Chapter - III

Role of Cassava in Sago Industries

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CHAPTER – III

ROLE OF CASSAVA IN SAGO INDUSTRIES

3.1. HISTORY OF SAGO INDUSTRY

"Necessity is the Mother of Invention". The sago and tapioca starch industry of Tamil Nadu is the result of scarcity created by the impossibility of imports of foreign sago and starch from Singapore, Malaysia, Holland, Japan and U.S.A., during the Second World War. In the year 1943, Mr. Manickam Chettiar, a dry fish merchant of Salem had the occasions to go to Kerala very often in connection with the trade. He found tapioca flour to be a good substitute for the American corn flour. Shri Popatlal G. Shah, an evacuee from Penang (Malaysia) came in touch with Shri. Manickam and taught him the technical know-how to manufacture sago out of tapioca flour. Thus tapioca was used in 1943 to manufacture both starch and sago. But the methods adopted were crude and primitive.

In order to meet the daily increasing demand for sago and starch, Mr.Manickam with the help of a genius mechanic M. Venkatachalam Gounder improved the methods and machinery of production. The productive capacity of the industry increased from 2 bags of 100 kilos to 25 bags per day. In 1944 there was a severe famine in the country as a whole, and tapioca being edible, the collector of Salem prohibited the export of tapioca from Salem District. The Salem sago and starch manufactures though very few in number formed an

association and represented their case before the Civil Supply Commissioner and got the prohibitory order of the District Collector and also that of Madras Government for the export of sago and starch to other states cancelled. In 1945 production of sago and tapioca starch increased appreciably.

The sago and tapioca starch industry was born during the Second World War. But the aftermath of the war posed a severe threat to its existence. The Second World War was over and imports of starch and sago began to increase from foreign countries under general license No. XI. Sago and starch manufacturers made the successful representation to Sri. C. Rajagopalachari, the civil Supplies and Industries Minister in the Interim Government and it resulted in the banning of imports of sago, which was extended up to 1949. The Tariff Board also gave protection to sago industry from time to time up to 1957 in one way or other.

Picture - 3.1

Sago Industry

The production of sago and starch industry expanded very fast. Sago was mainly consumed in West Bengal, Maharastra and other provinces. The traders from these provinces established themselves in Salem and thus risk and responsibility of marketing sago and starch was shifted from manufacturers to traders. New manufacturers entered the field body as the traders assured the market to them. The year 1953 began with a happy note for the industry, farmers, manufacturers, labourers and traders who were directly or indirectly involved in the production of sago and starch.

In 1957, misguided by some government officers and jealous traders, the Calcutta Corporation with the help of the Enforcement Branch seized about 8000 bags of sago from the traders in Calcutta under the bogey that Salem sago was not fit for human consumption. The action of Calcutta Corporation was terrific on the sago industry, and its price came down to Rs.20 per bag from Rs.65 within one month. Many manufacturers ceased the production and the agriculturists decided to switch over to the cultivation of other crops. This was the worst crisis faced by the industry since 1943.

The Sago manufacturers association faced the crisis boldly. They filed a case before the Supreme Court, against Calcutta Corporation. The sago manufacturer successfully established, by the analytical report that there was practically no difference between the good imported sago and the Indian product. They won the case. From that time Salem sago was also brought under Processed Food Act. Sago industry was thus saved.

Two major problems confronted the sago and starch industry in the last twenty years. Maize starch manufacturers managed to get a portion of imported maize under P.L.480 from the government, to manufacture starch at a very cheap and fixed rate throughout the year compared with the price of local maize from 1960. Tapioca starch, which was recently introduced to textile mills had to face keen competition with maize starch. Repeated representation were made by the Salem manufacturers to the External Affairs Ministry to prevent the diversion of imported maize from human consumption to manufacturing of maize starch. Their view point was appreciated by the government at a very late stage and the diversion of imported maize under P.L.4809 was stopped for starch manufacturers from 1964-65. The second major problem faced by the industry in this period was imposition of 10 per cent excise duty on sago which was ultimately removed by the government after strenuous persuasion and representation made by the traders and manufactures.

Indeed, the growth of the industry is certainly a successful story for which there are a few comparisons in Indian industrial history. In 1913, there was only one unit and its production was in mounds. In 1945, there were seven units and the production was in few tonnes. In 1949, there were 45 units with about 7000 tonnes production of sago and starch. In 1957, there were 125 units producing about 23000 tonnes of sago and starch.

In 1993, there were about 852 units in India out of which 725 units are located in Tamil Nadu. In Salem District alone there are 649 units constituting 89.5 percent. In 2008-09 there were about 359 sago industries located in Tamil Nadu. In Salem District alone 120 units are located in Attur and Gangavalli area.

The people of Maharastra, West Bengal, Madhya Pradesh, Gujarat and other states use sago as food article. Many dishes such as Pappad, Chivda Vada, Upma, etc., are prepared out of sago. Tapioca starch is used as textile starch and laundry starch for manufacturing dextrin, liquid glucose and dextrose. Detergent soap manufacturers and all manufacturers of adhesive gums use tapioca starch as their main raw material. Gold finger and custard powder are prepared from tapioca starch for human consumption. So many industries use tapioca starch as filling agent.

Tapioca waste like Thippi (remaining after starch and sago) is extensively used as cattle feed and the powder extracted from this residue known as Thippi flour or paste flour is used for various pasting purposes.

Sago and tapioca starch industry in Salem District and Tamil Nadu has had a phenomenal growth in the last 47 years. Though it is a recent industry of Tamil Nadu, its role particularly in Salem economy is very great indeed. It has already affected and has vastly increased the trade potential in addition to giving scope for employment opportunities for labour.

Today Salem District has the largest concentration of sago manufacturing units in the country. Thus within a short span of 40 years, sago industry has made a phenomenal progress attaining the rightful place among the important industries in India. In the history of economic development in the recent years, sago units are perhaps the singular example of not only providing large scale employment to weaker sections of the community but also drawing from the village executives who have been able to start, manage and run sago factories effectively. Such people as were acquainted with farming, mounted even the American transition from rural-agricultural to an urban-industrial economy. A great deal of credit should go to the manufacturers of sago in Salem District who started the industry from scratch.

A unique feature of the industry is that every sago unit manufactures not only sago, an edible food item but also starch which serves as the industrial raw material in foundries, textile industries and in certain food industries like biscuit making. The production of sago and starch in Attur Taluk is estimated to be about 1.5 thousands tonnes per year. However, the importance of sago industry arises from the fact that it has created a demand for a minor tuber crop, namely tapioca, grown in large quantities, in the southern states of Kerala and Tamil Nadu.

3.2. GLOBAL VS INDIAN SCENARIO

Of the tropical root and tuber crops, Cassava occupies first position in terms of area and production globally. It is found as staple food for those living

in several tropical countries of South America and Africa, like Brazil, Nigeria, Ghana etc.

"Globally cassava is grown in an area of 18.51 million hectare producing 202.65 million tonnes with a productivity of 10.95 hectare. It is grown in 102 countries in the world. African continent occupies the first position covering 66.21 per cent of cassava area producing 53.37 per cent of the world cassava as it is a staple food in many of the African countries. Even though area is more in Africa, its production, is low due to low productivity (8.82 hectare), which is lower than the world average productivity[1]".

Though rice and wheat form a major part of the staple for Asians, it is to be noted that Asian continent is the second largest in terms of area (19%) and production (29%) of cassava with a productivity of 16.76 hectare. South America has 13.44 per cent of area producing 16.79 per cent (third rank) of the world production.

Nigeria is having the largest area under cassava (22.25%) among all the cassava growing countries in the world with an annual output of 38.18 million tonnes. Congo Democratic Republic occupies second position in cassava area producing 10.00 per cent of the world production. Brazil occupies the third position in terms of area and second rank in terms of production in the world.

Picture - 3.2

Tapioca Plant

All the major cassava growing countries in the Asia continent have the productivity more than the world average productivity. Indonesia, Thailand, Vietnam and India are the major countries growing cassava in Asia. India acquires significance in the global cassava scenario due to its highest productivity in the world (27.92 hectare) and cultivated in an area of 240,000 hectare producing 6.7 million tonnes. Countries covering more than 85 % of the cassava area are more than 88 % of the world production.

