056 thousand MT) followed by China (4657 thousand MT), Thailand (2222 thousand MT), Mexico (1925 thousand MT). When compared to world average (7202 kg per hectare), India's productivity is slightly low at 7065 kg per hectare. Brazil ranks first in productivity (12394 kg per hectare), which is well ahead of world average. The world area under mango has been estimated at 4825 thousand hectare whereas India covers an area of 1848 thousand hectares constituting 38.31 per cent of the total area.

The world trade in fresh mangoes forms an insignificant portion of world production (0.06 %). India's share in world mango market is less than 15 per cent but mangoes account for 30 per cent of total fruit exports from India.

Sample Respondents:

Mango farmers have been categorized according to level of education. Of the total 92 mango growers, 32 farmers (34.8%) passed higher secondary. Fifty eighty farmers (63%) attained education up to

secondary level. Only two farmers were graduates. The state wise position revealed that except West Bengal, 10 per cent and 24 per cent of the sample farmers in Andhra Pradesh and Maharashtra respectively had primary education.

Majority of farmers (52.2%) belonged to the General Caste. About one third of total samples i.e.33.7 per cent were in category of OBC. Samples belonging to SC/ST and minority category constituted 16 per cent. Out of 92 sample growers, only 17 samples (18.5%) had a family size up to 3 members. As many as 40 sample growers had a family size between 4 and 6. State wise sample growers with family size between 4 and 6 in Andhra Pradesh stood at 75.5 per cent, followed by Maharashtra (62.5%) and West Bengal (50%). Distribution of occupational pattern of the sample growers observed that business men accounted for 43.5 per cent (40) of the total, followed by traders 38 per cent (35) and cultivators 18.5 per cent (17).

Twenty one samples (22.8 %) had a land holding size between 10.0 and 20 acres, followed by 20 samples in the land holding of 5.01to 10 acres. About 20 samples growers (23.9%) belonged to land holding category of up to 5 acres. Total area covered under plantation for the sample growers stood at 1452.4 acres. Out of which 46.1 per cent (666.9 acres) belonged to the size class of 10.01 to 25 acres, followed by 30.8 per cent in the size class of 25.01 to 50 acres and 18.3 per cent in the size class of 5.01 to 10 acres. Age wise distribution of mango orchards revealed that 32 orchards (34.8%) were in the age group of 41 to 50 years. Only 6 orchards had an age of above 50 years. As many as 7 orchards belonged to the age group of up to 10 years, and 20 orchards were in the age bracket of 11 to 20 years. As many as 27 orchards were in the age group of 31 to 41 years.

Technical Aspects of Cultivation:

Usually, all types of soil are conducive to mango cultivation. In the month of June, seeds @ 50 kg per hectare may be sown. When the plants are around 30-40 days old, they should be thoroughly mixed with the soil using plough so that the decay enhances the fertility of the soil.

Ideal for mango plantation will be 18-20 trees per acre, which will ensure sufficient sunlight, production and color, quantity of the fruit. The ideal spacing between two plants is required to be 20 metres. There are many methods of plantation: square, rectangle, polygon, etc.

But square method is the most popular and easiest. Selected grafted sapling should be removed from earthen pot or polythene packs carefully and the saplings should be planted straight at the center of pits already mixed with fertilizer by removing 8-10 cm of soil. After plantation, water should be poured on the plant

During winter and summer young plants are watered frequently to ensure proper growth. In case of adult trees, irrigation at 10-15 days interval from fruit set to maturity is beneficial for improving yield. On completion of one month of planting of saplings, weeds in the orchard are required to be removed by ploughing. To get regular and good production, both urea and phosphate fertilizers may be applied in required proportion twice every year. There is a need to increase the quantity of fertilizer according to growth of the tree. A sapling is prone to the various diseases and pests attack and proper care may be taken in this regard.

Inter crops such as vegetables, legumes, green gram, black gram, cow pea, *guar,* sweet clover (*Senji*), pea, lentil, moth bean and fenugreek can be cultivated in mango orchard to supplement income of the growers in the initial period. Besides, intercropping in orchard promotes infestation of pests and diseases in greater intensity. Hence, regular plant-protection measures against pests and disease of the mango crop are essential. These inter crops save the orchard soil from being eroded during the rainy season, facilitate nitrogen in the orchard soil and prevent the growth of weeds. If cover crops or inter crops are taken regularly, the weeds will automatically be suppressed.

One of the important schedules in mango orchard management is maintenance of excellent sanitary conditions in the orchard and regular pruning of the malformed parts (both vegetative and floral) in the tree, if any. This will ensure reduced incidence of mango malformation. A proper round-the-year cultural schedule must be drawn up. Proper irrigation of trees, particularly during summer, is very essential to get quality crop from the bearing trees and proper growth in young plants. While bearing trees ought to be irrigated at an interval of a fortnight during summer, younger plants need weekly irrigation.

Mango trees respond well to organic manure applications. The recommended practice for one hectare of mango tree is about 25 liters of *Pachagavya* (mixed in 750-800 liters of water) and four to five MT

of vermicompost. Spraying *Panchagavya* has been found effective in the control of fruit fly menace, a common infection in all fruit bearing trees. Trees treated with organic manures bore large sized leaves and form a dense canopy with profuse rooting systems. The taste and shelf life of the fruits are also found to be more satisfactory. The mango can be preserved for long if the fruit is collected with at least 8-10 mm. of its stalk. After collecting the fruit, mangoes are sorted out according to size and shape and are kept in wooden boxes or card board boxes with a capacity of 50-100 mangoes for packaging. The boxes should have sufficient number of holes to allow ventilation. To prevent any sort of damage, each fruit should be wrapped in newspaper and placed in the box.

Generally green mangoes plucked at maturity could be preserved for a longer time than ripe ones plucked from the tree. Regulated humidity, low temperature and usage of chemicals delay ripening of the mangoes. 5^{o} - 10^{o} C temperature and 85 - 90 per cent of relative humidity is ideal for storage of various varieties of mangoes. Very low temperature can damage mangoes. Paraffin layer (3%) on the mango gives it a longer shelf life. It can be preserved for two weeks if it is put into cold water of 12^{o}-15^{o} C and with room temperature of 15^{o}C.

Market Channels:

In Andhra Pradesh, mango reaches the consumers through five channels such as Pre- harvest Contractor, Up Country Traders, Village Traders, Commission Agents and Processing Units. From the grower, mango reaches the export destination through the following channels: (a).Post-harvest Contractor (Up Country Traders, Processors, Village traders and Exporter), (b) Market Commission Agents/Wholesalers (Up country Market, Industrial Users/Unit, Processing Unit and Importer) and (c) Up Country Trader (Retailer, Whole sales Stockiest, Retailer and Stores). Overall, mango reaches to the consumers through five different channels. Channel I (Grower—Commission Agents/ Village Traders—Up Country Traders—Retailers—Consumers) constituted 55 per cent of total arrivals, followed by 25 per cent by channel II- Post-harvest Contractors—Commission Agents—Retailers—Consumers), 10 per cent by channel III (Up Country Traders—Retailers—Consumers), 7 per cent by channel IV (Local Wholesalers—Retailers—Consumers) and 3 per cent by channel V (grower and processors). The commission agents (CAs) are the most important link in the marketing of mango controlling about two- thirds of the total markets. These CAs also act

as grower cum trader and facilitate the trade between the mango grower and UCTs.

Producer's share in the consumer price in channel I stood at 28.80 per cent, while it was 34.74 per cent in channel II, and 33.59 per cent in channel III. Channels IV and V accounted for 44.05 and 100 per cent, respectively. The majority of farmers of Sindhudurg, Maharashtra send their mangoes through transporter to the commission agents at Vashi and Pune. The sale price and various deductions like transportation charges, commission (8% in Pune and 10% in Vashi), loading and unloading (up to 5 per cent) are immediately conveyed to the farmers through a receipt known as Patti**.** Some commission agents used to deduct the postage charges for forwarding the patti to the farmers. A few farmers, who are not tied up with commission agents, send their mangoes to other markets where prices are higher. A few enterprising farmers were directly selling a part of their produces through their contact at Mumbai, Nasik and Pune. These channels fetched maximum price to the farmer.

The proportion of expenditure in the price of 1 kg of mango paid by the consumer is 33.83 per cent. About 9.83 per cent goes towards cost of packing, 10.43 per cent towards transportation and 13.57 per cent towards commission and hamali charges, thus leaving 40 per cent of the consumer price towards share of the farmer. It is entirely the producer's surplus as the cost of production is already taken into account. The percentage spread being 20, marketing efficiency is low. The marketing efficiency can be increased by reducing the interference on the commission agents, thereby lowering the intermediate cost.

Market Price and Mango:

In case of Aurangabad market, the regression coefficient of price is negative and significant in 2005 and 2006 while it was positive but not significant in 2004. In Kolahpur market**,** the regression coefficient of price is negative in 2004, 2005 and 2006 though it was significant in 2004 only. Hence, these estimated equations largely substantiate the inverse relationship between arrivals and price. In the event of more arrival there is a fall in market price.

Amrapali variety of mango in Malda, West Bengal fetched the highest price at Rs 1500 per quintal, followed by Himsagar at Rs 1,300 per quintal, Langra at Rs 1,200 per quintal and Laxman / Gopalbhog at

Rs 1,000 per quintal during 2004. Price realized for Amrapali mango, however, reduced to Rs 1,300 per quintal in 2005 and 2006.

Yield:

Average yield of mango orchard in two selected districts of Andhra Pradesh stood at 6.5 metric ton per hectare in the age group of 6 to 14 years, while the stabilized yield recorded at 12.5 metric ton per hectare in the age bracket of 15 to 35 years. Average yield of Alphonso mango in Sindhudurg, Maharashtra was 4.5 MT/ ha during 6 to 14 years compared to Kesar mango in Aurangabad, Maharashtra at 3.46 MT / ha. However, the stabilized yield of Alphonso mango on orchards aged 15 to 35 years was lower at 4.73 MT/ ha as against Kesar mango at 4.88 MT/ ha.

Income from Orchards:

The annual net income earned per hectare was higher (Rs 55,024 / ha) in Alphonso mango than Kesar mango (Rs 44,773 /ha) during tender age. During adult period Kesar mango earned higher net income at Rs 67,993 / ha than Alphonso mango (Rs 53, 698/ha). Net income accrued by Fazli variety of mango in Malda district, West Bengal was Rs. 2,96, 000 per hectare, followed by Langra at Rs 2,81,500, Himsagar at Rs. 1,87,500/ha and Laxmanbhog (Rs.1,20,000 / ha). The financial rate of return (FRR) from mango orchards is highest at 23.21 per cent in Aurangabad district, followed by Chittoor (20.83%) and Sindhudurg (17.66%). The sensitivity analysis in two varieties of Mango in Maharashtra stated that the FRRs were 15.15 per cent and 20.82 per cent respectively.

Cost of Processing Units:

The indicative cost for establishing mango pulping unit with an installed capacity of 600 metric tons of pulp per annum is about Rs. 35 lakh, while for an aseptic unit the cost is estimated at Rs 2000 lakh. The average annual operational cost of a 600 MT capacity pulp making unit was estimated to be about Rs. 105.7 lakh. The cost of production per ton and per kg of pulp worked out to Rs. 12,858.50 and Rs.12.85 respectively. The canning units reported a gross income of Rs.122.12 lakh and net income of Rs.16.42 lakh.

Profit of Processing Units:

The ratio of net profit to capital investment (0.47) was not very encouraging for canning units. The share of manufacturing cost to gross value of production for canning units stood at 13.45 per cent, which is an area of concern suggesting appropriate management of various canning centers for greater profitability. Average cost of production per unit and per kg of jelly was worked out to Rs. 2.45 lakh and Rs. 28.54 respectively. Net income was arrived at Rs. 54,500 per unit and Rs. 6.36 per kg. Cost of production constitutes 81.83 per cent of gross income. The ratio of net profit to capital employed (0.64) was encouraging for jelly units that demonstrate efficiency in the use of capital with higher rate of return. However, profit margin (18.16%) in jelly making units needs to be further improved through appropriate management of various costs.

All the processing units in the district are covered under Fruits Products Order (FPO). The products such as pulp/ concentrate produced were to conform with the FPO specifications as enunciated in Fruits Products Order, 1955, and Fruits Products Order, 1977. The large firms have also acquired HACCP certification. The large scale processing firms processed different commodities namely, mango, guava, papaya and vegetables. These firms work almost throughout the year, unlike medium and small scale firms, which are processing mango and guava fruits and work for three to four months in a year.

The large firms employ a large number of workers i.e, 700. The small firms on the other hand employ, on an average, 256 workers. Processing industry being a seasonal industry, most of the employment is on a part time basis. The operating ratio of small firms stood at 0.76 while it was 0.82 for large firms. This signified that for every rupee of gross income a substantial portion of operation cost is incurred. The gross ratio was 0.93 for small firms and 0.97 for large firms. This revealed that a large portion of gross income is utilized for meeting the total expenses. The capital turnover ratio was worked out to 0.81 for small firms and 0.91 for large firms revealing that every rupee investment by small firms generated a gross income of 81 paisa. These measures show that large firms are more efficient than the small firms. The value of rate of return on investment registered 0.056 for small firms and 0.027 for large firms, revealed that every rupee of capital investment generated a net return of about 3 paisa and 6 paisa. This measure shows that small firms are more efficient than large firms.

The IRR of small firms (19.31%) was higher than large firms (17.5%). The mango processing plant has least payback period for small firms (5 years) followed by that of large firms (6 years). The shorter payback period for mango processing plants provides an important opportunity for an entrepreneur.

The breakeven point for small firms (Rs. 113.54 lakh) was on the lower side as against large firms (Rs. 1138.85 lakh). The BEP in physical terms for small firms is the least with 605.52 tons, while it was 5014.25 tons for large firms. It is implied that the firm should operate at a level generating gross revenue and produce output above these values by the respective firm size classes to be profitable.

Backward and Forward Linkages:

The processing industry has backward linkages with six marketing channels, basically to source the basic/major raw material i.e., mango pulp. Two of these channels are: (i) Producer——Processor and (ii) Producer—Regulated market ——Processor, and both accounted for 80 per cent of total raw material by processing firms.

The mangoes required for processing are supplied directly by the orchards. Normally, these orchards are owned by the promoters of the processing units. The traders located in the Mandies are another important source of raw material supply. The processing industry has forward linkage with five market channels. Two of these five channels: (i) Processor——Exporting Pulp, and (ii) Processor—Exporting Agencies—Exporting Pulp, account for about 85 per cent of the disposal of the mango pulp by the processors.

The small processing firms have lesser access to international market and depend heavily on the merchant exporters to export mango pulp on pre-contract basis. This has a bearing on the profitability of the processing units. The low variability in the unit value realization in case of mango pulp as against the unit value realization of mango fruits seems to suggest the need for greater incentives for the processing sector.

Supply Chain System (SCS):

In order to facilitate the Supply Chain Management (SCM), the Govt. of Andhra Pradesh had sanctioned a scheme for promotion of export of mangoes through mango growers Cooperative Organizations'. As a

part of the scheme, a cold storage plant was set up in 1993 as 'Post-harvest Temperature Management Scheme' at AMC, Vijaywada. Exports were taken up under the management of Marketing Department during the initial years through refer container by sea and air. However, the progress in export front was not that encouraging. To smoothen out the SCM for mango processing sector, 'Chittoor District Canners' Federation was formed during 1991. Later it was rechristened as Chittoor District Fruit Processors Federation. The Federation used to assist units in "hazard analysis and critical control point" (HACCP) Certification with assistance from APEDA, modernization of cluster with Andhra Pradesh Industrial and Technical Consultancy Organization (APITCO), seek soft loan and subsidy with APEDA, Ministry of Food Processing Industry (MFPI), and National Horticulture Board (NHB).

The Federation of Farmers' Association (FFA), an authorized body to address the issues of mango growers in consultation with the government of Andhra Pradesh, managed to form six exclusive mutually aided cooperative societies (MACS) of mango growers in Chittoor District. The Agri-Terra of Netherland, through the FAO, the FFA and Horticulture Department of Andhra Pradesh has initiated the project and is helping the farmers to develop these cooperatives, which provided an additional value of 20 per cent to the growers. The cooperatives eliminated the second-rung traders / commission agents from the supply chain by providing a direct interface between the buyer and seller. Besides making it easier for companies to enter into agreements, these MACS strengthen the hands of mango growers. The tie-up resulted in saving of transportation charges and market cess. The idea is to strengthen the supply chain and facilitate a direct linkage between the corporate buyers and farmers. On its part the FFA imparts training to the farmers on application of pesticides and improving quality.

Input and plant materials are available sufficiently in Srikalahasthi, Tirupati, Mallavalli in the study district. All sorts of pesticides and chemicals are locally available in major towns. Processors procure mangoes directly from "mandi", growers, and traders. Another important input in the pulp industry is packaging and packing material, such as cans, aseptic bag, and cartons. The units undertaking the processing on 'job' work basis are supplied with required cans material, labels, and packing materials by Export Houses which have provided production orders.

Power supply by Andhra Pradesh Transmission Corporation (APTC) is quite adequate to run the units. Diesel generating units have been installed to meet power requirements during shut down. Water, being a major requirement for processing unit, is available sufficiently at site. A good network of transport arrangements is provided to transport both raw materials and finished products. Both sea and air transport is available at Chennai, which is 185 km from Chittoor and 300 km from Vijayawada.

Institutional credit and Sources of Credit:

Data collected from a sample of 10 bank branches (3 branches of Indian Bank, 5 branches of Regional Rural Bank and 2 District Central Cooperative Bank) in Andhra Pradesh revealed that crop credit to mango during the last three years constituted a share of 38.7 per cent of total crop loan accounts and 47.1 per cent of total crop loan amount. Term loan for establishment of mango orchards constituted 19.1 per cent of the total Agricultural Term Loan (ATL) Accounts and 17.2 per cent of the ATL amount during the period 2003-06. However, interactions with banks revealed that banks are not much inclined to provide term loan owing to its long term tenure, up to 10 years

Pre-harvest contractor, VT/CAs are adequately provided with `Secured Over Draft' facility from banks. They utilize the same in lending to farmers as also in going for lease / contract of mango orchards. Bank loan is also utilized by them for procuring mangoes from the field as also from the market in order to supply to Up Country Traders (UpCTs), as there remains time lag of 30-75 days while getting payments from UpCTs.

All processing unit have working capital arrangements with banks, which range from Rs. 20 to 60 lakh, depending on their requirements. Banks work out the working requirement based on Nayek Committee recommendations.

The short term loans for maintenance of Alphonso mango orchards in Maharashtra have been availed from bank in the district and the same shows an increasing trend. In all the sample cases, farmers availed of bank credit for maintenance of the orchards especially after introduction of KCC scheme. A part of requirement has also been met by purchasing inputs on credit from suppliers and availing advance from traders cum middlemen (Dalals).

Progressive farmers are invariably availing bank loans, but small farmers normally lease out their orchards to farmers-cum-traders and receive money in advance to meet the maintenance expenses till fruiting stage. Out of the 25 sample beneficiaries, bank loan particulars in respect of 12 farmers have been collected. Most of the sample farmers used a part of the KCC limit for Investment in mango orchard.

The average annual maintenance cost of mango orchard up to plucking stage comes to Rs. 62,700 lakh as per the current package of practices. However, loan actually availed by the farmers was at Rs. 35,920 per hectare. The banks assessed the loan requirement at Rs. 600 per tree for meeting maintenance expenses and accordingly sanctioned KCC limit of Rs. 60,000 per hectare. The remaining portion of the maintenance cost was met out of own funds and/or by availing of credit from traders-cum- middlemen and input dealers on terms, which restricted free marketing. This indicates there is ample scope for bank finance.

The apathy of farmers towards bank loan is primarily due to the fact that alternative options for arranging maintenance expenses are in practice in the district. At times, the input agents provide inputs on credit and collect their dues in harvesting season. However, traders-cum- middlemen continue to be the primary source of finance (20-30 per cent of the anticipated production as advance) at the door steps of the farmers, during October to January, without going through elaborate documentation. Farmers reported that no interest was charged till settlement of yearly account in June. However, interest is charged @ 2 per cent per month on the outstanding balance, if any, of the advance after settlement around June.

Constraints

Mango does not bear a good crop every year and tends to follow alternative bearing pattern. However, there is no effort to minimize irregular bearing by adopting suitable cultural practices, like open canopy management, pruning, adequate manuring etc.

Fruit drop has been a problem for certain farms. Farmers opined that even after careful farming mangoes were infected with spots (mango diseases), due to which it did not fetch remunerative prices. Application of recommended doses of plant growth regulators at the appropriate stages of fruit growth, following of proper plant nutrition,

plant protection measures and cultural practices, especially irrigation schedule, could greatly reduce the fruit drop.

Lack of training / awareness creation on various cultivation practices for producing good quality mango and post-harvest requirements are some of the areas of concern. More than 20-30 per cent of the produce is lost in post-harvest operations due to non-availability of proper infrastructure, like handling the produce, poor transport/ storage facilities, absence of pack houses with automatic sorting, washing, waxing, packing, pre-cooling, storage and marketing. To address a few of the issues, the State Governments may further develop a Horticulture Hub, with an end-to-end approach, under private-public partnership.

Generally, international trade demands mango varieties that are with fibre-less pulp, good aroma, attractive color (preferably red, pink, purple or yellow) and better sugar and acid blend. Efforts are not being made to produce and grade mango based on such tastes and varieties. Therefore, export strategy should be to respond to the choices of the consumers of the importing countries.

Many African and Latin American countries have become major suppliers to European market. Philippines (70%) is the largest supplier to Japan. Australia exports its "Kensington Pride" variety to Japan. Pakistan has given its 'Ratual mango' a permanent place in the eating table in the Gulf. Therefore, efforts for mango exports from India need to be strenghthened with well planned strategies.

Issues and Strategies

Fruit Size and Shape Improvement — Under-nourished trees cannot exhibit correct shape and size of the fruits. For optimal development of the fruit, location specific nutrient management schedule with optimal doses needs to be developed and provided to the farmer. Hit and miss method as followed by certain farmers may not serve the purpose. Canopy management needs to be stressed to achieve the desirable leaf size.

Uniformity of Shape and Color Exhibition— An attractive shape is always appealing to the buyer. Color development and bright exhibition are possible through exposure of the fruit to solar light and temperature, through canopy management, adequate nourishment and stage of harvest. Early harvests always lack good color development on ripening.

Blemishes / Scars on Fruits— Different types of blemishes and scars on the fruit make it unattractive for marketing and the fruit gets rejected while grading. Various causes for the occurrence of blemishes / scars need to be identified and suitable remedial measures may be taken up to reduce such occurrences. The Indian Agricultural Research Institute (IARI), has introduced two mango varieties which have an acidic-sweet taste. They have also developed a technology to prevent infection of mango fruit by insects.

Export Promotion Strategies— Concerted efforts need to be made to intensify promotion of exports. These include: (i) strengthening infrastructure base, (ii) efficient post-harvest management, (iii) better improved packaging, (iv) exploring new markets, (v) improving cold storage and transportation logistics, (vi) developing India brand mangoes and campaigning abroad about the quality, (vii) promoting an efficient export marketing network to optimize our export and (viii) setting up of more quality control laboratories in the Export Processing Zones. Exploring new export destinations has to be the priority.

Post-harvest Infrastructure— The success of post harvest consideration depends upon the identification of appropriate technologies, sourcing and creation of need based infrastructure, followed by its proper management.

Since the creation of post harvest infrastructure requires huge capital investment initially, its creation has to be considered on merit so that the proposed infrastructure remains in operation for at least 200-250 days in a year.

Creation of collection centers with facilities of sorting, grading, transporting and marketing in nearby urban areas requires to be stressed. Such facilities could be created by a group of farmers growing mango by forming a cooperative society or an association of farmers or Self Help Groups (SHG).

Some AMCs are contemplating strengthening the existing market and post-harvest handling infrastructure by utilizing the subsidy assistance from the Ministry of Agriculture, Government of India through the Scheme for Development / strengthening of Agricultural Marketing Infrastructures, Grading and Standardization.

For distant markets and exports, establishment of pack houses with automatic sorting, washing, waxing, packing, pre-cooling, storage and

marketing on large scale could be considered by public and private sector. The pack houses need to have adequate capacity and should have the link to pre-cooling unit/ cold storage. Provision of refrigerated / insulated vans to have cool chain up to marketing may also be considered in the pack house with the aim to market quality graded products.

The development of adequate cold storage capacity with latest technology/ cool chain would help not only in increasing the shelf life and minimizing post-harvest losses through proper storage but also will help farmers in taking timely marketing decisions. Cold storages with multi-chamber/ multi-commodity concept need to be popularized. Environment friendly and modern cooling system need to be introduced on par with some developing countries.

There is the need to establish one vapour heat treatment plant (VHPT) to sort out the problem of fruit fly, which is the main hindrance for exporting mangoes to Japan, USA and European countries. There should be a provision for the exporting mangoes in modified atmospheric containers.

Mangoes are transported in trucks, open pickup or bigger trucks. Specialized transport vehicles should be used, which may have separate cabins and partial shade so that losses during transportation can be minimized. For export purpose cargo flights need to be introduced for mango.

There is shortage of trained and skilled manpower for the management and operations at field level. There is need to create world class firm/ mango orchards for which capacity building needs to be initiated. An "effective technology transfer system" (ETTS) may be promoted to take up technology development/ transfer to mango growers/ processors.

Recommendations

- Growth and sustainability of small firms is important as they constitute about 75 per cent of total mango orchards in the sample. Since small mango growers are viable, the support and incentive should be given so that they cover part of their cost of establishment and successfully face the competition.
- The mango processing industry may be supported as the unit value realization of mango pulp is more stable than that of raw

mango. It also has a number of forward and backward linkages benefiting the economy of the region.

- Contract farming may be promoted to ensure timely and adequate supply of raw materials and to minimize the cost of raw materials. It will minimize the marketing margin in the supply of raw materials of the processing industry.
- Domestic consumption may be promoted through campaigns and by producing diversified products to serve as a cushion to the mango processing industry against fluctuations in demand in the international markets.
- The Cooperative societies should be set up to help the small firms to increase their access to the international markets and realize higher price for their output.
- Small firms are poor in adopting the adequate quality standards and appropriate technology. This calls for support and nurturing by Government to help technology up-gradation and adoption of Hazard Analysis Critical Control Point (HACCP).
- Government should promote the production of mango and other horticultural commodities in the region to promote adequate supply of raw materials throughout the year for increasing the capacity utilization of firms.
- The Mango being a potential horticulture crop needs to be developed by adopting a cluster approach. The Department of Horticulture (DOH) may categorize the districts into specific clusters.
- There are several varieties of mango, which need to be identified and given a geographical identity. The Department of Horticulture may make efforts to locate the places linked with a particular variety of mango and there after attempt for registration of geographical identity of such local varieties. Brand development of mango is needed in such a way that it would lead to integrated growth of that crop.
- Considering the existence of senile and unproductive orchards mainly in Krishna district (20%) Andhra Pradesh; Murshidabad (30%), West Bengal and Sindhudurg (30%), large scale replantation needs to be initiated to rejuvenate such orchards.

Improved root stocks need to be introduced and strategies finalized to promote high density planting of mangoes. The Department of Horticulture may popularize the improved package of practices among growers and ensure that the new plantations are established.

- The availability of genuine planting material in the required quantity is lacking. The DoH may take necessary action and ensure that adequate and good quality mango planting material is available for new mango plantation. There has been a demand in certain quarters to create Horticultural Crops Planting Material Authority (HCPMA) for ensuring quality of planting material.

- Alternative bearing has been creating problems in mango production to a large extent. While in one year it creates glut with excess production, the next year it results in short supply due to low production. This has resulted in high price of mango, which affects processing units by increasing cost of production. The crop production can be regulated to a certain extent through pruning immediately after the harvest, followed by adequate manuring, judicious irrigation and effective plant protection measures. An appropriate package of practice may be popularized by the DOH in selected districts of the states.

- There is an increasing need to set up pack houses with washing, waxing, packing, pre cooling and storage, including refrigerated vans for transportation at the production center. The pack houses need to be designed in such a manner to facilitate year round operation, taking into consideration the availability of other perishable products in the region. These may be linked with terminal markets.

- There is a requirement to establish one Vapour Heat Treatment Plant (VHTP) to sort out the problem of fruit fly, which is the main hindrance for exporting mangoes to Japan, USA and European countries. There may be a provision for the export of mangoes in modified atmospheric containers in ships.

- Mango processing industry, particularly pulp making, has enough potential to grow in the future. This is because of the fact that consumer preference for synthetic drinks has been declining due to growing health consciousness and increase in purchasing power. Jelly and pickles making also has immense potential for

growth. Proportionately, production and productivity of good quality/ mango capable of processing has to increase for which availability of adequate institutional credit is essential. Credit is required for crop establishment and maintenance, installation of on-farm infrastructure, such as drip irrigation, processing units, export credit, etc. Banks are expected to provide adequate credit to various segments of mango industry, keeping in view the banking plan / potential envisaged in the Potential Linked Credit Plans (PLCPs) presented by NABARD.

- The credit purveyed to the mango sector is not getting reflected in the present system of data generation by banks. There is a need to streamline data on credit flow to mango separately for various activities, especially in the AEZs. Credit flow in AEZs may be included as an item of agenda in the district level and state level bankers' meets.

- Data on area, production and yield also needs to be streamlined after conducting proper survey. Data generated by the department and other agencies at the field level vary to a large extent. Similarly, there is a need to streamline the data and put in place a system to update and publish the data on market arrival and prices of mango, variety-wise.

- There is need to regularly review and monitor the working of AEZs and various issues confronted by stakeholders in the AEZs at the state/ district levels, to identify constraints and initiate corrective actions.

- Marketing cycle of Alphonso mango in Maharashtra is being done almost entirely on credit. The traders, commission agents, exporters, retailers, etc. operate only on credit and the farmer receives his proceeds only after it is realized from the ultimate consumer. In the process, the middlemen get a major share of the benefit from the investment of the primary producer. Therefore, adequate bank credit must be made available to the farmer throughout the entire cycle of production and marketing.

- Less than 5 per cent of the total mango produced in Sindhudurg and Aurangabad districts in Maharashtra is reported to be processed. Further, lower quality mangoes sold for processing fetch less price. There is an immediate need to scale up the volume of processing, to increase shelf life of mango and improve

the returns by suitable value addition. A few farmers are processing mangoes on a limited scale with this end, which is required to be upscaled with suitable policies.

- Exporters purchase quality mangoes from markets as also directly from the farmers. Except for a few big farmers, other farmers are not aware that their produce is being exported. Registration of export oriented mango orchards, on the lines of grapes in Maharashtra has not picked up. It needs to be expedited by the Agriculture Department.

- The Self Help Groups (SHGs) / Farmers Clubs of mango farmers in selected districts of Maharashtra may organize mango festivals with the help of their counterparts in other districts. The mango farmers can be taken on study tours to other places for awareness and skill development.

Chapter I

Introduction

1.1 Botanical Name of Mango and its Cultivation

The Mango, *Mangifera indica L*, which belongs to the family of *Anacardiaceae,* is one of the most important tropical and subtropical fruits of the world and is popular both in fresh and processed forms. It is called as the king of fruits on account of its nutritive value, taste, attractive fragrance and health promoting qualities. In many languages it is called the mother of all tropical fruits and is the national fruit of India. Mango has been in cultivation in Indian subcontinent for well over 4,000 years and has been the most favorite fruit since ages. Historical facts revealed that mango was introduced to India archipelago from the main land. Some researchers are of the view that it had originated in the Indo –Burma region. Presently, besides India, it is being cultivated world over especially, in the South and South-East Asian countries, African countries, tropical Australia and the USA. In USA mango is grown mostly in Florida, Hawaii, etc.. Mango is also grown in Venezuela, Mexico, Brazil, West Indies Island and Cambodia.

1.2 Mango in Sanskrit Scriptures

Mango has been portrayed in the ancient paintings and sculptures, Hindu folklore and mythology, legends and in the sacred Sanskrit scriptures dating back to 2000 BC. Mango continued to be grown as a seedling tree until the establishment of the Moghul rule in India. During the Moghul period seedling trees were designated as distinct varieties and attempts were made to promote vegetative propagation. Akbar, the great Moghul emperor (1556 to 1605), planted mango orchards of 0.1 million trees near Darbhanga in Bihar. This was the time when mango actually got royal patronage. In India the first systematic record of varieties of mango was available in “Ain-e-Akbari”, the biography of Akbar, AD 1590, by Abul Fazl. However, mango orchard remained the prerogative of the “Rajas and Nawabs” for a very long time. Mango cultivation has now been taken up commercially.

1.3 Important Characteristics of Mango

The mango tree is a large branched perennial tree with height of 30-40 m and a crown radius spreading about 10 m. The flowers are

produced in terminal panicles of 10-40 cm long and each flower has 5 petals of 5-10 mm long. After flowering, the fruit, which is a drupe, takes three to six months to ripe. The Mango fruit varies considerably in size, shape, color, presence of fiber, flavor, taste and several other characters. The shape of the fruit varies from round to ovate-oblong or longish, with the length ranging from 2.5 to 30 cm in different varieties. The weight of mango goes up to 2.5 kg for some varieties. However, the average size of mango available in India marked weighs about 200- 350 grams. The ripe fruit is yellow, orange or red in color; usually reddish on the side facing the sun. Mango is well adapted to tropical and sub tropical climates. The ideal temperature ranged for mango is 24^0 to 30^0 C during the growing season, along with high humidity. A rainfall ranging from 890 mm to 1015 mm in a year is considered to be ideal for growing mangoes. Dry weather before blossoming is conducive to profuse flowering. Mangoes, ripe or unripe, are widely used as a fresh fruit. It is also used to make juice, milk shake, pulp, jam, jelly, pickle, and chutni. Ripe mango is often cut into thin layers, desiccated, folded and then cut and sold as mango chewy bars. Pieces of the fruit can be mashed and used in ice-cream. Dried unripe mango, mainly amchur is used as a spice in India.

1.4 Nutritional Value of Mango

Mango is nutritious and an excellent source of carotene as compared to other fruits. The nutritive value per 100 gram mango is presented in **Annexure 1.1**. A 100 gram of edible portion of the mango contains about 1,990 mcg of beta-carotene (vitamin A), which is much higher than the same in other fruits. Eating mangoes in the season may provide a store of vitamin A in the liver, sufficient to last for the rest of the year and highly beneficial for the prevention of vitamin A deficient disorders, like night blindness. Mangoes, both ripe and unripe, are good source of vitamin C. About 16 mg of vitamin C is present in 100 gram of mango. Ripe mango provides a good source of calories and supplies 74 kcal per 100 gram.

