CHAPTER – II

REVIEW OF LITERATURE

2.1 INTRODUCTION

Many studies have been conducted in the field of Sago industry focusing the problems of chemical and production modules and a few studies have identified the problems in the case of Functional Management, such as purchase of Raw Materials, Finance, Marketing, Effluent treatment and power cut. But the present study has been conducted to cover all the problems stated above and in particular to identify the problems and prospects and the present scenario of Sago industry with reference to Tamilnadu in general with Salem and Namakkal districts as the thrush areas simultaneously.

2.2 REVIEW OF LITERATURE

Booth, et al., (1974) in their study, have stated that the evolving these changes have little effect on the human acceptability of roots when boiled and considered that with certain vegetable. It was considered that with certain storage may in fact be advantageous particularly for animal feed purposes by encouraging a higher consumption. However, a conversion of starch to sugars may obviously be a disadvantages for certain industrial purposes.
Deja Tulananda, (1974)\(^2\) in his article, has found that after three consecutive harvests without soil reconditioning the average yield and quality have diminished. Fertilizer is being employed but not extensively, as expenses for fertilizer create an additional burden for the planters. Here again certain interest from the authorities concerned should be emphasized. In regard to shipping facilities, freight changes by regular liners were very high for pellets and chips. Reorganization of local trade was essential. Local co-operatives should be encouraged, and more low-interest financial assistance should be allocated. It therefore seems that there were good prospects for the future of Thailand tapioca yet, without long-term planning to improve the present situation, Thailand tapioca may not be in a competitive position.

Firman Manurung, (1974)\(^3\) in his article, has stated that the products were equal to the pure dried cassava and the pellets contained much less meal, almost three times as much cassava could be used in Holland and the price of the product would increase to approximate the nutritional value. Thus he has result the problems faced by the industry in its effort to meet the demands, each processing step in analyzed, and possible improvements with regard to quality and reduction in production cost were suggested from these analyses.

Hrishi, (1974)\(^4\) in his study, has concluded that the problems concerning cassava cultivation in India and possibilities for stepping up
production in future. The necessity of developing the processing technology was emphasized. As a result of all the efforts recently being made toward increasing production of cassava in the country it will become necessary to open up new avenues for its utilization. In addition to expanding the existing starch industries, new processing technology had to be developed.

Truman, et al., (1974)⁵ in their article, have suggested that many intangibles associated with the projection of future demand for cassava. These were unquantifiable Nevertheless, the overriding impression was that cassava and cassava products have used in larger quantities in non producing countries, general, live stock, and industrial production trends suggest that there could be an increasing need for cassava products. Furthermore, the expected growth in demand in non producing countries suggests, that cassava has also be used more in the industrial starch and animal feed industries of the producing countries. Both the industrial starch and animal feed market require processed cassava. However, to research on cassava processing was very fragmented.

Grace, M.R. (1977)⁶ in his article, has concluded that the need for suitable methods or equipment and technology to reduce the water consumption in tapioca starch production without sacrificing the starch extraction efficiency. It is necessary to have a thorough knowledge on the different unit operations involved in the starch production. Water
requirement, product output and effluent generation to develop technology to solve the water problem.

Meuser, F. et al., (1978) in their study, have found that the extraction of starches from tapioca roots, chips and pellets on a laboratory scale was studied in view of the possible yields product quality and use of by products. It was observed that the processing of roots to starch and by products was simpler and more effective compared to that of chips and pellets better product quality was achieved. The greatest difficulties arise while processing chips and pellets, as it was difficult to remove impurities before disruption by grinding. Moreover, the problem of removal of waste water will also arise. The purity of starch from chips and pellets cannot be improved even by pretreatment of the ground material through steeping or fermentation.

Padmaja, G. (1990) in her study, has reported that the starch or sago factories were becoming obsolete and use of labour intensive indigenous technologies, which often imported off colours, off odour and microbial contamination to starch. Since the enzymatic processes are likely to develop as soon as the roots were dug up and during manufacture, which ultimately reduces the quality of the end products, it is necessary to process the roots immediately after harvesting.