According to FAO classification, Root and tuber crops form staple diet for three percent of the global population. Cassava is mostly used for human consumption in the African continent and South America. Industrial utilization of cassava is prominent in Thailand, Indonesia, Vietnam and India in the form of starch, sago, dried chips, flour and the like.

In India, 60-70 per cent of the total cassava production is used commercially to produce sago, starch, dried chips, flour and the like. Human consumption of cassava is common in Kerala and in northeastern states like Assam, Meghalaya that as raw/cooked tubers and as sago in Gujarat, Maharashtra, West Bengal states.

Picture - 3.3

Arrival of Tubers to the Factory

3.3. TAPIOCA PROCESSING

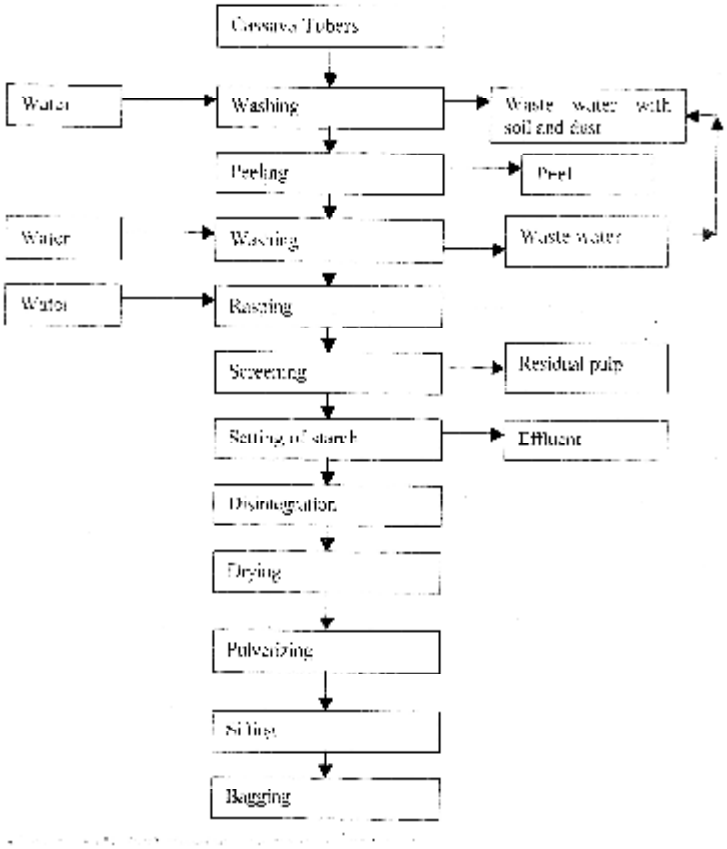
The process of manufacturing came into force many decades ago in Attur Taluk as a home industry and even today the process involves only manual labour. The separation of the starch granules which are locked in the cells together with all the other constituents of the protoplasm (proteins, soluble carbohydrates, fats and so on) can only be removed by the purification process in the watery phase. Processing the starch can therefore be divided into the following stages.

Picture - 3.4

Stocking of Tapioca before Grinding

The process flow chart for the production of starch from cassava is given below.

Figure - 3.1
Production of Starch



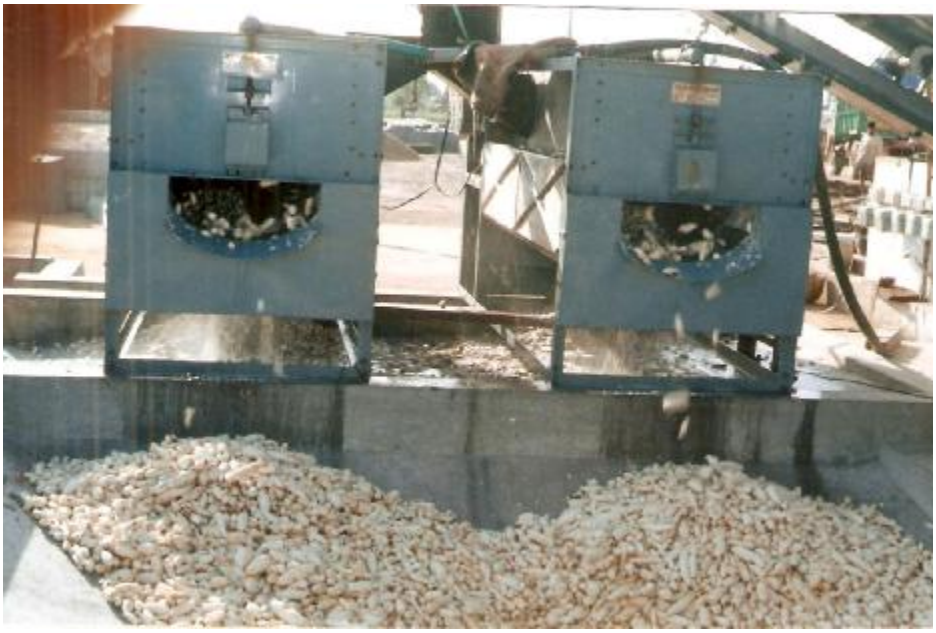
Peeling and Washing

Roots are peeled manually and washed in masonry tanks. The tubers are cut longitudinally and transversely to a depth corresponding to the thickness of the peel which can they be easily removed. Any dirt remaining on the smooth surface of the core of the root can now be washed off and the peeled roots are deposited in cement basins where they remain immersed in water until taken out for rasping.

There is a loss of starch in manual peeling. Tamil Nadu Agricultural University developed a mechanical tuber peeler which consists mainly of a cylindrical rotor fitted with a number of cutting blades. The unit is powered by HP electric motor and has a capacity of 950 kgs. Per house, while the peeling efficiency is 83 percent and the starch loss is about 5 percent. The cost of the Electric motor is Rs.56,500.

Washing is done by a short period soaking of the peeled roots in water in cement tanks. Processors claim that the washed water is replaced daily but in some factories it is changed once in 2-3 days. Roots are not rinsed with fresh water prior to feeling into Raspers.

Picture - 3.5



Peeled Tubers

Due to inadequate washing, the adhering mud particles in the tuber become responsible for the poor colour of the starch produced. In order to accomplish a more effective and fast method of washing, mechanical washers can be employed. The mechanical washers are perforated cylindrical tanks which are immersed in water. A spiral brush propels the roots, while they are subjected to vigorous scrubbing in order to removal all dirt. A pump is fitted to one end of the machine and connected to a series of jets arranged along the carrying side of the brush. These jets produce a counter to the flow of the roots ensuring that they received efficient washing.

Another efficient washer is a rotary drum with an interior pipe which sprays water on the roots. The drum is either wooden or perforated metal about 3 to 4 metre long and 1 metre in diameter with horizontal opening and mounted

inside a concrete tank. In some, rotating paddles are fitted along the axis. Washing is done by the action of water sprayed assisted by the abrasion of the roots both against one another and against the sides of the cylinder or the paddles.

Rasping or Pulping

It is necessary to rupture cell walls, in order to release the starch granules. Pressing the roots against a swiftly moving surface provided with sharp protrusions usually carries this out. During this process, the cell walls get ruptured and the whole of the root is turned into a mass in which a substantial portion of the starch granules are released. It is difficult to remove all the starch even with efficient rasping devices, in a single operation. Therefore, the pulp is generally subjected to a second rasping process after screening. It may be estimated that an efficiency of about 85 percent is attained at first rasping. In the secondary rasper, the indentation of the blades should be a bit more fine about 10 cm as compared with 8 cm. for the primary rasper. The overall rasping efficiency can there be raised to over 90 per cent by the secondary rasper. The rasping is carried out in different ways with varying efficiency. In India, rasping is done in machines using a wooden roller, over which sheet metal rasping surface is nailed. These devices though inexpensive are relatively less efficient or the rasping blades must be replaced frequently on account of rapid wear. Therefore the material selected for the rasping blades should have adequate surface hardness in order to minimise the wear. Rasping

devices need special hardened steel for the rasper blades in order to improve their efficiency in terms of making starch granules free. This avoids contamination of starch with iron and there will be more recovery of starch. Water addition during rasping has to be reduced so that final slurring will have more of starch and less of water. Starch recovery from tubers depends on the efficient crushing operation. It is reported that in order to have the kinetic energy necessary to obtain the rasping effect, the rasping motor would have a linear velocity of about 25 m/s.