1.5 Commercialization of Agriculture— Traditional to New crops

Mechanization, diversification and commercialization of agriculture resulted in shifting of cropping pattern from traditional crops to new crops, which had contributed to the increased area and production under Mango. Changing demand pattern also contributed significantly to shifting of more area under production of mango. However,

marketing and processing of mango have not picked up commensurate with the level of production. Further, supportive mechanism in the form of agriculture inputs, post-harvest infrastructure set up, such as packaging, pre-cooling, cold storage, pack houses, marketing system, and institutional credit have not come up in proportion to the increase in production of fruit.

Even though India is the world's largest producer of mango, it accounts for less than one per cent of global mango trade. Around 95 per cent of India's mango exports are routed to the Middle-East countries, whereas only 5 per cent is channeled to Europe and America, Japan, Hong Kong etc. Further, exports of mangoes in the processed form remain limited. Besides, high perishability, absence of post-harvest facility, lack of standardized supply chain system, etc. resulted in loss of about 25-30 per cent of the total mango production during post-harvest period. This reduces further availability of fruits for consumption, value addition and export. There are issues such as weak institutional arrangements, limited marketing facilities, lack of coordination among the various organizations, etc. that have acted as hindrance to the growth of mango. The whole lot of the issues encompasses the supply chain system (SCS) within the mango-processing sector. The importance of this study on mango lies in addressing these issues affecting the above mentioned parameter.

1.6 Development under Agri-Export Zone (AEZ) of Mango in India

The Government of India in the year 2001-02 had announced formation of AEZs in selected areas of different states and later it was incorporated in the Export Import (EXIM) Policy. The concept of Agri Export Zone attempts to take a comprehensive look at a particular produce/ product located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing / packing, leading to final exports. The entire report is centered on a cluster approach of identifying the potential products, the geographical region in which these are grown and adopting an end-to-end approach of integrating the entire process, right from the stage of production till it reaches the market. In India, 11 Mango AEZs were formed in various regions. The details are presented in **Annexure 1.2**

Out of 11 mango AEZs in India, 5 AEZs are located in Andhra Pradesh, followed by Maharashtra (2), and 1 each in Uttar Pradesh, Gujarat, Tamil Nadu West Bengal. In Andhra Pradesh there are 10 districts

where mangoes are cultivated while there are 9 districts in Maharashtra, 7 districts in Uttar Pradesh, 8 in Gujarat, 2 in West Bengal and 5 in Tamil Nadu. The State Agricultural Marketing Board is the nodal agency for implementation of the AEZs. The National Horticulture Mission (NHM) identified mango as one of the core commodities having scope for further growth. The Agricultural and Processed Food Products Export Development Authority (APEDA) since its inception in 1986, has been playing a major role in the export of mango and mango based products by providing various services at both national and international level.

1.7 Rationale / Background of the Study

The selected states enjoy a favourable environment, which inter-alia include suitable agro climatic conditions, huge domestic market, cheap labor etc. All these offer a tremendous potential to increase the overall production of mango and mango based products on the one hand and contributing to the nation's exportable surplus on the other. The commodity specific study on mango was planned in the states of Andhra Pradesh, Maharashtra and West Bengal in order to have a full perspective of the commodity in its varied facets, i.e. production, processing, marketing, exports, cost of cultivation, etc.. The present report in the form of Occasional Paper is the consolidation of three state reports of commodity specific study. .

1.8 Organization of the Study Report

The report has been organized in **twelve** Chapters. Chapter one covers introduction and Chapter two outlines the objectives, and methodology. Chapter three describes India's place in world of mango. Chapters four and five analyze the trends of area, production and yield of major mango producing states as well as profile of mango growers/ orchards respectively. Chapter six dwells upon cultivation and cultural practices of mango, while chapter seven outlines marketing aspects focusing on role played by different channels, value chain, market arrivals and price spread etc in select states. The economics of mango orchards and processing have been worked out in Chapter eight and nine respectively. Chapter ten covers post-harvest management, export of mango based products and performance of export zones. The supply chain management of mango and credit related issues have been discussed in chapter eleven while chapter twelve identifies constraints, policy issues strategies and suggestions for furthering production, processing and export of mango.

Chapter - II

Objectives and Methodology

This chapter is confined to objectives, study design and methodology. The specific objectives of the Study are as follows:

2.1 Objectives

- To analyze the growth patterns in area, production and productivity of mango in selected states vis-à-vis India.
- To study the cultivation practices of mango as also the adoption of modern technology, along with the economics of mango orchards
- To describe the aspects relating to marketing of mango and mango based products, price spread, various channels, their efficiency, etc.
- To describe the process involved in mango processing, its economics and issues affecting the processing industry, etc.
- To ascertain the export performance of mango and mango based products, role of AEZs in export promotion, etc.
- To analyze the post-harvest management practices of mango as also availability of infrastructure and backward and forward linkages for and effective supply chain system for mango and mango related products.
- To identify the constraints of mango cultivation and suggest remedial measures.

2. 2 The Scope of the Study

The study covers a sample of mango growers, mango processors, traders, exporters, mango growers' association etc. in three states i.e. Andhra Pradesh, Maharashtra and West Bengal. The findings & recommendations are based on discussions with district level functionaries like, officials from the Department of Horticulture (DOH) at the district level, marketing committees, banks, District Development Managers (DDMs), Lead Development Managers (LDMs) of the study districts as also the final consumers of mango and mango based products. Generally, mango arrivals and prices vary

considerably across different markets even within a given district. Consequently, price spread, market efficiency and other related parameters differ. Therefore, the findings of the study presented in this report should be interpreted judiciously and should not be generalized across the state and districts.

2.3 Methodology and Sample Design

While addressing the issues affecting mango as a horticultural commodity, the study adopted 'FARM to PLATE' (FTP) approach. The study concentrated on issues involved from production of mango to its marketing and consumption by the households. In production stage, the study dealt with the 'Farm Economics' to understand the cost of cultivation and income accrued to the cultivators of mango. In the processing stage, the study attempted to analyze different products of value addition and economics of such value addition. Lastly, in marketing stage, the study focused on identification of different channels of marketing, price spread, marketing efficiency, etc. and identified critical issues involved for improving efficiency. The study also outlined 'Supply Chain Management System' (SCMS) covering the collaboration and harmonized relationship covering input supply, production, harvesting, marketing, storage, processing, etc.

2.4 Selection of States

A comprehensive view based on the criteria of area and production was taken to select 3 states viz. Andhra Pradesh, Maharashtra and West Bengal for the present study. Taking into account the last five years' data (2005-06 to 2008-09) on area, India, on an average covers an area of 2,070 thousand hectares under mango cultivation. The share of Maharashtra was highest at 22.1 per cent followed by Andhra Pradesh (20%), while it was lowest for West Bengal (3.5%). In terms of production, Andhra Pradesh contributes 27 per cent, Maharashtra 5.5 per cent and West Bengal 4 per cent of all India production.

2.5 Selection of Districts

In Andhra Pradesh, production of mango is concentrated in all the districts. However, in terms of ranking, Krishna district in Coastal Region (4.96 lakh MT), Chittoor district in Rayalseema Region (3.91 lakh MT) and Khammam district in Telengana Region (3.34 lakh MT) stand first, second and third position, respectively. Further, a number of mango processing units (pulp and jelly making) are located in

Chittoor and Krishna districts. With a view to harnessing the export potential of mangoes produced in the state, AEZs for mango pulp in Chittoor district and AEZ for fresh mango for Krishna district has been set up in the state. Accordingly, Krishna and Chittoor districts were selected for the study. Mango jelly making units were confined to East Godavari district and a few jelly making units were visited for the purpose of the study. Accordingly, East Godavari district was also selected. From both the districts, four blocks were selected in Chittoor district and five blocks in Krishna district, considering the area, production and arrival of mango to the nearest market yard. Damancheruvu, Chittoor, Triputi and Bangarupalem blocks were considered from Chittoor district and Nuzivid, Tiruvur, Agiripalli, Vissannapet and Gampalagudum blocks were taken into account in Krishna district (Table 2.1).

Table 2.1: No. of Selected States, Districts and Respondents

Name of State	Number of Districts	Number of Sample Respondents	Share (%)
Andhra Pradesh	3 (Chittoor, Krishna, East Godavari)	75	40.33
Maharashtra	2 (Sindhudurg, Aurangabad)	59	31.72
West Bengal	2 (Malda and Murshidabad)	52	27.95
Total	**7**	**186**	**100**

Source—Field Survey, Chittoor—36, Krishna—33 and East Godavari—6

In Maharashtra Alphonso and Kesar varieties of mango are of immense economic importance to the rural people of the state. The major Alphonso growing districts are Ratnagiri, Raigad, Thane, and Sindhudurgh. The Kesar variety is grown in Aurangabad, Jalna, Beed, Latur, Ahmedanagar and Nasik districts. It was, therefore, decided to take up both the varieties of mango (i.e Alphonso and Kesar) and conduct a study in two major districts growing these two varieties. Accordingly, Sindhudurg district was selected for Alphonso mango. The Aurangabad district was selected for the study of Kesar mango. In each districts at least two blocks were covered. Jalna district, adjoining Aurangabad was covered to study the Kesar variety of mango. In West Bengal, Malda and Murshidabad districts in 2005 covered an area of 25,250 hectare and 11,564 hectare, respectively

under mango cultivation. These two districts together constituted 53 per cent of total area of mango in the state. Therefore, Malda and Murshidabad districts were selected in West Bengal (Table 2.1).

2.6 Sample Size of Selected States

A total of 186 samples respondents were selected from three states, of which Andhra Pradesh had 75 samples (40.33%), followed by Maharashtra 59 respondents (31.72%) and West Bengal 52 (27.95%).

Total samples were distributed by various categories which are presented in Table 2.2. Mango growers constituted 49.47 per cent of total sample while Mango processors and Traders/ Exporters represented 17.75 per cent and 15.59 per cent of total respectively. Share of total samples to other "others" were only 8.06 per cent.

Table: 2.2. Distribution of Samples by Category

Category of sample / State	Andhra Pradesh	Maharashtra	West Bengal	Total	Share
Mango Growers	42	40	10	92	49.47
Mango Processors	18	03	12	33	17.75
Traders /Exporters	15	04	10	29	15.59
Banks	-	07	-	07	3.76
Nursery Owners	-	-	10	10	5.37
Others	-	5*	10@	15	8.06
Total	**75**	**59**	**52**	**186**	**100.00**

Source--Field Survey , * Mango Growers Associations/ Cooperative (2), Marketing Mandi (1), Farmers' Club (1) Transport Agent (1), and @ Contractor.

2.7 Data Collection

The study is based on both primary and secondary data. Secondary data was collected mainly from published sources of State Governments, Government of India. Publications from Agricultural and Processed Food Products Export Development Authority (APEDA), National Horticulture Board (NHB), Department of Marketing and Directorate of Economics and Statistics (DoES), State Governments, Websites of different organizations and institutions were made use of. Information was also obtained from nurseries, Farmers' Clubs,

mandis, Mango Growers Associations and transport agents. Statistics were compiled from other input suppliers, units involved in post-harvest handling of mango, district level nodal officers, AEZs, market yards, banks and financial institutions etc.

Primary data was collected through direct interview method using pre designed survey schedules/ structured questionnaires. The actual investment cost for establishment of the orchard was collated items-wise from the sample farmer. Such items include land preparation, pitch digging, blasting cost of plant, propping, compost, fertilizers, chemicals, irrigation, fencing around the orchard, watch and ward, etc. The expenses incurred during the initial five years of plantation were taken in the investment cost. Annual maintenance cost included all the cultivation expenses (paid out cost + imputed value of inputs, including family labor). Availability of planting materials and other inputs was ascertained from progressive farmers, nurseries, inputs agents, research centers and government departments. The package of farming practices was also confirmed from the research centers and Agriculture Departments as also infrastructure for post-harvest management of mango. The data on prevailing practices, constraints and the scope for processing of mango were ascertained from a few food processing units. The marketing cost data covering plucking, packaging, transport to the market, market fee, etc. were obtained from farmer. These details were also cross checked with the information gathered from the transport operators and commission agents. The data on price realized was obtained from the farmers and it was cross-checked with the data from the marketing committee for the year 2005-06. The process of bidding in the market was ascertained from Agricultural Produce Marketing Committees (APMCs). The information in this regard, furnished by the sample farmers' and growers' associations was also appraised. Some of the wholesalers/ commission agents purchased good quality mangoes for exports directly from farmers while a few of them were engaged in graded mangoes for exports by purchasing the same from the markets. Such exporters were interviewed for ascertaining various costs, formalities, quality norms and price realized by them. The data on requirement of bank credit for mango cultivation and its availability was ascertained from bank branches and controller of some banks. The views of District Development Manager (DDMs), NABARD and the Lead District Manager (LDM) of the respective districts on credit related matters were also considered.

2.8 Data Analysis

Various tools of analysis, in addition to tabular form, percentages, etc, were used to assess the feasibility of the mango units.

1. Capital Ratio

(a) Capital turnover ratio = Gross income / Average capital investment

(b) Capital per unit of gross income = Total capital invested on the mango unit / gross income from the unit

2. Expense Income Ratio

(a) Operating ratio = Total operating expenses/ Gross Income

(b) Fixed Ratio= Fixed Expenses/ Gross Income

(c) Gross Profit Ratio = Gross income/ Gross Expenses

3. Project Evaluation Techniques

(a) Net Present worth (NPW) = Sum total of discounted benefit- Sum total of discounted costs

(b) Benefit Cost Ratio= Sum total of discounted benefit / Sum total of discounted costs

(c) Internal Rate of Return= Lower discount rate + difference between the two discount rates x {NPW of benefit at lower discount rate / NPW of benefit at higher discount rate, sign ignored]

(d) Break Even Point = Fixed Cost / Sale price per unit- Variable cost per unit= F / (P-V)

4. Marketing Efficiency (ME)

The Marketing efficiency is arrived through the concept of 'price spread'. The price spread is defined as the difference between the price per unit of output paid by the consumer and that received by the producer. This difference is accounted for by various costs, particularly marketing costs, incurred by the market intermediaries and the margins retained by them. In the absence of direct linkage between the mango grower and the consumer, it is the middleman who has been taking advantage of the situation. And indicator of the efficiency of any supply chain is the extent of the price spread between the

producers and the consumer. A higher price spread would indicate a lower marketing efficiency. When the producer's share in the consumer price is high then the marketing efficiency is high.

Ps= Pf / Pc x100

Where Ps= Producer's share in consumer's price, Pf= Price of the produce received by the farmers and Pc =Price paid by the consumer. In other words, ME= Summation of Intermediary Margins/ (Consumer Price-Producers' Farm Gate Price).

5. Export Competitiveness (EC)

Export competitiveness of mango is measured by the Nominal Protection Coefficient (NPC). The NPC is the ratio of domestic price to FOB price/ border price/reference price of commodity.

NPC=Pd / Pfob

Where, NPC= Nominal Protection Coefficient

Pd= Domestic Price

Pfob= Price fixed at the time of consignment for export (Freight on Board)

Domestic price is the wholesale price in the post harvest season. FOB price has been provided by the exporters and this has been calculated by using international price adjusted for freight charges, marketing and packing. If the resulting NPC is less than unity, the commodity is treated as globally more competitive.

2.9 The Reference Year of the Study was 2005-06

Chapter - III

India's Place in the World of Mango

This chapter deals with India's share in the world of mango in terms of area, production, yield and export. In the process the chapter outlines the major mango producing countries and their share in total area and production of world mango.

3.1 Global Scenario

India's Position of Mango Production in Fruits and Vegetables in World Market

According to Food and Agriculture Organization (FAO) mango is one of the six major fruit crops in the world. India's position in production of various fruits and vegetables in the World is presented in Table 3.1.

Table 3.1: India's Position in Production of Fruits and Vegetables in World

Crop	Rank	Crop	Rank
Apple	10	Brinjal	2
Banana	1	Cabbage	2
Mango	1	Cauliflower	1
Papaya	2	Peas	1
Pine Apple	4	Onion	2
Grapes	10	Potato	3
Cashew	1	Total Vegetables	2
Coconut	3	-	-
Total Fruits	2	-	-

Source: Indian Horticulture Data Base 2009

It is evident from the data presented in Table 3.1 that India ranks first in mango production in the world.

3.2 Area, Production, and Productivity of Mango to Total Fruit Crops

Mango accounts for more than one third of total area under fruit crops (38%) and about 20 per cent of total fruit production in 2008-09. This is evident from the table:—

Table: 3.2: Area, Production and Yield of Mango to Total Fruit Crops

Year	Area (in million ha.)	Percentage to total area under fruit crops (%)	Production (in million MT)	Percentage to total fruit production (%)	Yield of Mango (kg/ha)
1991-92	1.07	37.5	8.71	30.4	8100
2001-02	1.57	39.3	10.02	23.3	6400
2005-06	2.08	39.1	12.66	22.9	6100
2008-09	2.30	37.8	12.75	18.6	5500
CAGR	**7.62**	**-**	**3.08**	**-**	**-3.15**

Source: Indian Horticulture Data Base 2009, CAGR= Compound Annual Growth Rate

Share of India's area under mango to total fruits area in 1987-88 was 43.5 per cent, which declined to 37.8 in 2008-09. The share of mango to total fruit production started declining over the year. In 1987-88 the share stood at 37.4 per cent which reduced to 18.6 per cent in 2008-09. The CAGR showed that growth in area was 7.62 per cent, which was quite high compared to growth in production (3.08%). Productivity experienced a negative growth of 3.15 per cent. Year wise details are exhibited in **Annexure 3.1.**

3.3 Area, Production and Yield of Mango in Major Producing Countries of the World

Mango is commercially grown in about 83 countries in the world. Major mango producing countries are China, Mexico, Pakistan, Indonesia, Thailand, Nigeria, Brazil, Philippines and Haiti. The total world production during 2010 was estimated at 34.75 million MT where India enjoys the top slot (13.05 million MT), followed by China (4.65 million MT), Thailand (2.22 million MT), and Mexico (1.92 million MT). When compared to world average (7202 kg per hectare), India's

productivity (5500 kg/ha in 2008) is low. Brazil ranks first in productivity (12394 kg per hectare) which is well ahead of world average productivity. The important mango cultivars in major producing countries are presented in **Annexure 3.2**. Country wise area, production and yield of mango are depicted in Table 3.3.

Table: 3.3 Area, Production and Yield of Mango in Major producing Countries of the World in 2010@

Name of the Country	Area in (million ha)	Share to total (%)	Production in (million MT)	Share(%) to total	Yield (kg./ha.)
Brazil	0.008	1.86	1.11	3.20	12394
China	0.059	12.35	4.65	13.40	7855
Guinea	0.010	2.25	0.020	0.58	1658
India	1.86	38.55	13.05	37.76	7065
Indonesia	0.035	7.32	1.93	5.58	5523
Mexico	0.021	4.38	1.92	5.54	9123
Nigeria	0.015	3.22	0.080	2.49	5570
Pakistan	0.018	3.85	2.01	5.80	10850
Philippines	0.019	4.12	1.19	3.45	6032
Thailand	0.036	7.65	2.22	6.40	6052
Others	0.069	14.45	5.49	25.80	7933
Total	**4.82**	**100.00**	**34.76**	**100.00**	**7202**

@ Provisional /Estimated, Source: FAO Data Base 2009

Although India is the world's largest producer of mango, its yield is low. Low yield is one among many problems identified, others being post-harvest damage, size of orchards not amenable and absence of product brands. Indian mangoes are world famous and have great potential for export as compared to other fruits of the country. The reasons for low productivity of mangoes in India are that most of the commercial cultivars are location specific with long gestation period and alternate bearing habit, viz., Dashehari, Langra, Chausa, Bombay Green, Alphonsa, Banganpalli, Pairi, Himsagar, Kesar, Mulgoa, etc.(Table 3.3)

3.4 Trend in Area under Mango—World and India

The world area under mango during 2010 has been estimated at 4.82 million hectare whereas India covers an area of 1.84 million hectares, constituting 38.31 per cent of the total area. Details are exhibited in Table 3.4.

Table 3.4: Trends in Area under Mango -World and India

(Million hectares)

Particulars	2004	2005	2006	2007	2008	2009	2010*	Average
World	3.65	3.8	4.17	4.35	4.52	4.69	4.82	4.29
India	1.56	1.60	1.68	1.71	1.75	1.81	1.86	1.70
Share of India to World (%)	**42.65**	**41.35**	**40.28**	**39.42**	**38.72**	**38.55**	**38.31**	**39.78**

* Estimated, Source: FAO Data Base 2009

3.5 Trends in Production of Mango—World and India

World production of mango has been estimated at 34.75 million MT, while India produces 13.05 million MT representing 37.57 per cent of world production. India's share in world production during 2004-2010 is depicted in Table 3.5:

Table 3.5: Trends in Production of Mango—World and India

(Production in million MT)

Particulars	2004	2005	2006	2007	2008	2009	2010*	Average
World	25.57	27.96	29.70	31.10	33.44	33.76	34.75	30.90
India	10.87	10.80	11.75	12.014	12.29	12.75	13.05	1193
(%) **	**42.52**	**38.62**	**39.46**	**38.62**	**37.88**	**37.76**	**37.57**	**38.62**

*Estimated, Source: FAO Data Base 2009, ** India's share to World's Production

3.6 Trends in Yield of Mango—World and India

Yield of mango in the world was 6990 kg per hectare in 2004, while it was 6970 kg per hectare in India. Thus, India's yield was lower by 20 kg per hectare compared to the world yield during 2004.

Productivity of mango in the world improved by 212 kg per hectare (7202 kg/ha) in 2010 and in India by only 95 kg per hectare (7065 kg per hectare). This shows that yield of mango between World and India has slight variation. The position is given in Table 3.6:

Table: 3.6 Yield of Mango during 2004-2010—World and India

(Yield kg per hectare)

Particulars/ Year	2004	2005	2006	2007	2008	2009	2010@	Average
World	6990	7226	7125	7150	7180	7192	7202	7152
India	6970	6750	6995	7005	7025	7045	7065	6979

@ Estimated, Source: FAO Data Base 2009

3.7 Indices of Area, Production and Yield of Mango—World and India

Taking into account 2004 as the base year, world production of mango has increased by 36 per cent in 2010. This was mainly due to enhancement of area by 32 per cent and improvement of yield by 3 per cent. In India, production escalated by 20 per cent during the period from 2004 to 2010. The increase in production is attributed to coverage of more area under mango. The trend is shown in Table 3.7:

Table 3.7: Indices of Area, Production and Yield of Mango—India and World

Year	World		Yield	India	
	Area	Production		Area	Production
2004	100	100	100	100	100
2005	105	109	103	103	99
2006	113	109	101	107	108
2007	118	122	102	110	110
2008	123	131	106	113	113
2009	128	132	103	116	117
2010*	132	136	103	118	120
CAGR	**4.57**	**5.14**	**0.43**	**2.57**	**2.87**

*Provisional, Base Year 2004 =100, Source: FAO Data Base 2009, Compiled from absolute data

On an average, area under mango in the world increased by 4.57 per cent per year while in India it was 2.57 per cent per year. In case of production, world recorded an annual hike by 5.14 per cent per year compared to 2.87 per cent per year in India. Average annual growth rate of yield in world was only 0.43 per cent and in India it was 0.30 per cent.

3.8 Exports of Mango from India

The world trade in fresh mangoes forms a small portion of world production (only 0.60%, **Annexure 3.3**). India's share in world mango market is less than 15 per cent but mangoes account for around 39 per cent of the total fruit exports from India (Mulley). In the near future mango exports from India are likely to go up. During the period 1994-95 to 2008-09 only 1.34 per cent of total mango production per year was exported from India. Currently around 95 per cent of India's mango exports are routed through Middle East countries. Given the strong consumers preference for Indian mangoes, well planned export and commodity promotion programme can help the country to achieve a dominant position in the world market. Data on exports of mango from India during 1994-95 to 2008-09 are displayed in Table 3.8:

Table: 3.8: Exports of Mango from India

Year	Export (thousand MT) @	Value (Rs. Crore)	Production (thousand MT)	Share of exports to product (%)
1994-95	70.44	115.15	10993	0.54
1997-98	116.48	169.18	10234	1.13
2000-01	112.97	279.00	10057	1.12
2003-04	171.01	402.39	11490	1.49
2007-08	219.19	598.54	13997	1.56
2008-09	247.15	627.81	12750	1.33
Average	156.20	365.20	11586	1.34
CAGR(%)	**17.91**	**31.80**	**1.14**	**-**

Source:-APEDA, Indian Horticulture Data Base, 2009 and National Horticulture Board, @ fresh and Pulp

On an average 156 thousand MT of mangoes valuing Rs. 365 crore per year including fresh mangoes and pulp was exported to many countries during the period from 1994-95 to 2008-09. Mangoes are mainly exported to Bangladesh (24 thousand MT), UAE (21 thousand MT), Saudi Arabia (4 thousand MT), Nepal (3 thousand MT), UK (1 thousand MT), Russia (2 thousand MT), etc. Export of mango accounts for 1.34 per cent of production per year over the 1994-95 to 2008-09 (Table 3.8). Year wise export of fresh mango and mango pulp is given in **Annexure 3.3.**

3.9 Speciality and Quality of Indian Mango

Indian mango is a special product that fulfils the high standards of quality and nutrients. A single mango can provide up to 40 per cent of the daily dietary fibre needs. In addition, this luscious fruit contains potassium, beta-carotene and antioxidants. In India, mangoes are mainly grown in tropical and subtropical regions from sea level to an altitude of 1,500 m. Mangoes grow best in temperatures around 27^0C.For maintaining highest quality standards, State-of-the-art pack-houses have been set up in major production zones. Keeping in view the different country requirements, internationally recognized treatment facilities like hot water treatment, vapour heat treatment and Irradiation facilities have also been set up at various locations across the production belt.Unique product identification systems, compliant to the traceability, networking and Pesticide Residue Monitoring Plan have been developed for the consumer safety, and readiness to product recall in case of any emergency (health hazards related).

3.10 Varieties

India is the home to about 1,000 varieties of mango. However, only a few varieties are commercially cultivated throughout India. Most of the Indian mango varieties have specific eco -geographical requirements for optimum growth and yield. The Northern/Eastern Indian varieties are usually late bearing compared to the Southern and Western Indian varieties. Some of the local varieties of mango bear fruits throughout the year in extreme southern parts of India.

The important Commercial Varieties of mangoes are given in Table 3.9:

Table 3.9: State wise Commercial Varieties of Mango in India

Andhra Pradesh	Banganapalli, Suvarnarekha, Neelum and Totapuri
Bihar	Bombay Green, Chausa, Dashehari, Fazli, Gulabkhas, Kishen Bhog, Himsagar, Zardalu and Langra
Gujarat	Kesar, Alphonso, Rajapuri, Jamadar, Totapuri, Neelum, Dashehari and Langra
Haryana	Chausa, Dashehari, Langra and Fazli
Himachal Pradesh	Chausa, Dashehari and Langra
Karnataka	Alphonso, Totapuri, Banganapalli, Pairi, Neelum and Mulgoa
Madhya Pradesh	Alphonso, Bombay Green, Dashehari, Fazli, Langra and Neelum
Maharashtra	Alphonso, Kesar and Pairi
Punjab	Chausa, Dashehari and Malda
Rajasthan	Bombay Green, Chausa, Dashehari and Langra
Tamil Nadu	Alphonso, Totapuri, Banganapalli and Neelum
Uttar Pradesh	Bombay Green, Chausa, Dashehari and Langra
West Bengal	Fazli, Gulabkhas, Himsagar, Kishenbhog, Langra and Bombay Green

Chapter - IV

Trends in Area, Production, and Yield of Mango in Major States

This chapter deals with area, production and productivity of mango in major states.

4.1 State-Wise Scenario

The major mango growing states in India are Uttar Pradesh (UP), Gujarat, Andhra Pradesh (AP), Maharashtra, Odisha, Bihar, West Bengal, Karnataka, Goa, Haryana, Madhya Pradesh (MP), Punjab and Tamil Nadu. The region wise popular varieties grown in different parts of the country comprise Alphonso, Kesar from Western India, Banganpalli, Totapuri, and Neelam from Southern States, Fazli from Eastern State and Langra, Chausa and Dusheri from Northern States.

4.2 Area under Mango in Major States

Area wise, Andhra Pradesh occupies 21.55 per cent of the total area under mango in the country, followed by Maharashtra (19.79%), Uttar Pradesh (11.74%), Bihar (6.2%) and Karnataka (6.1%).

Area under mango in major states is given in Table 4.1:

Table 4.1: State wise Area under Mango during 1996-97 to 2008-09

(Thousand hectare)

Year	AP	UP	Karnataka	Bihar	Mahara.	WBl	Others	India
1996-97	271.4	256.2	116.5	151.8	65.5	55.7.	427.8	1344.9
2001-02	341.2	253.0	115.4	139.3	164.4	65.4	506.2	1575.8
2006-07	471.4	261.4	129.1	140.8	447.7	78.2	625.3	2153.9
2008-09	497.7	271.2	141.3	144.1	457.0	86.0	711.7	2309.0
CAGR	**6.94**	**0.49**	**1.77**	**-0.42**	**49.80**	**4.53**	**5.56**	**5.97**

Source: Indian Horticulture Data base 2009, CAGR= Compound Annual Growth Rate, Note: AP=Andhra Pradesh, UP=Uttar Pradesh, WB= West Bengal

Compound annual growth rate of area under mango was 49.80 per cent in Maharashtra where as it was 6.94 per cent in Andhra Pradesh, 4.53 per cent in West Bengal and 1.77 per cent in Karnataka. CAGR of area under mango was 5.97 per cent for All India. The year wise growth in area under mango during 1996-97 to 2008-09 is furnished in **Annexure 4.1.**

4.3 Production of Mango in Major States

In Andhra Pradesh production in 1996-97 was recorded at 3.25 million MT, which increased 4.44 million MT in 2001-02 then declined to 3.86 million MT in 2005-06 and 2.52 million MT in 2008-09. In case of Uttar Pradesh, there was a declining growth rate over four points of time. The trend was positive for other states. Production of Mango in major states is given in Table 4.2:

Table 4.2: State wise Production of Mango

(Million MT)

Year	AP	UP	Karnataka	Bihar	Maharashtra	WB	Others	India
1996-97	3.25	3.5	1.10	0.09	0.019	0.006	0.089	9.98
2001-02	4.44	1.95	1.16	1.25	0.055	0.058	2.09	10.02
2006-07	3.86	2.98	1.36	1.30	0.064	0.054	3.01	13.73
2008-09	2.52	3.46	1.28	1.32	0.071	0.054	2.85	12.74
CAGR(%)	**-2.42**	**-0.19**	**1.34**	**3.84**	**21.9**	**4.53**	**60.14**	**2.31**

Source: Indian Horticulture Data base 2009,CAGR= Compound Annual Growth Rate, Note: AP = Andhra Pradesh,UP= Uttar Pradesh, WB= West Bengal

It transpired from the Table 4.2 that CAGR of mango production in Andhra Pradesh and Uttar Pradesh during the period from 1996-97 to 2008-09 was negative at 2.42 per cent 0.19 per cent, respectively, while growth rate was very high (21.9%) in Maharashtra followed by West Bengal (4.53%), Bihar (3.84%) and Karnataka(1.34%). The year wise production of mango in states has been showcased in **Annexure 4.2.**

4.4. Yield of Mango in Major States

Yield of mango in major states revealed that yield per hectare of mango in Andhra Pradesh declined over the years as also in Maharashtra and Uttar Pradesh, while it improved in other states including All

India. The state wise trend of yield is presented in Table 4.3:

Table 4.3: State wise Yield of Mango

(Yield kg per hectare)

Year	AP	UP	Karnat.	Bihar	Mahar.	W Bengal	Others	India
1996-97	11980	13840	9500	5997	3000	12000	4270	7400
2001-02	7170	7700	9800	8900	3400	8944	4141	6400
2006-07	8220	11400	10600	9300	1400	7000	4184	6400
2008-09	5100	12800	9100	9200	1600	6400	4050	5500
CAGR(%)	**-10.37**	**-0.62**	**0.32**	**4.10**	**-16.34**	**6.73**	**0.40**	**-2.56**

Source: Indian Horticulture Data base 2009, Note— CAGR= Compound Annual Growth Rate, Note: AP = Andhra Pradesh,UP= Uttar Pradesh, WB= West Bengal

In Maharashtra the CAGR of yield was negative at 16.34 per cent, followed by Andhra Pradesh (-10.37%) and Uttar Pradesh (-0.62%). The CAGR of India was recorded at –2.56 per cent in Table 4.3. The long term trend in yield state wise is presented in **Annexure 4.3.**

4.5 Area, Production and Yield of Mango in Selected Districts of Andhra Pradesh

Mango is cultivated in 22 districts of Andhra Pradesh. Chittoor district occupied an area of 58.9 thousand hectares and Krishna district 80.4 thousand ha in 2008-09. Both districts accounted for 28.8 per cent of total area in Andhra Pradesh. The Chittoor district produced mango to the level of 508.7 thousand MT and Krishna district 607.5 thousand MT and both constituted 44.25 per cent of total production of Andhra Pradesh. Area and production of Krishna district are 80.4 thousand hectares and 607.5 thousand MT respectively (Table 4.4). Year wise area, production and yield in Chittoor district and Krishna district are shown in the **Annexure 4.4 and Annexure 4.5** respectively**.**

Table: 4.4: Area, Production and Yield of Mango in Selected Districts of Andhra Pradesh

District/year	Area (thousand hectare)		Production (thousand MT)		Yield (kg / hectare)
	1998-99	2008-09	1998-99	2008-09	1998-99 to 2008-09
Chittoor	33.0	58.9	106.8	508.7	3236
Krishna	61.2	80.4	803.4	607.5	13127
Sub total	**94.2**	**139.3**	**910.2**	**1116.2**	**9662**
Share @	**33.4**	**28.8**	**40.1**	**44.25**	**662**

Source: Directorate of Economics and Statistics, Govt. of Andhra Pradesh, @ Percentage of two districts to total Andhra Pradesh

Yield of mango in Krishna district is higher (13127 kg /ha) than Chittoor district (3236 kg/ha). Taking both the districts, the yield rate in 1998-99 was worked out at 9662 kg per hectare which is higher by 662 kg/ha compared to Andhra Pradesh (9000 kg/ha) in 1998-99. The productivity was higher to the level of 2911 kg/ha in 2008-09 as against 5100 kg per hectare of Andhra Pradesh in 2008-09 (**Annexure 4.6)**. The year-wise share of area and production of these two selected districts vis- a- vis Andhra Pradesh presented in **Annexure 4.7**

4.6 Major Mango Producing Districts of Maharashtra

Major mango producing districts in Maharashtra are indicated in Table 4.5:

Ratnagiri district contributes 10 and 18 per cent of the mango area and production, respectively. The yield in Ratnagiri is same (3400 kg /ha) with that of the state as a whole. All these major mango producing districts of Maharashtra have more or less similar yield as compared with state average. It lends support to the fact that increase in the area under non-traditional regions of the state may have decreased the average yield of the state (Table 4.5).