Sreenarayanan, V.V. et al., (1990) in their study, have found that the upper layer of sediment flour, which has a yellowish green tint, contains
many impurities and is generally scraped off and discarded. The remaining moist flour is then stirred up with water and transferred to another tank where starch is settled. The final settled moist flour is removed by using a crowbar.

Igbera, J.C. et al., (1992) in their study, have reported that a rapid separation of starch from the milk and the removal of impurities from the colloidal material could be achieved by centrifugation. Hydraulic jack may be used as dewatering technique but putting cassava starch pulp in bag of woven cloth and subjected to high compressive pressure.

Vinceswary, S. et al., (1994) in their article, have stated that the nutrient content of sago pith and subsequently sago hampas is very low, the bulk being crude fibres and some starch attached to the hampas. The protein content is about 0.6-0.7 per cent, which is unfavourable for most animals. The fibre content of sago hampas is about 12 per cent fungal treatment of sago hampas seems possible. Fungi can grow rapidly and able to utilise complex carbohydrates such as starch and lignocellulose. An important area of research into the utilization of sago hampas would be find suitable, palatable, non-toxic, high protein-containing and rapidly-growing fungi to grow and utilize the sago hampas. The hampas could be supplemented prior to inoculation with different and economically viable sources of nitrogen available around the factory area. Microbial utilization could result in the production of biomass as quality animal feed supplements.
Periasamy, M. (1996)\textsuperscript{12} in his article, has stated that the inorganic constituents like phosphate, sulphate, chloride, and several metals were also found in trace quantities. Most factories dispose of the effluent into the nearby rivers, streams or lakes. It releases undesirable odour, pollutes the environment and surface ground water.

Radhakrishnan. (1996)\textsuperscript{13} in his study, has revealed that the settling and purification of starch after the separation of starch by screening, the starch milk is subjected to a settling process. The starch milk is pumped to a tank fitted with effluent outlet at varying heights. Settling takes about 6 to 20 hours depending on the quantity as well as the size of the settling tank.

Horst, et al., (1998)\textsuperscript{14} in their article, have stated that the health with high life expectancy and to become self efficient, which supply and demand for domestic consumption was guaranteed, each government must strive and direct all its efforts towards increasing renewable resource production, thereby maintaining or reducing its demand by diversification of the staple food and at the same time remove health hazardous wastes. Increased monoculture with a single outlet has continued to cause problems to farmers and the ecological environment. The sago palm can provide the community with housing material, bioenergy mushroom industry, meal industry, and ethanol, microbial biomass protein for feed sago flour or meal for food and effluent for biofertilizer. They concluded that socio economic process strategy has as its core unit the biogas production through anaerobic
digestion to remove the ever increasing infectious disease outbreaks in the developing countries. Most of these countries have no or low efficiency human and animal waste treatment plants.

Adi Mulyanto, et al., (2000)\textsuperscript{15} in their study, have suggested that a private owned company that produces tapioca starch, almost of the employees were daily workers and incidental workers. For that, the numbers were always different from day to day. The working time was not fixed. It depends on the raw material stock. The largest numbers of workers were concentrated, in the drying process, they have responsibility starting from collecting the starch in the sedimentation basin to the finished dried tapioca starch. Drying process was extremely on the sun dependent. In the rainy season, or when the sun was not shine, the wet tapioca was stored in the concrete basin and it should be flooded with water as an effort to preserve the tapioca. Even though it can be preserved for two months, as a result, the quality of the starch will decrease.

Thongchai Sribophakun, et al., (2000)\textsuperscript{16} in their study, have found that a mass integration for segregation mixing, reusing, and direct recycle was generated to solve the water - wastewater problem as a whole plant concept. Discharged water from each unit as well as the fresh feed were considered as source of water, whereas units that accept water was considered as sinks. This set of allocated equation is then combined with the process. Constraints and solved as an optimization problem to target the
minimum freshwater feed to the system and to design the water network simultaneously.