Screening

In separating the pulp from the free starch, a liberal amount of water must be added to the pulp as the rasper delivers it and the resulting suspension stirred rigorously before screening. The screening is done either manually or by using machines depending on the size and sophistication of the factories.

In the small mill, screening is done by hand. The rasped root mass is put in batches on a cloth fastened on four poles and hanging like a bag above the drain leading directly to the sedimentation tanks. The pulp is vigorously stirred with both hands while screening. A simple form of rotating screen consists essentially of a conical frame of hard wood fixed on a hallow horizontal axis, atleast 3 metres long covered with ordinary cloth or phosphor bronze gauge. The crude pulp reaches the lower end of the cone it is more or less completely washed.

The screen in mounted close to the rasper at a slightly lower level in order to ease the flow of the crude pulp. The washed pulp discharged at the screen is carried off by some form of conveyor from the industry to some space outside. This is later on dried and used as cattle feed.

In bigger factories, the shaking screen replaces the rotating screen. It consists of a slightly inclined horizontal frame. 4 metre in length and covered with gauze, which is put into lengthwise shaking motion in short strokes by means of an eccernic rod. The fresh pulp after being mixed with water in distribution tanks is conducted by pipes to the higher end of the screen. During screening, the pulp remaining on top of the screen is slowly pushed downward by the shaking motion.

It is advantageous to let the suspensions pass a series of increasing fineness (60, 100, 150, 200, 250) the first one retaining the core pulp, the others the fine particles. The pulp remaining on the first of these screens is often subjected to a second rasping or milling operation and then returned to the screening stations. Efficient rinsing of the pulp on the screens is promoted by attaching one or more shallow transverse channels to the screen where the strong whirling movements caused by the shaking of the screen effectively loosens the starch granule from the pulp.

An efficient machine for the separation of starch from cellulose fibre is the jet extractor or the continuous perforated basket centrifuge. The starch pulp slurry is put in a conical basket and centrifugal action separates the starch

dispersion from the fibrous pulp. Jets of water sprayed in the pulp as it travels the length of the course ensure recovery of the starch. For efficient screening and to avoid break down, it is better to mount shaking screen on the sides of the wall using ball bearings. Soft water should be used for the separation of starch.

Setting and Purification of Starch

For starch separation from the slurry, there are four methods available and they are:

(a) Conventional sedimentation

(b) Use of starch tables

(c) Use of centrifuge and

(d) Use of hydrocons

In Tamil Nadu, most of the tapioca industries invariably adopt settling a tank for separation of starch. The level of production and convenience of handling determine the size and the number of brick work cemented tanks. The most common sizes of the tanks used are $40' \times 13'$, $80' \times 13'$, and $120' \times 13'$. Settling takes longer periods ranging from 6 to 20 hours depending on the quantity as well as the size of the settling tank. However, longer the settling time the more is the action of the enzyme and microorganisms. The upper layer of sediments flour which has a yellowish green tint contains many impurities and is generally scraped off and rejected. The remaining moist flour is then stirred up with water and left to settle again in most cases two settlings suffice to obtain reasonably clean flour. In larger factories producing flours for

special purposes, settling may be repeated several times with or without the addition of chemicals. Stirring slurry in tank to remove fine dust particles from starch is done manually which is very unhygienic. There is scope to design and fabricate machines for separation of starch.

A rapid separation of starch from milk and the removal of impurities from the colloidal suspension can be achieved by centrifuging. But centrifuging cannot replace entirely the gravity of settling operation and settling has to be employed after centrifuging, to separate the starch from any remaining solid impurities. A 100 centrifuging capacity horizontal type centrifugal separator driven by a 3HP electric motor has been developed by Tamil Nadu Agricultural University. The diameter and height of the imperforate basket used are 50 cm and 30 cm respectively. The optimum speed of this centrifuge was found to be 800 rpm. It is suggested that similar centrifuges can be scaled up to obtain the required capacity for a given plant thereby replacing the present sedimentation method followed in most of the plants.

Drying

The removal of the free water from the starch sediment obtained from settling tanks or centrifuges must be dried by evaporation, either in the open air (sun drying) or by mechanical dryers. The mechanical dryers used for this purpose include, drying ovens, chamber dryers, drum dryers, belt dryers, funnel dryers and pneumatic dryers. Though mechanical drying is costly, uniform and

quicker drying is possible, while using mechanical dryers besides facilitating drying throughout the period, irrespective of weather conditions.

Picture - 3.6

Drying of Sago

Finishing and Packaging

"Crude dry tapioca flour consists of hard tumps of starch. As it cannot be used as such, it has to be subjected to a pulverising process followed by dry screening. Roller crushers can be employed for pulverising and a sieve size of 100 to 200 mesh is used for screening. It is finally packed in jute bags[2]".

Picture - 3.7

Storage of Starch bags in factory

3.4. MANUFACTURE OF SAGO

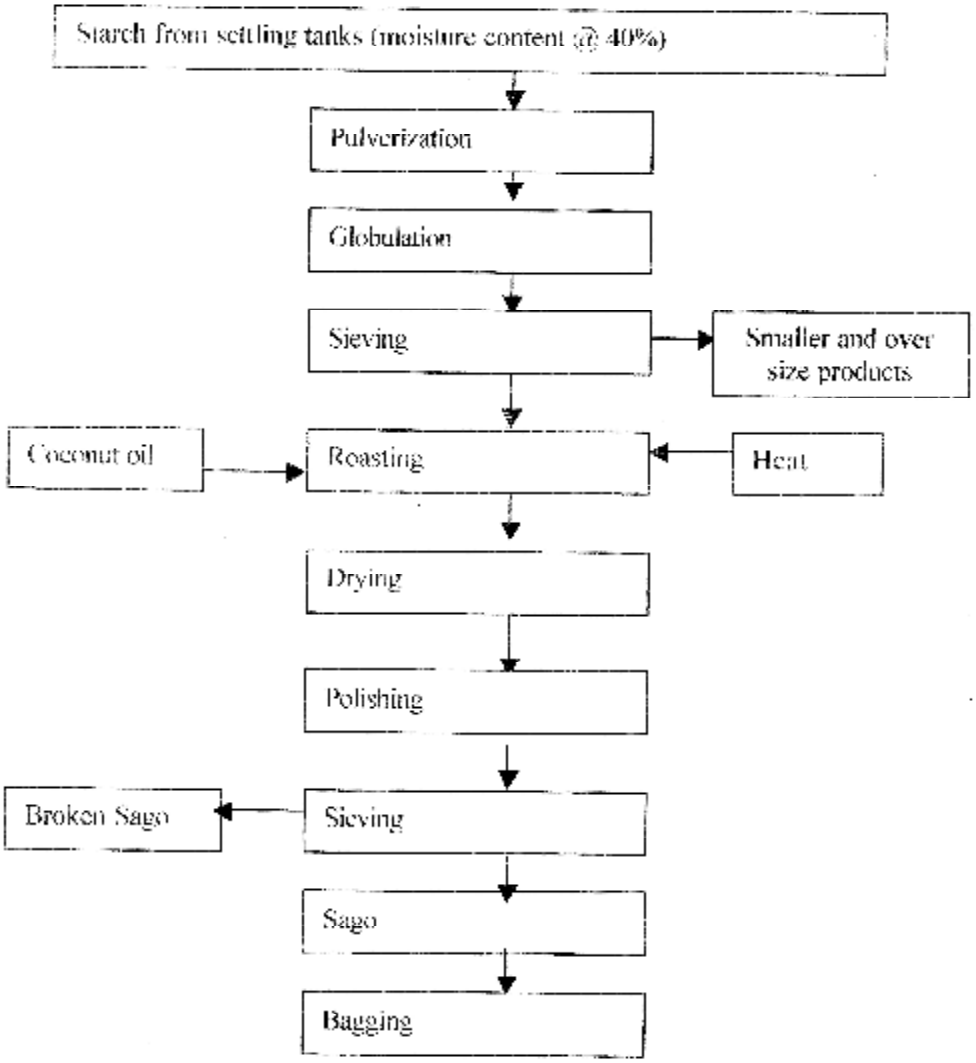
"The raw material for the manufacture of sago is the flour scooped from the sedimentation tanks after the excess water has been drained. The operations involved are pulverisation, globulation, sizing, roasting, drying, polishing, screening and packing, pulverisation is done in spike mills and the wet starch is subjected to globulation in vibratory units provided with gunny cloth surfaces forming two pouches. Each pouch or sack can hold 10 to 12 kg. of wet starch powder for globulation. The globulated starch powder is then graded in oscillating screens. The sago so formed is given a mild roasting on hot plates at about 100°C for about 6 to 8 minutes. The roasted sago is then dried in the sun on cemented floor for about 8 to 12 hours depending on the intensity of sun shine. During roasting sago lumps are formed which passing the material through disintegrate breaks down[3]".