Table 4.5: Area, Production and Yield of Mango in Major Districts of Maharashtra during 2008-09

(Area in thousand hectare, Production in thousand MT and yield in kg per hectare)

District	Area	Share (%)	Production.	Share (%)	Yield
Ratnagiri	43.61	10.24	117.35	18.63	3400
Raigad	41.58	9.77	81.82	12.99	3390
Thane	37.28	8.76	70.25	11.16	3400
Sindhudurg	23.26	5.46	53.87	8.55	3390
Pune	16.53	3.88	47.41	7.53	3399
Ahmedanagar	20.79	4.88	24.38	3.87	3399
Nanded	17.73	4.16	34.76	5.52	3399
Aurangabad	15.10	3.55	14.74	2.34	3399
Other Districts	209.87	49.30	185.19	29.40	883
Total of Maharashtra	**425.80**	**100.00**	**629.80**	**100.00**	**3400**

Source: Directorate of Horticulture, Govt.of Maharashtra

4.7 Cultivation of Mango in Selected Districts of Maharashtra

Area under mango cultivation in Maharashtra has been continuously rising over the years. Production, however, has been declining due to fall in yield. The production in the selected district of Singhudurg of Maharashtra has been increasing over the years mainly due to the rise in productive area. The compound annual growth rate of area stood at 1.98 per cent, while it was 8.64 per cent for production and -2.35 per cent in yield (**Annexure 4.8**).

The areas adjacent to the sea shore give early and better yield of Alphonso mango. Therefore, Alphonso cultivation is more popular in Devgad, Malvan and Vengurle Talukas of the district. In recent years, cultivation of mango has spread throughout the district. The taluka wise area under mango cultivation is indicated in Table 4.6:

Table 4.6: Taluka wise Area under Mango Cultivation in Sindhudurg district of Maharashtra in 2008-09

Name of the Block	Area in thousand hectare	Per cent to total
Devgad	7.98	33.26
Malvan	4.13	17.25
Vengurle	3.43	14.30
Kudal	2.75	11.47
SawantWadi	2.52	10.52
Kankavali	2.49	10.40
Vaibhavwadi	0.67	2.80
Total	**23.99**	**100.00**

Source: Directorate of Horticulture, Govt.of Maharashtra

The production in Singhudurg district of Maharashtra has been increasing over the years **(**Annexure 4.8) due mainly to rise in productive area. The compound annual growth rate of area stood at 1.98 per cent, while it was 8.64 per cent in productive area and -2.35 per cent in yield per hectare. The yield of Mango at 3400 kg per hectare in Sindhedurg district of Maharashtra is very low in comparison to all India average of 5500 kg/ha in 2008 (Annexure 4.8).

In Aurangabad district, cultivation of Kesar variety of mango is a recent development. It was gathered from the field study that oldest Kesar mango orchard in the district, and so also in the state, is about 20 years old. However, in view of the better price available to farmers in growing Kesar Mango, more and more number of orchards is coming up in the district. On an estimate, 5-10 per cent of the mango trees in the district constitute Kesar variety. Aurangabad, Paithan and Kannad are the major Kesar mango growing talukas in the district. Year wise data relating to area, production and yield is depicted in **Annexure 4.9.**

4.8 Cultivation of Mango in Selected Districts of West Bengal

Mango is one of the most popular fruits of Malda district**.** About 250 varieties of mango are grown in the district, in comparison to 1100-1200 varieties in the country. Mango was cultivated in 26400 hectares

in 2009 with annual production of 19, 02,000 MT. The average size of mango orchard was 0.23 hectare. The average productivity stood at 7,204 kg per hectare in Malda. The CAGR of area, production and productivity was recorded at 0.76 per cent, 10.86 per cent and 8.02 per cent respectively. Area, Production and productivity related data of mango during 1990-2008 are furnished in **Annexure 4.10.** There are 10 mango growing blocks in Malda district. Out of this English Bazar devoted 9156 hectare, accounting for 34.56 per cent of total area under mango followed by Ratua II (2542 hectare) and Ratua I (2540 hectare). In terms of production, English Bazar block ranks first (46335kg), Ratua II stood second (28986 kg) and Manik Chak reckoned third (27412 kg). The information of mango growing blocks of Malda district is given in **Annexure 4.11.**

Murshidabad district is famous for its quality mangoes. Mango orchards occupy a sizeable area in Murshidabad. More than 85 varieties of mangoes are grown in the district of which 33 are commercially important. Most of them are famous for their taste and quality. Those were liked by Nawab Nizams of Subey Bengal. The various commonly grown commercial varieties are *Rani Pasand, Bombai, Bimli, Biara, Bhababi, Bariha, Fazli, Golapkhas, Golapbhog, Anaras, Champa, Molaemjam, Himsagar, Sadoulla, Nabab Pasand, Mohanbhog ,Langra, Surma Fazli,Chausa, Kalapahar, Kohitoor, Neelametc.*. Recently introduced varieties are Mallika and AmraPalli. Total area in the district was 15587 hectare with an annual production of 126102 metric ton in 2009. Average yield was 7937 kg per hectare. Average size of mango orchard was 0.25 hectare. There are 13 important blocks are there where mango is grown. Lalgola, Suti-II, and Jiaaganj blocks constituted 19.79 per cent, 19.69 per cent and 16.62 percent of total area of the district respectively. In terms of production all three blocks accounted for 17.82 per cent, 17.32 per cent and 15.62 per cent respectively. Data relating to area, production, etc. of the mango growing blocks of Murshidabad district are furnished in **Annexure 4.12.**

Chapter - V

Profile of Mango Growers and Mango Orchards

This chapter confines to the profile of sample mango growers (farmers) in the selected three states of Andhra Pradesh, Maharashtra and West Bengal. The analysis is based on certain parameters like age, level of education, social status, occupational pattern, size of family etc. Attempt has also been made to classify the mango orchards according to size of land holding.

5.1 Age wise Classification of Mango Growers/ Farmers

As many 31 sample farmers constituting 33.7 per cent of the total sample (92) belong to the age group of 36-45 years and 30 sample farmers accounting for 32.6 percent are in the age group of 26-35 years and 19 farmers representing 20.7 per cent are in the age bracket of 20-25 years. There is only 1 farmer who attained the age above 55 years. State wise picture revealed that in Maharashtra, 20 farmers were aged between 26 and 35 years and 14 in the range of 36 to 45 years (Table5.1).

Table 5.1: Age wise Distribution of Sample Mango Growers

Year	AP@	Per cent	MH@	Per cent	W B@	Per cent@	Total@	Per cent
20-25	5	11.9	10	25.0	4	40.0	19	20.7
26-35	20	47.6	06	15.0	4	40.0	30	32.6
36-45	14	33.3	15	37.5	2	20.0	31	33.7
46-55	02	4.7	09	22.5	-	-	11	12.0
55 & Above	01	0.8	-	-	-	-	01	1.0
Total	**42**	**100.0**	**40**	**100.0**	**10**	**100.0**	**92**	**100.0**

Source: Field Data , @ Number of Sample Mango Growers / Farmers , Note: AP= Andhra Pradesh, MH= Maharashtra, WB= West Bengal

5.2 Classification of Mango Growers/ Farmers by Level of Education

Mango farmers have been categorized according to the level of education. Of the total 92 mango growers, 32 farmers representing 34.8 per cent of the total passed higher secondary. Fifty eight farmers accounting for 63 per cent attained education up to secondary level.

Only two farmers (2.2%) were graduates. The state wise position revealed that except West Bengal only. Ten (10) per cent and 24 per cent of the sample farmers in Andhra Pradesh and Maharashtra respectively had primary education (Table 5.2).

Table 5.2: Distribution of Sample Mango Growers by level of Education

Level of Education	AP@	Per cent	MH@	Per cent	W B@	Per cent@	Total	Per cent
Primary	4	9.5	10	24.0	4	40.0	18	19.6
Post Primary	6	14.3	06	15.0	3	30.0	15	16.3
Secondary	12	28.6	10	25.0	3	30.0	25	27.1
Higher Secondary	18	42.9	14	35.0	-	-	32	34.8
Degree	02	5.1	-	-	-	-	02	2.2
Total	**42**	**100.0**	**40**	**100.0**	**10**	**100.0**	**92**	**100.0**

Source: Field Data , @ Number of Sample Mango Growers, , Note: AP= Andhra Pradesh, MH= Maharashtra, WB= West Bengal

5.3 Classification of Mango Growers/ Farmers by Social Group

Majority of the mango growers (52.2%) belonged to general caste. About one third of the total samples i.e 33.7 per cent were in the category of OBC. Samples growers belonging to SC /ST and minority category constituted only 16 per cent. State-wise, the picture was same (Table 5.3).

Table 5.3: Distributions of Sample Mango Growers by Social Group

Social Cast Group	AP@	Per cent	MH@	Per cent	W B@	Percent@	Total	Per cent
General	20	47.6	22	55.0	06	60.0	48	52.2
OBC	14	33.3	14	35.0	03	30.	31	33.7
SC/ST	06	14.3	-	-	-	-	06	06.5
Minority	02	4.8	4	10.0	01	10.	07	09.6
Row Total	**42**	**100.**	**40**	**100.0**	**10**	**100.0**	**92**	**100.0**

Source: Field Data, @ Number of Sample Mango Growers, Note: AP= Andhra Pradesh, MH= Maharashtra, WB= West Bengal

5.4 Classification of Mango Growers/ Farmers by Family Size

Out of a total of 92 samples, only 17 samples forming 18.5 per cent had a family size up to 3 members. As many as 40 samples (43.5%) had a family size between 4 and 6. State wise sample growers with family size between 4 and 6 in Andhra Pradesh stood at 75.5 per cent, followed by Maharashtra (62.5%) and West Bengal (50%). (Table 5.4)

Table 5.4: Distribution of Sample Mango Growers by Size of Family

Size of Family	AP@	Per cent	MH@	Per cent	W B@	Per cent@	Total	Per cent
Up to 3	9	20.5	10	25.0	02	20.0	17	18.5
04-06	32	75.5	25	62.5	05	50.0	40	43.5
07 and above	01	4.0	05	12.5	03	30.0	35	38.0
Row Total	**42**	**100.**	**40**	**100.0**	**10**	**100.0**	**92**	**100.0**

Source: Field Data, @ Number of Sample of Mango Growers, Note: AP= Andhra Pradesh, MH= Maharashtra, WB= West Bengal

5.5 Classification of Mango Growers/ Farmers by Occupational Pattern

Distribution of occupational pattern of 92 sample growers observed that business men constituted 43.5 percent (40) of the total, followed by traders accounting for 38 per cent (35) and cultivators 18.5 percent (17). Business men and traders dominate (81.5%) in mango sector. State wise the same trend is noticed. (Table 5.5)

Table: 5.5 Distributions of Sample Mango Growers by Occupational Pattern

Occupation	AP@	Per cent	Mahar@	Per cent	W B@	P.cent@	Total	Per cent
Cultivation	10	23.8	05	12.5	2	20.0	17	18.5
Business	20	47.6	15	37.5	5	50.0	40	43.5
Trading	12	28.6	20	50.5	3	30.0	35	38.0
Total	**42**	**100.0**	**40**	**100.0**	**10**	**100.0**	**92**	**100.0**

Source: Field Data, @ Number of Sample of Mango Growers

5.6 Classification of Sample Mango Growers by Size Class of Land

Twenty one sample growers (22.8 per cent) of the total had a landholding size between 10.01 and 20 acres, followed by 20 samples in the land holding of 5.01 to 10 acres. As many as 22 sample growers accounting for 23.9 per cent belonged to land holding class up to 5 acres (Table 5.6).

Table 5.6: Land Size Class Wise Distributions of Sample Mango Orchards

Size of land holding (Acre)	AP@	Per cent	MH@	Per cent	W B@	Per cent	Total@	Per cent
Below 2.5	2	4.8	4	10.0	2	20	08	8.6
2.5-5.0	8	19.0	4	10.0	2	20.0	14	15.3
5.01-10	13	32.0	5	12.5	2	20.0	20	21.8
10.01--25	15	35.7	5	12.5	1	10.0	21	22.8
25.01-50	4	9.5	22	55.0	3	30.0	09	31.3
Total	**42**	**100.0**	**40**	**100.0**	**10**	**100.0**	**92**	**100.0**

Source: Field Data , @ Number of Sample Mango Orchards (Farms)

5.7 Distribution of Mango Growers by Area of Land Holding

Total area covered under mango plantation for the sample growers was arrived at 1452.4 acres. Out of which maximum 46.1 per cent (666.9 acres) belonged to the size class of 10.01 to 25 acres, followed by 30.8 per cent in the size class of 25.01 to 50 acres and 18.3 per cent in the size class of 5.01 to 10 acres (Table 5.7).

Table 5.7: Area wise Distribution of Sample Mango Orchards

(Area in Acre)

Size in Acre	AP@	Per cent	MH@	Per cent	W B@	Per cent	Total@	Per cent
Below 2.5	4.5	0.9	2.0	0.6	5.0	0.8	11.5	0.8
2. 51 to 5.0	32.5	5.7	-	-	25.0	3.8	57.5	4.0
5.01 to 10.0	117.5	20.6	13.0	6.0	135.5	20.7	266.0	18.3
10.01 to 25.0	303.5	53.4	6.0	2.6	360.4	54.9	669.0	46.1
25.01 to 50.0	110.5	19.4	207.0	9.8	130.5	19.8	447.5	30.8
Row Total	**568.0**	**100.0**	**228.0**	**100.0**	**656.4**	**100.0**	**1452.4**	**100**

Source: Field data, @ Area under Mango Plantation, Note: AP= Andhra Pradesh, MH= Maharashtra, WB= West Bengal

5.8 Age Wise Distribution of Mango Orchards

Age wise distribution of mango orchards revealed that 32 orchards constituting 34.8 of the total attained the age group of 41 to 50 yea Only 06 orchards had an age of above 50 years. As many as 07 orchards belonged to the age group of up to 10 years and 20 in age bracket of 11-20 years. About 27 orchards had age group of 31-40 years.

Table 5.8: Distribution of Sample Mango Orchards by Age

Age Group (Year)	AP@	Per cent	MH@	Per cent	W B@	Per cent	Total@	Per cent
Up to 10	4	9.5	3	7.5	-	-	7	7.6
11 to 20	3	7.1	3	7.5	4	40.0	10	10.9
21 to 30	4	9.5	4	10.0	2	20.0	10	10.9
31 to 40	13	31.0	12	30.0	2	20.0	27	29.3
41 to 50	18	42.9	13	32.5	1	10.0	32	34.8
Above 50	-	-	05	12.5	1	10.0	06	6.5
Total	**42**	**100.0**	**40**	**100.0**	**10**	**100.0**	**92**	**100.**

Source: Field Data, @ Number of Sample Farms, Note: AP= Andhra Pradesh, MH= Maharashtra, WB= West Bengal

Chapter - VI

Cultivation and Cultural Practices of Mango Orchard

This chapter deals with various cultivation practices like, land preparation, digging of pits, preparation of drainage, sapling plantation, inter cropping, cover tree etc. while cultural practices includes application of manure, fertilizers, irrigation, spraying, weed/ pest control, etc.

6.1 Land Preparation

Usually, all types of soil are conducive to mango cultivation. However, high and medium high land with exposure to sunlight throughout the day and having alluvium or fertile soil should be identified. The depth of soil should be 2-2.5 m. The sand, stones, pebbles, hard layer or soda containing layers at a depth of 1-1.5 m may be removed for growth of plants. Inadequate food and water affects the growth and productivity decreases, fruits drop prematurely and the trees dry up. There should be adequate water drainage system and irrigation facilities during summer and winter seasons.

If the land used for cultivation for the first time is uneven or full of weeds, then it has to be made cultivable by removing the weeds and by leveling of the land. In the month of June, seeds @ 50 kg. per hectare may be sown. When the plants are around 30-40 days old, they should be thoroughly mixed with the soil using plough so that the decay enhances the fertility of the soil. During the next summer, pits of specified depth need to be dug. Distance between pits should be fixed depending on the mango variety and fertility of the soil. The soil of the upper and lower level of the pit should be exposed to adequate sunlight for 15-25 days. This results in the destruction of various insects present in the soil. Before plantation of the saplings, 40-50 kg. cow-dung or compost, 2.5 kg. mustard or *neemkhol*, 500 gm. super phosphate and 25 gm 2 per cent folidol powder should be mixed with the soil of the pit and thereafter the pit may be filled with soil.

6.2 Sapling Plantation

Grafted clean healthy sapling having a straight shoot with green leaves should be identified for planting. Ideal time for planting of saplings is from mid-June to mid-September, i.e. during monsoon. In areas

prone to flood or heavy rainfall, saplings should be sown at the end of the monsoon season and in areas prone to low rainfall, it must be sown at the beginning of the monsoon season. It is advised to plant/ sow the saplings in the evening. Nearly 400 plants of crossbred variety per hectare for 5 m X 5 m distance and 82 plants of indigenous variety per hectare for 11 m X 11 m. distance may be planted (Table 6.1).

Table 6.1: Number of Saplings

Variety	Distance	Measurement of the Pit
Amrapali, Mallika, Neelum	5 mtr. X 5 mtr.	75 cm X 75 cm X 75 cm
Any indigenous variety (Himsagar, Fajli, Laxmanbhog, etc.)	11 mtr. X 11 mtr.	1 mtr. X 1 mtr. X 1 mtr.

Ideal density for mango plantation will be 18-20 trees per acre, which will ensure sufficient sunlight, production and color, quantity of the fruit. The ideal spacing between two plants is required to be 20 mete However, at present it is found that 30 trees are planted per acre with an idea of increasing production per acre. But production in such cases is found to decrease after 8 - 10 years because the orchard becomes congested and there will be lack of sunlight.

There are many methods of plantation - square, rectangle, polygon, etc. But square method is the most popular and easiest. Selected grafted sapling should be removed from earthen pot or polythene packs carefully. Care should be taken so that soil from the root does not break or come off. Then the saplings should be planted straight at the center of pits already mixed with fertilizer by removing 8-10 cm of soil. Thereafter, the loose soil should be lightly pressed around the sapling by hand to ensure that there is no gap at the base of the sapling. The growth will be affected if water or air gets through. The soil at the base of the sapling should be high so that no rainwater can accumulate at the spot. It is advisable to provide some support in the form of sticks which help them grow straight and strong. After plantation, water should be poured on the plant. It is advisable to plant the sapling at a specified distance in block or line. This ensures production round the year in the same orchard.

6.3 Post-plantation Nursing

During winter and summer young plants are watered frequently to ensure proper growth. In case of adult trees, irrigation at 10-15 days interval from fruit set to maturity is beneficial for improving yield. However, irrigation is not recommended for 2-3 months prior to flowering as it is likely to promote vegetative growth at the expense of flowering. It is advisable to provide little irrigation regularly during winter and summer season. Also provision of irrigation to saplings up to five years is necessary as per details given in Table 6.2 :

Table 6.2: Provision of Irrigation to Saplings up to Five Years

Provision of Irrigation/Age of Sapling	Irrigation Interval		
	Summer		Winter
	Light Soil	Heavy Soil	Light Soil
Up to 6 months	2-3 days	3-4 days	3-4 days
Above 6 months and up to 1.5 year	4-6 days	6-8 days	7-8 days
Above 1.5 and up to 5 years	7-10 days	10-15 days	9-15 days

If it rains frequently, irrigation will be reduced accordingly. After flowering, it is recommended to provide irrigation 3-4 times at an interval of 15-20 days. It would result in increased production along with healthy, delicious and colorful fruit. An earthen ring has to be prepared around an adult tree where irrigation needs to be provided, while for a young plant, basin is required for irrigation water, so that less water is wasted.

At the base of the saplings, soil should be kept high so that rain water does not accumulate at the base or adequate drainage should be provided for rain water. After one month of planting of saplings, it is recommended to remove weeds present in the garden by ploughing. It should also be done in old mango orchards during post-harvest period.

To protect mango trees and its fruits from storm, it is advisable to plant 'storm stopping' trees e.g. *Debdaru, Kalojam, Jhau, Lambu, Sishu*, etc. trees in the south-western side of the orchard. This is mainly on

account of a stronger probability of south-westerly storm in eastern part of the country during March-April, duration of flowering.

Extreme temperatures, both hot and cold, are harmful for the saplings. Temperature over 37.5^{0} Celsius or below 7^{0} Celsius causes immense damage to saplings aged 3-4 years. They can be protected from bad weather if covered by dry grass or straw.

After 1-2 years of planting the grafted sapling, they start flowering. It is suggested to break them off because it does not help the roots and branches to grow properly and the tree becomes very weak. If any branch comes out from the stock of the tree it is better to prune them off immediately. Further, it may be ensured that the plant grows straight for at least 1 meter. It should not have more than 4-6 branches spread out evenly in all direction.

To get regular and good production, both urea and phosphate fertilizers can be applied in required proportion twice every year. There is a need to increase the quantity of fertilizer according to growth of the tree.

6.4 Application of Fertilizers

Fertilizer in the following mentioned quantity per plant per year can be applied by mixing with the soil in two doses, i.e. once after collection of fruit or before *monsoon* (June-July) and again when fruits begin to form, keeping a distance of 1 feet from the base of the tree. Irrigation is a necessary supplement after this application (Table 6.3).

Table 6.3: Applications of Fertilizers per Tree

Name of the fertilizers	1st year	Growing rate of quantity per year	Quantity for mature tree (10 years)
Compost-dung/compost leaves/courtyard manure	40 kg	6 kg	100 kg
mustard or neemkhol	2.5 kg	-	-
Urea	-	150 gm	1.5 kg
Super phosphate	-	125 gm	1.25 kg
Murate of potash	-	125 gm	1.25 kg

6.5 Diseases and Pests Attack

A sapling is prone to the following diseases and pests attack at an early age.

Anthracrose--Mango trees are prone to fungal attack in areas with heavy rainfall, moisture and humidity. It is seen in young leaves and branches. Initially, deep brown or black spot appears. Therefore, the young branches gradually dry up from the top. There is a need to keep the orchard clean. It is essential to cut the affected part of the tree and burn it. In addition to this, Copper Oxichloride, e.g., Blitox @ 4 gms / lt should be mixed with water and sprayed. Further, Mancozeb, e.g., Dythen M 45 @ 2.5 gms / lt, Captan or Caftaf @ 2.0 gms/lt, Bavistin 1 gm/lt should be mixed with water and sprayed twice at an interval of 15 days. It is advisable to spray medicine in affected orchards in August-September.

Leaf-cutter Bug — In the beginning of monsoon a brown colored female pest lays eggs in the center of leaves and cuts the leaf in such a manner as if it has been cut off by a scissor. The affected leaves with egg drop to the ground. Many a time it is seen that most of the newly sprouted leaves of the affected branch are cut, resulting in the sapling becoming weak, which is detrimental to its normal growth. This problem is seen during monsoon only. Growing trees are also prone to such attack. Therefore, in order to get rid of these pests, during winter season, the orchard should be freed of weeds and the soil should be dug and mud loosened. When this type of attack is observed, Endosulphar (2 ml/lt) or Carboryl (2 g/lt) may be sprayed on the sprouting leaves. The affected leaves on the ground may be collected either for burning with the help of kerosene oil or for dumping them by pesticides to prevent further contamination.

Hole Driller Bug— The larva of this pest makes a hole at the tip of growing branches and enters them. This hole could be as deep as 8-10 cm. As a result, the branches dry up. Spraying of Carboryl @ 3g/ It water is recommended on new sprouting branches for good result. Injecting these holes with kerosene or petrol also gives good results.

Mealy Bug—The flat white colored pests are found on the branches sticking together. It looks as if a layer of curd has been applied on the branch. They suck the juice from the branch, resulting in the soft branches getting dried up. Diemithoete @1ml/lt water is recommended

for spraying. During the month of November, it is advisable to protect the tree from attack of these pests by covering the main trunk with a layer of mud and then by a polythene sheet of 1 foot width. Folidol powder can also be sprinkled around the main trunk.

6.6 Inter Cropping

As mango trees take longer time to yield profit to the grower, it is desirable to supplement one's income by growing some short-term crops till the orchard is not shaded by trees. Such crops when taken in the orchard are called inter crops. There is another kind of cropping in the orchard when the orchard soil is covered with some crop which in due course is turned back to the soil to supplement organic matter of the orchard soil. There are called cover crops. These two types of crops (inter crops and cover crops) are important operations in the management of a good orchard, although many growers do not pay much attention to it. In case of traditional mango varieties, no fruits can be expected from mango trees during the initial 7-8 years. When the saplings are small, there is enough vacant space in between the trees in the orchard, the farmers can use the in-between space commercially. Some tips are illustrated hereunder:

Inter crops such as vegetables; legumes, short duration and dwarf fruit crops like, chilly, ladies finger, brinjal, etc. can be cultivated during *kharif* season. During *rabi,* vegetables and pulses can be grown. During April, ladies finger, *moogdal,* soyabean can be cultivated. Fruits like papaya, guava, pineapple etc. can be grown depending on the agro-climatic condition of the region. The water and nutrient requirements of the inter crops must be met separately.

It is recommended not to grow turmeric, ginger or any crop which draw more nutrients from the soil. However, once the saplings grow into big trees, coriander, pulses etc. can be planted in between the trees where sunlight is available. It helps to safeguard soil erosion, enhance water retaining capacity and fertility. Nowadays, cultivation of some flowers, like marigold, *sarpagandha*, *aswagandha*, etc. is quite profitable.

Vegetables that have their roots within 25 cm depth of the soil are considered good for intercropping. These are tomato, beans, radish, *palak* etc. These vegetables can be taken profitably in a growing orchard by appropriate application of nutrients to the soil and also

maintaining an optimum level of moisture. Among the annual crops, due consideration should be given to the legumes such as pea, lentil, moth bean, black gram and green gram.

While taking some of the short-term and early fruit bearing crops as an inter crop, due consideration is essential for the selection of a particular fruit. This is essential because the roots of such trees may start competing with the roots of main fruit trees for nutrient and moisture. The feeler trees, unless removed at appropriate time when primary fruit trees start giving economic crop, may create problems of low orchard efficiency. Keeping this point in view, it is apparent that wherever pineapple and strawberry can be grown, these serve as ideal inter crops.

Wherever frost hazard is less, an inter crop like papaya can be taken profitably in a mango orchard. Likewise, in the northern plains of India, *'Sharbati* peach can be an excellent inter crop for mango orchard. *Phalsa* and guava can also be included in the early stage of growth of the trees, provided these are maintained properly by adequate pruning and removal at proper time.

The method of growing inter crop in an orchard is different in the young and the bearing orchards. In the former the entire land is utilized, leaving only the basin portion of the tree. The tree is located in the middle of the bed in which the crop is grown. As the trees grow in age, the size of the basin increases and the area of inter crops get reduced gradually. When the trees attain good bearing age, the inter crop is grown in between the tree rows in one direction, i.e. on two opposite sides of the trees, leaving the other two sides open. The trees are enclosed by a strong bund on two sides running from one end of the orchard to the other. This facilitates irrigation of the trees within the bonded space independent of the inter crop. It also provides space for movement during plant protection and other operation in the orchard.

While taking inter crop, a common mistake is committed. The fruit trees are left to obtain nutrients from the same fertilizer dose applied to the inter crops. This is one of the main causes of decline in mango production. The inter crop and the fruit trees must receive separately their independent requirements of fertilizer, irrigation and sunlight.

Besides, intercropping in orchard promotes infestation of pests and

diseases in greater intensity than under clean cultivation. This is due to increase in the humidity and vegetation around the trees due to inter crops. Hence, regular plant-protection measures against pests and disease of the mango crop are essential. In case of mature mango orchard, inter crops can be grown where there is sufficient sunlight.

6.7 Principles of Inter Cropping

Inter crops should occupy a secondary place in the orchard, primary consideration being given to the orchard. Therefore, some principles are followed in inter cropping. The crops that may grow tall and have a tendency towards excessive growth should be discouraged. At least 120 cm radius must be left from the base of the growing fruit trees for taking inter crops. Such inter crops should be selected that do not exhaust the nutrients and moisture from the soil, essential for the growth of fruit trees. Perennial or exhaustive crops should be discouraged as an inter crop in the orchard. Bee farming in mango orchards gives scope for extra income and extra fruit production every year.

Inter cropping is practiced in both the sample districts of West Bengal but not extensively. Mostly brinjal, potato, *haldi, musur,* black *jeera* and dhania*, kalai dal*, elephant foot, white potato is cultivated. In the old mango orchards consisting of the adult trees with big canopy, intercropping cannot be practiced due to lack of sunlight. The crops thus cultivated are sold in the market and they can earn 24000/- to 30,000/- per acre annually. One of the features observed in Malda district is that the open area with sunlight in the mango orchard is given to *bargadars* for cultivation of inter crops. He may be given financial assistance by the orchard owner. He will use his own labor and in turn give half the share of the vegetables produced to the owner. This is known as *'tal barga'.*

6.8 Cover Crops

These crops save the orchard soil from being eroded during the rainy season, particularly in areas where drainage is not proper. Water-holding capacity of the soil is increased and the biological complex of the soil is also improved. It is preferable to take leguminous crops for cover cropping so that nitrogen fixation in the orchard soil is facilitated. Another advantage of cover crops is that they will prevent the growth of weeds. During rainy season *(Kharif)* green gram, black gram, cow pea and *guar* are preferable. During winter season *(Rabi),*

it is desirable to take sweet clover (*Senji*), pea, lentil, moth bean and fenugreek. The most important point in the selection of cover crops is the requirement of water of a particular crop. If a particular crop needs to be irrigated frequently when the orchard trees do not need water, this will certainly tell upon the productivity of the fruit trees. For example, if berseem is taken in a mango orchard during winter when fruit bud differentiation and flowering is expected and the orchard is irrigated too frequently, it may not be conducive to the productivity of the tree in general.

6.9 Cultural Schedule and its importance - Some Important Suggestions

Factors responsible for the decline of fruit yield and proper fruiting pattern mostly pertain to management practices such as nutrition of trees and control of weeds, insect pests and diseases. If trees do not present a healthy appearance and leaves look somewhat yellowish, it is obvious that such trees suffer from under-nutrition.

If the cover crops or inter crops are taken regularly, the weeds will be automatically suppressed. A constant watch over the diseases and pests of mango is necessary for ensuring quality crop from trees. When humidity builds up appreciably during the flowering time, incidence of mango hopper and powdery mildew is very much increased, and sometimes this may result in no fruit set.

One of the important schedules in mango orchard management is maintenance of excellent sanitary conditions in the orchard and regular pruning of the malformed parts (both vegetative and floral) in the tree, if any. This will ensure reduced incidence of mango malformation.

Proper irrigation of trees, particularly during summer, is essential to get quality crop from the bearing trees and proper growth in young plants. While bearing trees ought to be irrigated at an interval of a fortnight during summer, younger plants need weekly irrigation.

Trees must be regularly observed for any setback due to any cause and steps must be taken immediately to remedy it. A proper round-the-year cultural schedule must be drawn up beforehand and operations should be done as per schedule. This will ensure production of quality crop from healthy mango trees.

6.10 Irregular Bearing Habit of Mango Tree

Generally, mango trees do not bear fruit every year. It is observed that a tree, which bears good number of fruits in a year, does not bear fruit or bears very few fruits in the subsequent year. This nature of mango trees is called irregular bearing. It is a serious problem and therefore in order to regularize the mango production the following steps can be taken.

It has been observed that two to three times evening-out of the land, regulated application of fertilizer and irrigation results in growth of new branches when the flower comes. These branches bear fruit during next winter. This method gives some production even in unproductive years. To get flowers in extremely fast growing trees, it is advisable to remove 1 inch skin in a ring form from the branches of the tree. It must be done during August-September, i.e. before four months the flowering season. It results in increased content of carbohydrate and nitrogen in the branch, which helps flowering.

It has been observed through various experiments that if in a particular tree in a particular year, flowers come in good quantity, it is better to destroy some. This helps in preserving nutrients in these branches which in turn help in growth of new leaves in these new branches during summer and spring. It also helps flowering in these branches during the next season and regulating the irregular fruit bearing habit of the tree.

Some varieties bear fruits two to three times in a year. Generally ripe mangoes of these varieties are not good in quality. But some are very good, viz. *'chini dofola', topa dofola'.* These types can be grown to get production throughout the year. Flowering of the trees is dependent on hormones present in the tree, like oxin, jibbareline or growth control hormone present in the tree. Good results are obtained when these hormones are externally sprayed. Diseases and pest attack results in the loss of flower and reduces the volume of production. There is a need for spraying of plant protection chemicals in appropriate quantity and on time help to control diseases and pests.

Mango trees respond well to organic manure applications. Organic manures such as vermicompost, *panchagavya* and vermiwash are used for promoting healthy growth and fruit formation. From the initial planting stages to caring of full grown trees, *Panchagavya* and vermicompost can be effectively used to supply essential nutrients to

the trees and prevent pest infections. Vermicompost is prepared by using earthworms. Vermiwash is the liquid collected after the passage of water through a column of activated earthworms. It is very useful as an organic spray for all crops. *Panchagavya* is an organic growth promoter, which is prepared by mixing cow dung, cow urine, cow milk, curd and *ghee* in suitable proportions, and is sprayed on the plants. It contains several macro, micro nutrients, beneficial bacteria and fungi, which aid in growth promotion and act as effective pest repellents. It can be prepared by thoroughly mixing five kilos of fresh cow dung and one litre of cow's *ghee* in a plastic or cement tank or earthen pot. The mixture is stirred daily for three to four days. About three litres of cow's milk, two litres of cow's curd, three litres of sugarcane juice, three litres of tender coconut water and 10 to 12 bananas are mixed well and added to the mixture. The entire concoction is allowed to ferment for fifteen days. The container should be covered with a net (or) cotton cloth to allow aeration of the fermenting unit. The concoction is stirred two or three times a day for about fifteen days and then used. For mango trees of about 6-7 years age, vermicompost may be applied at the rate of 10 kilograms per tree in one litre of water may be sprayed over the foliage (crown) and at the base of the tree. Spraying *Panchagavya* over the crown and at the base of the tree must be done four to five times. The first spraying must be done before the flowering season (January-March) to increase flower formation. A second spraying must be done after 15-20 days. The process must be repeated till the flowers turn into small size buds. Once the buds start forming then the application can be done once a month. Use of Panchagavya and vermicompost has been found to increase the size, number and enhance the color of the fruits. The fruits thus grown become more acceptable for export.

6.11 Recommended Practices

The recommended practice for one hectare of mango tree is about 25 litres of *Pachagavya* (mixed in 750-800 litres of water) and four to five MT of vermicompost. Spraying *Panchagavya* has been found effective in the control of fruit fly menace, a common infection in all fruit bearing trees. Trees treated with organic manures bore large sized leaves and form a dense canopy with profuse rooting systems. The taste and shelf life of the fruits are also found to be more satisfactory. The interaction of the root hairs of these trees with the organic manures also increases the activity of the nitrogen-fixing bacteria in the soil. The organic manures also act as a carrier medium for the

development of several beneficial micro organisms such as azospirillum, azotobacter, rhizobium and phosphor bacteria.