**Montri Chulavatnatol, (2001)** in his study, has stated that the starch is one of the most important energy sources of the living world. While all green plants can fix atmospheric carbon dioxide and synthesize sucrose and starch, only some plant species can actively accumulate and store starch. Rice, corn, wheat, maize, potato, cassava, jam and sag palm were among the known plants with high contents of storage starch and they were widely consumed as caloric sources in the forms of human food and animal feed. Agricultural practices have not only made these crops the main part of the rural living but also have resulted in better yielding varieties of most of them. Due to the rising concerts over energy shortage and the environments, future promising products from starch which may reach the commercial scale will be ethanol fuel and polylactic acid as biodegradable practices. For sago starch to be developed as a prominent raw material, much had to be done on speeding up the maturity of the plant and reducing pollution during starch processing.

**Sudhandhiran, (2001)** in his report, has found that a process of roasting which is being used at many sago units was 12 to 15 per cent inefficient as compared to the efficiency level of this mechanical roaster. Many sago factory owners are showing interest on sago and starch dryer and metallic rotary screens experiments have been carried out by some
companies on the above equipments. The cost factor remains one of the major blocks in introducing new machinery. The sago factory owners were ready to purchase costly, to install machinery from the manufacturers and usually fabricate most of the equipments with the help of local engineering, workshops. However the machinery manufactures feel that the sago factory owners should take into account that the cost of running these machinery manufacturing units.

**Wattanachant, et al., (2002)**\(^{19}\) in their article, have stated that the hydroxypropylation and cross linking processes were more effective for the starches with high swelling power. For this reason, waxy and tapioca starches were usually selected to be used as basis for commercially modified starch. They have suggested that it was more difficult for hydroxypropylation to take place inside the granules of rice, wheat and corn, than in the granules of waxy and tapioca starches.

**Sajeev, M.S. et al., (2002)**\(^{20}\) in their study, have suggested that the settling is an important unit operation in cassava processing where the extracted starch is separated from its aqueous dispersion under gravity.

**Tamilnadu energy development agency Chennai, (2003)**\(^{21}\) has stated that the tapioca is a crop of great economic importance, both as human food, animal feed as well as raw material for industrial products. In India, tapioca is grown over an area of about 3 lakh hectares, with a production of 58 to 68 lakh tones of tubers. Tamilnadu ranks second in terms
of cultivation and production of tapioca after kerala but it stands first in respect of processing of tapioca in sago and starch throughout the country meeting about 80 per cent of country’s demand. There were about one thousand sago starch industries is small-scale sector scattered throughout the state of which 800 units were located in and around salem district. About 3 cubic metre of wastewater is generated for processing one tone of tubers, which contains high pollution load, and has to be treated to meet pollution norms set-up by the state pollution control board. At present, there are more than 100 units producing bio - gas, using tarpaulin cover over the conventional anaerobic lagoons and utilizing the biogas produced for roasting of sago and generation of electrical energy.

Azronnizan Aziz, et al., (2004) in their article, have suggested that the chemical modifications on starches have markedly altered physicochemical properties compared with their parent starches. The report that acetylating of starch was found to increase hydrophobicity and thus is a useful approach towards increasing the water resistance of starch attempts to modify physicochemical properties of sago starch by etherification and etherification were described. These results revealed that the chemical modification improves the physic-chemical properties of sago starch.

Rajasekar, (2005) in his article, has suggested that the tapioca starch and sago are scorching the trading market with price gains close to 12 per cent over last month as supplies shrunk over recent weeks, according to
statistics available with sagoserve, the country’s lone government trade exchange for tapioca products in Salem, Tamil Nadu. Tapioca had been hurt by scanty rains in the cultivated areas of Tamil Nadu. Tapioca market in India was estimated to be in the range of Rs. 200 Crore annually. Currently, average bidding for Sago runs at Rs. 1,370 a bag (90 Kg), a jump from Rs. 1,230 a month ago while tapioca starch price surged to Rs. 960 from Rs. 857. Though Kerala tops in tapioca production in the country, Tamil Nadu with 82,000 hectares under tapioca cultivation stands first in terms of processing tapioca into starch and sago. In Tamil Nadu, Salem district plays major role in serving the Indian sago market with 650 processing units. The domestic and export prices were functions of supplies at Salem sagoserve. Tapioca (a ten month crop) supplies peak during November to February.