A sago roaster (conduction dryer) has been designed and fabricated by the Tamil Nadu Agricultural University. It consists mainly of a food hopper-drying cylinder and electrical heating coils (12 kw capacity) and is driven by a one HP electric motor. The trials conducted with the roaster go to show that the temperature of 170°C with the retention time of 3 minutes is adequate for roasting of sago uniformly.

Sago is one of the important products made from tapioca starch commonly used in the dietary preparation. The unit operations for sago manufacture are given below.

Figure - 3.2

Manufacture of Sago



Pellets from Tapioca

In countries like Thailand and Indonesia, tapioca is a foreign exchange earner. Tapioca pellets manufactured are exported as cattle feed to the West European countries. Not only the cost of transport and storage of pellets is comparatively less, but also the product reaches the destination undamaged

pelletisation also facilitates mixing of tapioca with groundnut cake, minerals and other nutrients, which would fetch better price in the market. Therefore the development of pelletisation plant for tapioca in our country appears to be very promising.

Sago units undertake two types of operations namely slurry recovery and thippi drying operations when they remain idle soon after the regular operations. The nature of both these operations do not involve the functioning of the entire plant. Slurry operations do not involve the crushing section of the plant. It refers to salvaging of some starch, which is accumulated from the effluent water, let into storage tanks in the course of the total tapioca crushed, and therefore is negligible for any recovery on day to day basis. However, when the units do not crush tapioca during the non optimal period, they start clearing the slurry by mixing it with little water. There upon it undergoes all the subsequent process of production other than crushing. Sago produced from slurry will be slightly dull in colour instead of the usual white, and hence is considered to be inferior in quality. These slurry operations are carried on for a month or two depending upon the availability of water and the extent of slurry accumulated.

Similarly a second set of operations, namely Thippi (residue) drying is also a salvage operation, wherein the fibrous waste (obtained in the course of sieving the root milk) is dried. This fibrous waste, Thippi will come to about 3 to 4 percent of the total roots crushed. Thippi operations require only the

drying yards and all other sections of the plant remain idle. Such thippi drying operation lasts for even a month, and since it does not require water, this will be the last operation to be done before the sago units shut down their plants totally for repairs of tanks and drying yards.

These two sub operations, besides helping the units to realise utilisation of a section of capital, which otherwise remain idle, prove to be quite productive and profitable.

Besides being easy to cultivate, tapioca contains more calories than many other crops. As a consequence, the production cost per calorie of tapioca is relatively very low, making it for cultivation to feed people in developing countries with food problems in Asia, Africa and Latin America. It is foreseen that the role of tapioca as food in these regions will keep on growing. Flour derived from tapioca is a perfect substitute for flour made from maize, sorghum, wheat etc.

3.5. CASSAVA IMPROVEMENT ASPECTS

"Cassava", *(Manihot esculenta* crantz) also known commonly as Tapioca, continues to be a crop of food security for the millions of people especially in the developing countries of the globe. It is an important alternate source of energy, to meet the demands of the increasing population. This crop has the potency to produce more food per unit area, capacity to withstand adverse biotic and abiotic stresses and adaptability to the conditions of drought and marginal lands. The crop has been cultivated in India for more than a

century. Cassava was introduced into India by the Portuguese, when they landed in the Malabar region, presently part of Kerala state during the 17th Century, from Brazil. The popularization of the crop in the state of Kerala was attributed to the famous king of Travancore State, Sri Visakham Thirunal by introducing popular varieties from Malaya and other places. Cassava saved the people of erstwhile Travancore province from the clutches of famine during II World war (1939-45), when import of rice from Burma (Myanmar) was stopped and the subsequent times of food scarcity. Cassava was used as substitute to rice (staple) especially by the people of low income strata. With the changing economic conditions and the rise in standard of living of the people, it has become a "side dish" even for the affluent sections of the society.

Picture - 3.8

Cassava

Hither to acting as a crop of food security, the end uses of cassava saw a huge change with the production of many value added products such as starch, sago etc. Industrial use of cassava started initially with the production of diversified products like starch and sago. During Second World War, cassava starch and flour production commenced in Kerala. But later, problems like unsuitable weather conditions for drying of starch and relatively very high labour costs led to the diminishing of the industrial conversion and use of cassava in Kerala state. Consequently area under the crop has come down from 3,00,000 ha in 1970s to 94,300 ha in 2003-04.

In 1943, Mr. Manickam Chettiyar of Salem, Tamil Nadu found cassava flour as a good substitute for American corn flour and marketed in Chennai. Sago production commenced in Tamil Nadu with the technical know-how from Malaysia. By 1945, production of sago and starch increased appreciably. Factors like suitable climate for drying of starch, low labour costs in Tamil Nadu prompted the development of cassava based industries and making it as a commercial crop today. The end of Second World War posed a threat to the existence of these industries due to import of these commodities from foreign countries under Open General License (OGL). But successful attempts of sago and starch manufacturers convinced the Govt. and this resulted in banning of the imports and thus saved these industries. “Scarcity created due to restriction on imports of sago and starch from Singapore, Malaysia, Indonesia and USA during Second World War was also one of the factors for the development of

the sago and starch industry in Tamil Nadu. At present there are approximately 800 cassava based industries in Tamil Nadu. Area under the crop has increased to 95,000 hectares in 2003-04".[4]

Taking the successful example of Tamil Nadu, where cassava has changed itself from food crop to commercial crop, some progressive farmers cum industrialists from East Godavari District of Andhra Pradesh started cultivating and popularising the crop to produce sago as well as chips for export. With a view to develop sago industry with modern technology, the then industrialists (Sri Jami Ramulu, Sri Manyam Surya Narayana Murthy, Sri Alladi Kantaiah and Sri Palacherla Kasulu) collected cassava cuttings from Salem in 1965 and distributed to farmers in East Godavari district for cultivation. Slowly sago industry emerged there as a cottage industry by 1970. The area under cassava has increased from 4 hectares in 1960 to 19,450 hectares in 2003-04. At present there are 65 cassava based industries functioning in Andhra Pradesh and the area is still increasing.

"Cassava is also cultivated in an area of 6,300 hectares in north eastern states of Assam and Meghalaya as a food crop and to some extent for the production of sago. The states of Maharashtra and Gujarat have also taken up cultivation in several thousand ha and a few processing industries have also been set up in these states".[5]

3.6. UTILIZATION PATTERN OF CASSAVA

Cassava finds a place in the home front as well as in the industrial front. In the home front, it is consumed as cooked/baked tubers in culinary preparations and in making pappads. In Kerala, the maximum production goes for human consumption.

Cassava and fish when cooked and consumed together forms a good combination of dietary carbohydrate and protein. Nowadays cassava dishes are seen in big hotels and restaurants. In a limited quantity it is consumed as baked tubers in Tamil Nadu and Andhra Pradesh during harvesting season. Cassava fried chips is another form of utilization observed in Tamil Nadu and Kerala at cottage industries level.