It was observed that in both the sample districts of West Bengal, some of the progressive orchard owners who are cultivating mangoes themselves have started using organic fertilizers and pest repellents. It was reported that it not only improves the health of the trees but also the quality and taste of the mangoes. These types of mangoes have high demand in the western countries and it is expected that as more and more farmers take up this practice, the export of mangoes will increase in the coming year. The District Horticulture Department has taken initiative in guiding and motivating the farmers regarding this type of cultivation and is organizing Demonstration Camp.

6.12 Harvesting

The ripening and quality of a mango depends on at what stage of maturity it is plucked. Premature plucking will affect the actual taste, smell and shape. Factors which help determine plucking of mango at the right time are -

- When yellow color appears on top of the fruit.
- When ripe mango starts dropping from tree.
- When the gravitational pull of the mango is between 1:1.01 and 1: 1.02, e.g., if a mango sinks in a bucket of water, then it is at the right stage of maturity.
- When there are 30 ripe mangoes out of 100 in the tree.

If the fruits are collected through the process of checking the branches, it may fall on the ground, causing both external and internal damage to the fruit. The mango can be preserved for long if the fruit is collected with at least 8-10 mm of its stalk. For this, proper apparatus should be used for safe collection of fruit. Mango collecting apparatus have a knife and a net at the head of a long bamboo pole. Mangoes are cut with a portion of stalk and brought down in the net. Collected mangoes are to be placed on a net made from bamboo in upside downslide so that the gum runs off and does not fall on the fruit. As a result, no black spot appears on the fruit and it can be preserved for a long time.

After collecting the fruit, it is necessary to sort immediately according

to size and shape. Wooden boxes or card board boxes with a capacity of 50-100 mangoes are mostly used for packaging. The boxes should have sufficient number of holes to allow ventilation. To prevent any sort of damage, each fruit should be wrapped in newspaper and placed in the box.

Generally green mangoes plucked at maturity could be preserved for a longer time than ripe ones plucked from the tree. Regulated humidity, low temperature and usage of chemicals delay ripening of the mangoes. Around 5^{o} - 10^{o} C temperature and 85 - 90 per cent of relative humidity is ideal for storage of various varieties of mangoes. Very low temperature can damage mangoes. Paraffin layer (3%) on the mango gives it a longer shelf life. It can be preserved for two weeks if it is put into cold water of 12^{o}-15^{o} C and with room temperature of 15^{o}C.

Chapter - VII

Marketing Aspects: Role of Different Channels, Market Arrivals and Price Spread

The healthy marketing system for a particular commodity has to provide required information, technology, marketing linkages for better price realization by farmer. Marketing efficiency of a particular commodity is evaluated by looking at the producer's share in the consumer's rupee. The present chapter addresses the issues affecting marketing of mango.

The major commercial varieties of mango marketed in Andhra Pradesh are Banganapalli, Neelam, Tota Puri, Subarna Rekha.

7.1 Marketing Channels for Mango in Andhra Pradeh

Based on the discussion with the farmers, traders and representatives of processing units, it was observed that mango reaches the consumers through four channels.

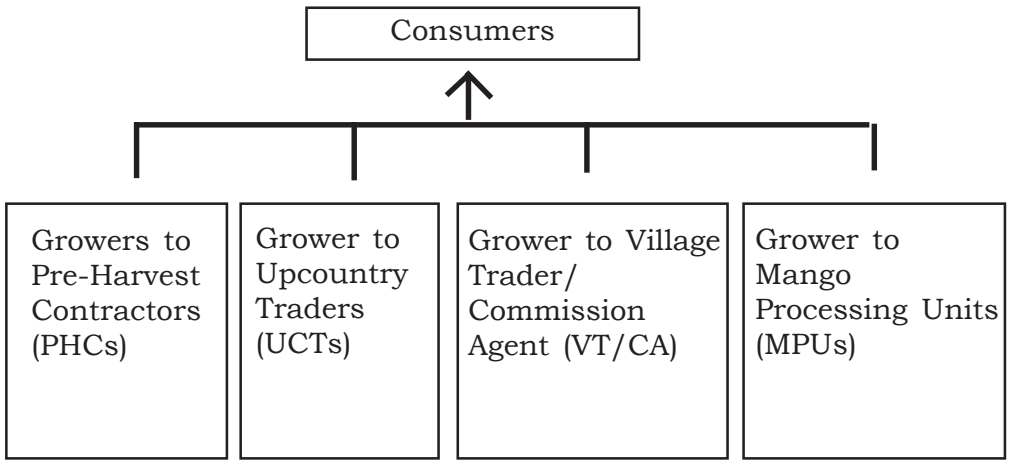

Chart 7.1: Marketing Channels of Mango

From the grower, mango reaches the export destination through any of these four channels. A comprehensive chart depicting different channels/ sub-channels is depicted in Chart 7.2:

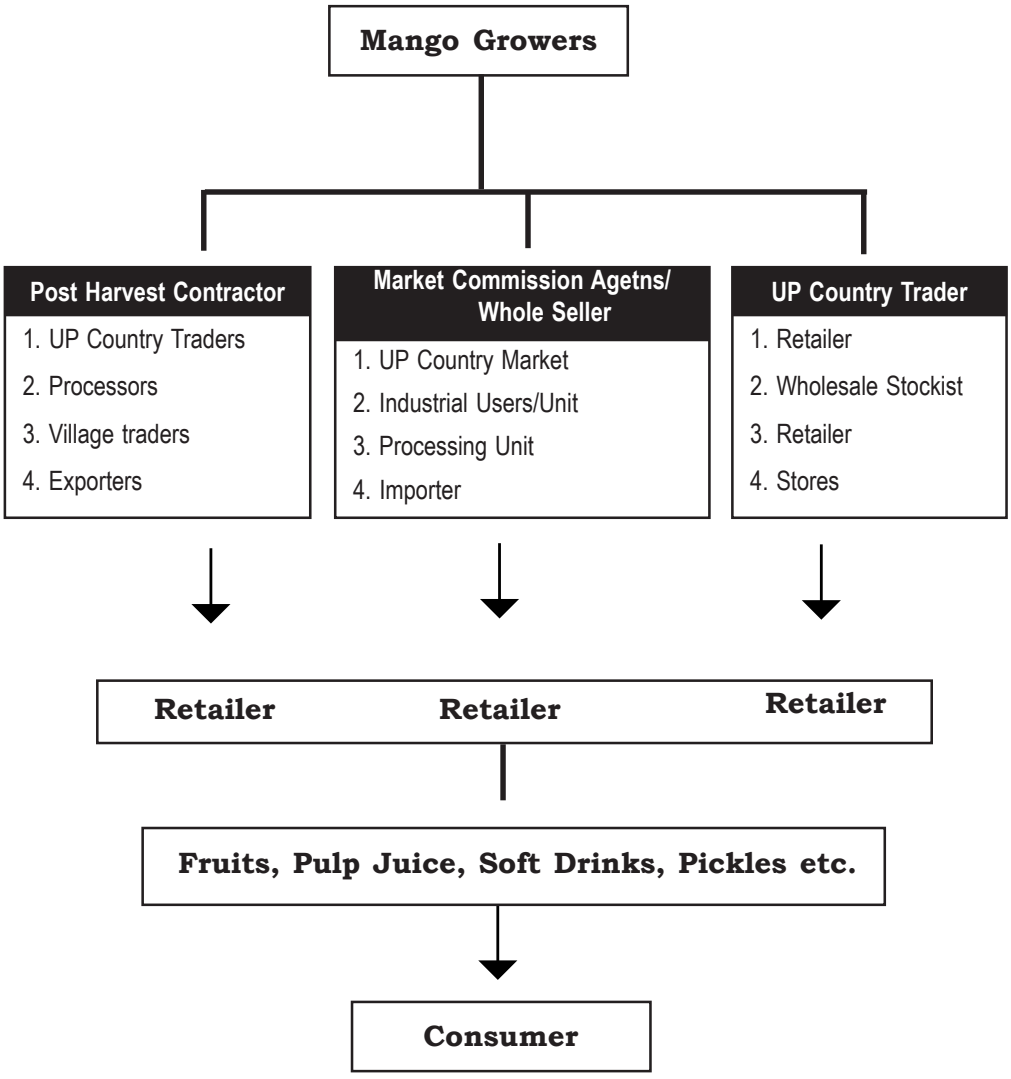

Chart 7.2: Export Dimension of Mango –Different Channels and Sub Channels

7.2 Post - harvest Contractor (PHC)

The orchard owner leases out his orchard as per contract to the PHCs. Both the parties agree to abide by the terms and conditions stipulated at the time of agreement (which is almost invariably oral in nature). The PHCs visit the mango orchards just after the mango harvesting season (during August/ September) to survey the orchards. On completion of the survey, the negotiation takes place between the grower and contractor. These contractors also take up the works of required input application to the leased orchards including plant protection to obtain optimum fruit yield. PHCs after harvesting mango sell it in the open market or to processing units like a grower who undertakes self-marketing.

7.3. Up Country Traders (UCTs)

Many traders from neighbouring states visit mango markets in Chittoor and Krishna districts during mango season. Traders from Bangalore, Chennai, Mumbai, New Delhi, Kolkata, Nagpur, Jaipur, Ahmadabad and Hyderabad participate in mango trading in Chittoor and Krishna districts. UCTs visit mango orchards during the months of January, February and survey the orchards at flowering stage and estimate the output for the forthcoming harvesting season. Based upon the estimation, UCTs fixed the prices for the purchase of mango production from the orchard owners. Unlike the PHCs, the UCTs do not undertake maintenance of the farm. Under an informal agreement, UCT pays an advance (10-20 %) to the orchard owners. The price is settled before the harvest and payment is made soon after the completion of marketing.

7.4. Mango Processing Units

The mango processing activity in Chittoor district commenced during 1965 with enterprising fruit merchants, M/s Haneef and Sattar, setting up a small unit named HANSTAR, at Damalcheru to extract mango pulp which worked for a few years only (Naidu, 2002). A more organized effort was initiated by a prominent mango grower Late Shri Subramanya Reddy who established M/s India Canning Industries, the first merchandised fruit processing unit. However, no new units were commissioned during the period 1971-80. Thereafter mango pulp units were established at frequent intervals.

The processors purchase mango for production of pulp from traders

as well as mango growers. Totapuri mangoes are mainly used for preparing pulp because of its pulp-yielding rate. The processors reach the mango orchards, testify the quality, determine the price and offer advances to the grower. As the pulp content depends upon the quality, processors insist on sorting and grading of mangoes and prices are determined accordingly. Processing units purchase mangoes from market yards as they are assured of large quantities to run the unit continuously till the mango season is over.

7.5. Village Trader (VT) / Commission Agent (CA)

About 60 per cent of mango growers transact through village trader/ commission agent (VT/CA) channel. VTs often provide advance to the farmer with the condition that grower has to sell his produce to them. They resell mangoes to UCTs / retailers. But VT collects 10 per cent of value of trade towards commission charges. If due to any unforeseen situation (pests, cyclones etc.) the growers fail to settle the advance, the same gets adjusted from the next year's sale proceeds. However, inadequate information of prices and lack of weighing facilities are a few limitations of this channel.

Overall, mango reaches the consumers through five different channels (Table 7.1). However, it is very difficult to come out with a clear cut demarcation of channels as some PHCs also act as CAs, some CAs act as traders. They themselves also act as local wholesalers. Many of the CAs / traders are also mango orchard owners and contribute substantially to the mango production. Discussions with the different players in the market as mentioned above revealed the following types of marketing channels (Table 7.1).

Table 7.1 Share of Different Marketing Channels of Fresh Mangoes in Andhra Pradesh

Sr. No	Marketing Channels	Share (%)
1.	Grower-----CAs/VTs-----UCTs----Retailers-----Consumer	55.0
2.	Grower ----PHCs -------- CAs-----Retailer-------Consumer	25.0
3.	Grower-----UCTs----------Retailers-----Consumers	10.0
4.	Grower-----Local Wholesalers ----Retailer------Consumer	7.0
5.	Grower-----Processors-----Consumers	3.0
6.	Growers----Consumer	Negligible
	Total	**100.0**

7.6. Mango Market Yards in Chittoor and Krishna Districts

Mango production in Chittoor district arrives at five different market yards. They are Chittoor, Damancheruvu, Bangarupalem, Tirupatti, and Puttur. In Krishna district, mango production mostly arrives at Nunna market yard in Vijayawada. In Chittoor market yard varieties of mango arrive. The commission agents facilitate the trade between the mango farmers and purchase Puttur market yard handles smaller quantities of mango. As it lies on the Tirupati- Chennai Highway, mango production reaches either Tirupati or Chennai directly from the mango orchards. In Tirupati market yard, three varieties (Bangana Palli,Tota Puri, and Neelam) of mangoes are being traded. The arrivals of mangoes are mainly from outside the notified area such as Putur, Nagari, Kodur (Kapada district). Damalacheruvu market yard, one of the oldest private market yards in Chittoor district, consists of about 100 mandis. It is an open market and no action takes place. Mangoes arrive from Vellore, Kuppam and all the mondals of the district. The traders from far off place like Delhi, Kolkata, Raipur, Ahmedabad, Nagpur, Mumbai, Bangalore, visit this market yard for buying mangoes. The command area of Bangarupalyam market yard covers four mandals and 77 villages consisting of about 1000 mango growers.

The Nuna market yard under Golapudi AMC near Vijaywada consists of 81 shops. Every year about 7,000 to 8,000 trucks each containing 10-11 metric ton mangoes are being supplied in different parts of the country, mainly in Azadpur mandi of Delhi. Traders in these market yards also provide finance to the farmers. Major varieties of mango, ie Benishan, Totapuri, etc.. are coming to Nunna market yard. About 15 to 20 per cent of Totapuri mango comes to this market and the rest is sold in the orchard itself. Maharashtra, Gujarat and West Bengal use this for picking in the early season. About 70 per cent of mangoes are exported to other states. The rest 30 per cent is sold to local traders. Traders from Maharashtra, Gujarat, and West Bengal visit Nunna market yard and take advantage of early season picking, when the prices remain usually high.

7.7. Market Arrivals and Prices of Mango

The data on annual arrivals of mangoes and prices in five market yards in Chittoor district and Nunna market yard in Krishna district during 1997-98 to 2005-06 are presented in Annexure **7.1.**

The continuous drought conditions in Chittoor district during the last four years had hampered the arrival of major agricultural produce in the market yard. Further, production of mango fluctuates due to alternate bearing nature of the crop, which affects the market arrival as well. Absence of effective marketing linkages also hampers the mango arrival to various market yards. Growers prefer to sell directly to processing units, local/ outside wholesalers.

Mango prices vary a great deal from year to year, depending upon each year's total production and various other factors like, the prevailing prices, demand, transport, marketing facilities, etc. Whole sale prices of mango also vary considerably based on the supply / demand of particular varieties, periods of availability, weather condition, variety, quality etc. Daily arrivals have also a direct bearing on the prices. Thus, fluctuations in prices are of an irregular pattern. Ordinarily, the prices are high at the commencement of the season. They start declining gradually as the supplies increase. Later on, when the arrivals decrease, they tend to recover and reach a high level again before the close of the season. The monthly wholesale price index of mangoes (All India) for ten years period is presented in **Annexure 7.2.**

7. 8. Role of Up Country Traders in Price Fixation

The field study revealed that UCTs obtain supply prospects of mango from the village and supply to the terminal markets. UCTs acting as traders, also determine prices at the village level and at the terminal markets. In fact, daily price depends upon visit to number of UCTs in the village and market yard every day. If number of UCTs is large, mango price is reported to be high and vice versa. Thus, influence of UCTs is more significant on prices than that of local trade Mango growers, mostly small and marginal farmers are unaware of the final price of their produce, which they sell to the traders. Farmers feel cheated as traders garner higher margin.

However, as UCTs facilitate selling of mangoes on the farm itself, small farmers who do not have their own transport are greatly benefited. If UCTs purchase from the market, they engage in financial links with mandi owners (Traders). Traders borrow from UCTs before the mango season to meet working capital requirement and the account is settled in installments or at the end of the season. After purchase from the farmers or market depending upon the distance, transport arrangements are made by the UCT. Around 400 trucks take mango

to Up country markets every day during the season (April-May) from Nuzivid mandal of Krishna district. About 40-45 rakes are exported in a year from this station (One rack= 40 wagons x 26 MT = 1040 MT). Similarly, about 100 trucks leave from Damancheruvu market yard in Chittoor to different places in North India.

7.9. Role of Commission Agents

The commission agents (CAs) are the most important link in the marketing of mango, controlling about two- thirds of the total markets. These CAs also act as grower-cum-trader and facilitate the trade between the mango grower and UCTs. The study revealed that the purchasers normally pay Rs. 60 for loading/ unloading / grading of mangoes to CAs. They are required to pay 1 per cent of the turnover as market fee to the AMC and 4 per cent of the turnover as commission to the CAs. The CA collects the market fee from purchasers on behalf of the AMC. For this purpose the AMC provides receipts to the CAs. CAs, who are also traders, avail Secured Over Draft (SOD) from banks and utilize the same in lending to mango farmers for consumption/ production purpose {@24 per cent interest per annum}.The amount of advance is decided on several factors such as areas under mango, expected production, past track record of the mango supply to the CAs etc. After harvest of mangoes, farmers sell mangoes to the CAs and 10 per cent of the sale proceeds as commission charges.

7.10. Price Spread

Price spread is the difference between the retail price paid per unit by the consumer and the price received by the farmer / producer for same quantity of the produce. Price spread in marketing of mango is analyzed by following the product movement from the mango grower to the consumer. Various costs (particularly marketing costs) and margins together with the farm gate price constitute the consumer price of mango. It is a fact that there is a direct relationship between the consumer price and the length of the marketing channel. In other words, the consumer price is the lowest when marketing channel is the shortest, i.e. when the mango grower directly sells to the consumers. However, the magnitude of sale that takesplace through the direct channel was negligible. In the absence of direct linkage between mango grower and the consumer, it is the middlemen who have been taking the advantage of the situation. An indicator of the

efficiency of any supply chain is the extent of price spread between producer and consumer. A high price spread would indicate a lower marketing efficiency. Conversely, a low level of price spread would denote a high efficiency of the supply chain mechanism. Producer's share in the consumer price is high when the marketing efficiency is high. The price spread in different channels of mango marketing is presented in **Annexure 7.3**.

The marketing margin (MM) as percentage of consumer minus producer price difference is a measure of efficiency of the marketing channel. High proportion of MM indicates low marketing efficiency and vice versa. The producer's share in consumer price and market margins as proportion of consumer minus producer price differentials in various channels of marketing of mangoes is furnished in Table 7.2 :-

Table 7.2: Producer's Share in Consumer's Price and Marketing Efficiency in Andhra Pradesh

Marketing Channels	Producer's share in Consumer Price	Marketing Margin as % of consumer-producer price differential	Market Efficiency
1.Grower---CAs/VTs---UCTs---Retailer----Consumer	28.80	63.80	Low
2.Grower ---PHCs ---CAs---Retailers----Consumers	34.74	68.50	Lowest
3.Grower----UCTs---Retailers---Consumers	33.59	65.50	Low
4.Grower---Wholesalers--Retailers---Consumers	44.05	62.20	Low
5.Grower----Consumer	100.00	0.00	Highest

Source: Field data

7.11. Marketing Channels for Alphonso Mango in Maharashtra

The majority of the farmers of Sindhudurg district send their mangoes through transporter to the commission agents at Vashi and Pune, who market on behalf of the farmers. The sale price, total amount

payable, and various deductions like, transportation charges, commission (8% in Pune and 10% in Vashi), loading and unloading (up to 5 per cent) are immediately conveyed to the farmers through a receipt known as Patti**.** Some commission agents used to deduct the postage charges for forwarding the patti to the farmers.

A few farmers, who are not tied up with commission agents, send their mangoes to other markets where prices are higher. A few enterprising farmers were directly selling a part of their produce through their contact at Mumbai, Nasik and Pune. These channels fetched maximum price to the farmers. Local sales from the orchards were limited to the left out mangoes, which are sold directly to the processors towards the end of June. The average sale pattern through the channels for the sample farms during 2005-06 is indicated in Table7.3:

Table 7.3: Channel of Mango Marketing in Maharashtra during 2005-06

Channels	Number of Farmers	Portion of Produce (%)	Average Price (kg/ha)
Farmer—Commission Agents---Wholesaler ---- Retailer--Consumer-	25	90	30
Farmer---Consumer	2	1	35
Farmer—Processor	12	5	12

Source: Field Data

7.12. Marketing Cost and Average Price Realized by Farmers

An attempt has been made to examine the share of mango farmers in the price per unit (kg) paid by the consumer. Details are depicted in Table 7.4:

Table 7.4: Cost Incurred and Price Realized by Alphonso Mango in Maharashtra (2005-06)

Particulars	Age of Orchard (Years)		
	Less than15	15-25	Above 25
Total No. of Fruit Bearing Trees with the Farmers	916	347	682
Annual Maintenance Cost per Tree (Rs.)	573.3	658.2	624.1
Cost of Marketing per Tree (Rs.)	757.8	813.1	835.8
Grand Total of Annual Cost per Tree (Rs.)	1331.2	1471.3	1459.9
Average Production per Tree (kg)	77.2	79.9	82.2
Average Cost per kg (Rs.)	17.24	18.41	17.76
Weighted Average Sale Price Realized per kg (Rs)	30.20	30.20	29.10
Weighted Average of per kg Share of Farmers in the Sale Price (Rs.)	**12.8**	**11.7**	**11.5**

Source: Field Data

The weighted average cost of maintenance and marketing of the produce of a tree come to Rs.628 and Rs. 811, respectively. The mango grower, on an average, realizes share in sale price of Rs 12 per kg. This is primarily because of the unusually high expenditure incurred in marketing of the produce. The expenditure incurred for production and marketing of one kg of Alphonso mango and percentage share of each item of expenditure are shown in Table 7.5.

Table 7.5: Production and Marketing Expenses and their Share in the Price of One Kg of Alphonso (2005-06)

Factors of Production	PC&L	CP&L	Transp.	Com, & H	SPR	FS
Amount in price of 1 kg (Rs.)	7.85	2.95	3.13	4.07	30	12.00
Percent share in price of 1 kg (%)	**26.17**	**9.83**	**10.43**	**13.57**	**-**	**40.00**

Source: Field Data, Note:PC&L= Production Cost and Labor, CP&L= Cost of Petti and Labor, Com& H= Commission and Hamali, SPR= Sale Price Realized, and FS=Farmer's Surplus

The above data reveals that the marketing expenditure is considerably more than the annual maintenance cost of tree. There is hardly any scope for reduction in cost under 'Production Cost' and 'Cost of Peti', 'Packing Charges', etc. In view of the fact that Alphonso mango needs to be marketed at distance places, existing packaging process is most suitable and cost effective. However, if the mangoes are marketed locally, the cost on packaging can be substantially reduced. Further, the transportation cost can be minimized by opening marketing centers in the locality/ district head quarter. Similarly, the cost towards 'Commission, and Hamali" etc. , which accounts for 13.57 per cent of price realized in sale of 1 kg of Alphonso mango, can also be reduced if the produce is marketed locally, as commission, as high as 10 per cent is being charged by Commission Agents in urban marketing centers of APMC, Vashi. Therefore, provision of marketing outlets locally is pertinent in order to increase the share of the primary grower in the ultimate price paid by the consumer.

7.13. Role of Transport Operators (TOs) and Commission Agents (CAs) in Marketing

The Commissions Agent (CA)-cum-Wholesalers (WS) normally lift the produce from the mango growers through local transport operator. The wholesalers (WSs) also operate in the field through sub agents. On receiving the 'Pettis' of mango from the mango grower, the CA determines the per Petti price through open auction or through the non-transparent *rumali system*. On the basis of the price so determined, the *CAs* issue patties to the grower. A Patti indicates the amount payable to the farmer with details such as cost of the mangoes and various sorts of deduction towards transportation. Agent's commission, Hamali (Mazdoor) charges, octorai, *Tapal Charge* (Postage), etc. The commission was 10 per cent in Vashi and 8 per cent in Pune and other markets during the period of study.

a. Transport Operators—A transport agent at Vengurle, Sindhudurg is in the business of collecting mangoes and sending them to traders on a commission for the last forty year. During 2004-05, he had transported 1, 35,000 pettis (2025 MT) to Mumbai and 30, 300 pettis (450 MT) to Belgaon. Similarly, during 2005-06, he had sent 1, 25,000 pettis (1875 MT) to Mumbai and 25,000 pettis (375 MT) to Belgaon in Karnataka. The transporter normally, sends the pettis to Vashi market in truck loads. However, if the pettis collected are less than a truck load, the stock is sent by bus or train. The transportation

charges during 2005-06 came to around Rs. 5 per petti, which included truck charges, labor charges for loading and unloading, handling charges in the godown, toll charges and miscellaneous charges including administrative charges of the transporter. There are a number of such transporters throughout the district.

b. Commission Agents (CAs)— The CAs have their offices in" mandis" / market places. In majority of the cases, these agents arrange to transport mango pettis from the orchard to the market place. The CAs start paying advance to the mango growers in November and December to enable growers to carry out various farming operations. Such advance payments range between 10 and 30/40 per cent of anticipated value of production, which in turn is arrived at on the basis of average production of last 5-10 years. Some commission agents do not make advance payments as there is a possibility that farmers might sell the produce in cash to an agent other than from whom advance is received. In most of the cases, the CAs have developed cordial relation with the farmers over the years and take advantage of this trust to lift the produce on a continuous basis. The agents often bank on the relationship and make a little advance payments to win over the farmer. The advance paid to the farmers prior to production is not adjusted against the sale price of mango at the time to final settlement of account (boxes) with the farmers in the month of June. The CA was not ready to reveal their margin. The strong inter linkages between marketing and credit (advance payments) is visible in the study area. However, their relationship is weakening with increase of Kisan Credit Card (KCC) and awareness of the farmers about other markets as reported by some of the CAs and farmers.

7.14. Efficiency of Marketing Channels

Due to the presence of Commission Agents (CA) and Wholesalers (WSs,) and Retailers, the cost per kg gets multiplied and the burden is ultimately borne by the consumer, in the form of higher prices. Similarly, this increased expenditure on the items of marketing, other than production, also resulted in the reduction of producer's share in consumer's price. In Table 7.5, the per cent share of expenditure in the price of 1 kg of mango paid by the consumer is 26.17 per cent under production cost, 9.83 per cent towards cost of packing, 10.43 per cent towards transportation and 13.57 per cent towards commission and hamali charges, thus leaving 40 per cent of the consumer price towards share (margin/surplus) of the farmers. It is

entirely the producer's surplus as the cost of production is already taken into account. The price spread being Rs.18 and farmer's share in consumer's rupee (price) being only 40 %., marketing efficiency is low (Table 7.5). The marketing efficiency can be increased by reducing the interference on the commission agents, thereby lowering the intermediate cost (Table 7.5).

7.15. Arrival and Price of Kesar Mangoes in Aurangabad

The commission agents and traders charge commission from mango growers for marketing the produce. There is no standard procedure for charging commission. However, in APMC markets, there are approved rates for charging commission by agents. Farmers were spending about Rs. 3, on an average, for marketing one "petti" of Kesar mango in Aurangabad Market**.** Arrival and Price of Kesar Mangoes in Aurangabad is presented in Table 7.6:—

Table 7.6: Arrivals and Price of Kesar Mangoes in Aurangabad during 2004 to 2006

(Arrivals in metric ton and modal price in Rs. per quintal)

Year/ Month	2004		2005		2006
	Arrivals	Modal Price	Arrivals	Modal Price	Arrivals
March	25.00	556.43	13.30	1077.22	14.90
April	174.50	603.42	65.40	819.74	55.70
May	137.10	673.68	86.80	653.41	182.20
June	129.00	650.00	141.10	591.35	180.00
A.A.P@	----	634.49	--	678.71	---

Source: Field Data, @ AAP= Average Annual Price

It is observed from Table 7.6 that there is substantial increase in the modal prices during 2006. Modal price is the price in a distribution that occurs most frequently.

7.16. Marketing Cost and Average Price Realized by Farmers in Kesar Mango in Aurangabad

Weighted average costs for annual maintenance and marketing of the produce of a tree has been arrived at Rs. 337 and Rs. 495 respectively (Table 7.7). The mango grower realizes a net income of Rs. 13 per kg, which includes cost of own labor and supervision. The details of expenses incurred and income derived by the farmers are critically analyzed in the table 7.7.

Table 7.7: Cost Incurred and Price Realized by Kesar Mango in Aurangabad, Maharashtra

Particulars	Age of Orchard (Years)		
	Less than10	10-15	Above 15
Total No. of Fruit Bearing Trees with the Farmers	448	1505	1762
Annual Maintenance Cost per Tree (Rs.)	298.50	631.83	378.00
Cost of Marketing per Tree (Rs.)	344.67	567.67	731.00
Grand Total of Annual Cost per Tree (Rs)	643.17	929.50	1109.00
Average Production per Tree (Kg)	48.67	71.67	85.00
Average cost per kg in (Rs.)	13.17	12.67	13.00
Weighted Average Sale Price Realized per kg (Rs.)	26.50	26.00	27.00
Weighted average of per Kg Share of Farmers in the Sale Price (Rs.)	**13.00**	**13.17**	**14.00**

Source: Field Data

The expenditure towards annual maintenance in case of Kesar mango per tree is less than that of Alphonso mango tree. The average annual maintenance for Kesar mango tree is Rs. 337 as against Rs. 628 for an Alphonso tree. Further, marketing cost in respect of Kesar mango at Rs. 19 per petti of 2.5 kg i.e. Rs. 8 per kg is much less in comparison to that of Alphonso mango at Rs. 162 per petti of 16 kg i.e. Rs. 10 per kg. However, due to variation in yield, the Kesar mango growers get a net surplus of Rs. 13 per kg whereas the same in respect of Alphonso mango was Rs. 12 per kg (Table 7.7 and Table 7.4).

7.17. Marketing Expenses and their Share in the Price of One Kg of Kesar Mango

The expenditure incurred for production and marketing of one kg of Kesar mango and percentage share of each item of expenditure are shown in Table 7.8.

Table 7.8: Marketing Expenses and their Share in the Price of One Kg of Kesar Mango

Factors of Production	PC&L	CP&L	Transp	Com,&H	SPR	FS
Amount (Rs) in price of 1 kg	5.27	4.66	1.77	1.30	26.00	13.00
Percent share in price of 1 kg (%)	**20.27**	**17.93**	**6.81**	**5.00**	**-**	**50.00**

Source: Field Data, Note: PC&L= Production Cost and Labor, CP&L= Cost of Petti and Labor, Com. &H= Commission, Hamali etc, SPR= Sale Price Realized, and FS=Farmer's Surplus

Table 7.8 indicates that marketing expenses is almost one and half times more than the annual maintenance cost of tree. There is hardly any scope for reduction under 'Production Cost' and 'Cost of Petti', 'Packing Charges', etc. However, the transport cost can be minimized by opening market centers in the locality or district head quarter. Therefore, provision of marketing outlets locally may increase the share of the primary grower in the ultimate sale price (Table 7.8).

7.18. Relationship between Price and Arrivals of Mango

The mango produced in the state is mainly marketed in urban centers, i.e. Vashi, Pune, Nasik, Nagpur and Aurangabad. Besides, it is being marketed in Surat, Bangalore and Hyderabad. Mango in the state is mostly harvested and marketed during March to July. The trend in price of mango is simply reflective of its market arrivals, which in turn entirely depends on plucking of matured fruits from the trees as mango has a very short shelf life.

The correlation and regression analysis has been drawn to establish relationship between the price of mango and arrivals in some of the markets in Maharashtra. This relationship was established for major markets of Aurangabad and Kolhapur for which reliable and comparable data are available on daily basis. Daily basis data were considered more relevant than aggregated weekly and monthly data.

The daily data on peak season (March to May) is taken into account for the three years 2004, 2005 and 2006.In Aurangabad, Kesar variety of mango is grown and in Kolahpur division mainly Alphonso is grown. This comparison also is based on ground level prices and arrivals of Alphonso and Kesar mango. As these are the major representative markets, the trends and conclusions are more or less applicable to the rest of the markets of Maharashtra. The results are given in the Table 7.9:-

Table 7.9: Relationship between Prices and Arrivals of Mango in Maharashtra

Market	Year	Period	CRC@	Constant (a)	PC** (b)	DF #	R^2
Aurangabad	2006	Ma-May	-0.5095	1755.68 (3.62)*	-0.61(-.14)*	49	0.26
	2005	Ma-May	-0.6308	860.52 (4.24)*	-0.69(-6.14)*	57	0.4
	2004	Ma-May	0.1578	156.24(0.31)	0.81(1.12)	49	0.02
Kolahpur	2006	Ma-May	-0.215	2148.35(0.98)	-0.47(-1.88)	73	0.05
	2005	Mar-Apr	-0.2196	1339.91(0.61)	-0.25(-0.87)	15	0.05
	2004	Ma-May	-0.5139	11185.75(3.98)*	-0.58(-3.00)*	25	0.26

Source: Prices and arrivals data from http//agmarknet.nic.in (cmmdatrep.asp), Note-figures in brackets are "t" values and * indicates significance at 99 % level, @ indicates =Correlation Coefficient (CRC), **denotes price coefficient (PC) t and # shows degree of freedom (DF).

In case of Aurangabad market, the regression coefficient of price is negative and stastically significant in 2005 and 2006 while it was positive but not significant in 2004. In Kolahpur market, the regression coefficient of price is negative in 2004, 2005 and 2006 though it was statistically significant in 2004 only. Hence, these estimated equations largely substantiate the inverse relationship between arrivals and price. In the event of more arrival, there is a fall in market price. During the study it was gathered that farmers try to disperse supply and realize higher prices in different markets (Table 7.9).

7.19. Price of Mango in West Bengal

As stated earlier, the wholesale price of mangoes in Malda, West Bengal varies considerably because of prevalence of various factors. There is no uniform pattern for price quotations. Thus the sale of mangoes, both in wholesale and retail trade, varies from place to place, causing difficulty in comparing prices in different markets. However,

an attempt has been made to record the maximum and minimum price of different varieties of mango in Malda during 2004 to 2006 (**Annexure 7.4).** It is revealed from the data in Annexure 7.4 that Amrapali mango fetched highest price at Rs. 1500 per quintal, followed by Himsagar at Rs. 1300 per quintal, Langra at Rs. 1200 per quintal and Laxman / Gopalbhog Rs. 1000 per quintal during 2004. Price realized for Amrapali mango, however, reduced to Rs. 1300 per quintal in 2005 and 2006. The same trend was noticed in other varieties also (Annexure 7.4).