Srinivas, et al., (2005) in their study, have found that the prices were not favourable during these periods to cassava growers. The cassava tuber prices were not favourable during January to June in a year, while it was favourable between July to December there were fluctuations in the prices of cassava and its products during different quarters in a year. Prices of starch, sago and market forces were influencing the price determination process for cassava tubers. Though maximum transaction of starch and sago takes place through sagoserve, it had limited role in controlling the market forces. Thus there was necessity for the government to intervene in controlling the market forces like traders and middlemen and steps have to
be taken to fix the minimum support price for cassava tubers based on the cost of production to protect the intents of farmers’ at least in Tamil Nadu in future. Then only it is possible to control the wide seasonal fluctuations in cassava based products.

Andrew Graffham et al., (2006), in their article, have stated that the current situation is that, the hydrocyclone technology was little used after its validation, but water shortages in ca. 2000 forced a number of factories to start adoption. It was estimated by sago serve’s technical representative that can 20-25 factories now use the technology which represents 5 to 10 per cent of the industry. The equipment is currently locally fabricated with imported cyclones. Sago serve currently preys 50 per cent of the costs of the hydro cyclones. This supports is mandated role to support the industry. The starch storage technology is currently not being used. The hydrocyclone technology is being used by 20-25 commercial starch or sago producing factories in the Salem district of Tamilnadu in India. For the hydro cyclone technology, the scale use is currently 20-25 factories out of a total industry of ca. 400 hundred factories covered by sago serve producing ca. 0.3 million tons of starch and sago. Although a couple of factories established the use of the hydrocyclone technology in 1996, their use did not really increase until there were water shortages in 2000.

Edison, et al., (2006) in their study, have revealed that the practices such as sett hill, sett length and planting method were uniformly. The
farmers has given first place to the infrastructural constraints comprising non-availability of hybrid planting materials lack of adequate knowledge and skill on improved cultivation practices, lack of special development programme. However farmer beneficiaries, of lab to land programme expressed. Economic and marketing constraints such as high cost of cultivation, lack of proper marketing system, inadequate industrial exploitation, less price for hybrid tubers well adopted by majority of the farmers.

**Manickavasagan, A. et al., (2006)** in their article, have stated that the most of the tapioca processing units in India today price of sago and starch. Most take steps to preserve information. Separate starch from slurry by employing the gravity settling method sedimentation in settling tanks allows the contact of starch with water. This process leads to fermentation in which alcohols and organic acids are formed and polluting the environment. Waste water from tapioca processing factories contains high chemical oxygen demand and causes pollution. The effluent from tapioca industries is acidic and organic in nature, contributing biological oxygen demand. The pattern of effluent production was almost similar in all factories when compared to other products. Since the quality of waste water released from the starch settling tank is not suitable for reuse in the production process, almost all factories are facing severe problems in treating the huge.
Gopalakrishna. K. et al., (2007)\(^{28}\) in their article, have stated that the starch manufacturing industrial units, such as sago mills, both in medium and large scale, suffer from inadequate treatment and disposal problems due to high concentration of suspended solids present in the sludge. Sago mill wastewaters and waste water coming from the vegetable-tanning factory were more polluting in nature. The effect on the water bodies is magnanimous when they are discharged without any treatment. The wastewaters are highly organic and also complex in nature. Therefore the treatment of such wastewaters with aerobic technology is possible due to the development of many advanced reactor designs.

Govindaswamy, K.A. (2007)\(^{29}\) in his report, has stated that a large number of farmers in salem and neighbouring districts of Namakkal, Dharmapuri and Krishnagiri were dependent on the income from tapioca cultivation. Farmers could be protected from the price fluctuations in the market, the state government fixed a price for the tapioca tuber. The government should initiate steps to streamline the starch content in tapioca tuber. There were irregularities in determining the starch content, which affected the farmers, the association claimed. The middlemen were collecting commission both from the farmers and the starch and sago manufacturers. This practice should be administration to convene a tripartite meeting with the tapioca farmers manufacturers and officials to sort out problems in tapioca cultivation and procurement.
Guillaume Gruere, et al., (2007),\textsuperscript{30} in their study, have found that the cassava was subject to fewer pests in high attitude, and grown well on the local fertile land without any intensive external input. Cassava requires good water resources. Which tend to become scare in certain parts of the plains with the more frequent occurrences of drought and depletion of the water resource, but was not a problem with the heavier precipitation in the kolli hills environment.