In the industrial front, it has wide applications. Many value added products are prepared from cassava such as starch, sago, flour and chips. Cassava starch is having wide industrial applications. It is used in textile industries as sizing agent in pharmaceutical industries, making adhesives, dextrin manufacturing, paper industry, laundry and in many fast food preparations. A sizeable quantity of cassava produced in Tamil Nadu and Andhra Pradesh is processed in the industrial sector.

Flour is made from cassava dried chips, and this finds applications in gum industry, in making Kumkum (Vermillion) and in making colours applied to faces during celebrations and festivals. Residue (Starch and sago industries fibrous waste) and Peel (Waste from chip industries) are used as an ingredient in poultry and cattle feed preparations.

3.7. CASSAVA PRODUCTION SYSTEM IN TAMIL NADU

Tamil Nadu occupies the second position in terms of area and production of cassava in India and its productivity is the highest in the world. It is cultivated both under irrigated and rainfed conditions. Sixty per cent of the crop is grown under irrigated conditions in Salem, Erode, Dharmapuri and Namakkal Districts, while forty percent of the crop is cultivated as rainfed crop in these districts. However the cassava area in Kanyakumari district is mostly cultivated under rainfed conditions and it accounts for nearly 12 per cent of area.

Paddy, sugarcane, turmeric and vegetables are the major crops grown under irrigated conditions in the tracts where cassava is cultivated. Groundnut, Black gram, Bengal gram, Grain Sorghum (Jowar), Fodder Sorghum, Pearl Millet (Bajra), Finger Millet (Ragi) are the crops under rainfed conditions.

Cassava is cultivated both as mono crop as well as inter crop. It is found as intercrop in coconut orchards. Black gram, bengal gram, tomato, onion are raised as intercrops in Cassava. Cassava is rotated with Paddy and Turmeric under irrigated conditions.

Two predominant cassava varieties viz., H-226 and H-165 released from CTCRI are cultivated in Tamil Nadu since 1976 and these occupy more than 70 per cent of the area. In addition Mulluvadi, Kumkum Rose, Burma, CO_2 are also seen cultivated in many areas recently. More than ninety per cent of

cassava produced is for industrial use and grown largely by marginal, small and medium size farmers. In the industrial belt of Salem, large farmers also cultivate this crop.

3.8. CULTIVATION PRACTICES

1. **Land preparation:** "Land, where cassava is cultivated have mostly red and black soils. Land preparation is done using bullock and tractor ploughs. Land is ploughed 5 to 6 times on an average either with tractor or bullock ploughs 15-20 days before planting. Before the fourth ploughing, grass and other weeds are removed using manual labour. Manures are spread before the last plough in the field. Ridges and furrows or beds and channels are then made before planting[6]".
2. **Nursery:** Nursery is raised for the crop grown under irrigated conditions. Nursery raising is in practice in Salem, Erode and Namakkal districts only. However in other districts, only direct planting is observed. Setts are prepared using a local equipment "Kuchi cutter" into pieces of six inches length. Very few farmers adopt the sett treatment for controlling scales and mealy bugs with chemicals during nursery stage. Setts are planted on raised beds at a closer spacing and are sprinkled with water and then covered with palm leaves. Water is given to the setts depending on the atmospheric temperature at an interval of 4-5 days till the setts are ready for transplanting. Setts are transplanted in 15 to 20 days after the emergence of first leaf from the stem. Nursery is raised in an area of 10 to 13.5 sq.m sufficient to transplant in one hectare of main field.

3. **Transplanting:** Rooted setts are planted in the main field at a spacing of either 75 × 75 or 90 × 90 cm between the rows and between the plants. Planting the setts along the ridges is also observed. Setts are planted vertically at a depth of 7 to 8 cm.

4. **Planting season:** Under irrigated conditions, crop is planted during December to February while it is planted in July - September as rainfed crop.

5. **Manures and fertilizers:** Farmers incorporate FYM before last ploughing @ 12.5 to 25 t hectares". When cassava is grown under irrigated conditions after paddy, farmers do not apply FYM (Farm Yard Manure).

   Fertilizers like diammonium phosphate, single super phosphate, muriate of potash and complex fertilizers are applied by the farmers. Fertilizer is applied in two to three split doses as basal or top applications, after weeding the crop. Farmers apply fertilizers indiscriminately, both under irrigated and rainfed conditions. Fertilizers are applied after 2 to 3 months of transplanting in the main field, at an interval of 15 to 20 days. N, P_2O_5, K_2O are applied @ 65 : 100 : 170 kg hectare under irrigated conditions and 25 : 25 : 150 kg hectare" under rainfed conditions.

6. **Intercultural operations:** On an average seven to eight weedings are done in irrigated cassava and four to five weedings in rainfed grown cassava. Very few farmers apply weedicides and this may be due to high

cost of weedicides, lack of knowledge on time and type of weedicides to be applied and also due to cheap availability of labourers for manual weeding. During third weeding, earthing up is also done and mostly women labourers are employed for this operation. Weeding and inter cultural operations are carried out during 15,30,50,70,115,145,175 days, after planting in the main field.

7. **Irrigation:** On an average, 15 to 16 irrigations are given during the crop growth, depending upon the availability of soil moisture. Irrigation is given immediately after transplanting/planting, within a week after planting and from then onwards at 10 days interval for five months. Irrigation channels are made at the time of land preparation. Ground water is the major source of irrigation.

8. **Pests and diseases:** Among the diseases, CMD (Cassava Mosaic Disease) and tuber rot are the major diseases. As such farmers do not adopt any control measures for these diseases. Some farmers apply Bavistin. Recently, Spiralling white fly has become an important insect attacking the crop.

9. **Harvesting:** Before harvesting, irrigation is given for the easy lifting of tubers. Crop is harvested using contract labourers. On an average irrigated crop is yielding 381 hectares while under rainfed conditions, yield ranges from 20 to 251 hectares. Depending on the variety planted, crop is harvested from 8^{th} month.

10. **Storage of planting material:** Healthy planting materials are stored under shade vertically for a maximum period of 3 months. No chemical treatment is given to the stored planting material. It was told that the planting material loss may be up to a maximum of ten per cent during storage. Planting materials are covered with palm leaves.

3.9. COST OF CULTIVATION OF CASSAVA IN TAMIL NADU

Cassava is grown in irrigated and rainfed production systems in Tamil Nadu. The survey carried out in 2007-08 indicated that the cost of cultivation was Rs.80,649.92 / hectare under irrigated conditions, whereas in rainfed conditions it was Rs.50,174.09 as gross cost. Labour cost was more, when cassava was grown under irrigated conditions than in rainfed. Labour expenditure was also maximum under irrigated conditions due to high incidence of weeds. Rental value of land is also higher in irrigated lands. Family labour involvement was observed to be more, under irrigated production system.

On an average, the farmers get 26.43 tonnes of tubers per hectare and sell at an average rate of Rs.2.23 per kg. This leads to a gross income of Rs.58,875.81 from one hectare of cassava. It may be noted that average yield in Tamil Nadu was 37.6 hectare. However, it was observed that farmers could get only 26 hectare in the surveyed areas. Even though the net income was less in irrigated (Rs.8,238.89) over rainfed (Rs.14,529.79) system, the farm business income was higher in irrigated (Rs.25,208.92) over rainfed (Rs.22,395.07),

indicating the overall profitability of cassava farming under irrigated conditions. Farm investment income was more from irrigated cassava compared to rainfed cassava.

3.10. TAPIOCA CULTIVATION IN SALEM

In Tamil Nadu nearly 800 sago factories are functioning out of which 359 factories are located in Salem district. The tubers produced in this district are mainly used for sago and starch production. But tuber cultivation is not sufficient to run the factories throughout the year and hence tubers from Kerala state are also bought and utilised by these factories.

Although the national tapioca productivity is far above the global productivity (Indian 17.7 tonnes per hectare and the world 9.4 tonnes per hectare) the crop has the potential yield as high as 90 tones per hectare under proper crop husbandry. The reason for the low yielding of tapioca is inadequate adoption of improved production technology by the farmers and cultivation of inferior local varieties which are susceptible to mosaic disease. Although high yielding varieties of tapioca with field tolerance to mosaic disease were developed, the spread of the high yielding varieties is still very low due to lack of well orgainsed extension programme unlike cereals and other commercial crops.