Chapter - VIII

Economics of Mango Orchards

This chapter deals with farm economics of Mango cultivation based on sample borrowers in selected districts viz. Chittoor and Krishna districts of Andhra Pradesh, Sindhudurg and Aurangabad districts of Maharashtra and Malda and Murshidabad districts of West Bengal.

8.1. Economics of Mango Orchards in Chittoor and Krishna Districts, Andhra Pradesh

The economics of mango orchards in the selected districts of Andhra Pradesh (Chittoor and Krishna districts aggregated) is presented in Table 8.1:

Table 8.1: Yield, Cost of Investment, Cost of Maintenance and Net Income of Mango per Hectare in Andhra Pradesh in 2005-06

Particulars/ Age (Years)	1-5	6-14	15-35
1.Yield (MT/ ha)	0	6.5	12.5
2.Selling Price (Rs./MT)	0	4500	4500
3. Gross Income (Rs./ ha)	0	29250	56250
4.Cost of Investment/Capital Cost (Rs./ha)	62500	0	0
5.Cost of Maintenance (Rs./ ha)	0	13750	13750
6.Net Income (Rs./ha)	**-62,500**	**15,500**	**42,500**

Source: Field data

Taking into account Chittoor and Krishna districts together the average annual yield of mango stood at 6.5 metric ton per hectare in the age group of 6 to 14 years, while the stabilized yield was recorded at 12.5 metric ton per hectare for orchards having attained the age of 15 to 35 years. Annual gross income in 2005-06 worked out to Rs. 29500 per hectare and Rs. 56500 per hectare in the lower (6-14 years) and higher age (15.35 years) respectively. The annual net income earned in 2005-06 was Rs.15500 per hectare and Rs. 42500 per hectare respectively. The entire capital cost would be covered in four years after the sixth year, if the borrowers resort to own fund.

Otherwise, the amount would be capitalized in the event of institutional finance.

8.2 Economics of (Alphonso) Mango Orchards in Sindhudurg District, Maharashtra

Attempt has been made to assess annual net income accrued per hectare in Alphonso and Kesar varieties of mango in Sindhudurg and Aurangabad districts, respectively (Tables 8.2 and 8.3).

Table 8.2: Yield, Cost of Investment, and Cost of Maintenance and Net Income of Alphonso variety of Mango per hectare in Sindhudurg of Maharashtra in 2005-06

Particulars/ Age of Orchards (Years)	1-5	6-14	15-35
1.Yield (MT/ ha)	0	4.52	4.73
2.Selling Price (Rs./MT)	0	30,000	29,200
3. Gross Income (Rs./ ha)	0	1,35,600	1,37,643
4.Capital Cost (Rs./ha)	1,84,996	0	0
5.Cost of Maintenance (Rs./ ha)	0	35,401	35,886
6.Cost of Marketing (Rs. /ha)	0	45,116	48,059
7. Total Cost(4+5+6)	1,84,996	80,517	83,945
6.Net Income(Rs./ha)	**-1,84,996**	**55,024**	**53,698**

Source: Field data

Net income from Alphonso variety in Sindhudurg district was assessed as Rs. 55,024 per ha in 2005-06 for orchards aged 6-14 years and Rs. 53,698 per ha. in 2005-06 for orchards aged 15-35 years.

8. 3. Economics of Kesar, Mango Orchards Aurangabad District, Maharashtra

Average yield of Alphonso mango was higher than Kesar. It was 4.5 MT/ ha compared to 3.46 MT / ha during 6 to 14 years. However, the stabilized yield of Alphonso mango during 15 to 35 was lower at 4.73 MT/ ha as against Kesar mango (4 .88 MT/ ha). The annual net income earned per hectare was higher (Rs. 55,024 /ha) in case of Alphonso mango than Kesar mango (Rs. 44,773 /ha) during tender age. During adult period, Kesar mango earned higher net income at Rs. 67,993 / ha compared to Alphonso mango at Rs. 53,698 / ha. (Tables 8.2 and 8.3)

Table 8.3: Yield, Cost of Investment, Cost of Maintenance and Net Income of Kesar Variety of Mango in Aurangabad per Hectare

Particulars/ Age of Orchards (Years)	1-5	6-14	15-35
1.Yield (MT/ ha)	0	3.46	4.88
2.Selling Price (Rs./MT)	0	26,000	27,000
3. Gross Income (Rs./ ha)	0	89,960	1,31,760
4.Capital Cost(Rs./ha)	1,36,244	0	0
5.Cost of Maintenance(Rs./ ha)	0	18,996	21,735
6.Cost of Marketing(Rs./ha)	0	26,229	42,033
7. Total Cost (4+5+6)	1,36,244	45,225	63,767
6.Net Income (Rs/ha) {3-7}	**-1,36,244**	**44,773**	**67,993**

Source: Field data

8.4 Cost and Revenue per hectare of Model Orchard (50 Tree) in Malda District, West Bengal

Cost and revenue per hectare of Model Orchard (50 tree in Malda district) is given below

Net income accrued by Fazli variety of mango was Rs. 2,96, 000 per hectare followed by Langra at Rs. 2,81,500 per ha., Himsagar at Rs. 1,87,500 per ha. and Laxmanbhog, Rs.1,20,000 / ha.

Table 8.4: Cost and Revenue per hectare –Model Orchard of Unique Variety (50 Trees /ha) in Malda, West Bengal

Variety	PT(Qtl)	TP(Qtl/ha)	FGP (Rs./Qtl)	TCO(Rs./ha)	R(Rs./ha)	NI(Rs./ha)
1.Aswina	8	400	725	30,000	2,90,000	74,000
2.Fazli	9	450	725	30,000	3,26,250,	2,96,000
3.Langra	7	350	890	30,000	3,11,500	2,81,500
4.Himsagar	5	300	725	30,000	2,17,500	1,87,500
5.Laxmanbhog	5	250	600	30,000	1,50,000	1,20,000
6.Gopalbhog	5	250	550	30,000	1,37,500	1,07,500

Source:—Field data, Note—PT= Production/Tree, TP=Total Production, FGP=Farm Gate Price, TCO=Total Cost of Operation, R=Revenue, NI=Net Income

8.5 Capital Cost / Investment Cost / Cost of Establishment of Andhra Pradesh

The cost of investment of mango orchard was estimated at reference year prices (2005-06) rather than at historical prices since majority (73%) of the sample mango orchards were of more than 15 years of age and as such reliability of the historical cost would be questionable as it is fraught with memory recall bias and the farmers do not maintain any records of expenses made by them. The cost of investment of the mango orchards in the sample district, on an average, was estimated at Rs. 31,750 per hectare during first year (Table 8.5). The total cost of investment (Rs. 31,750 as initial investment and maintenance cost of Rs. 30,750 per year till fifth year) is reported at Rs. 62,500 depending, upon the quality of soil, irrigation and planting material (Table 8.5).

Table 8.5: Average Cost of Establishment of Mango Orchard during First Year (per hectare) in Andhra Pradesh

Particulars	Average Amount (Rs.)	Share (%)
Land Preparation	6,250	19.69
Manures and Fertilizers	6,000	14.90
Plant Protection	3,000	9.45
Planting Materials	3,125	9.84
Implement*	1,750	5.51
Fencing	3,125	9.84
Intercropping	4,750	14.96
Irrigation	2,250	7.09
Miscellaneous	1,500	4.72
Total	**31,750**	**100.00**

Source: Field data * Expenses on sprayers and other implements used

8.6 Cost of Maintenance of Mango Orchards (From 10 th year onwards) in Andhra Pradesh

Manuring, plant protection and irrigation are the major components in the maintenance cost, apart from the labor charges for various cultural operations such as weeding, input application, training,

pruning, etc.. The annual maintenance cost per hectare of full grown mango orchard (from 10 th year onwards) has been worked out to Rs. 13750. (Table 8.6):

Table 8.6: Cost of Maintenance of Sample Mango Orchards in Andhra Pradesh (2005-06)

Particulars	Average Amount(Rs./ ha)	Share (%)
Labor	3500	25.45
Manures and Fertilizers	4250	30.91
Plant Protection	2000	14.55
Irrigation	2500	18.18
Miscellaneous	1500	10.91
Total	**13750**	**100.00**

Source: Field data

8.7 Gross and Net Income of Mango Orchards in Andhra Pradesh

The average yield of mango varies from orchard to orchard depending on the climate, soil texture, cultivation practices adopted etc.. In case of sample mango orchards in the study districts, the average yield was reported at 12.5 MT/ hectare in a stabilized orchard of 15 years and above. Considering the same yield, the economics of mango orchards has been arrived at for the average situation presented in Table 8.7.

Table 8.7: Gross and Net Income from Sample Mango Orchards in Andhra Pradesh

Particulars	Amount (Rs.)
Gross Returns @average yield of 10 metric tonnes per hectare and selling price of Rs. 4,500 per tonne	56,250
Annual Cost of Maintenance	13,750
Net Income	42,500

Source: Field data

8.8 Cash Flow Statement of Mango Orchards of Andhra Pradesh

The economics of mango orchards in the sample districts was worked out with the following assumptions as assessed during the study:-

- Since the sample mango orchards were established without replacing any other crop, the pre development income of these lands was assumed to be zero.
- The mango orchard starts yielding from the sixth year onwards and stabilized yield is obtained from 15 th year up to 35 years.
- The costs of maintenance of a mango orchard in the early years of planting is less than the matured orchards i.e. viz, Rs 10,000 per hectare (6th / 7 th year), Rs 11,250 per hectare (up to 9 th) , Rs 13,750 per hectare (from 10th year). Variation is due to increase in nutritional and inter cultural requirements. The cash flow statement in Mango orchard is brought out in the Table 8.8**.**

Table 8.8: Cash Flow from Cultivation of Mango Orchard per hectare

Item	Year									
	1-5	6	7	8	9	10	11	12	13	14
Yield**	0	2.0	3.75	5.00	6.25	7.50	8.75	10.00	10.00	11.25
Gross income*	0	9000	16875	22500	28125	33750	39375	45000	45000	50625
TC	62500	10000	10000	11250	11250	13750	13750	13750	13750	13750
NI	-62500	-1000	6875	11250	16875	20000	25625	31250	31250	36875

Source: Field data , Note *= @ Rs 4500 per ton, **= Metric ton per hectare, NI= Net income, T.C.= Total Cost

The farmers in Chittoor district were of the opinion that the recurring drought for the third consecutive year, viz., 2002-03, 2003-04 and 2005-06, had affected the economics of existing mango orchards (Table 8.8).

8. 9 Economics of Alphonso Mango in Sindhudurg District, Maharashtra

(i) Capital Cost

The investment cost for raising Alphonso mango orchard is incurred

during the initial five years of plantation. Such costs for cultivating the orchard in one hectare of land are given Table 8.9.

Table 8.9: Investment Cost per hectare of Alphonso Mango (in Rs.)

Year 1	Year 2	Year 3	Year 4	Year 5	Total 5 Years
79,408	34,674	34,676	19,228	14,936	1,84,996

Source: - Field data

(ii) Maintenance Cost

Maintenance cost for initial five years has been capitalized. Thereafter, the cost of maintenance keeps on increasing every year. However, for the purpose of arriving at the economics, the maintenance cost is grouped by taking account of the mean average maintenance cost. The details of maintenance expenses for raising one hectare of Alphonso mango orchard are given in Table 8.10.

Table 8.10: Cost of Maintenance per hectare of Alphonso Mango Orchard (in Rs.)

Year	6 to 10	11 to 14	15 onwards
Cost (Rs./ ha)	25, 104	25, 146	62, 760

Source: - Field data

8.10 Cash Flow Statement of Alphonso Mango Orchards in Sindhudurg District, Maharashtra

The cash flow statement for Alphonso mango orchard has been prepared on the basis of the following assumptions and information.

1. The capital cost has been taken as per actual basis during the initial five years. It works out to Rs. 1, 84,996 per hectare for 5 years. (Table 8.9)

2. The annual maintenance cost is Rs. 573 per tree for trees of 6 to 15 years old. The same for trees of more than 15 years old is Rs.641 per tree. Thus, the average annual maintenance cost comes to Rs. 628 per tree.

3 Income has been taken as stable from 15 th year onwards. The income during 6 th, 7 th, 8 th, 9 th, 10 th to 15 th year has been taken on the basis of actual yield and current price.

4. Net income has been arrived at after subtracting maintenance cost and marketing cost from the gross income.

5. The economic life of the mango tree has been considered as 35 years, though it continues to give yield until it reaches an age of about 100 years.

6. The salvage value of orchards, being very low when considered for a period of 35 years has been ignored.

7. Most of the Alphonso orchards in the state were raised in the 1980s under various schemes of state government and each item of expenditure was subsidized to a large extent. Therefore, subsidy component is ignored while computing internal rate of return (IRR) in the model projects.

8. The orchards are being developed in hitherto unused lands/ barren lands. The pre- development income being negligible in the project area, the same has not been taken into consideration.

The Cash Flow Statement of Alphonso Mango Orchard is given in **Annexure 8.1.** The facts that generation of income from the orchard starts from the sixth year of plantation and that income stabilizes from 15 year onwards are evident from the Annexure 8.1.

8.11 Cash Flow Statement of Kesar Mango in Aurangabad District

The cash flow statement of Kesar mango orchard in Aurangabad, Maharashtra is depicted in **Annexure 8.2**

(i) Capital Cost

The investment cost for raising Kesar mango orchard is incurred during the initial five years of plantation. Such costs for cultivating the orchard in one hectare of land are given in Table 8.11.

Table 8.11: Investment Cost per hectare of Kesar Mango (in Rs)

Year 1	Year 2	Year 3	Year 4	Year 5	Total 5 Years
44,649	18,118	21,005	24,615	27,857	1,36,244

Source: - Field data

(ii) Maintenance Cost

Maintenance cost for initial five years has been capitalized. Thereafter, the cost of maintenance keeps on increasing every year. However, for the purpose of arriving at the economics of orchard, the maintenance cost is grouped by taking account of the mean average maintenance cost. The details of maintenance expenses for raising one hectare of Kesar mango orchard are given in Table 8.12.

Table 8.12: Cost of Maintenance per hectare of Kesar Mango in Maharashtra

Year	6 to 10	11 to 14	15 onwards
Maintenance Cost (in Rs./ha.)	21,029	36,800	52,752

Source: - Field data

8.12 NPW, BCR and IRR for Mango Orchard per hectare in Selected Districts of Andhra Pradesh and Maharashtra

The mango orchard in the selected districts was viable with the present level of yield, cost and price. The financial rate of return (IRR) worked out to 20.83 per cent (Table 8.13).

Table 8.13 : NPW, BCR and IRR of Mango Orchard per hectare

S.N.	Particulars	District	
		Chittoor	Sindhdurg
1	Present Worth of Discounted Cost (PWC) at 15 % discount factor (Rs. per hectare)	1,06,382	4,11,429
2	Present Worth of Benefit (PWB) at 15 % discount factor (Rs. per hectare)	1,26,248	4,52,275
3	Net Present Worth (NPW) Rs. per hectare	19,866	45,846
4	Benefit Cost Ratio (BCR)	1.19	1.11
5	Internal Rate of Return (IRR (%)	20.83	17.66

Source: Field data

It is evident from the Table 8.13 that NPW registered the highest value at Rs 1,25,534 per hectare for Aurangabad district compared to Sindhudurg (Rs. 45,846 /ha) and Chittoor districts . (Rs.19,866/ha). The internal rate of return (IRR) was more than 15 per cent for all the sample orchards and as such the investment in mango is financially viable (Table 8.13).

8.13 Sensitivity Analysis of Sample Orchards in Sindhudurg and Aurangabad Districts of Maharashtra

Since there are wide fluctuations in production and price of mango as per the grass root level situation in the study area, sensitivity analysis was attempted by increasing cost by 5 per cent and decreasing benefit by 5 per cent. Table 8.14 shows the details.

Table 8.14: NPW, BCR and IRR of Mango Orchard per Hectare under Sensitivity Analysis

Sr No.	Particulars	Mango Variety
		Alphanso
1	Present Worth of discounted Cost (PWC) at 15% discount factor (Rs./ha))	4,32,000
2	Present Worth of Discounted Benefit (PWB) at 15% discount factor (Rs /ha)	4,34,411
3	Net Present Worth (NPW) Rs. per hectare	2,411
4	Benefit Cost Ratio (BCR)	1.01
5	Internal Rate of Return—IRR (%)	15.15

Source: Field data

Under the sensitivity analysis, the BCR is more than one in both Alphonso and Kesar variety of mango. Thus, the investments in these varieties are beneficial. Similarly, the IRR at 15.15 per cent and 20.82 per cent, respectively stand the test of sensitivity analysis. It is more than the threshold limit of 15 per cent reckoned for opportunity cost of capital (Table 8.14).

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Chapter -IX

Technical Aspects and Economics of Mango Processing

This chapter describes the processing aspects of mango, value chain involved in processing, economics of mango processing, problems associated with mango based products etc. An attempt is made to work out economics based on field data collected in three states and examine mango processing units in the light of the survey conducted in Chittoor district of Andhra Pradesh.

In Andhra Pradesh, 90 per cent of mango orchards are having Baneshan (Banganapalli) variety, which is not a pulp variety. Of the remaining 10 percent area, most of it is occupied by Totapuri, also called as Collector and Subarnarekha, which are suitable for pulp extraction. It is estimated that only 6 per cent of the total mango production is processed. Mangoes are processed into various types of products as explained below.

9.1 Raw Mango Products: Pickle, Amchoor, Mango slice and Green Mango Beverage

For pickles, the fruits are peeled, sliced into small pieces and mixed with 20 per cent salt, 7.5 per cent chilly powder, and 1 per cent asafetida on weight basis. Spices are then mixed in it and the slices dipped in boiled cool oil. The whole mixture is then kept for few days with frequent stirring and then filled in clean glass jars. Mango slices from peeled mangoes are dipped in solution of potassium meta-bisulphate (1.5%) for 5 minutes and dried in sun or solar dehydrator. Amchoor is obtained by grinding the dried slices. Raw mango slices are dipped in 1.5 per cent potassium meta-bisulphate solution for 5 minutes, drained, mixed with equal amount of powder salt and stored in polythene pouches. These slices could be used later for the required food/ product preparation.

Whole raw mangoes are boiled with equal amount of water and pulp is extracted to one kg of extract, 1.6 kg sugar, 1.6 liter water, 80 gram salt, 20 gram mint, 10 gram cumin, 4 gram black pepper and 20 gram citric acid are mixed. The mixtures is heated and filled in clean glass bottle. It may be used as raw mango squash, a modified version of 'Panna'.

Ripe Mango Products: Pulp, Mango Jelly, Beverages, Squash, Mango Leather

Fully ripe mangoes are washed, peeled and cut into slice. The slices are then homogenized into pulp, which is filtered through a sieve to remove the fibre. The pulp is heated to 76-78^0 C and to two gram citric acid and gram potassium meta-bisulphate are added per kg of pulp. It is filled in sterilized glass/jars and the lids are sealed with wax. For mango jelly, mango is cut into 6 to 8 slices, the bulky juice is sent to sieve, seeds are separated and thick mango juice collected in wooden pot. Sugar or jaggery is mixed in 1.4 proportion. The preparation is subject to natural drying process on bamboo-thatched beds. About 7 to 9 layers of juice are applied for natural drying every day and the process goes on for 25 days.

Mango juice may be prepared by mixing 1/3rd of fresh or stored pulp with 2/5th of water. Sugar and citric acid are added so that total soluble solid (TSS) and acidity of the product reach 15 and 3 per cent respectively. The mixture is heated to 95^0 C filled hot in clean sterilized bottle. The bottles are sterilized for 10-15 minutes, cooled to room temperature and stored. Squash is prepared by mixing 1 kg of pulp with sugar syrup (1 kg sugar in 750 ml water). The whole mixture is heated to 76-78^0 C and 25-30 gram citric acid is added to it. The prepared squash is filled in sterilized bottle and stored. The homogenized mango pulp is taken and potassium meta-bio-sulphate is added to it @ 2 gram/kg of pulp. The pulp is then spread on trays smeared with butter and sundry. The process is repeated so as to obtain a thickness of 0.60 to 1.25 cm. Finally the dried product is cut into pieces and wrapped in butter paper or polythene cellophane sheet. The different processing activities in the mango product chain are presented in Chart 9.1.

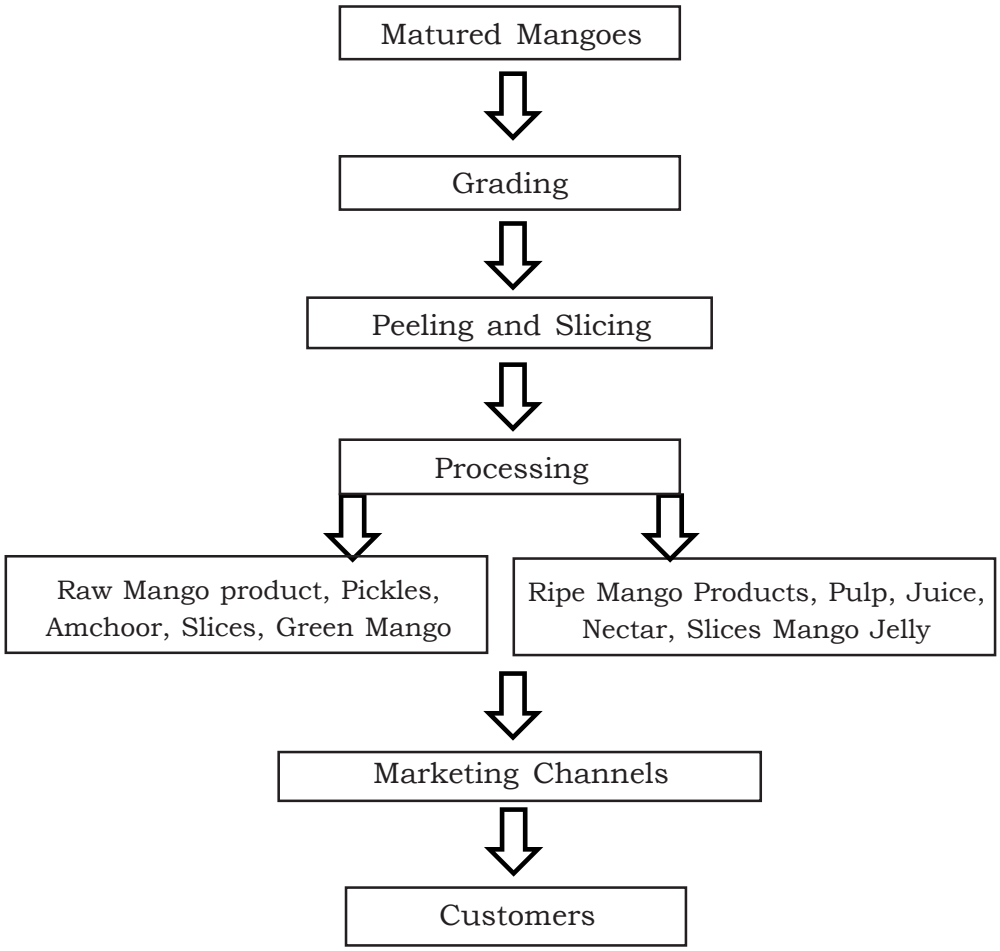

Chart 9.1 Different Processing Activities in Mango Product Chain

Waste Utilization—During mango processing, peel and stones are generated as waste, which is about 40 -50 per cent of fruit weight. They are rich in various nutrients and many value added products could be obtained from them. Good quality jelly grade pectin and edible fibre could be extracted from ripe mango peel. Mango peel, has lignocelluloses composition and hence its complete breakdown is difficult. Its decomposition depends on cow dung in 3: 1 ratio, which results in its successful biodegradation. Mango kernel contains high amount of fat and starch. The oil extracted from kernel is of good quality and could be used in cosmetic and shop industries. About 10 per cent alcohol could be obtained from mango kernel by co-culture fermentation.

9. 2. Mango Processing in Sample District of Andhra Pradesh

Major value products prepared from mango are pulp, pickles and jelly. These have been taken up as village and household enterprises in Krishna, East Godavari and Vishakhapatnam districts. Sunsip, Allana, Vinsari, Fruitech, Jain Irrigation, Galla Foods, and Capricorn Food Products are major processors of mango fruit pulp and these are concentrated in Chittoor district.

9.3. Manufacturing Process of Mango Pulp

A flow chart of process involved in preparation of mango pulp is presented in Chart 9.2

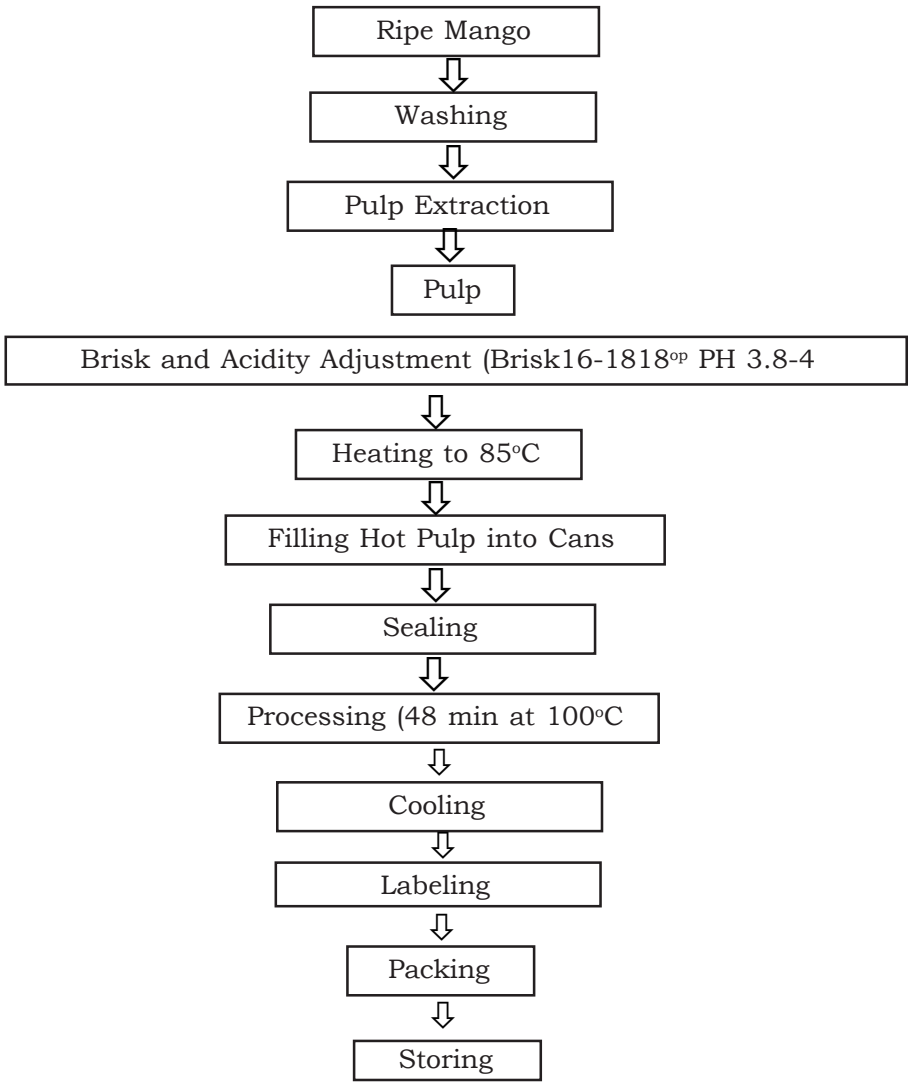

Chart 9.2: Flow Chart of Preparation of Mango Pulp

Once mango season starts, matured mangoes are brought from the market and are ripened in the ripening shed. Usually, fruits are ripened in about 7-8 days under tropical conditions. The usual practice is to place the fruits in single layers on paddy straw in closed but well ventilated rooms. The fruits become ripe uniformly in the temperature ranging from 19.4 ^{0} to 21.1 ^{0} C. The ripened fruits are then washed with water in tubs to remove the adhering impurities and dirt. The prepared mangoes are passed through pulper fitted with 30 mesh sieve to obtain the pulp. The pH of the pulp is adjusted to 3.8-4 by adding citric acid. It may also be sweetened so that a brix value of 16-18 ^{0} is attained, as per the requirement. Ascorbic acid if added to the pulp is helpful for retention of colour, flavor and carotene. The pulp is then heated to 85^{0}C and sterilized cans are filled with pulp. Thereafter, the cans are sealed, processed at 100^0 C for 45 minutes and cooled. Then the cans are moved to a store room where the cans are labeled and packed in card board cartons until they are lifted by the export houses/ agents.

9.4 Investment Cost and Pulp Making Unit in Andhra Pradesh

The indicative cost for establishing mango pulp canning unit with an installed capacity of 600 metric tons of pulp per annum is about Rs. 35 lakh, while for an aseptic packing unit the cost is estimated at Rs. 203 lakh (Table 9.1)

9.5. Costs and Returns of Processing Mango into Canned Pulp in Andhra Pradesh

The duration of operation of mango processing units depends on the varieties of mango processed and source of procurement. For example, if the unit processes only the Totapuri mango grown in Chittoor district, the fruits are available from the first week of June to the end of July (50-60days of operation). If the fruits of Totapuri are produced from Krishna District, the length of processing could go up by another 15 days (from 15 May). Similarly, those units, depending on the orders received from the export houses, may process Alphonso Mango, as the fruits are available from April end onwards from Karnataka. Thus, the operation of these units is seasonal. With a view to increasing the operational days and the profit ratios, some of the units have been exploring the possibilities of processing other fruits and vegetables, such as papaya, tomato, guava, etc.

Table 9.1: Indicative Investment Cost of Mango Pulp Units (2005-06)

Aseptic Packing Units		Per cent	Canning Units	
Particulars	Value (Rs.lakh)		Particulars	Value (Rs.in lakh)
Land Value –Lease	1.50	1.25	Land Value –Lease	0.10
Buildings	25.00	5.32	Buildings	15.00
Machinery	168.00	89.63	Machinery	15.53
a. Plastic Crates	0.30	0.16	a. Plastic Crates	0.13
b. Fruit Washer	2.50	1.33	b. Fruit Washer	2.00
c. Inspection Conveyor	1.80	0.95	c. Belt Conveyor	1.00
d. Screw Conveyor	2.00	1.06	d. Screw Conveyor	1.00
e. Pulper	2.50	1.33	e. Pulper	1.00
f. Roto Pump	1.00	0.53	f. RotoPump	0.75
g.Boiler	3.50	1.86	g. Boiler	3.00
h. Gen set	3.00	1.59	h.Kettles /Pasteurizer	2.45
i. Filtron Machine	2.00	1.6	i.Filling Tank &P. Lines	0.50
j. Star Asept	150.00	79.74	j. DS-24	0.50
ETP	8.00	4.25	. Retards	0.10
Total	**203.0**	**100.0**	l. Gen Set	2.15
			ETP	3.50
			Total	**34.88**

Source: Field data

The average annual operational cost of a 600 MT capacity pulp making unit was estimated to be about Rs. 105.7 lakh. The cost of production per metric ton and per kg of pulp worked out to Rs 12,858 and Rs. 12.86. The canned units reported gross income of Rs. 122.12 lakh and net income of Rs. 16.42 lakh .The profit margin was arrived at 15.53 per cent in case of canned pulp making units.Net profit to gross returns (sales) ratio was 0.134.

Table 9.2: Costs and Returns of Processing Mango into Canned Pulp

Item	Per 600 ton/unit	Per metric ton	Per cent to total	Per kg
A. Input Cost (in Rs):				
i.Mango	6570000	9825	76.41	9.13
ii.Sugar	1008000	1000	7.78	0.88
iii. Citric Acid	165000	93.8	0.73	0.09
iv. Labor	1260000	633.92	4.93	0.63
2.Utilities (Electricity, Diesel etc)	941864	784.89	6.10	0.62
3. Packing Material	*	*	*	*
Total Input Cost	9944854	11346.36	95.95	1139
B. Interest on working capital @13%for 6 months (Rs.)	625068	520.89	4.05	0.52
C. Total Cost (A+B) (Rs.)	10569932	12858.50	100.00	12.86
D. Gross Return (Rs)	12211922	14856.01	-	14.86
E. Net Return (Rs.)	1641990	1997.51	-	2.00

Source: Field data, * Supplied by Export houses

Packaging is an important component in canning. However, as all canned pulp units mostly do manual work and after receiving orders from various export houses, they need not incur any cost on packing. The export houses are supplying all materials for canning and packaging. Tin cans are made of thin steel plate of low carbon content lightly coated with tin metal. The cans are lacquered inside with acid resistance gold colored enamel to seal microscopic spaces on the surface of ordinary tin can. Depending upon the requirement of the export houses, the cans are manufactured in-situ in the processing units. Three sizes of cans namely 5.25 kg, 3.1 kg and 0.85 kg are extensively used by canning units for consignment (Table 9.2).

9.6 Various Profitability Ratios

Various profitability ratios have been computed and presented in Table 9.3. These ratios measure the efficiency of the activities of canning units thus, identifying operating problems and strengths. The ratio

of net profit to sales measures the earning capacity of canning firms. The ratio of expenses to sales indicates the extent of expenses that occurred in relation to sale and denotes the control of the management over the expenses. The ratio is indicative of the operational efficiency of canning firms. The high value of this ratio suggests that limited control is exercised over the expenses having negative implication for operational efficiency. The ratio of net profit to capital employed is a measure of return on investment and is a useful way of looking at the overall performance of the business. It indicates that performance can be improved either by generating more sales volume per rupee of capital employed or by increasing the profit margin of each rupee. However, the ratio (0.47) was not that encouraging for canning units. The capital intensity and limited scope of triggering demand for mango pulp posed difficulties in improving the ratio. Further, the narrow margin (15.53%) in canned units (% of manufacturing cost to gross value to production) is an area of concern, suggesting appropriate management of various costs for greater profitability (Table 9.3).

Table 9.3: Profitability Ratio of Canned Pulp Making Unit (2005-06)

Particulars	Value
1.Total Cost (Rs. lakh)	105.70
2. Gross Return/ Sales (Rs. lakh)	122.12
3. Net Profit (Rs. lakh)	16.41
4. Capital Investment (Rs. lakh)	34.88
5. Ratio of Expenses to Sales	0.87
6.Ratio of Net Profit to Sales	0.13
7.Ratio of Net Profit to Capital Investment	0.47
8. Capital Output Ratio	0.29
9.Capital/ Labor Employed Ratio	2.77
10. Manufacturing Cost as % to Gross Value of Production	86.79

Source: Field data.

9.7 Mango Jelly in East Godavari District of Andhra Pradesh

Mango jelly is an age old industry in East Godavari district. It is mostly a seasonal industry , functioning from May to July in a year.