In Salem, tapioca is largely grown as irrigated crop and the average yield of tapioca is about 32 tonnes per hectare which is mainly due to irrigation and adoption of high yielding varieties. The average cultivated area is about

28000 hectares per year. The important varieties grown in Salem District are H-226, H-165. The other varieties cultivated in this district are MVD-1 and Malabar.

Attur, Rasipuram, Namakkal and Salem are the major tapioca growing taluks in Salem District. About 60% of the area is under irrigated condition and 40% comes under rainfed condition. In varietial aspects H-226 covers 65% of the total area in Salem District.

3.11. CASSAVA MARKETING SYSTEM

Though cassava production centres are concentrated in Southern India, the marketing centres are distributed throughout the country for different value added products produced from cassava. Cassava is consumed either directly as cooked tubers or the products prepared from cassava.

3.11.1. Human Consumption Market

Cassava is consumed as baked tubers, as fried chips and as a culinary item in Kerala, Tamil Nadu and Andhra Pradesh. Forty per cent of tapioca produced in Kerala is consumed as vegetable in the form of boiled tubers, fried and parboiled chips. Ten per cent of tapioca is converted into chips for making flour and for using in snack food preparations.

Contract merchants or village agents collect the tubers from farmers and supply to wholesalers in wholesale markets like Nedumangadu in Thiruvananthapuram district of Kerala. Retailers purchase from wholesaler for further distribution to consumers. Some cottage industries make fried chips in Kerala. They supply to bakeries in the surrounding towns for retail sales.

Cassava as Food

Cassava was an important part of the diet of people below poverty line in the yester years in Kerala. But with the improvement in the standard of living and availability of cereals, people are shifting from cassava to cereals. Cassava along with fish forms a very good combination of carbohydrate and protein. Now it is common to find this combination of cassava and fish in big hotels and restaurants.

In Tamil Nadu, cassava is consumed as fried chips. Petty vendors purchase raw tubers from wholesale market and convert into fried chips for selling. Fried chips are produced mostly during harvesting season of the crop. It is commonly found in Salem, Erode and Namakkal districts. Cassava is also consumed as baked tuber during the harvesting season. It is seen during the harvesting season in cities like Chennai and Coimbatore in Tamil Nadu. Quantum of cassava production used for human consumption is 20 percent only and the remaining production is used in starch, sago and chips production. However, in Kanyakumari district, the consumption pattern reflects Kerala state.

In Andhra Pradesh, very small quantities of tubers are consumed in baked form. Edible tubers are cultivated in very small area. During harvesting season, these tubers are sold in shandies. Another form of consumption is by preparing papads at home level. During the harvesting season it is common to see that farmers consume baked tubers in the field itself. It is a common belief

among the public that consumption of cassava tubers results in knee joint pains. Ninety nine percent of the production goes for industrial utilization in Andhra Pradesh.

3.11.2. Animal Feed Market

Cassava as an ingredient of cattle feed is gaining popularity in the recent past. Raw tubers, flour made from cassava dried chips, residue and skin are the most common forms of cassava used as cattle feed. Besides cattle feed preparations, cassava residue flour is also used in the fish and poultry feed preparations. Fresh cassava tubers, to the tune of 30 percent of cassava production in Kerala are used to feed cattle.

During the crop production season, it is common to see the feeding of dried leaves to cattle. Some farmers soak the dried chips and then feed them to the cattle. Buffaloes fed with cassava leaves and chips showed improvement in the milk yield.

Picture - 3.9

Thippi – Cattle Feed

Cassava waste is mainly used as a source of carbohydrate and as a buffer in Cattle feed formulations. Sand and Silica content to the tune of six per cent is the most limiting factor in the usage of cassava waste, as cattle feed.

Cassava waste (Residue & peel) is used relatively in less quantity than de-oiled rice bran *(DOB).* Most of the cattle feed preparations contain 5-10 per cent of cassava waste compared to 35-40 percent of DOB. As the latter is preferred to cassava waste as it contains 16 percent protein, in addition to good quantity of carbohydrate, as well as its availability throughout the year. Cassava waste faces stiff competition from DOB, maize and jowar. Only when price of cereal grains such as maize and jowar is high, industrialists are showing interest in cassava waste.

Cassava thippi & peel flour find a good market in Maharashtra, where small dairy farm units use this flour in cattle feed preparations. In Andhra Pradesh and Tamil Nadu, this flour is used in cattle feed.

Thippi from starch and sago industries and peel from farmers making chips and starch and sago industries is procured by flour millers for making flour. Fine, rough, coarse flour and bharada flour are the four different flours prepared from cassava thippi and peel. Flour millers supply the flour to the wholesalers in Maharashtra and in turn it is supplied to secondary wholesalers through commission agents. Small dairies/ farms directly purchase them from wholesalers. Bharada quality floor is especially used in making swine feed. Cassava thippi and peel flour units are concentrated in East Godavari district of

Andhra Pradesh and Salem district in Tamil Nadu. It is common to observe the feeding of cattle with raw tubers in Kerala.

The knowledge of using cassava waste as an ingredient of cattle feed is known to a very few cattle feed industrialists due to lack of publicity. When this factor is taken care of, cassava waste can find a good market in cattle feed industries in future.

3.11.3. Market for Commercial Products

Many value added products of commercial importance are produced using cassava starch, sago, chips and flour.

Starch

It is the most important value added product produced from cassava. Approximately 400 starch processing units are located in Tamil Nadu. Starch is mainly used in the textile industry, in making adhesives, in pharmaceuticals, in paper industry, in confectionery industry etc. Eighty to ninety per cent of the cassava starch produced in India is from Tamil Nadu while the remaining quantity is from Andhra Pradesh.

In Tamil Nadu, fifty percent of starch is marketed through 'SAGOSERVE' and the remaining quantity is marketed directly or through commission agents by the millers to the wholesalers. Traders and primary wholesalers participate in the secret auction for purchasing the starch at 'SAGOSERVE'. Primary wholesalers / traders are from Maharashtra, West

Bengal and Gujarat. They further distribute the starch to secondary wholesalers, either directly or through commission agents. Secondary wholesalers distribute to retailers in different places, who in turn supply to the consumers. Commission agents charge one per cent of the value of the product as their commission. Wafer industries located in Namagiripet area of Namakkal district purchase wet starch for the preparation of wafers.

Only one industry M/s Vensa Bio-Tech, in Andhra Pradesh is producing cassava starch; further it produces liquid glucose from cassava starch. Five to six units in Kerala produce white and yellow dextrin using cassava starch.

In the recent past, India started exporting cassava starch from Chennai, Mumbai and Kolkata ports to Sri Lanka, USA, Australia, South Africa and the Gulf countries, though in small quantities.

Sago

Sago is another important value added product produced from cassava. Sago production units are located in Tamil Nadu, Andhra Pradesh, Gujarat and Maharashtra. Moti, Medium, Bada dana and Nylon Sago are the different types of sago produced in the country. Nylon sago is produced in Tamil Nadu and Andhra Pradesh while Moti dana is produced in Andhra Pradesh only. Nearly 400 sago producing units are located in Tamil Nadu, while 26 units are located in Andhra Pradesh.

The different types of Sago are given below:

- Grades of Sago
  - Super Fine
  - Milk white
  - Special
  - Best

The other types of sago produced by some of the units in the cluster are Nylon Sago and Sago Brokens.

- Grades of Starch
  - Textile Grade
  - Edible Grade
  - Glucose and Laundry Grade

Starch also is marketed thorough 'SAGOSERVE' as well as through Salem traders directly. The manufactures undertake the following measures to improve the grade of the sago / starch.

- Washing the tubers thoroughly with jet washing.
- Peeling of outer skin with help of shaking machines with peeling devices and rotary peelers.
- Hand peeling.
- Use of chemicals like bleaching liquid and sulphuric acid to remove unwanted materials and to improve the colour.

- Use of agitators instead of manual walking process in the starch setting tanks.
- Proper roasting of the product.
- Keeping a high level of hygiene in the factory.

Though sago production is limited to Tamil Nadu and Andhra Pradesh, it is consumed throughout the country. Maximum sago is consumed in Maharashtra. *Payasam, Kichidi, Upuma, Bonda are* the different items prepared using sago. Sago is used mostly as baby food in West Bengal. In the remaining parts of the country, it is consumed mainly in preparing *payasam* and wafers.

Pune and Nagpur in Maharashtra and Kolkata in West Bengal, Patna in Bihar, Kanpur and Varanasi in Uttar Pradesh, Gauhati in Assam are the main marketing centres for sago in India besides the production centres in Tamil Nadu and Andhra Pradesh. Fifty per cent of sago in Tamil Nadu is marketed through 'SAGOSERVE' which charges a sales tax of 2 percent for the sago it transacts.

In Andhra Pradesh, it is marketed through commission agents and one to two per cent of the value of the sago transacted is taken as commission. It is also transacted on consignment basis. Sales tax @ 4 percent is paid for the sago sold from Andhra Pradesh. While in West Bengal, there is no tax on sago, as it is considered as baby food. Sago market in Andhra Pradesh is a 'buyers market' as traders are dominating the trade.

Demand for sago is generally more during festival seasons and in *Sravan* month (August) due to more marriages being held then.

Since the traders dominate the sago trade in India, M/s. 'SAGOSERVE' helped in eliminating commission agents between processor and primary wholesaler but not between primary wholesaler and secondary wholesaler. Nowadays in the retail market, sago is marketed through an attractive consumer packets of [1]*A, ½, 1* and 2 kg sizes. It is also exported from Mumbai, Kolkata and Chennai ports under different names like *Sago Appalam* and *Sagopith*.

Chips

"Cassava dried chips are produced in Andhra Pradesh, Kerala and Tamil Nadu. East Godavari district in Andhra Pradesh, Salem district in Tamil Nadu and Kozhikode, Kannur and Thiruvananthapuram districts in Kerala are the centres of chips production in India. Chips are prepared during the harvesting season by farmers and chip producing units. Village agents collect the chips from farmers and supply to flour millers. Flour millers collect chips from farmers directly also and the chips are used mainly to produce chip flour for further using it in textiles, making different food items, adhesive industry, corrugation industries and the like[7]".

PICTURE 3.10

Cassava Chips

Some stockiest with the expectation of good prices during off-season collect chips from farmers and store in go downs and they apply banned chemicals like BHC for protecting from insects during storage.

Chips are also exported to European countries like Belgium and Italy, whenever there is export demand. Chips are exported mainly from Kakinada port. General problem expressed about the quality of chips from Andhra Pradesh is high percentage of sand and silica content.

In Andhra Pradesh and Tamil Nadu, the chips are mainly used in the preparation of food items called muruku besides their use in feeding cattle. Chip prices depend on factors like quality of chips, competition from millers, artificial scarcity created by stockist and the export demand.

Chip flour making units are concentrated in Andhra Pradesh, Tamil Nadu and Kerala. Chip flour is mainly used in textile industries, adhesive

industry, Kumkum (Kumkum is the red colour powder used in poojas by Hindus and also as bindi by women folk) preparation, making colours, in corrugation industry and in preparing food items.

Ichhilkaranji in Maharashtra is a big centre for chip flour for using it as stiffening agent in textile industries. Industries manufacturing kumkum are located in Chennai. Colours are made using cassava chip flour in Hathrus district of Uttar Pradesh, as adhesive in cracker industry at Sivakasi (Tamil Nadu) and for making food items called muruku in Tamil Nadu and Andhra Pradesh.

Chip flour is marketed either directly or through the commission agents to wholesalers. Commission agents charge one to two per cent of the value of the goods transacted as commission.

Baroda quality flour is the flour prepared from small pieces of tubers. These tubers are peeled, chipped, dried and then ground to coarse powder. This powder is mixed with thippi and peel flour and is mostly used in animal feed industries and gum making.

Wafers

It is another important value added product from cassava starch; seventy wafer making cottage industries are functioning at Namagiripet taluk of Namakkal district in Tamil Nadu. These wafers are marketed through WAFERSERVE, (The Namagiripet Tapioca byproducts industrial cooperative

service society Ltd.) It eliminated middlemen between processor and primary wholesaler to some extent.

Demand for wafers is more in northern states like Delhi, Gujarat and Uttar Pradesh besides Bangladesh and wafers are sold in attractive consumer packets. Involvement of brokers is limited in this trade.

3.12. EXPORT TRADE

Cassava finds place in the international trade either in its raw form or in its processed form. India has been exporting cassava products since 1950s in different forms. Cassava exports declined after 1960s due to domestic food situation especially in Kerala. However in the late eighties, the exports picked up momentum.

Cassava is exported in different forms like Raw tubers, Frozen tapioca, Tapioca chips, Manioc starch, Tapioca & substitutes, Tapioca flour, Sago pith and Sago flour from different ports of the country.

3.12.1. Raw Tubers and Frozen Tapioca

Very small quantities of cassava raw tubers are being exported to Middle East and Gulf countries in two forms. l. Raw tubers 2. Frozen tapioca. These exports are routed through Kochi sea port and from Kozhikode and Thiruvananthapuram air ports. Raw tubers are exported in cartons packed and filled with sawdust. The frozen tapioca is exported after peeling the tubers and cutting into small pieces and freezing at 18°C in the frozen containers of ship.

These exports are meant to meet the demand of ethnic Indian population in the Gulf and Middle East countries.

3.12.2. Tapioca Chips

"Dried cassava chips are exported mainly to European countries like Netherlands, Belgium, Italy and Russia. Even though published data shows that cassava chips were exported between 1972-73 and 1985-86, recent trade enquiries in Andhra Pradesh revealed that even in 1987-88, 1992-93 1993-94 and 1995-96, dried chips continued to be exported from Kakinada port to the European countries[8]". Some of the export specifications for chips are:

1. Moisture content of chips should not exceed 11%
2. Chips with fungus attack should not be more than 2%
3. Percentage of thin roots, chips with stem portion should not exceed 2%
4. Dust in the chips should not exceed 1.5 to 2%

Trade enquiries indicated that high percentage of sand and silica in the chips is the general problem in the quality of chips exported from India. If there is export demand, then the chips collected by middlemen, commission agents and traders are exported. The importers will accept the produce, only when the quality controllers (SJS and Geocum) certify, that it meets the export specifications.

3.12.3. Manioc Starch

Manioc starch exports started only recently from India i.e. from 1992-93 onwards, It is exported from Chennai, Mumbai and Kolkata ports to European

countries and South East Asian countries. Our major problem in starch exports is the inconsistency j in the quality of starch. During 1997-98 India exported 3,385.47 tonnes of starch earning Rs.2.89 crores in foreign exchange. However, India is facing a stiff competition in (manioc) starch export from Thailand. India is not able to compete in the international market for cassava starch due to its poor quality and high price. Due to less production costs in Thailand, starch prices are less in Thailand in the global market compared to Indian prices.

3.12.4. Tapioca and Substitutes

Under this group, various value added products prepared from cassava starch in the form of flakes, grains, pearls and siftings in smaller forms are exported. This group has a major share among the cassava exports from India. These products are routed through Chennai, Mumbai and Kolkata ports.

3.12.5. Sago Pith and Sago Flour

Published data shows that products under the headings sagopith and sago flour are exported from India. Therefore, it is assumed that sago pith and sago flour are the products prepared using cassava starch. These exports are destined to Bangladesh and Middle East countries from Mumbai and Kolkata ports.

Cassava exports from India showed wide fluctuations over the years. Inconsistency in the quality of the product, competition from other countries

like Thailand and inability to compete with international prices are found to be some of the reasons for the wide fluctuations in the quantity of cassava exports.

3.13. USES OF STARCH AND SAGO

Broadly speaking starch is employed by two categories namely food and non-food industries.