Manufacturing of Mango Jelly Jelly is a semi solid product prepared by boiling a clear strained solution of pectin containing fruit extract free from pulp after the addition of sugar and acid. Pectin is the most important constituent of jelly. Usually, 0.5-1.0 per cent of pectin of good quality in the extract is sufficient to produce jelly. Pectin, sugar, acid, and water must be present approximately in the required proportion pectin 1, sugar 65-70 %, citric acid 1% and water 33.38%). The ripe mango fruits are cut into 6-8 slices by manual peeling. The bulky juice is sent for sieving. The sugar is sprinkled into fruit extract while it is boiling to ensure complete dissolution. Well prepared mango pulp is spread on clean bamboo mats to form a sheet of 2 mm thickness. The size of the mat generally used is 1.35 m x 1.35 m. On its drying another layer is spread over this and allowed to dry. About 7-9 layers of pulp are applied for natural drying. The dried slab is cut into required size and packed for marketing.

9.8. Economics of Jelly Making Unit in Andhra Pradesh

Generally, from one metric ton of ripe mango fruit, 350-400 kg of pulp used in jelly making is produced. The economics of sample jelly manufacturing units is presented in Table 9.4.

Table 9.4: Cost and Returns of Sample Jelly making Units (2005-06)

Particulars	Per unit (Rs lakh)	Per Kg (Rs)	Per cent
1. Input Cost (a-f)	2. 455	28.64	100.00
a. Mango	1. 500	17.50	63.31
b, Sugar	0.600	7.00	21.71
c. Labor	0.155	1.81	6.54
d. Consumables*	0.128	1.49	5.40
e. Depreciation	0.057	0.66	2.39
f. Interest	0.015	0.18	0.65
2. Gross Income	3.000	35.00	-
3. Net Income(2-1)	0.545	6.36	-

Source: Field data, * Mat, cloths, firewood etc.

Average cost of production in 2005-06 per manufacturing unit and per kg of jelly was worked at Rs 2.45 lakh and Rs 28.54, respectively. Net income has been arrived at Rs 54,500 per manufacturing unit at Rs 6.36 per kg. Cost of production constitutes 82 per cent of gross income. Net profit on cost was 22.1 per cent (Table 9.4).

Various profitability ratios are computed and presented in the Table 9.5:

Table 9.5: Profitability Ratio of Jelly Making Unit in Andhra Pradesh (2005-06)

Particulars	Value
1. Total Cost (Rs.)	2,45,510
2. Gross Return (Sales) (Rs.)	3,00,000
3. Net Profit (Rs.)	54,490
4. Capital Investment (Rs.)	85,000
5. Ratio of Expenses to Sales	0.82
6. Ratio of Net Profit to Sales	0.18
7. Ratio of Net Profit to Capital Employed	0.64
8. Capital Output Ratio	0.28
9. Manufacturing Cost as % to Gross Value of Production	81.84

Source: Field data

The ratio of net profit to capital employed (0.64) was encouraging for jelly manufacturing units that demonstrate efficiency in the use of capital with higher rate of return. However, profit margin (18.16%) in jelly making units needs to be further improved through appropriate management of various costs. (Table 9.5)

9.9 Mango Processing Units in Chittoor District of Andhra Pradesh

The mango processing activity gained momentum when an organized effort towards growth of a cluster was initiated during 1980 by M/S India Canning Center .This resulted in the establishment of 23 units between1981 and 1990. Subsequently, more units were established. As many as 56 units were installed between 1970 and 2006 (Naidu, 2002)

A wide range of investment has been made towards commissioning of mango units. The investment across different firms ranges from Rs. 1 lakh to Rs. 1600 lakh (Table 9.6)

Table 9.6: Investment Pattern of Mango Processing Units in Chittor

Sl.No	Range of Investment (Rs in lakh)	No of units	Per cent to total
1.	Up to 15	1	1.78
2.	15-30	3	5.35
3.	31-40	10	17.86
4.	41-50	10	17.86
5.	51-100	8	14.29
6.	101-500	8	14.29
7.	501-1,000	10	17.86
8.	1,001-1600	6	10.71
Total.		56	100.00

Source: Adapted Table 3 from KVReddy and Pramad Kumar's article, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June 2010, PP282

Graphic 9.1 Shares of Different Ranges of Investment Pattern of Mango Processing Units

About 11 per cent of the firms have an investment between Rs. 10 to 16 crore falling in the category of large enterprises. While 18 per cent of the firm have an investment range of Rs. 5 to 10 crore and fall in the size group of medium enterprises, the rest of the 72 per cent of the firms fall in the investment range of small and micro enterprises. The range of investment, however, is mainly associated with escalation of cost of investment rather than production capacity.

All the processing units in the district are covered under Fruits Products Order (FPO). The products such as pulp/ concentrate produced shall confirm to the FPO specifications as enunciated in Fruits Products Order, 1955; and Fruits Products Order, 1977.The large firms have also acquired HACCP certification. There are technological differences across the various size classes of firms.

9.10 Status of Export of Processed Mangoes in Chittoor District of Andhra Pradesh

There is an increasing trend in export of both mango fruits and mango pulps in terms of quantity and value. The export of mango pulp showed a quantum jump from 13 thousand metric tons in 1999-2000 to 120 thousand metric tons in 2006-07, revealing the importance of mango processing industry in the region. The low variability in the unit value realization in case of mango pulp as against the unit value realization of mango fruits seems to suggest the need for greater incentives for the processing sector. (Table 9.7),

Table 9.7: Export of Mango and Mango Pulp from Chittoor District, Andhra Pradesh

(Quantity in metric tons, Value in Rs. crore and Unit Value Price Rs. per ton)

Year	Fresh Mango Fruits		Mango Pulps		
	Quantity	Value	Unit Value	Quantity	Value
1999-2000	275	0.55	20,000	13,538	25.72
2000-01	288	0.53	18,403	14,487	28.00
2001-02	540	0.99	18,333	16,785	37.00
2002-03	760	1.67	21,974	20,410	45.00
2003-04	360	0.67	18,611	22,413	49.31
2004-05	580	1.16	20,000	26,224	57.69
2005-06	600	0.60	10,000	95,360	190.72
2006-07	200	0.20	10,000	1,20,200	264.44

Source: : Adapted Table 4 from KVReddy and Pramad Kumar's article, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June 2010, PP 283

9.11 Forward and Backward Linkages of Mango Processing Industry in Andhra Pradesh

The forward and backward linkages are very important from the point of view of farmers, processors and exporters. The mango processing industry is important for the economy of the Chittoor district and that of the country as it has better backward and forward linkages (Table 9.8)

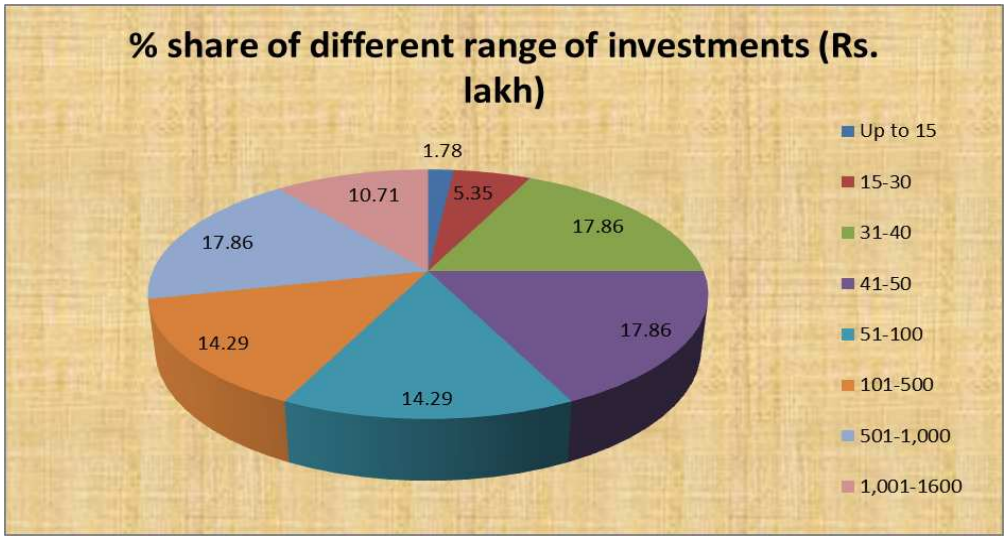

Table 9.8: Forward and Backward Linkages of Mango Processing Industry

Backward Linkages	P	Forward Linkages
Producer—Pre-harvest Contractor— Regulated Market ---------- Producer----Regulated Market---- Producer Distant Wholesale Market Producer------VillageTraders Producer--Unregulated Market	R 0 C E S S O R	Firm using Pulp as input-----Wholesaler of output Retailer - Consumer Firm using Pulp as input----Exporting Output Exporting Pulp Exporting Agencies---Exporting Pulp Wholesaler—Retailer-----Consumer

Source: : Adapted Figure I from K.V.Reddy and Pramad Kumar's article on article on " An Economic Appraisal of Mango Processing Plants of Chittor District of Andhra Pradesh", PP 284, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

The processing industry has backward linkage with six marketing channels basically to source the major raw materials i.e, mango pulp. Two of these channels are (i) Producer——Processor and (ii) Producer—Regulated market ——Processor, which account for 80 per cent of total raw material by processing firms.

The mangoes required for processing are supplied directly by the orchards. Normally, these orchards were owned by the promoters of the processing units. The traders located in the Mandies are another important source of raw material supply. There are four major market yards set up in the district exclusively for mango trading in the season, located at Kattamanchi, Bamalcheru, Tirupathi and Puttur.

The processing industry is forwardly linked with five market channels. Two of these five channels, i.e, (1) Processor——Exporting Pulp; and (2) Processor—Exporting Agencies—Exporting Pulp, account for about 85 per cent of the disposal of the mango pulp by the processors.

The small farms have lesser access to international market and depend heavily on the merchant exporters to export mango pulp on pre-contract basis. This has a bearing on the profitability of the processing units.

9.12 Economic Feasibility of Mango Processing Plants

Table 9.9 provides information on the capacity, investment and commodities processed by large scale, medium scale and small firms. The large scale firms processed different commodities namely mango, guava, papaya and vegetables. These firms work almost throughout the year, unlike medium and small scale firms, which are processing mango and guava fruits and work for three to four months in a year.

Table 9.9 Per Factory Capacity, Investment and Commodities Processed by Different Categories of mango Processing plants.

(Rs. in crore)

Particulars	Scale of Production	
	Large Scale	Medium Scale
1.Capacity (metric tones)	13,000	52,200
2.Capacity Utilized (per cent)	75	50
3.Fixed Cost	15.00 (57.87)	6.00 (60.98)
4. variable Cost	10.92 (42.13)	3.84 (39.02)
5. Total Cost	**25.92 (100.00)**	**9.84 (100.00)**
Commodities Processed	Mango, Guava, Papaya, Vegetables	Mango and Guava

Source: : Adapted Table 6 from the article on " An Economic Appraisal of Mango Processing Plants of Chittor District of Andhra Pradesh" by K V Reddy and Pramad Kumar, PP 285, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

9.13 Employment Details

Employment details are depicted in Table 9.10. The large firms employ a large number of workers i.e, 700. Small firms on the other hand employ only 256 workers. However, most of the employment is on a part time basis, the processing industry being a seasonal industry.

Table 9.10: Employment Details of Different Categories of Mango Processing Firms

Employment	Nature of Firms	
	Large	Medium
1.Executives	10	10
2. Managers	5	2
3. Workers (a) Full Time (b) Part Time	 100 600	 - 500
4. No. of Months Operational	10	5

Source: : Source: : Adapted Table 7 from the article on " An Economic Appraisal of Mango Processing Plants of Chittoor District of Andhra Pradesh" by K V Reddy and Pramad Kumar, PP 286, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

9.14 Cost and Returns As well as Profitability Ratios

The cost and returns for the various size classes of processing firms are summarized in table 9.11.

Table 9.11: Cost and Returns of the Processing Firms by Categories

Particulars	Large	Medium	Big
1. Mango Pulp (Tons) Avg/ unit	5959	2280	860
2. Revenue from Mango Pulp	1214.40	446.25	131.25
3. Revenue from Guava Pulp	55.24	51.00	30.00
4. Revenue from Papaya	34.50	-	-
5. Revenue from Vegetables	57.50	-	-
6. Total Revenue (2+3+4+5)	1361.60	497.25	161.25
7. Fixed Cost	1111.42 (84.45)	413.77(86.61)	123.12(82.10)
8. Variable Cost	209.25 (15.85)	63.96(13.39)	26.85 (17.90)
9. Total Cost (7+8)	1320.67 (100.00)	477.73	149.97
10. Net Return	40.93	19.52	11.25
Income Expenses Ratio			
a. Operating Ratio	0.82	0.83	0.76
b. Fixed Ratio	0.15	0.13	0.17
c. Gross Ratio	0.97	0.96	0.93
Capital Ratio			
a. Capital Turnover Ratio	0.91	0.83	0.81
b. Rate of Return on Investment	0.027	0.033	0.056

Source: Source: : Adapted Table 11 from the article on " An Economic Appraisal of Mango Processing Plants of Chittor District of Andhra Pradesh" by K V Reddy and Pramad Kumar, PP 288, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

It is observed that small firms produce 860 tons of mango pulp per unit whereas the large firms produce 5,995 tons. Total revenue generated, on an average, varies from Rs. 161.25 lakh for small firms to Rs. 1,361.6 lakh for large firms. Net revenue available for small firms was Rs. 11.25 lakh and Rs 40.93 lakh for large firms. Thus, the processing firms are profitable. The financial analysis ratios (income expenditure ratio and capital ratio) were computed to further understand operational efficiency of these firms. The operating ratio ranges from 0.76 for small firms and 0.82 for large firms. This signifies that in every rupee of gross income, a substantial portion of operational cost is incurred. The fixed ratio varies from 0.13 for medium firms to 0.17 for small firms. Relatively large share of gross income is used for meeting the fixed expenses. The gross ratio is less than one, signifying the efficient operation of firms. However, it is substantially high and varies from 0.93 for small firms to 0.97 for large firms. This reveals that a large portion of gross income is utilized for meeting the total expenses. It also reveals that small firms are more efficient than other size class of firms.

The capital turnover ratio ranges from 0.81 for small firms to 0.91 for large firms revealing that every rupee investment by small firms generates gross income of 81 paisa. This measure shows that large firms are more efficient than small firms. The rate of return on investment gives a better picture of efficiency. The value of rate of return on investment varies from 0.027 for large firms to 0.056 for small firms showing that every rupee of capital investment generates a net return of 3 paisa and 6 paisa. This measure shows that small firms are more efficient than large firms.

9.15 Feasibility of Mango Processing Units

All the three class of firms are feasible as per NPW and BC Ratio criteria. The BCR of small firms is higher than that of large firms for all discount rates. This reveals that small firms rank higher than large firms. Table 9.12 shows the details.

Table 9.12: Feasibility of Mango Processing Units

D.F(% age)	Large		Medium		Small
	NPW	BCR	NPW	BCR	NPW
10	679.5	1.07	159.1	1.04	129.6
12	399.5	1.04	66.8	1.02	86.4
15	72.4	1.01	-40.6	0.98	35.9
20	-219.5	0.96	-135.3	0.94	-9.6

Source: : Adapted Table12A from the article on " An Economic Appraisal of Mango Processing Plants of Chittor District of Andhra Pradesh" by K V Reddy and Pramad Kumar, PP 289, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

The feasibility of mango processing units used the criteria of internal rate of return (IRR) and payback period. The IRR of small firms (19.31%) is the highest followed by that of large firms (17.5%) and medium firms (13.87%). All three size class of firms are feasible as their IRR is greater than the opportunity cost of capital. Thus, the small firms rank the highest and the medium firms rank the lowest as per the IRR criteria. Table 9.13 depicts the details.

Table 9.13: Feasibility of Mango Processing Plants

Feasibility Measure	Large Firms	Medium	Small
IRR (%)	17.50	13.87	19.31
Payback Period (Years)	5.99	6.89	5.25

Source: Source: : Adapted Table 12B 6 from the article on " An Economic Appraisal of Mango Processing Plants of Chittor District of Andhra Pradesh" by K V Reddy and Pramad Kumar, PP 290, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

9.16 IRR, Pay Back Period etc.

The payback period explains the number of years in which the investment is paid back by the project. Investment in mango processing plant has least payback period for small firms (5.25 years) followed by that of large firms (5.99 years) and medium firms (6.89 years). The shorter payback period for mango processing plants provides an important opportunity for an entrepreneur.

The break even analysis helps the entrepreneur in taking managerial decisions as to what should be the level of operation of the firm. Both the variable cost of production and the output price per ton of processed products is the lowest in case of small firms and highest for the large firms (9.14). The large firms have access to the international markets; whereas the small firms depend on merchant exporters to dispose the product in the international market. The large firms adhere better to the quality standards demanded in the international market as compared to small firms. These are the major reasons for the differential in the output prices across the firm size groups.

9.17 Break Even Analysis

Table 9.14: Break even Analysis for Mango Processing

(in Rupees)

Particulars	Scale of Operation	
	Large Scale	Medium Scale
1. Price per ton of Processed products	22712.26	21889.21
2.Variable Cost of Processed Products/ ton	18539.16	18147.71
3. Money Terms (Break Even Point---BEP)	113885016	38096825.9
4. Quantity Terms—tons –BEP	5014.25	1746.82

Source: : Adapted Table 13 from the article on " An Economic Appraisal of Mango Processing Plants of Chittor District of Andhra Pradesh" by K V Reddy and Pramad Kumar, PP 290, Indian Journal of Agricultural Economics, Vol.65, No 2, April to June issue, 2010

The breakeven point for small firms (Rs. 113.54 lakh) is the lowest followed by medium firms (Rs. 380.97 lakh) and the large firms (Rs. 1138.85 lakh) respectively. The BEP in physical terms for small firms with 605.52 tons is the least followed by medium and large firms with production of 1746.82 tons and 5014.25 tons respectively. It is implied that the firm should operate at a level generating gross revenue and producing output above these values by the respective firm size classes, in order to be profitable.

Chapter - X

Post- harvest Management, Exports of Mango Based Products and Performance of Export Zone

The present chapter analyzes the post harvest management of mangoes for exports, and export performance of mango and mango based products.

10.1. Post Harvest Management of Mangoes for Exports

Mangoes are generally harvested at maturity and ripened for optimum quality. Fruits are handpicked and plucked with a harvester. The best way to observe maturity in mango is color of the pulp, which turns cream to light yellow on maturity. The harvesting needs to be done in the morning hours and fruits should be collected in plastic trays and kept in shades. The fruits harvested with 8-10 mm long stalks appear better on ripening as undesired spots on skin caused by sap burn are prevented. Such fruits are less prone to stem-end rot and other storage diseases. A simple, low cost and portable mango harvesting device has been propagated by AEZ, Krishna district costing Rs. 2,000, which is subsidized by 50 per cent. The post- harvest losses in mangoes have been estimated in the range of 20-30 percent from harvesting to consumption stage (Table 10.1).

Table 10.1: Post- harvest Losses of Mango at Various Stages and Other Crops in Andhra Pradesh

Stage	% Losses for Mango	Crop	% Losses
1.Field Level	10	Grape	25
2. Transport	5	Mango	20
3.Packing	2	Pomegranate	10
4.Storage	9	Sweet Orange	20
5. Processing	4	Banana	30
6.Total	30	Sapota	22
		Onion	25

Source: S. Mahendra Dev and N. Chandrasekhara Rao (2004), " Food Processing in Andhra Pradesh—Opportunities and Challenges", Working Paper No.75, June

Grading– In order to reduce value loss and to remove the field heat, the produce should be harvested during the coolest part of the day, i.e. in the morning. A preliminary grading is done immediately after harvesting at the field level. The mangoes are graded according to size and maturity.

Desapping– Matured mangoes exude large amount of sap from the cut stem. As the sap contain lots of resorcinol (oil), which burns the mango skin if contracted by the sap, the mangoes are desapped by placing them in framework in an inverted position for two hours to completely remove the sap from the fruit.

Processing– After the desapping process, the mango is processed in a post-harvest treatment line having following operations in a common facility center (pack house).

10.2 Post-harvest Operations

Pack house/ Grading and Packing Center

A pack house is a place where products are brought after harvesting, to prepare them as per market requirements, in terms of washing, brushing, waxing, grading, packing, cooling, etc. It also carries out value addition without modifying the appearance of the product. The shelf life of the product is enhanced by providing the congenial conditions. Keeping in view the variety of crops, two to three grading and sorting lines may be installed. After sorting, the produce is packed in various desired packs and pre-cooled. The operational steps in the pack house would be as under:

Sorting, Washing, and Cleaning — A preliminary storing of produce is carried out to remove un -marketable and foreign matter such as plant debris, soil, stone, etc. pieces before the produce is passed on for further operations. Cleaning and washing are carried out with flush of cold water to clean the produce, which has acquired latex stains from injures caused during harvesting.

Fungicide Treatment—— As decay caused by molds / bacteria is a major cause of loss of fresh produce during the period of transportation and marketing, fungicides are applied after the produce is washed and dried. The fruits are taken to a trough containing detergent and 0.5 per cent fungicidal solution. After treating the fruit with the detergent and diluted fungicidal solution (Binomial powder), the fruit is wiped off with muslin cloth till dirt and latex stains are completely removed.

After treatment with the fungicidal solutions, the fruit is dried with dry muslin cloth and spread on the grading table and air-dried.

Size, Grading and Waxing— The fruits so treated are finally graded according to the size, maturity and quality without any blemish. Selection and grading in a small packing house are best done by human eye and by hand and assisted by sizing rings. For long distance destination the fruit is treated with wax. The wax emulsion is kept in a vessel and a muslin cloth is soaked in it and applied on individual fruit. This is carried out to enhance appearance and limit water loss from produce.

Packaging— The fruit is packed in corrugated fiber boxes (CFBs) with necessary bursting and puncture resistance and compression strength. The specification details of CF boxes are recommended by APEDA.

Pre-cooling —- After packaging the mango in CF boxes, the packed "cartons" are placed in pre-cooling rooms where the temperature is set at 12.5^0 C with 90-95 percent relative humidity. Once produce is placed in pre-cool, it will radiate heat to the room by virtue of field heat and heat of respiration. As soon as the produce is brought to its optimum storage temperature, the respiration will be brought under control and the maximum storage life of the produce will be realized. It is observed that the fruit pulp temperature comes down from 35^0C to 12.5^0C in about six hours.

10.3 Cold Storage

After pre-cooling, the produce is brought to cold storage to extend its shelf life. The harvested fruits are pre-cooled to 10-12 ^{0} C and then stored in an appropriate temperature. The fruits of Dashehari, Mallika and Amrapalli are pre-cooled at 12^0 C and then stored at 8^0C with 85-90 per cent relative humidity. The fruits can be stored for 3-4 weeks in good conditions and at low temperature. The development of cold storages, including cold chain, for transport has an important role to play in reducing post-harvest losses. The bio chemical and microbial changes are slow at low temperatures. As such, refrigerated cold storages are used to prolong the shelf life of perishable produce. The fruits can be stored for 3-4 weeks in good condition at low temperature. The problem of chilling injury at low temperature can be overcome by keeping the fruits in 0.5 per cent ventilated polythene bags.

Transportation— The truck has been adopted as the most convenient mode of transport due to easy accessibility between the orchard and the market. However, these trucks are not found suitable for transporting these horticultural materials as they exert a lot of pressure on the fruits and do not have temperature control devices. Therefore, it is imperative to design and develop suitable transport system. "Refer containers" (Refrigerated vans) may be found useful for long distance transport and export purposes, as they would help in reducing the post harvest losses. The processes in post-harvest management of mangoes are depicted in Chart 10.1 below.

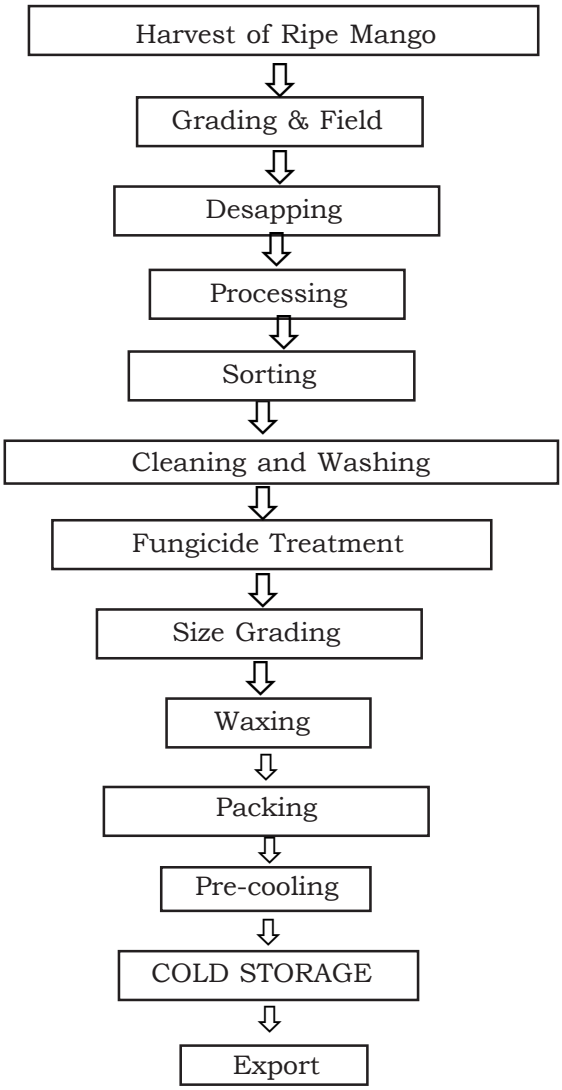

Chart 10.1 Flow Chart of Post –harvest Operations of Mango Export

10.4 Export Performance of Mango

Fresh Mango——As stated earlier, the quantum of fresh mango exported from India during 1987-88 was 20.30 thousand metric ton which has enhanced to 83.70 thousand metric ton in 2008-09. In terms of value realization, it was Rs. 23.24 crore in 1987-88 and Rs. 120.5 crore in 2008-09. Share of export to production was about 1.5 per cent.

Mango Pulp— As regards mango pulp, on an average, India exports about 105 thousand metric ton worth Rs. 390 crore.

Other Mango based Products— India's export of mango and mango-based products during 2004-05 registered a marginal growth of 6.62 per cent over the previous year. (Table 10.2).

Table 10.2: India's Export of Mango/ Mango based Products to Major Markets during 2002-03 to 2004-05 (Rs in Crore)

Country	2002-03	2003-04	2004-05	% change (2004-05 over 2003-04)
Saudi Arabia	103.96	86.82	103.12	18.77
UAE	66.88	69.09	54.72	-20.80
Netherland	42.41	40.50	49.16	21.38
Bangladesh	13.89	35.36	29.20	-17.42
UK	36.68	25.25	25.62	1.47
Kuwait	20.24	19.22	16.04	-16.55
Republic of Yemen	28.32	18.23	34.07	86.89
USA	19.44	17.14	15.38	-10.27
Japan	9.45	7.33	14.42	96.73
Nepal	8.07	6.15	5.66	-7.97
Lebanon	7.62	5.42	6.37	17.53
Oman	5.67	5.48	6.07	10.77
France	9.73	3.69	7.71	108.94
Total	**468.87**	**436.01**	**464.89**	**6.62**

Source: APEDA

Saudi Arabia continues to be the largest market for Indian mango and mango based products. Export to this market in 2004-05 registered a growth of 18.77 per cent over the previous year, when the same reached a level of Rs. 103.12 crore as against Rs. 86.82 crore in 2003-04. The other export markets showing a sharp growth during the period comprised: France (108.94%), Republic of Yemen (86.89%), Netherlands (21.38%), and Lebanon (17.53%). On the other, the countries representing decreasing trend during the period included: UAE (20.80%), Bangladesh (17.42%), and Kuwait (16.55%).(Table 10.2)

10.5 Export Prices of Mango and Mango Pulp

APEDA, since its inception in 1986, has been playing a major role in the export of Mango and Mango based products. They provide various services to trade and industry. These include identification of new markets, regular participation in both national and international trade fairs and also vigorous launching of promotional campaigns for mango and mango based products like mango pulp, juices, chutney and pickles. The computation of the ratio of domestic price (DP) at Chennai as collected from exporters in both the study districts to the international border prices (FOBP) shows that both mango pulp and fresh mango are highly price competitive in the international market. Table 10.3 shows the details.

Table 10.3: Export Competitiveness of Mango/ Mango Pulp

Items	Prices during 2005-06		
	FOBP at Chennai Port (US dollar)	Chenni (RS)*	DP (Rs) #
Fresh Mango—Alphonso	1820	80080	18000
Neelam	1000	44000	8000
Banganapalli	1600	70400	4500
Mango Pulp --- Totapuri	900	184186	23000
Alphonso	1050	214884	--
Raspuri	900	184186	23000

Source: Exporters from Chittoor and Vijawada, * Us dollar is converted to rupee @ Rs. 44 per US dollar, , # Standard price at which the processors procure mango from various Market YardsS in Chittoor and Vijayada.

Chapter - XI

Supply Chain Management and Credit Support

Supply chain management (SCM) represents the management of entire set of production, manufacturing/transportation, distribution and marketing activities by which a consumer is supplied with a desired product. The practice of SCM encompasses the disciplines of economics, marketing logistic and organizational behavior to study how supply chains are organized and how institutional arrangements influence industry efficiency, competition and profitability. One can also include the production practices in the field to understand food safety and traceability.

11.1 Supply Chain Management (SCM) of Mangoes in Andhra Pradesh

Supply Chain System (SCS) for mangoes covers a balanced and efficient relationship, encompassing input supply, production, harvesting, storage, processing, marketing, export etc. of mangoes. It also manages such relationship in a collaborative and efficient manner to garner optimum benefit.

Agri-Export Zone— Considering the existing production of mango and mango pulp as well as future potential for facilitating supply chain management, the AEZs for mango and mango pulp were notified in 2002. However, there is no significant development in linkages, both backward and forward and no breakthrough was made in developing quantity standard and post-harvest management for increasing exports. Number of mango pulp making units, production of mango pulp as also export of fresh mango and pulp have picked up in Chittoor AEZ. However, the infrastructure in terms of post-harvest facilities like pack-houses, cold storages, etc. has not come up to exploit the potential. In mango AEZ in Krishna district, as against the target of 25 pack-houses, only two pack houses have come up. Only one post-harvest facility is available at AMC, Vijaywada (Gollapudi). Export of fresh mango from Krishna district has always been below 500 MT per annum. Currently, export of mango by air cargo takes place in passenger air craft, due to which the freight charges are very high. There are mango growers' cooperative organizations and they have not been able to plan an organized production and marketing system. They have also not been able to reduce the marketing channels. These channels are so long, increasing margins to middlemen and thus

aggravating marketing efficiency. In order to facilitate the SCM, the Govt. of Andhra Pradesh had sanctioned a scheme for the promotion of export of mangoes through Mango Growers Cooperative Organizations'. As a part of the scheme, a cold storage plant was set up in 1993 as 'Post-Harvest Temperature Management Scheme' at AMC, Vijayawada. Export activities were taken up under the management of Marketing Department, Government of Andhra Pradesh during the initial years through "refer container" by sea and air. However, the progress on the export front was not that encouraging (Table 11.1).

Table 11.1: Performance of Post harvest Management Unit at AMC Vijaywada

Pried	Average quantity Exported (MT)	Average Service Charges Collected	Average. Expenses Incurred	Exported to Countries
1993-2001	143.82	1.70	7.33	Singapore, Dubai, Hong-Kong, Malays
2002-2006	124.20	0.61	5.81	

Source: Field data,

The AMC Vijayawada was charging nominal service charges from exporters. The unit has the facilities of one cold storage plant with 20 MT capacity, two pre-cooling units each with a capacity of 20MT. Vijayawada Association of Fruits and Vegetable Growers, consisting of 230 members in Vijayawada, has been engaged in the export of mangoes since 1994. They have been using the pack house and cold storage unit at Golapudi AMC. They use the protocol developed and given by Central Food Technological Research Institute (CFTRI) for export through central marketing fund of mango. Further, as the protocol for sea shipment has not yet stabilized, APEDA engaged a scientist from Belgium to develop a protocol for cases where more than 15 days sea journey is required. Vitas Company Export Private Limited, Chennai, visits AMC Gollapudi every year and also visits the mango orchards and purchases the fruits at the ripening stage. The graded mangoes are priced at Rs 15,000 per MT and are of good size and quality, labeled as "Garden Fresh Mangoes".

Marketing— In both the study districts, exclusive mango market yards are functioning for marketing of produce. There is also an excellent

network of traders, both local and up country, commission agents, etc. to assist the smooth flow of the product (fruit) from growers to final consumers. However, even though growers/ Traders Associations are informally functioning in both the districts, they have not taken up any initiatives to reduce the large margins made by the middle level functionaries. They have not made any attempt even to reduce the length of the marketing channels. Such growers associations have not made any visible attempt in creating awareness with regard to quality improvement in fruits. However, conduct of "Mango Festival" has been a regular affair in Chittoor district that creates a lot of awareness among the growers/ traders /processors on quality issues.

Growers'/ Processors' Federation——- In order to smoothen out the SCM for mango processing sector, 'Chittoor District Canners' Federation was formed during 1991. Later it was rechristened as Chittoor District Fruit Processors Federation. The Federation associated units in 'hazard analysis and critical control point' (HACCP) Certification with assistance from APEDA, modernization of cluster to Andhra Pradesh Industrial and Technical Consultancy Organization (APITCO), seek soft loan and subsidy with APEDA, Ministry of Food Processing Industry (MFPI), National Horticulture Board (NHB). The details of National Horticulture Mission are given in **Appendix–11.1.** In consultation with Pollution Control Board (PCB) and other technical institutes, the Federation helps the units in developing exact technology to treat liquid and solid affluent wastes.

The Federation of Farmers' Association (FFA), an authorized body to address the issues of mango growers, in consultation with the government of Andhra, managed to form six exclusive mutually aided cooperative societies (MACS) of mango growers of Chittoor District. The Agri-Terra of Netherland, through the FAO, the FFA and Horticulture Department of Andhra Pradesh has initiated the project and is helping the farmers to develop these cooperatives. The cooperatives are expected to result in an additional value of up to 20 per cent to the growers as they cut second-rung traders / commission agents from the supply chain, providing a direct inter face between the buyer and seller. Besides making it easier for companies to enter into agreements, these MACS are expected to strengthen the hands of mango growers. The tie-up would result in saving of transportation charges and market cess. The idea is to strengthen the supply chain and facilitate a direct linkage between the corporate buyers and

farmers. On its part, the FFA would give training to the farmers on issues such as pesticides and improving quality.

Input Supply— As far as input availability for growers is concerned plant materials are available sufficiently in Srikalahasthi, Tirupati, Mallavalli in the study district of Andhra Pradesh. All sorts of pesticides and chemicals are locally available in major towns. Processors procure mangoes directly from 'mandi', growers, and traders. Generally processors go for a storage capacity of 7 days fruit requirement to match the ripening cycle.