Food Industries

"Tapioca flour is made use of by these industries thanks to a number of characteristics. These include the fact that it aids the thickening and solidifying process, gives a sticky consistency and preserves the balance of water in various foods. Tapioca flour is consequently employed as a feed stock by industries making such products as soup, candy, pudding, sausages, bred, ice-cream and vermicellis. It is used as a binder by the pharmaceutical industry in making pellilized machine[9]". Moreover due to its saccharification property tapioca flour is used for manufacturing food seasonings, glucose, fructose, soft drinks and canned food.

Glucose Industry

Tapioca starch accounts for as much as 80 percent of the total raw material made use of by the glucose industry. The flour however, has to be of the 'super grade' variety. Demand for this type of tapioca flour by the glucose industry is estimated at 10000 – 15000 tonnes annually. Glucose syrup is a solution derived from saccharification of starch. It is further purified and made

into a concentrate, which is highly popular and is used for used making sweets and drinks.

Seasoning Powder Industry

The bulk of tapioca starch is used as feeds stock for the production of paper, textiles, glue plywood and alcohol.

Paper Industry

Raw material, such as wood, grass, straw and bagasse are defibrized into pulp which is further processed into paper. Surface treatment is needed in the production of quality paper as it increases surface smoothness, improves appearances, increases strength and prevents ink and water penetration into the paper. A solution made from tapioca starch and other substances including a sizing agent and pigment particles, is used in the surface treatment process. This process is called surface sizing, in which the starch solution increases the smoothness of the surface and fills up pores, making it smoother to write on and harder for ink to penetrate. Some of the solutions will penetrate into the paper making is stronger and more resistant to shear.

Textiles Industry

Tapioca starch is used by the textile industry in treating yarn smoother and less fluffy while increasing its tensile strength. Starch is applied to the yarn in the warp sizing process. The treated yarn is dried mechanically and printed. Tapioca flour assists in making printing more even.

Plywood Industry

Tapioca starch is used for making glue which is an important raw material of the plywood industry. The strength and the quality of plywood depend largely on the quality of glue. Tapioca starch is highly appropriate for making this glue and is consequently used in large quantity accounting for about 50 percent of the raw materials. Glue made from tapioca starch has fine texture and is relatively cheap.

Glue Industry

Tapioca starch becomes sticky when it is mixed with hot water or certain chemicals. It stays sticky over a very long period of time. However only purified, low-acidity tapioca starch is fit for making industrial glue, namely dextrin and oxidised starch.

Picture - 3.11

Cassava Starch Liquid Gum

Alcohol Industry

"Increased priority has been given to alcohol with other non-oil energy like wind, solar power and bio-gas. In several agricultural developing countries experiments have been conducted to produce alcohol as a substitute for petroleum. Brazil is a case in point where a large volume of alcohol is produced yearly and is mixed with gasoline to form what is called gasohol. The mixture proves as good as gasoline and less polluting when used in motor vehicles. In Thailand ethanol is produced – 70 percent of it goes for domestic consumption and the rest for export. The former is accounted for mainly by the alcoholic beverage industry and hospitals.

Tapioca is an apt raw material for alcohol manufacture, while supply is abundant all year round and its prices low. Production of ethanol per unit of tapioca is quite high as experiments show that a tonne of fresh tapioca yields 180 litres of 95 percent ethanol[10]".

There is a great need for diversification of tapioca processing industry. Pelletisation of tapioca for cattle and poultry feed is a promising one. Also more attention should be given for starting of more tapioca starch based industries for the production of alcohol, liquid glucose, dextrine and lactic acid in the small sector for which indigenous equipments, machineries and processes are to be made available.

3.14. THE ROLE OF "SAGO SERVE" IN THE CLUSTER'S GROWTH

Prior to the formation of 'SAGOSERVE', an industrial cooperative service society, the manufacturers of starch and sago in this district faced a lot of problems such as lack of financial assistance, warehousing and marketing facilities for tapioca products. The merchants used to offer low prices for their goods and exploited the manufacturers due to an absence of organized marketing and warehousing facilities.

To overcome these problems, the sago / starch manufacturers in 1981 formed the Salem Starch and Sago Manufacturers Service Industrial Co-operative Society Ltd., popularly known as the 'SAGOSERVE' under the Tamil Nadu Co-operative Societies Act, 1961. This society is functioning under the administrative control of the Director of Industries and Commerce, Government of Tamil Nadu.

After the emergence of 'SAGOSERVE', the bargaining power of manufacturers has substantially increased and the menace of middlemen in this trade has been completely eliminated. Owing to the sustained efforts of the society, sago / starch industry has now become the backbone of Salem district's rural economy providing employment to more than 5 lakh people both in agriculture as well as factories.

Other Institutions

Besides 'SAGOSERVE', the following institutions are active in the Growth and development of the starch and the sago manufacturers and traders of the Salem cluster.

C.T.C.R.I - The Center Tuber Crops Research Institute, Shreekariyam, Thiruvananthapuram, Kerala is doing pioneering research and development works on tuber crops especially Tapioca. It has released a number of high yielding, high starch varieties for the benefit of the farmers and Industry. It has also standardised the manufacturing process of many tapioca based products. It offers technologies to the entrepreneurs who want to set-up industries on tapioca - based products. It has also development and patterned some useful equipment for the industry.

C.T.C.R.I. is successfully collaborating itself with a S.B.I. project Uptech, Samalkot at Andhra Pradesh in imparting technical knowledge on modern methods of cultivation to the farmers growing tapioca as well as to the sago factory owners on modern methods of processing. However, the distance between the cluster and the institution hampers effective linkage between the institution and the cluster.

Taminadu Agricultural University (TNAU) Coimbatore

The T.N.A.U is a reputed institution doing research on tapioca and has released many high yielding high starch varieties like Mulluvadi, CO_2, CO_3 for the farmers of Tamil Nadu. Through its engineering department it has developed many labour saving equipment for the industry. The T.N.A.U research center for tapioca and caster at Yethapur is doing excellent research work on tapioca cultivation and imparting knowledge to the farmers on modern methods of tapioca cultivation. Currently the Project Uptech (Sago Industry)

has entered into an M.O.U. with the university to implement its agricultural programme through the latter's research station at Yethapur. In this programme the farmers will be educated on the modern method of tapioca cultivation through demonstrations, village meetings and mass media. Sufficient amount of planting materials of improved varieties of tapioca will be developed and supplied to farmers through this programme.

The Home Science Department of T.N.A.U. has developed many recipe based on sago, which can be profitably utilized for marketing sago products. However, the sago factory owners do not have any effective linkages with this institution.

District Industry Centre

The D.I.C. is situated at the district head quarters and offers many incentives to the small scale industries situated in the backward areas. Their main work is to register the small scale units and give them a registration certificate. They also provide subsidy on electricity charges incurred by the entrepreneurs and help the latter in getting licenses to set-up a unit.

Pollution Control Board

The Pollution control board takes steps to control the pollution so as to maintain the environment. They control and monitor the pollution control measures taken by the sago factory owners. However they do not give any technical guidance or plan layout for the erection of effluent treatment plants.

Regional Testing Laboratory, Salem

This laboratory is under the control of the Department of Industry and Commerce of the Government of Tamil Nadu and provides facilities for testing of sago and starch for various parameters including compliance under the I.S.I. standards.

Department of Agriculture and Horticulture

The Departments of Agriculture and Horticulture provide necessary extension work to impart knowledge on modern method of cultivation for the farmers.

NABARD

The District Development Officer of National Bank for Agriculture and Rural Development is helping the district administration in formulating developmental plans for the industries in the district.

Commercial Banks

There is a good network of commercial banks in the cluster. They offer both cash credit and term loan facilities to the sago industry is so far covered by institutional finance and there is large gap between the need for the credit and its availability.

Co-operative Banks

There is a good network of co-operative banks in the cluster. They also offer credit facilities to the sago factory owners. Obtaining loan form Co-

operative Banks is somewhat easier than obtaining loans from commercial banks.

3.15. SUMMARY

Tapioca, a root crop, plays a vital role in the economy of country and is gaining significant importance in the recent years as one of the major source of starch, Sago, glucose, fructose, ethanol and an array of chemicals based on glucose are ethanol.

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