Power supply by Andhra Pradesh Transmission Corporation (APTC) is quite adequate to run the units. Diesel generating units have been installed to meet power requirements during shut down. Water, being a major requirement for the processing unit, is available sufficiently at site. A good network of transport arrangements is provided to transport both raw materials and finished products. Both sea and air transport is available at Chennai, which is only 185 km from Chittoor and 300 km from Vijayawada.

Various enzymes, like bio-tropilase enzyme for consistency of mangoes are being purchased from M/s Biocon, Bangalore. Citric acid (for maintaining the pH level of the pulp), ascorbic acid (added as per customers' requirement) are being arranged from Bangalore and Chennai. Various machineries required for installing the canning unit are Plastic Crates, Fruit washer , Belt conveyor, Screw conveyor, Pulper, Roto pumps, Boiler Kettles/ Pasteurizer, Flanger, (to seal one side of the tin), and Embosser (for labeling). These are available in Chittoor and Bangalore.

Another important input in the pulp industry is the packaging and packing material, such as cans, aseptic bag, and cartons. The units undertaking processing on a job-work basis are supplied with required can material, labels, and packing materials by Export Houses which have provided production orders. Aseptic packing sizes are mostly of 200 litre [228 kg double strength (DS) or 215 kg single strength (SS)], 45 kg, 54 kg, and 91 kg, depending on buyers' specification. Mostly DS aseptic packages go to Europe and USA. The SS aseptic packages are supplied to Coca-Cola, Indian fruit juice manufacturers like, Pepsi, Parle, and Godrej. Cans are mainly supplied to Middle East countries (like Saudi Arabia, Dubai, Yemen, Kuwait) Korea, Japan, Singapore, Australia, etc.

11.2 Production Credit Support to Mango Growers in Andhra Pradesh

Data collected from a sample of 10 bank branches (3 branches of Indian Bank, 5 branches of Regional Rural Bank and 2 District Central Cooperative Bank) revealed that crop credit to mango growers during the last three years constituted a share of 38.6 per cent of the total crop loan accounts and 47.1 per cent of total crop loan amount (Table 11.2).

Table 11.2: Crop Loan for Maintenance of Mango Orchards by Sample Bank Branches

(Accounts in number and Rs. in lakh)

Year	Total Crop Loan		Of which Mango		Percentage
	Accounts	Amount	Accounts	Amount	Accounts
2003-04	10452	883.83	3786	396.76	36.22
2004-05	12214	1190.19	4818	560.92	39.45
2005-06	16303	1756.18	6306	836.85	38.68
Total	**38969**	**3830.20**	**15070**	**1814.03**	**38.67**

Source: Indian Bank, RRB and DCCB

Pre-harvest contractor, VT/ CAs are adequately provided with 'Secured Overdraft' facility from banks. They utilize the same in lending to farmers as also in going for lease / contract of mango orchards. Bank loan is also utilized by them for procuring mangoes from the field as also from the market in order to supply to up-country traders (UCTs), as there remains time lag of 30-75 days while getting payments from UCTs. Similarly, term loan for establishment of mango orchards constituted 19.1 per cent of the total Agricultural Term Loan (ATL) Accounts and 17.2 per cent of ATL amount during the period 2003-06. However, interactions with banks revealed that bankers are not inclined to provide term loan owing to its long term tenure, up to 10 years (Table 11.3).

Table 11.3: Agricultural Term Loan for Establishment of Mango Orchards by 10 Sample Bank Branches in Andhra Pradesh

(Account in number and Rs in lakh)

Year	Agricultural Term Loan		Of which Mango		Percentage
	Account	Amount	Account	Amount	Account
2003-04	42	19.87	21	13.25	50.00
2004-05	227	124.3	33	20.25	14.54
2005-05	281	240.16	51	32.6	18.15
Over all	550	384.33	105	66.1	19.09

Source: Indian Bank, RRB and DCCB

The company, after procuring the fruits from growers/ professionals and suppliers, routes the entire sale proceeds through their bank accounts. The system continues working so long as there is smooth flow of the margin to the growers after adjusting their repayment. However, the growers complained that the company delayed the payment, resulting in late repayment of loan by growers. All processing activity has working capital arrangements with banks, which range from Rs. 20 to 60 lakh, depending on their requirements. Banks work out the working requirement based on Nayak Committee recommendations.

11.3 Production Credit Support to Mango Growers in Maharashtra

The short term loans for maintenance of Alphonso mango orchards have been availed from banks in the district and the same shows an increasing trend. In all the sample cases, farmers availed bank credit for maintenance of orchards, especially after introduction of KCC scheme. A part of the requirement has also been met by purchasing inputs on credit from suppliers and availing of advance from traders-cum-middlemen ("Dalals"). Progressive farmers are invariably availing bank loans, but small farmers normally lease out their orchards to farmers-cum-traders and receive money in advance to meet the maintenance expenses till fruiting stage. Out of the 25 sample beneficiaries, bank loan particulars in respect of 12 farmers have been collected, which are given in Table 11.4. Most of the sample farmers used a part of the KCC limit for investment in mango orchard.

Table 11.4: Availment of Bank Credit by Some Sample Beneficiaries in Sindhhudurg District, Maharashtra

Sample Case No.	No. of Trees	Financing Bank/ Branch	Purpose/ Activity	Loan (Rs.)	Bank loan /hectare
1	800	SDCCB, Vengurle	KCC	2,00,000	25,000
2	200	SDCCB ,Vengurle	KCC	55,000	27,500
3	1000	SDCCB ,Vengurle	KCC	7,40,000	74,000
4	300	SDCCB ,Vengurle	KCC	1,85,700	61,900
5	125	SDCCB ,Vengurle	KCC	1,27,000	1,01,600
6	1050	BOM, Jamsandha	WC	2,00,000	19,048
7	1600	BOM, Jamsandha	KCC	6,50,000	40,625
8	150	RSGB, Mutal	KCC	50,000	33,333
9	800	RSGB, Mutal	KCC	5,00,000	62,500
10	850	RSGB, Mutal	KCC	40,000	4,706
11	1780	BOL, Vijaydurg	TL	6,00,000	33,708
12	1500	RSGB, Mutal	KCC	3,00,000	20,000
Total	**10155**	**--**	**----**	**36,47,700**	**25,920**

Source—Banks, Note—KCC= Kisan Credit Card, WC=Working capital, TL= Term Loan

Average annual maintenance cost of mango orchard up to plucking stage comes to Rs 62,700 lakh as per the current package of practices. However, loan actually availed of the farmers was at Rs. 25,920 per hectare. In the reference year, the bankers assessed the loan requirement at Rs 600 per tree for meeting maintenance expenses and accordingly sanctioned KCC limit of Rs 60,000 per hectare. It is gathered that the remaining portion of the maintenance cost was met out of own funds and/or by availing credit from the traders-cum-middlemen and input dealers on terms, which restricted free marketing. This indicates there is ample scope for bank finance (Table 11.4).

11.4. Repayment Performance of Bank Loan in Maharashtra

The repayment performance of all the sample farmers was good as all the loans were standard. Moreover, bank loan was not available for trees taken on lease. The data on bank loans disbursed in the district during last three years for mango cultivation are given in Table 11.5.

Table 11.5: Details of Bank Loan Disbursed to Mango Growers in Sindhudurg District, Maharashtra

Particulars	2003-04	2004-05	2005-06
Productive Area Under Mango (hectare)	15,847	19,000	20,100
Assessed Credit Requirement (Rs. in lakh)	456.25	780.00	2654.60
Of which, Long Term	146.25	180.00	210.60
Short Term	310.00	600.00	2444.00
Bank Loan Disbursed (Rs. in lakh)	1476.98	2216.03	2195.30
Of which, Long Term	131.37	422.91	520.56
Short Term	1345.61	1793.12	1674.74

Source; Potential Linked Credit Plan of Sindhudurg, 2007-08, NABARD, Maharashtra Regional Office

The apathy of the farmers towards bank loan in Sindhudurg district is primarily due to the fact that alternative options for arranging maintenance expenses are in practice in the district. At times, the input agents provide inputs on credit and collect their dues in harvesting season. But traders cum middle men, who normally collect the produce through their local agents, continue to be the primary source of finance to the farmers. These traders-cum-middlemen provide advance ranging up to 20-30 per cent of the anticipated production at the door steps of the farmers, during October to January, without going through elaborate documentation. Farmers reported that no interest was charged by traders till settlement of yearly account in June. However, interest is charged @ 2 per cent per month on the outstanding balance, if any, of the advance after boxes are settled around June.

Chapter -XII

Constraints, Policy Issues, Strategies and Suggestions

This chapter outlines identification of constraints in the sample states, policy issues, strategies and suggestions for formulation of policies.

1. Constraints

i. Cultivation Aspects

Field studies revealed that availability of genuine plant material is lacking. Thus, small and marginal farmers are often deceived. Despite availabilty of mango cultivars, none of the cultivars have all the qualities like precocity, dwarfness, prolificity, regularity in bearing, resistance to pest and diseases, etc. However, adequate efforts have not gone in to developing improved varieties of mango through breeding. Further, efforts were hardly made to popularize the hybrid varieties and educate the growers and consumers on such varieties.

The study also observed that orchard management is not proper among many of the farmers. Improper spacing, not based on soil type, variety, rainfall/ irrigation, etc. giving rise to poor yield is common. Endeavours are yet to be made to rejuvenate the old orchards through new plantations. Some farmers followed blanket fertilizer doses, which are not based on soil type, irrigation and plant conditions. Several mango orchards have been inter cropped with paddy, which has resulted in good yield in the beginning. This may create several problems at a later stage like, low yield, decline in fruit quality and increased mortality of mango trees. Inundation and chloride injury had started, leading to leaf burning, twig drying and outbreak of diseases.

Mango does not bear a good crop every year and tends to follow alternate bearing pattern. However, there is no effort to minimize irregular bearing by adopting suitable cultural practices, like open canopy management, pruning, adequate manuring, etc.

Fruit drop (premature) has been a problem for certain farmers. They opined that even after careful farming, mangoes were infected with spots (mangu diseases), which did not fetch remunerative prices. However, in most cases, the farmers tended to take the advice of local

fertilizer/ pesticide dealers for its control, which often failed. Application of recommended doses of plant growth regulators at the appropriate stages of fruit growth, following of proper plant nutrition, plant protection measures and cultural practices, especially irrigation schedule, could greatly reduce the fruit drop.

ii. Inadequate Extension Services

Field studies observed that there is lack of training and awareness creation on various cultivation practices for producing good quality mango. Growers cultivate mangoes just for the sake of cultivation and they have no adequate knowledge on good agricultural practices. Horticultural officers are not adequately posted in the district for providing the required extension services. The Horticulture Department of the State Government always has been facing shortage of staff. There is inadequate awareness on post-harvest needs and its technology among the mango growers and traders.

iii. Infrastructural Bottlenecks

It has been reported that more than 20-30 per cent of the produce is lost in the post-harvest operations. This is mainly because of factors like non-availability of proper infrastructure in terms of facilities for handling the produce, poor transport and storage facilities. For distant markets and exports, infrastructure in the form of pack houses with automatic sorting, washing, waxing, packing, pre-cooling, storage and marketing has not developed commensurate with the level of production and export prospects. To address few of the issues and for giving further boost to the exports of fresh mangoes from the state, especially in the light of opening of mango exports to Japan, action has been initiated by the Department for establishment of 2 Vapour Heat Treatment Plant Centers, one each at Nuzvid (Krishna district) and Tirupati. 'Andhra Pradesh Agros' has been identified as the Nodal Agency for establishing these units. The government is also contemplating the development of a Horticulture Hub, with an end to end approach, under private-public partnership mode at Nuzvid in Krishna district, at an estimated cost of Rs. 28 crore. Thus modalities are being worked out.

The poor transportation and road condition coupled with inappropriate packing and temperatures as high as 40 ^{0}C further deteriorates the quality. The price of mangoes in international market

fluctuates on daily basis and long period of journey reduces the freshness as also price realization for mangoes.

The present position of post-harvest handling is not up to the mark. Even grading standards are not uniform and limited to a few varieties and that too are not mandatory. Only Agricultural Marketing Committee (AMC), Gollapudi is having one unit with facilities of cold storage, processing hall for hot water drip treatment, etc.

iv. Lack of Export Promotion and International Competition Strategies

Generally, International trade demands mango varieties that are with fibre-less flesh, good aroma, attractive color (preferably red, pink, purple or yellow) and better sugar and acid blend. Efforts are not being made to produce and grade mango, based on such tastes and varieties. Therefore, export strategy should be to respond to the choice of the consumers of the importing countries. Fresh mangoes are now one of the most liked tropical fruits in the United States. Per capita consumption doubled from 1.1 lbs per person in 1995 to an estimated 2.2 lbs in 2004. The US imported 638 million lbs of mangoes in 2004 at a cost of 196 million dollars. Mexico (63%), Peru (11%), and Brazil (9 %) were the major supply countries to the USA market.

The mango marketing seasons in various countries is given in **Appendix 12.1**. India's major marketing season is April to July, whereas it is produced round the year in Brazil, Colombia, Kenya and Venezuela. The season is quite long in Burkino Faso, Costa Rica, Indonesia, Jamaica, Mexico, Nicaragua and Peurto Rico. Very big mango orchards of a single variety of size ranging from 2,000 to 10,000 ha area have come up in those countries, keeping an eye on export market, which requires consistent bulk supply of uniform good quality.

Many African and Latin American countries have become major suppliers to European markets. Philippines (70%) is the largest supplier to Japan, having invested heavily in vapour heat treatment technology to ensure that the export variety of the "Manila Super" could be certified as fruit fly-free by the Japanese quarantine inspectors. Australia exports its "Kensington Pride" variety to Japan after winning the confidence of the Japanese health authority regarding its vapour heat treatment programme. Pakistan gives higher subsidies, charges low freight tariff and its proximity to Gulf countries

has given it's 'Ratual' mango a permanent place in eating table in the Gulf. Therefore, our efforts for mango exports need to be strengthened with well planned strategies.

2. Issues and Strategies

A number of issues need to be addressed to strengthen mango crop so as to cater to the export demand of mango and mango based products in India.

a. Growers

i. Fruit size and Shape Improvement

Under-nourished trees cannot exhibit correct shape and size of the fruits. For optimal development of the fruit, location specific nutrient management schedule with optimal doses need to be developed and provided to the farmers. Hit and miss method, as followed by certain farmers may not serve the purpose. Canopy management need to be stressed to achieve the desirable leaf size. In the study area it was observed that average age of the orchards is more than 40 years and the inter plant spacing ranged from 12-16 m.

ii. Uniformity of Shape and Color Exhibition

An attractive shape is always appealing to the buyer. Color development and bright exhibition are possible with exposure of the fruit to solar light and temperature, through canopy management, adequate nourishment and timely harvest. Early harvests always lack good color development on ripening.

iii. Blemishes / Scars on Fruits

Different types of blemishes and scars on the fruit make it unattractive for marketing and get rejected while grading. Various causes for the occurrence of blemishes / scars need to be identified and suitable remedial measures may be taken up to reduce such occurrences. The Indian Agricultural Research Institute (IARI), has introduced mango varieties, which have an acidic-sweet taste. They have developed a technology to prevent infection of mango fruit by insects. The two mango varieties Pusa Arunima and Pusa Surya, with characteristics such as appropriate acidic-sweet blend, golden color of the pulp and a cylindrical nut, would help the country in competing with Philippines in mango exports to Europe.

b. Exporters and Traders

i. Export Promotion Strategies

Concerted efforts need to be made to intensify export promotion efforts. Some of the point, which merits attention of the policy makers in this respect include: (i) strengthening infrastructure base, (ii) efficient post harvest management, (iii) improved packaging, (iv) including new markets, (v) improving cold storage and transportation logistics, (vi) developing India brand mangoes and campaigning abroad about the quality, (vii) promoting an efficient export marketing network to optimize export, and (vii) setting up of more quality control laboratories in the Export Processing Zones. Exploring new export destinations has to be the priority. Japan has opened up its market by lifting its 20 year-old ban on Indian mangoes in June 2006. Banganapali, including other exportable varieties can now be imported by Japan. Chinese market also needs to be tapped by mango farmers.

ii. Post -harvest Infrastructure

The success of post harvest activities depends upon the identification of appropriate technologies, sourcing and creation of need-based infrastructure, followed by its proper management. With the post harvest losses roughly pegged at 25-30 per cent of the production level (8.86 lakh MT) in the study area, it implies wastage of 2.7 lakh MT. The volume of production (even at the farm gate price of Rs. 4, 500 per metric ton) results in a loss of Rs. 122 crore of revenue to the mango sector.

Since the creation of post-harvest infrastructure requires huge capital investment initially, its creation has to be considered on merit so that the proposed infrastructure remains in operation for atleast 200-250 days in a year. Creation of collection centers with facilities of sorting, grading, transportation and marketing in nearby urban areas requires to be stressed. Such facilities could be created by a group of farmers growing mango by forming a cooperative society or an association of farmers or Self Help Groups (SHGs). Some AMCs are contemplating the strengthening of existing market and post-harvest handling infrastructure by utilizing the subsidy assistance from the Ministry of Agriculture, Government of India, through the scheme of development / strengthening of Agricultural Marketing Infrastructures, Grading and Standardization.

Pack Houses— For distant markets and exports, establishment of pack houses with automatic sorting, washing, waxing, packing, pre-cooling, storage and marketing on large scale could be considered by public and private sector. These facilities could be made available on hire basis to the farmers. Certain criteria like, urban areas with concentrated pockets of production, having good connectivity, availability of electricity and water round the year, hygienic surroundings etc, need to be considered for setting up of pack houses. The pack houses need to have adequate capacity and should have a pre cooling unit/ cold storage. Provision of refrigerated / insulated van to have cold chain up to marketing point may also be considered in the pack house with the aim to market quality graded products.

Cold Storage— The development of adequate cold storage capacity with latest technology/ cold chain would help not only in increasing the shelf life and minimizing post-harvest losses through proper storage but also help farmers in taking timely marketing decision. Cold storages with multi-chamber/ multi-commodity facilities need to be popularized. Environment friendly and modern cooling system needs to be introduced at par with some developing countries.

Vapour Heat Treatment Plant—— There is a need to establish one Vapour Heat Treatment Plant (VHTP) to sort out the problem of fruit fly, which is the main hindrance for exporting mangoes to Japan, USA and European countries. There should be the provision for the export of mangoes in modified atmospheric containers.

Rail, Air and Road Transport— Mangoes are transported in trucks, open pickup or bigger trucks. Specialized transport vehicles should be used, which may have separate cabins and partial shades so that losses during transport are minimized. Around 300 trucks take mango to the upcountry market every day during the season (April-May) from Nunna market yard in Vijayawada. Andhra Pradesh Mango is also sent through a special wagon from Nuzvid railway station. For export purpose, mango is being transported to Chennai air port. Gannavaram air port near Vijayawada is required to be upgraded and cargo flights need to be introduced for mango.

Capacity Building— There is a shortage of trained and skilled manpower for the management and operations at field level. There is need to create world class mango orchards, for which capacity building needs to be initiated. An effective technology transfer system (ETTS)

may be promoted to take up technology development/ transfer to the mango growers/ processor.

c. Processors

Mango pulp making units face a lot of constraints, as observed during the field study. As almost all canning units are operating on work order basis, export houses give only 50 per cent of the cost of advance. Rest is paid after the consignment is lifted in phases, which may go up to 6-7 months. Processors' money remains locked and they pay interest to banks on their borrowings. Further, because of competition and inconsistent international prices, exporters are offering unattractive conversion charges. Thus, most of the units are operating on reduced net margins.

Processors advocated the need for rationalization of sales tax rates. As per the existing structure, sales tax rate @ I2.5 per cent is charged if the pulp is manufactured and sold within the state of Andhra Pradesh. However, the same is only 4 per cent if the pulp is sold in other states or if it is manufactured in other states and sold in Andhra Pradesh. With regard to payment of 1 per cent market cess to the AMCs on the procurement of mangoes, this is waived by the government if the end product is exported or deemed as exported. However, this benefit has not been received by many of the processing units. Similarly, the subsidy on power tariff as announced under the Food Processing Policy of the State Government has not reached many of the units, as reported. Because of stiff competition from the large corporate units and increasing cost of manufacture, not adequately compensated by the job charges being paid by the export houses, many of the pulp units in the small scale sector are under the threat of becoming sick. It was also observed that for exporters, the interest charged by the banks under EPC is 7-8 per cent, whereas small scale processing units charged interest @ 12-13 per cent per annum. Exporters viewed that shipments by sea are not preferred due to unreliable sea protocols. Freight charges for Singapur, Dubai and Middle East are at Rs. 50 / kg. However, there is no air freight subsidy for mangoes. A few other facilities required in Chittoor district as revealed by processors include setting up of a common solid waste treatment facility, warehousing facility, to avoid carrying the produce to Chennai, etc. The Marketing Department may also conduct extensive studies on mango sector and provide information to the industry on a continuous basis on the demand and international market prices.

d. Marketing

The study revealed that middlemen are considered as a necessary evil in the marketing system. Two types of measures need to be directed for controlling the activities of middlemen. These are (i) regulating the marketing of mango, and (ii) creating alternative channels of trade for marketing of mango.

It is a known fact that the present commission levied by the commission agents is nearly 4-10 per cent of the total value. But the commission charges fixed under the APMC Act of the State may be 1 to 1.5 per cent. To correct the situation, it is necessary to have a dialogue with the traders and fix a reasonable commission (4-6%), which may partly be borne by sellers and buyers instead of sellers alone paying it as at present. This type of realistic approach may give results in getting the markets regulated and prevent other losses in weighing, handling etc.

It is suggested that creating producers cooperative organizations will solve most of the problems and increase the bargaining power. But marketing is a specialized activity and producer cooperatives consisting of small growers cannot undertake the job. So it is necessary to create marketing organizations, which can take care of marketing as well as trade in mango. The main features of the organizations may include establishment of collection centers at growing regions and regulation of all buying/selling activities through the organizations at the market yards. Further, registration of all buyers with the organizations, advancement of loans on the pledge of produce, disbursement of inputs through collection centers and arrangements with banks for providing production loans, etc. are other features of the organization. For sustaining the organization, a commission of 4-6 per cent may be charged. The Department of Horticulture (DoH) can be closely associated with the organization and some responsibility of collection centers can be entrusted to their field staff as has happened in the case of MAHAMANGO, a federation of mango producers societies in Maharashtra, promoted by Maharashtra State Marketing Board. The Horticulture Departments of the respective states like Andhra Pradesh and West Bengal may conduct detailed survey on its functioning and assess the scope for formation of such intervention.

e. Institutional Credit

The credit requirement of mango is very high. Presently middlemen meet part of the requirement of credit as farmers market the produce through middlemen. Therefore, to shorten the activities of the middlemen in the marketing channel, it is necessary to provide the credit required by the growers. At present, though the banks are advancing credit, it is limited to production of crop / establishment of mango orchards. However, in Sindhudurg district, credit does not cover the marketing cost. This can be achieved if the marketing organizations through its assembling centers arrange to supply the inputs on credit basis on the understanding that the producer sells through these marketing organizations. These organizations may request the banks located in area to route the credit through them. As the assembling centers of the organization will be distributing the credit in kind and cash components, there will be less scope for misutilization. The repayment will also be regular as the produce is marketed through these organization.

4. Policy Suggestions / Action Points

Growth and Sustainability

Growth and sustainability of small farms is important as they constitute about 75 per cent of total mango orchards selected. Since promoting small mango growers is a viable proposition, support and incentives should be given so that they overcome the competition due to opening up of the economy

1. Forward and Backward Linkages

The mango processing industry should be supported as the unit value realization of mango pulp is more stable than that of raw mango. It also has a number of forward and backward linkages, benefiting the economy of the region.

2. Contract Farming

Contract farming should be promoted to ensure timely and adequate supply of raw materials and to minimize the cost of raw materials. It will minimize the marketing margin in the supply of raw materials to the processing industry.

3. Promotion of Domestic Consumption

Domestic consumption should be promoted through campaigns and by producing diversified products to serve as a cushion for mango processing industry against fluctuations in demand in international markets.

4. Formation of Cooperative Societies

Cooperative societies should be set up to enable the small firms increase their access to the international markets and realize higher price for their output.

5. Availability of Adequate Quality Planting Material

Small firms are poor in adopting the adequate quality standards and the appropriate technology used is not favoring the market. This calls for the support and nurturing by government to help technology up-gradation and to adopt Hazard Analysis Critical Control Point (HACCP).

6. Promotion of Mango as Horticulture Crop by providing raw materials

Government should promote the production of mango and other horticultural commodities in the region to promote the adequate supply of raw materials throughout the year for increasing the capacity utilization of firms.

7. Cluster Approach

The mango being a potential horticulture crop needs to be developed by adopting a cluster approach. The Department of Horticulture may categorize the districts into specific clusters.

8. Branding and Registration for Geographical Identity of Mango

There are several varieties, which need to be identified and given a geographical identity. Such varieties are dependent on specific soil and climatic conditions. The Department of Horticulture may identify and make efforts to enlist the places linked with a particular variety of mango and thereafter attempt for registration of geographical identity of such local varieties, branding mango in such a way that it would lead to integrated growth of that crop.

9. Uprooting the Senile and Unproductive Orchards

Considering the existence of senile and unproductive orchards mainly in Krishna district (20 %) of Andhra Pradesh, Murshidabad district (30%) of West Bengal and Sindhudurg (30%) district of Maharashtra, large scale replantation needs to be initiated to rejuvenate such orchards. Improved root stocks need to be introduced and strategies are required to be finalized to promote high density planting of mangoes. The Department of Horticulture may popularize the improved package of practices among the growers and ensure that new plantations are established.

10. Transferring Latest Technology to Marginal and Small Farmers

The study revealed that availability of genuine planting material of the required quantity is lacking. It is learnt that banks are reluctant to offer term loan on account of non-availability of adequate planting material. The DoH may take necessary action and ensure that adequate and good quality mango is available for new mango plantation. Sometimes there has been a demand in certain quarters to create Horticultural Crops Planting Material Authority (HCPMA) for ensuring quality of planting material.

11. Popularizing Appropriate Package of Practices

It is believed that alternate bearing has been creating problems in mango production to a large extent. While in one year it creates glut with excess production, the next year it results in short supply due to low production. This results in high price of mango, which affects processing units through high cost of production. The crop production can be regulated to a certain extent through pruning immediately after the harvest, followed by adequate manuring, judicious irrigation and effective plant protection measures. The appropriate package of practice may be popularized by the DoH of the selected districts of the states.

12. Setting up Package Houses

There is an increasing need to set up pack houses with washing, waxing, packing, pre-cooling and storage including refrigerated vans for transport at the production center. The pack houses need to be designed in such a manner to facilitate year round operation, taking into consideration the availability of other perishable products in the region. They should be linked with terminal markets.

13. Establishment of Vapour Heat Treatment Plant

There is a need to establish one Vapour Heat Treatment Plant (VHTP) to sort out the problem of fruit fly, which is the main hindrance for exporting mangoes to Japan, USA and European countries. There should be a provision for the export of mangoes in modified atmospheric containers in ships.

14. Availability of Adequate Institutional Credit

Mango processing industry, particularly pulp making, has enough potential to grow in the future. This is because of the fact that consumer preferences towards synthetic drinks have been declining due to growing health consciousness and increase in purchasing power. Jelly and pickle making has also immense potential to grow. Proportionately, production and productivity of good quality/ processing worthy mango has to increase for which the availability of adequate institutional credit is essential. Credit is required for crop establishment and maintenance, installation of on farm infrastructure, such as drip irrigation, processing units, export credit, etc. Banks may provide adequate credit to various segments of mango industry, keeping in view the banking plan / potential envisaged in Potential Linked Credit Plans (PLPs) by NABARD.

Credit Support is required during the period when farmers are not able to sell the produce. Marketing cycle of Alphonso mango in Maharashtra is being done almost entirely on credit. The traders, commission agents, exporters, retailers, etc operate in the cycle only on credit and the farmer receives his proceeds only after it is realized from the ultimate consumer. In the process the middlemen get the major share of benefit from the investment of the primary producer. Therefore, adequate bank credit must reach the farmer in the entire cycle.

15. Streamlining Data on Credit Flow to Mango Sector

The credit purveyed to the mango sector is not getting reflected in the present system of data generation by banks. There is a need to streamline data on credit flow to mango separately for various activities, especially in the AEZs. Credit flow in AEZs may be included as an item of agenda for discussion in the district level and state level banker's meets. Further, data on area, production and yield also need to be streamlined after conducting proper survey. Data generated by

the Department and other agencies at the field level vary to a large extent. Similarly, there is a need to streamline the data and put in place a system to update and publish the data on market arrival and prices of mango variety-wise.

16. Regular Review and Monitoring of Progress and Issues

There is a need to regularly review and monitor the progress and various issues confronted by the stake holders in AEZs at the state/ district levels to identify constraints and initiate corrective actions.

17. Upscaling Processing Facilities

Less than 5 per cent of the total mango produced in Sindhudurg and Aurangabad districts in Maharashtra is reported to be processed. Further, lower quality mangoes sold for processing fetch less price. There is an immediate need to scale up the volume of processing, to increase shelf life of mango and better the return by suitable value addition. A few farmers are processing at a limited scale with this end, which is required to be upscaled with suitable domestic policies.

18. Registration of Export Oriented Orchards

Exporters purchase quality mangoes from markets as also directly from the farmers. Except for a few big farmers, other farmers are not aware that their produce is being exported. Registration of export orchards, on the lines of grapes in Maharashtra has not picked up. It needs to be expedited by the Agriculture Department of the respective State Governments.

19. Formation of Self-Help Groups

The Self Help Groups (SHGs) / Farmers Clubs of mango farmers in selected districts of Maharashtra could organize mango festivals with the help of their counterparts in other districts. The mango farmers can be taken on study tours to other places for awareness and skill upgradation.

Reference

1. http;/www.horticultureworld.net

2. National Horticulture Mission

3. National Institute of Nutrition (NIN), Hyderabad

4. Atteri, BR(1994), " A Study of Physical and Economic losses of Dasheri Chausa Varieties of Mango in Delhi Market, Bihar journal of Agricultural Marketing", Vol 2, No 4, PP325-329

5. Banerjee G.D, "Marketing of Mango processing under Institutional Finance—A case Study in Andhra Pradesh," Afro Asian Journal Of Rural Development**,** July-December 2001,Vol. 34, No. 2

6. Banerjee G.D, Horticulture— An Over View Poised for Golden Revolution – November- December Issue, 2002, Financing Agriculture, Agriculture Finance Corporation, Mumbai, July-December issue, 2002

7. Banerjee G.D, " Impact of Agro Processing Industry on income and employment of Small and Marginal Farmers", Indian journal of Agricultural Economics, Annual Conference, 2003

8. Indian Journal of Agricultural Economics,Vol.65,No-2, April-June Issue, "An Economic Appraisal of Mango Processing Plants of Chittoor district of Andhra Pradesh" by K V Reddy and Promod Kumar PP277-297

9. Josi M.G, S.S.Wadkar, P. D.Veerkar and A.G.Power (1999), "Comparative Economics of Scale of Processing Alphonso mango in to Pulp in South Konkan Region", Bihar journal of Agricultural Marketing", Vol 7, No 2, PP 190-194

10. Kurmanath, K.V (2007), "Mango Growers join hands to gain more values", http:// www.thehindubusiness line.com/2007/02/23 stories/

11. Naidu P.D (2002), Survey Report on Mango Production and Marketing in Chittoor district, ATMA,NATP,Chittoor District, Andhra Pradesh

12. NABARD,Consultation Workshop on Export Prospects of Indian Mangoes, Organized by NABARD on 23, February, 2005, Mumbai, Paper on Present Status of Export of Mango from India by Dr R.D.Muley, Director Horticulture, Maharashtra State

13. Rao Suryaprakasa (1993), “Mango Processing Industry in Andhra Pradesh”, Paper presented at workshop on Mango Production, Processing, Marketing, and export by Peddy Reddy Timma Reddy Foundation, November 1993, Hyderabad

14. Ramaswamy .C (2007), Supply Chain Management in Agriculture: Trends Status , Initiatives by Tamil Nadu Agricultural University, paper presented in the 8 th Agricultural Science Congress held at Tamil Nadu Agricultural University, Coimbatore, India,15-17, February, 2007.

Annexure 1.1:

Nutritive Value per 100 Gram Mango

Nutrients	Ripe Mango	Green/ Raw Mango
Protein (g)	0.6	0.7
Fat (g)	0.4	0.1
Minerals (g)	0.4	0.2
Fibre (g)	0.7	1.2
Carbohydrates (g)	16.9	10.1
Energy (kcal)	74	44
Vitamin C (mg)	16	3
Total carotene (mcg)	2,210	90
Beta carotene (mcg)	1,990	NA
Potassium (mg)	205	83
Sodium (mg)	26	43
Calcium (mg)	14	10
Iron (mg)	1.3	0.33
Phosphorus (mg)	16	19

Source National Institute of Nutrition (NIN), Hyderabad

Annexure 1.2:

State Wise Number of AEZs, and District Covered

State	Number of AEZ	Name of the districts covered
Andhra Pradesh	5	Krishna, Chittoor, Rangareddy, Medak, Mehboobnagar, Vijayawada, Hyderabad, etc (10)
Maharashtra	2	Ratnagiri, Sindhudurg,Thane,Raigad,Aurangabad,Beed, Jalna, Ahmednagar, Latur (9)
Uttar Pradesh	1	Saharanpur, Muzaffarnagar, Bijnaur,Meerut, Baghpat,Bulandshar, Jyotiphulenagar, (7)
Gujarat	1	Ahmedabad, Khed, Anand, Vadodara, Surat, Navsari, Bharuch, Narmada, (8)
West Bengal	1	Malda, Murshidabad (2)
Tamil Nadu	1	Madurai, Dindigul,Virdudhunagar,Tirunelveli, Teni (5)
Total	11	42

Source National Horticulture Mission,

Annexure 3.1:

Area, Production, and Yield of Mango to Total Fruit Crops during1987-88 to 2008-09

Year	Area (in thousand hectare)	Percentage to total area under fruit crops	Production (in thousand MT)	Percentage to total fruit production	Yield (in kg per hectare)
1987-88	1232.9	43.5	10350.4	37.4	8400
1991-92	1077.6	37.5	8715.6	30.4	8100
1992-93	1136.7	35.5	9223.3	28.0	8100
1993-94	1217.4	38.2	10113.3	27.1	8300
1994-95	1228.3	28.5	10993.3	28.5	9000
1995-96	1283.1	38.2	10810.9	26.0	8400
1996-97	1344.9	37.6	9981.2	24.7	7400
1997-98	1384.9	37.5	10234.2	23.7	7400
1998-99	1401.6	37.6	9781.8	21.4	7000
1999-00	1486.9	37.3	10503.5	23.0	7100
2000-01	1519.0	39.3	10056.8	23.3	6600
2001-02	1575.8	39.3	10020.2	23.3	6400
2002-03	1623.4	42.9	12733.2	28.2	7800
2003-4	1906.7	39.8	11490.0	23.3	6000
2004-05	1970.4	39.7	11829.7	24.0	6000
2005-06	2080.7	39.1	12663.1	22.9	6100
2006-07	2201.4	38.8	13734.0	23.1	6400
2007-08	2201.0	37.6	13997.0	21.3	9400
2008-09	2309.0	37.8	12750.0	18.6	5500
CARG	4.50	-	1.22	-	1.80

Source: Indian Horticulture Data Base, 2009

Annexure 3.2:

Important Mango Cultivars in Major Producing Countries

S.N	Country	Variety (Cultivars)
1	Australia	Kensington Pride, Banana, Early gold, Glenn, Haden, Irwin,Keitt, Kent, 'Zill'
2.	Bangladesh	'Aswina', 'Fazil', 'Gopal Bhog', ' Himsagar', 'Khirsapati', 'Langra', 'Kishan Bhog', 'Kohinoor', 'Kua Pahari', Mohan Bgog',
3.	Brazil	'Bourbon', 'Carlota', 'Coracao',' Espada', 'Itamaraca', ' Maco', ' Magoada', 'Rosa', ' Tommy Atkins'
4.	China	' Baiyu', ' Guixiang', ; Huangpi', ' Huangyu', 'Macheco', 'Sannian', 'Yuexi No.1
5.	Coasta Rica	'Haden','Irwin', ' Keitt', ' Mora', Tommy Atkins',
6.	Ecuador	'Haden', 'Keitt', 'Kent', Tommy Atkins',
7	Egypt	' Alphonso',Bullock's Heart','Hindi Be Sennara','Langra', 'Mabrouka', 'Pairie', Taimour', 'Zebda',
8.	Guatemala	'Haden','Kent', 'Tommy Atkins',
9	Haiti	'Francine', ' Madame Francis,'
10.	India	'Alphonso', 'Banganapalli', ' Bombay'' 'Bombay Green', 'Chausa', ' Dashehari', 'Fazli', 'Fernandian', 'Himsagar', 'Kesar',' Kishan Bhog','Langra', 'Mallika','Mankurad', 'Mulgoa','Neelum', 'Pairi', 'Samar Behisht Chausa', 'Suvarnarekha', 'Totapuri', 'Vanrag','Zardalu',' Amrapalli', 'Basngalora', ' Gulabkhas',
11	Indonesia	'Arumanis', 'Dodol', 'Gedong', 'Golek', 'Madu', 'Manalagi',' Cengkir','Wangi'
12.	Israel	'Haden',Tommy Atkins','Keitt,'Maya,'Nimrod',Kent','Palmer',
13.	Kenya	'Boubo',Ngowe','Batwi',
14.	Malaysia	'Arumanims', Kula Selangor2', Golek',Apple Rumni', Malgoa' ,Apple Mango', Maha-65 ',Tokboon'
15.	Mali	'Amelie', 'Kent',
16.	Mexico	Haden, Irwain , Kent, Manila, Palmer, Senssein, Tomnny Atkin, Vandyke,
17.	Myanmar	'Aug Din', 'Ma Chit Su', 'Sein Ta Lone, 'Shwe Hin Tha',
18.	Pakistan	'Anwar Ratol', 'Baganapalli', 'Chausa', 'Dashehari',;Golab khas', 'Langra', 'Siroli','Sindhri','Suvarnarekha', 'Zafran',
19.	Peru	'Haden','Keitt', 'Kent', 'Tommy Atkins',
20	Phillipines	Carabao, Manila Super, Pico, Binoboy, Dudul, Pahutan, Senora,
21.	Singapore	'Apple Mango', ' Arumanis', 'Golek', ' Kaem Yao', 'Mangga Dadol',
22.	South Africa	'Fascell', 'Haden', 'Keitt', ;Kent', 'Sensation', 'Tommy Atkins', 'Zill',
23.	Srilanka	'Karutha','Colomban', 'Willard', 'Vellai Colomban', 'Pettiamba', 'Malwana amba', 'Parrot Mango and Peterpasand', 'Dapara', 'Hingurakgoda'
24.	Thailand	'Nam Doc Mai', 'Ngar Charn','Okrong','Rad', 'Choke Anand', ' Kao Keaw', 'Keaw Savouy', 'Pimsenmun',
25.	USA	;Keitt', 'Kent',' Tommy Atkins',
26	Venezuela	' Haden', ' Keitt', 'Kent', Tommy Atkins',
27	Vietnam	'Combodiana'

Source: Horticulture World.net

Annexure 3.3:

Exports of Mango and Mango Pulp from India during 1994-95 to 2008-09

	Quantity in thousand metric ton			Value in crore (Rupees)	
	Mango	Pulp	Total	Mango Pulp	Total
1994-95	25.4	45.03	70.40	34.46	80.70
1995-96	22.7	38.51	60.78	36.03	84.61
1996-97	24.78	44.88	69.66	40.32	105.01
1997-98	42.89	73.59	116.43	45.87	123.31
1998-99	45.41	79.13	124.54	38.13	138.56
1999-00	34.63	71.55	106.18	72.38	196.52
2000-01	36.43	76.54	112.97	74.35	204.65
2001-02	44.43	81.00	125.43	76.74	241.34
2002-03	38.02	84.15	122.21	80.25	286.09
2003-04	60.55	110.52	171.07	84.94	317.45
2004-05	58.11	111.93	170.04	88.74	358.21
2005-06	62.58	135.06	197.64	92.74	402.45
2006-07	64.15	133.16	197.13	95.84	456.42
2007-08	68.23	151.65	219.19	99.95	498.99
2008-09	70.15	177.00	247.15	101.53	526.80
Increase (%)	176.06	291.11	250.06	194.26	552.27
CARG	15.13	19.40	16.72	12.95	36.82

Source: National Horticulture Board, CAGR= Compound Annual Growth Rate

Annexure 4.1:

Growth in Area under Mango Cultivation in Major states during 1996- 97 to 2008-09

(Area in thousand hectares)

Year	A.P	U.P	Karn	Bihar	Maha	W.Bengal	Others	India
1996-97	271.4	256.2	116.5	151.8	65.5	55.7	427.8	1344.9
1997-98	276.2	258.7	123.9	153.2	65.5	55.8	457.6	1384.9
1998-99	252.1	240.5	123.8	154.8	110.0	59.3	461.1	1401.6
1999-00	297.5	243.2	124.1	156.0	147.2	60.0	48.9	1486.9
2000-01	306.2	249.1	134.4	139.1	147.2	62.5	484.1	1522.6
2001-02	341.2	253.0	115.4	139.3	164.4	65.4	506.2	1575.8
2002-03	370.3	247.6	117.4	139.5	181.2	66.4	501.1	1623.4
2003-04	402.2	250.5	116.3	140.0	425.8	67.8	504.1	1906.7
2004-05	391.9	247.0	117.5	140.1	432.7	69.1	563.5	1961.9
2005-06	445.5	265.5	120.5	142.7	434.7	72.2	599.6	2080.7
2006-07	471.4	261.4	129.1	140.8	447.7	78.2	625.3	2153.9
2007-08	483.5	265.9	134.6	142.2	455.8	80.9	626.9	2201.4
2008-09	497.7	271.2	141.3	144.1	457.0	86.0	711.7	2309.0
CARG	6.94	0.49	1.77	-0.42	49.80	4.53	5.56	6.89

Source: National Horticulture Board, Others include Orissa, TamilNadu, Kerala, Gujarat, Goa, Madhya Pradesh, Haryana, Punjab etc

Annexure 4.2:

Growth in Production of Mango in Major states during 1996- 97 to 2008-09

(Production in thousand kg.)

Year	Andhra Pradesh	Uttar Pradesh	Karna-taka	Bihar	Mahar a shtra	West Bengal	Others	India
1996-97	3256.3	3548.0	1106.5	910.4	196.5	66.8	896.5	9981.0
1997-98	3314.1	1722.3	176.4	1838.9	65.5	547.4	1572.3	10234.2
1998-99	2269.6	2418.7	1176.5	1858.1	196.5	226.5	1635.0	9781.8
1999-00	2379.6	1106.7	1179.9	1871.9	500.5	666.0	2799.0	10503.5
2000-01	2449.5	2250.3	1291.4	1112.5	500.5	380.5	2161.5	10237.0
2001-02	2445.8	1950.4	1130.6	1253.5	559.6	585.0	2095.3	10020.2
2002-03	2932.1	4021.3	1098.2	1255.6	615.9	228.8	2541.7	12733.5
2003-04	3217.2	2100.1	1111.2	1540.1	629.8	405.9	2485.7	11490.0
2004-05	3135.2	2585.6	1105.9	865.5	634.3	460.8	2817.9	11605.2
2005-06	3565.4	2784.5	1303.7	978.5	645.8	492.5	2892.7	12663.1
2006-07	3865.2	2980.5	1368.8	1306.9	646.3	549.8	3016..5	13734.0
2007-08	4157.9	3365.0	1223.3	870.4	710.9	623.2	3026.9	13996.8
2008-09	2522.0	3465.9	1284.4	1329.8	712.8	548.9	2855.6	12749.8
CARG	-2.42	-0.19	1.34	3.84	21.9	4.53	60.14	2.31

Source: National Horticulture Board, Others include Orissa, Tamil Nadu, Kerala, Gujarat, Goa, Madhya Pradesh, Haryana, Punjab etc

Annexure 4.3:

Productivity of Mango in Major States during 1996- 97 to 2008-09

(Productivity kg per hectare)

Year	A.P	U.P	Karnataka	Bihar	Maharashtra	West Bengal	Others	India
1996-97	11980	13840	9500	5997	3000	12000	4270	7400
1997-98	12000	6660	9490	12000	1000	9952	3482	7400
1998-99	9000	10050	9500	12000	1793	3320	3547	7000
1999-00	8000	4550	9510	12000	3400	11100	4589	7100
2000-01	8000	9000	9630	7400	3400	6088	4465	6600
2001-02	7170	7700	9800	8900	3400	8944	4141	6400
2002-03	8000	16280	9350	8970	3390	3446	5071	7800
2003-04	8000	8380	9560	11000	1479	5985	4930	6000
2004-05	8000	10460	9400	6180	1466	6511	5005	5900
2005-06	8010	10488	10819	6857	1486	6821	4824	6086
2006-07	8220	11400	10600	9300	1400	7000	4184	6400
2007-08	8600	12706	9100	6100	1600	7700	5167	6400
2008-09	5100	12800	9100	9200	1600	6400	4054	5500
CARG	-10.37	-0.62	0.32	4.10	-16.34	6.73	0.40	-2.56

Source: National Horticulture Board, Others include Orissa, Tamil Nadu, Kerala, Gujarat, Goa, Madhya Pradesh, Haryana, Punjab, etc

Annexure 4.4:

Area, Production and Yield of Mango in Chittoor District of Andhra Pradesh during 1998-99 to 2008-09

Year	Area (thousand hectare)	Production (thousand MT)	Yield in kg/hectare
1998-99	33.0	106.8	3236
1999-2000	42.8	342.1	7772
2000-01	45.1	360.2	7986
2001-02	45.6	368.9	8090
2002-03	47.8	382.7	8006
2003-04	52.7	421.8	8000
2004-05	48.9	391.3	8,002
2005-06	50.7	396.5	7822
2006-06	53.4	402.7	7541
2007-08	56.1	409.6	7302
208-09	58.9	508.7	8636
Total	517.0	4091.7	--
Average	47.0	371.2	7 977
CAGR (%)	7.1	39.7	15.2

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh

Annexure 4.5:

Area, Production and Yield of Mango in Krishna District of Andhra Pradesh during 1998-99 to 2008-09

Year	Area (thousand hectare)	Production (thousand MT)	Yield (kg/hectare)
1998-99	61.2	803.4	13127
1999-2000	61.3	490.5	8000
2000-01	61.4	491.5	8004
2001-02	65.0	492.7	7580
2002-03	67.5	539.9	7999
2003-04	72.5	579.9	7986
2004-05	62.0	495.5	7996
2005-06	65.8	530.6	8063
2006-06	72.6	552.7	7613
2007-08	75.9	585.6	7715
208-09	80.4	607.5	7565
Total	745.6	6169.8	--
Average	67.8	560.1	8272
CAGR (%)	2.8	-202	3.9

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh

Annexure 4.6:

Area, Production and Yield of Mango in Chittoor and Krishna (Combined) Districts of Andhra Pradesh during 1998-99 to 2008-09

Year	Area (thousand hectare)	Production (thousand MT)	Yield (kg/hectare)
1998-99	94.2	910.2	9,662
1999-2000	104.1	832.6	7998
2000-01	106.5	851.7	7997
2001-02	110.6	861.6	7790
2002-03	115.3	922.4	8000
2003-04	125.2	1001.7	8000
2004-05	110.9	887.1	7999
2005-06	118.5	927.2	7824
2006-06	126.0	955.4	7582
2007-08	132.0	995.2	7539
208-09	139.3	1116.2	8011
Total	1332.6	10261.3	-
Average	121.1	932.8	7710
CAGR (%)	4.4	2.1	-1.55

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh

Annexure 4.7:

Share of Area and Production of Mango in Chittoor and Krishna (Combined) Districts to total Andhra Pradesh during 1998-99 to 2008-09

Area in thousand hectare and Production in thousand MT

Year	Area in Combined District	Area Andhra Pradesh	Share #	Production in Combined District	Production Andhra Pradesh	Share #
1998-99	94.2	276.2	33.4	910.2	2269.6	40.1
1999-2000	104.1	297.5	35.0	832.6	2379.6	35.0
2000-01	106.5	206.2	34.78	851.7	2449.5	34.8
2001-02	110.6	341.2	32.42	861.6	2445.8	35.2
2002-03	115.3	370.3	31.14	922.4	2932.1	31.2
2003-04	125.2	420.0	31.13	1001.7	3217.2	31.1
2004-05	110.9	391.2	28.30	887.1	3135.2	28.3
2005-06	118.5	445.5	27.00	927.2	3565.4	26.0
2006-06	126.0	471.4	28.28	955.4	3865.2	24.7
2007-08	132.0	483.5	26.45	995.2	4157.9	23.9
208-09	139.3	497.7	27.30	1116.2	2522.0	44.3
Total	1332.6	4200.7	31.70	10261.3	32939.5	31.15
Average	121.1	381.8	31.70	932.8	2994.5	31.15
CARG	4.4	-2.42	-	2.1	-2.42	-

Source: Directorate of Economics and Statistics Government of Andhra Pradesh, # Share of combined districts to Andhra Pradesh (%).

Annexure 4.8:

Area, Production and Yield of Mango in Sindhudurg District of Maharashtra during 1999-00 to 2008-09

(Area in thousand hectare, Production in thousand MT and Yield in kg/ha)

Year	Area	Productive Area	Production	Yield
1999-00	20.01	11.69	52.04	4450
2000-01	22.02	12.29	39.35	3200
2001-02	22.73	13.80	45.54	3000
2002-03	23.09	14.47	49.22	3400
2003-04	23.26	15.84	53.87	3400
2004-05	23.42	17.04	55.23	3240
2005-06	23.57	18.14	59.88	3300
2006-07	23.70	19.39	64.68	3335
2007-08	23.85	20.52	69.79	3400
2008-09	23.99	21.80	74.36	3410
CAGR (%)	1.98	8.64	4.20	-2.34

Source: Directorate of Horticulture, Govt.of Maharashtra

Annexure 4.9:

Area, Production and Yield of Mango in Aurangabad District of Maharashtra during 1999-00 to 2008-09

(Area in thousand hectare, Production in thousand MT and Yield in kg/ha)

Year	Area	Productive Area	Production	Yield
1999-00	13.26	2.64	7.61	2870
2000-01	13.81	2.96	9.36	3200
2001-02	14.25	3.19	10.54	3300
2002-03	14.91	3.42	11.65	3400
2003-04	15.10	4.33	14.74	3400
2004-05	15.25	4.63	15.99	3450
2005-06	15.41	4.91	16.94	3450
2006-07	15.57	5.21	10.85	3465
2007-08	15.74	5.37	18.66	3475
2008-09	15.91	5.67	19.73	3480
CA GR (%)	2.0	11.42	15.92	2.12

Source: Directorate of Horticulture, Govt.of Maharashtra

Annexure 4.10:

Area, Production and Yield of Mango in Malda District of West Bengal during 1990- 2009

Year	Area (Thousand ha)	Production (thousand MT)	Productivity(kg/ha)
1990	21.68	62.00	2860
1991	21.80	205.00	9400
1992	21.90	55.00	2510
1993	21.91	175.20	8000
1994	22.00	21.00	950
1995	22.20	260.00	11700
1996	22.40	22.00	980
1997	22.42	220.00	9810
1998	23.20	65.00	2820
1999	24.08	270.00	11210
2000	24.15	105.00	4350
2001	24.25	253.87	10450
2002	24.50	63.67	2600
2003	24.55	86.00	3500
2004	24.85	135.00	5430
2005	25.25	150.00	5940
2006	25.50	180.00	7060
2007	25.90	175.00	6760
2008	26.30	190.00	7220
CAGR(%)	0.76	10.86	8.02

Source District Horticulture Office, Malda

Annexure 4.11:

Area, Production and Yield of Mango Growing Blocks of Malda District of West Bengal in 2009

Block	Area (Ha)	Share (%)	Production (MT)	Share (%)	Yield (kg/ha)
English Bazar	9156	34.68	46335	25.36	5060
Ratua II	2542	09.63	28986	15.34	11403
Ratua I	2540	09.63	25845	13.68	10175
Manik Chak	3793	14.37	27412	11.59	7226
Old Malda	2122	08.04	21895	14.81	10318
Kalia Chak II	1892	07.17	15425	11.11	8152
Kalia Chak I	1596	06.04	7273	05.19	4795
Chanchal	1624	05.84	7673	3.82	4479
Harish Chandra Pur	1135	04.60	7156	3.76	6030
Total	26400	100.00	190200	100.00	7273

Source: District Horticulture Office, Malda, West Bengal

Annexure 4.12:

Area, Production and Yield of Mango Growing Blocks of Murshidabad, District of West Bengal in 2009

Block	Area (Ha)	Share (%)	Production (MT)	Share (%)	Yield (kg/ha)
1. Lalgola	3085	19.79	22471	17.82	7282
2. Suti-II	3068	19.69	21841	17.32	7119
3. Murshidabad-Jiaaganj	2590	16.62	19745	15.65	7623
4. Farakka	1005	6.49	9191	7.29	915
5. Raghunathganj	934	6.03	8768	6.95	939
6. Belganga-II	850	5.49	8533	6.77	10038
7. Bhagwangola-II	810	5.23	8298	6.58	10244
8. Berhampur	645	4.16	5699	4.52	8836
9. Domkal	552	5.54	4900	3.89	8876
10. Haroharpur	549	3.52	4872	3.86	8874
11. Nouda	482	3.11	4439	3.52	9210
12. Jallanji	412	3.09	3888	3.08	9436
13 Others	505	3.24	3457	2.75	6845
Total	15587	100.00	126102	100.00	7937

Source: District Horticulture Office, Murshidabad , West Bengal

Annexure 7.1:

Market Arrivals of Mango in Chittoor and Krishna Districts in Andhra Pradesh

Year	Bangarupallem		Chittoor		Damancheruvu	
	Quantity (MT)	Price (Rs./quintal)	Quantity (MT)	Price (Rs./ quintal)	Quantity (MT)	Price(Rs quintal)
1997-98	11307	2500	28721	3000	44426	5000
1998-99	3522	4500	17292	5000	28118	4000
1999-00	10499	3500	58319	2000	81825	2000
2000-01	3346	4250	14915	5200	22777	4000
2001-02	33423	2000	57321	3316	31612	3500
2002-03	7004	3000	19872	5536	34700	3000
2003-04	13750	4220	13096	4340	44025	3000
2004-05	31214	5840	27994	7828	46490	2500
2005-06	33491	3533	19975	5100	38307	2500
2006-07	-	-	8732	-	49031	3000

Year	Putur		Tirupati		Nunna
	Quantity (MT)	Price (Rs./quintql)	Quantity (MT)	Price (Rs/quintal)	Quantity (MT)
1997-98	18651	3250	9125	2500	-
1998-99	7856	4000	2876	5000	20542
1999-00	38903	3000	16710	2700	60000
2000-01	8600	4000	3270	4500	52000
2001-02	13371	3500	13421	2500	62058
2002-03	-	-	9650	4518	46824
2003-04	-	-	21411	2966	59285
2004-05	-	-	19288	4011	27710
2005-06	-	-	22257	3078	76538
2006-07	-	-	17794	4380	66720

Source: AMC Offices of respective market Yards, - denotes not available,

Annexure 7.2:

Monthly Whole Sale Price Index of Mangoes in India (1995-2005)

Year	Base Year 1993-94=100			
	April	May	June	July
1995	175.2	109.7	125.5	105.0
1996	141.3	119.5	137.3	156.2
1997	173.8	104.9	111.9	95.4
1998	191.0	195.8	204.7	242.0
1999	222.7	118.3	111.0	124.8
2000	208.6	168.5	180.6	174.6
2001	181.8	157.9	129.9	146.7
2002	196.6	163.5	149.8	160.2
2003	201.4	176.9	197.9	197.9
2004	240.0	223.4	176.8	176.8
2005	247.9	240.4	210.9	210.9
CAGR (%)	**3.53**	**8.16**	**3.52**	**4.76**

Source: Ministry of Commerce and Industry, Government of India

Annexure 7.3:

Price Spread for a Metric Ton of Mango in Different Marketing Channels in Andhra Pradesh (Value in Rs. / quintal)

NO	Particulars Channels	I	II	III	IV
1	Mango Grower				
	Sale Price	3600 (28.0)	3300 (34.7)	4400 (33.6)	3700 (52.9)
	Marketing Costs	-	-	200 (1.4)	-
	Net Price Received	3600 (28.8)	3300 (34.7)	4200 (32.1)	3700 (52.9)
2	VT/CA/PHC				
	Purchase Price	3600 (28.0)	3300 (34.7)	___	___
	Marketing Cost	200 (1.6)	300 (3.2)	___	___
	Sale Price	4400 (35.2)	4400 (46.3)	___	___
	Net Margin/Profit	600 (4.8)	800 (8.4)	___	___
3	Local Whole seller				
	Purchase Price	4400 (35.2)	4400 (46.3)	4400 (33.6)	3700 (52.9)
	Marketing Cost	150 (1.2)	800 (8.4)	150 (1.1)	400 (4.7)
	Sale Price	5100 (40.8)	6300 (66.3)	5300 (40.5)	4900 (67.1)
	Net Margin/Profit	550 (4.4)	1100 (11.6)	750 (5.7)	800 (9.4)
4.	UCTs/Whole Seller				
	Purchase Price	5100 (40.8)	___	5300 (40.5)	___
	Marketing Cost	1900 (15.2)	___	1900 (14.5)	___
	Sale Price	9100 (72.8)	___	3900 (71.0)	___
	Net Margin/Profit	2100 (16.8)	___	2100 (16.0)	___
5	Retailer				
	Purchase Price	9100 (72.8)	6300 (66.3)	9300 (71.0)	4900 (67.1)
	Marketing Cost	1000 (8.0)	850 (8.9)	950 (7.3)	850 (9.7)
	Sale Price	12500 (100)	9500 (100)	13100(100)	8400 (100)
	Net Margin/Profit	2400 (19.2)	2350(24.7)	2850 (21.4)	2650 (23.5)
	Gross Marketing Margin	8900(68.0)	6200(65.3)	8700 (66.4)	4700(47.1)
	Consumers Purchase Price	12500(100)	9500(100)	13100(100)	8400(100)

Source: Field data , Note Figures in parentheses indicate percentages to consumer's purchase price

Annexure 7.4:

Price of Mango in Malda, West Bengal during 2004 - 2006 (Rs. per quintal)

Variety	May		June		July	
2004						
	Max.	Min	Max	Min.	Max.	Min.
Gopalbhog	850	700	1000	900	----	
Himsagar	----	----	1300	1000	-----	
Langra	-----	-----	1200	950	-----	
Laxmanbhog	-----	-----	1000	700	-----	
Amrapali	-----	-----	1500	1050	1100	
Fazli	N.A.	N.A.	800	800	1600	
Guti(generic variety)	800	650	650	400	800	
2005						
Gopalbhog	----	----	600	400	N.A.	N.A.
Himsagar	-----	-----	550	450	N.A.	N.A.
Langra	-----	-----	1100	600	N.A.	N.A.
Laxmanbhog	-----	-----	600	400	N.A.	N.A.
Amrapali			1300	800	N.A.	N.A.
Fazli			900	700	1200	900
Guti(generic variety)			400	250	500	400
2006						
Gopalbhog	N.A.	N.A.	700	500	N.A.	N.A.
Himsagar	N.A.	N.A.	1200	700	N.A.	N.A.
Langra	N.A.	N.A.	1100	750	N.A.	N.A.
Laxmanbhog	N.A.	N.A.	800	600	N.A.	N.A.
Amrapali	N.A.	N.A.	1300	900	N.A.	N.A.
Fazli	N.A.	N.A.	800	700	1800	900
Guti(generic variety)	N.A.	N.A.	450	350	500	450

Source : Agricultural Marketing Department, Englishbazar, Malda, West Bengal, Max= Maximum; Mim= Minimum; NA= Not Available

Annexure 8.1:

Cash Flow Statement of Alphonso Mango Orchard in Maharashtra

Year	Capital Cost	Maintenance Cost	Mark. Cost	Total Cost	Total Income	Net Income
1	79,408	0	0	79,408	0	-79,408
2	36,748	0	0	36,748	0	- 36,748
3	34,676	0	0	34,676	0	-34,676
4	19,228	0	0	19,228	0	-19,228
5	14,936	0	0	14,936	0	-14,936
6	0	25,104	18,180	43,284	54,992	11,708
7	0	25,104	22,220	47,324	67,213	19,889
8	0	25,104	26,260	51,364	79,434	28,070
9	0	25,104	31,310	65,414	94,709	38,295
10	0	35,146	43,430	78,576	1, 31,371	52,795
11	0	35,146	46,460	81,606	1, 40,536	58,930
12	0	35,146	52,520	87,666	1, 58,867	71,201
13	0	35,146	58,580	93,726	1, 77,198	83,472
14	0	35,146	66,660	1, 01,806	2, 01,639	99,833
15--30	0	62,760	81,115	1, 43,875	2, 44,411	1, 00,536

Source: Field data,

Annexure 8.2:

Cash Flow Statement of Kesar Mango Orchard in Aurangabad District of Maharashtra

Year	Capital Cost	Maintenance Cost	Marketing Cost	Total Cost	Total Income	Net Income
1	44,649	0	0	44,649	0	-44,649
2	18,118	0	0	1,81,18	0	-18,118
3	21,004	0	0	21,004	0	-21,004
4	24,615	0	0	24,615	0	-24,615
5	27,859	0	0	27,859	0	-27,857
6	0	21,029	8,380	29,359	28,254	-1,105
7	0	21,029	11,901	32,930	40,363	7,433
8	0	21,029	17851	38,880	60,545	21,665
9	0	21,029	26,181	47,210	88,779	41,589
10	0	21,029	35,702	56,731	1, 21,089	64,358
11	0	36,800	47,602	84,402	1, 61,452	77,050
12	0	36,800	57,123	93,923	1, 93,743	99,820
13	0	36,800	65,453	1, 02,253	2, 21,997	1,119,744
14	0	36,800	71,403	1, 08,203	2, 42,179	1, 33,976
15--30	0	52,572	76,164	1,28,736	2, 58,324	1, 29,588

Annexure 11.1

National Horticulture Mission

Horticulture plays a pivotal role in lifting rural people above the poverty line. It has immense potential in addressing the problems which plague the rural economy like employment generation, value addition, quality control etc. Considering these potentialities, a major thrust has been placed on horticulture by Govt. of India. Though, there are ongoing schemes for development of horticulture, the Finance Minister has announced a new scheme named **National Horticulture Mission**. The mission has come into operation from April 2005 for all round development of horticulture. Budgetary allocation for the mission is Rs.630 crore for the whole country. The mission will ensure an end-to-end approach having backward and forward linkage covering research, production, post harvest management, processing and marketing under one umbrella in an integrated manner.

Action Plan

National Horticulture Board is implementing various developmental programmes across the country for Integrated Development of Horticulture. Broadly, there are three types of programmes being implemented by NHB. These are (i) Credit Linked Back Ended Subsidy Programme, (ii) Grant-in-aid Programme and (iii) Market Information

Under subsidy programmes NHB has implemented two Back Ended Subsidy Schemes:

- Under this scheme 20 per cent Back Ended Capital Investment Subsidy is provided upto a limit of Rs.25.00 lakh for setting up of Hi-tech Commercial Horticulture Projects. Under this scheme Term Loan is mandatory. Promoter has to avail at least 25 per cent term loan of project cost, for the project up to Rs.30.00 lakh and 40 per cent Term Loan where the project is more than Rs.30.00 lakh.
- Under scheme no.2 : Capital Investment Subsidy Scheme for Construction/Expansion /Modernization of Cold Storage / Storage for Horticulture Produce - 25 per cent subsidy is provided upto a limit of Rs.50.00 lakh.
- Under scheme no.3: Technology Development and Transfer-assistance is provided as grant-in-aid for visit of Progressive Farmers, Seminar/Symposium and R&D Project etc.

- Under Market Information Service scheme NHB collects the price and arrival data, market intelligence and other relevant information from major terminal markets in the country and National Bulletin is prepared for the benefit of farmers and traders.

Organic Farming

Organic farming in horticulture is becoming increasingly important. Its environmental and economic benefits have captured attention in many countries. Consumers' demand for organically produced food products has provided new opportunities for farming and business around the world. The basic rules of organic production are that the natural inputs are to be applied and synthetic inputs are prohibited. But there are exceptions in both cases, certain natural inputs determined by various certification programs to be harmful to human health or the environment are prohibited (e.g. Arsenic). Certain synthetic inputs determined to be essential and consistent with organic farming philosophy are allowed (e.g. insect pheromones). An organic production system can be designed to (a) enhance biological diversity within the system, (b) increase soil biological activity, (c) maintain long-term fertility, (d) recycle plant and animal waste, (e) rely on renewable resources in locally organized system, and (f) promote healthy use of soil, water and air, minimize all forms of pollution. Further, the Organic Production System handles agricultural products with emphasis on careful processing methods in order to maintain organic integrity and vital qualities of the product at all stages.

In view of the growing demand for the organically produced food items worldwide the natural advantages in this regard need to be fully exploited. In order to help the growers obtain the required certification for organically produced crops, awareness has to be generated through training and proper distribution of information. For adopting organic farming for perennial and non-perennial fruit crops, aromatic plants, spices etc. additional assistance will be given over and above the Area Expansion Program @ Rs.10, 000 per hectare subject to a limit of 4 ha. per beneficiary. For organic cultivation of vegetables, the maximum assistance will be limited to Rs.10,000 per ha. The NHM will also provide financial assistance up to a maximum of Rs.5.00 lakh for group of farmers covering an area of 50 ha. duly recommended by the State Government, on a case to case basis for certification of organic process/produce.

Creation of Market Infrastructure

The main objectives of providing assistance under this component are :

- to induce investments from private and cooperative sectors in the development of marketing infrastructure for horticulture commodities
- strengthen existing horticulture markets including wholesaler, rural haats
- focus on promotion of grading, standardization and quality certification of horticulture produce at farm/market level to enable farmers to realize better price
- create general awareness among farmers, consumers, entrepreneurs and market functionaries on market related Agricultural Practice including contract farming.

Assistance under the scheme

Sl.No. & Item	Estimated Cost	Norms of Assistance
1. Buy back intervention	Project based	Project based
2. Establishment of Marketing Infrastructure for horticultural produce in Govt./Private / Cooperative sector		Credit linked back-ended subsidy @25% of the capital cost of Project in general case and 33.33% in the case of hilly, backward States.
a) Wholesale markets	Upto Rs.100.00 crores	25% of the capital cost of project
b) Rural Markets /April Mandis/ Direct Markets	Rs.15.00 lakh	25% of the capital cost of project
c) Functional Infrastructure for collection, grading etc.	Rs.15.00 lakh	25% of the capital cost of project
d) Extension, quality awareness and market led extension activities for fresh processed products.	Project based	100 % assistance

Area Expansion Programme and the Role of Banks

No banks give loans for the maintenance of orchards or for cultivation purposes. The main reason is the system of contract and subcontract of orchards. In very few cases it found that the orchards are cultivated by the owners themselves. Even if these farmers need money, they do not get that from the banks. Moreover, it is noticed that the people taking contract and subcontract of the orchards, are businessmen/ *arhatiya*/commission agents etc. who do not need bank finance. The Area Expansion Programme has started in Murshidabad district of West Bengal and UBI has started financing for the said purpose and already financed seven/eight cases during 2005-06. However, initially banks were not willing to finance under the scheme because of the gestation period of five years and the farmers are unable to repay. Therefore, in order to help both the banks and the farmers, the District Horticulture Department has prepared schemes of Area Expansion along with intercropping, so that the farmers can have income from intercropping and start repaying from the first year itself. Under the Area Expansion Programme, the scale of finance fixed is Rs 30,000/ - per ha, but the farmers are going for an expansion of less than one ha (around 0.4-0.6 ha). In that case, the amount of bank loan is a small amount and the banks are not willing to lend. The DLCC in the district of Murshidabad had approved a copy of the land receipt verified by the District Horticulture Officer, who was a gazetted officer, as an instrument that was sufficient for the bank to lend under National Horticulture Mission for loan lesser than Rs. 50,000. The study observed that even for a small amount of bank loan under this scheme, possession of land deed was required and the loan was given through Kissan Credit Card. CARDB, Murshidabad had financed 24 cases during 2004-05. In Malda, it was found that Gour Gramin Bank was financing for mango grafting, but that also in very few cases. Area Expansion Programme under mango had yet to start in Malda during the study period.

Annexure 12.1

Peak Mango Marketing Seasons for Various Countries

Country	Peak Mango Marketing Season
Brazil	Year Round
Burkina Faso	March- July
Columbia	Year round
CostaRica	March-September
Gambia	May-July
Guatemala	March-July
Guinea	May-August
Ecuador	November-February
Egypt	August-October
India	April-June
Indonesia	May-August
Israel	July-December
Cote d Ivories	March-July
Jamaica	May-October
Kenya	Year round
Madagascar	November-December
Mali	March-July
Mexico	April-December
Nicaragua	April-July
Pakistan	June-August
Peru	September -May
Puerto-Rico	March-November
Senegal	May-July
South Africa	January-May
Spain	September-December
Sudan	June-August
Swaziland	January-March
USA	June-October
Venezuela	Year round
Zambia	January-March
Zimbabwe	November- April

Source: Commodity Specific Study in Andhra Pradesh- NABARD