Karunanidhi, (2007)\textsuperscript{31} has highlighted a proposal to condone high hydrogen cyanide (HCN) content in sago. Tapioca, the raw material for manufacturing sago and starch, contains HCN, high levels of which are lethal. The skin contains 85 per cent HCN while the remaining is in the white starchy part. Two years ago, Sagoserve, a Salem - based industrial Co-operative society formed to provide marketing and warehousing facilities to producers insisted that the HCN content is sago be brought down to below 1 ppm (parts per million). The pollution control Board limit for cyanides in effluent water is 0.2 ppm.

Mathivanan, (2007)\textsuperscript{32} in his study, has stated that the Tamilnadu was the state where the average production of tapioca was high in the world (38 tonnes per hectare), out of total 800 sago factories in Tamilnadu, 700 were functioning in Salem and Namakkal districts alone. They claimed that the starch – point assessment was differing from factory – to-factory thus causing losses to them. Middlemen were controlling the trade they charged
that the factory owners never adhered to the decisions taken at an earlier tripartite meeting. Sago and starch manufacturers, they were open for inspection with regard to the point assessment, while accepting that a few manufacturers had been permitting the middlemen to thrive, they insisted that the government should come to the rescue of the industry in this issue. They also claimed that stringent quality control measures of sago serve had caused severe hardships causing them heavy losses.

**Sundaramurthi, G. (2007)** in his article, has revealed that the Farmers complained that middlemen procure tubers at very low levels. They are prevented from selling directly to starch and sago manufactures. The district administration will initiate stringent measures to eliminate the role of middlemen in the tapioca tuber procurement process in Kolli Hills. He was speaking at a meeting organised to discuss problems in tapioca tuber procurement with farmers and starch sago manufactures in Kolli Hills. The meeting was conducted following complaint from farmers that the middlemen were purchasing the tubers at very low rates and preventing them from selling their produce directly to the manufacturers.

**Sundaramurthy, (2007)** in his study, has stated that the many of the factories in Namakkal district never adhere to the routes, causing heavy environmental pollution with untreated effluent thus affecting the farm lands.

**Tavva Srinivas, (2007)** in his article, has found that the cassava in India was used mainly in the human consumption, industrial and animal feed
sectors. In India nearly 60 per cent of cassava was used industrially in the production of sago, starch and dry chips. These result revealed that sago production industry, cassava starch finds applications in a wide range of industries like textiles, corrugation box, paper and paper conversion industries or liquid gums for domestic sector. The study had clearly indicated that in the industrial sector, the projected cassava demand was highest in the adhesive sector especially in the corrugation gums and paper conversion industries. The demand of the paper industry was also high. Cassava starch production had to be enhanced envisaging the projections of starch requirements in different sectors of its use.

Vaiypuri, (2007), has made an attempt to point out that many farmers prefer to sell products to middlemen. The agriculture – based sago and starch industry, once thriving, is struggling for survival. A heap of serious issues confronts both the industry and the tapioca farmers who provide the raw material informed. Sources now put at least a part of the blame for the travails on the middlemen in the sector. Tapioca is cultivated or nearly 1.3 lakh hectares in the state, producing 48 lakh tonnes of the crop. Tamil Nadu is a top grower; the average per hectare yield is 38 tonnes. It is grown on 21 per cent of the state’s irrigated lands. This is the major crop in the districts of salem, Namakkal, Erode, Tiruvannamalai, Villupuram, Dharmapuri and Karur, and sustains more than three lakh farmers. Some 800 Sago and starch factories depend on the crop. But even as the industry faces
ordeals, the middlemen quick and easily make money of the industrialists and the hardworking peasants. Here these middlemen decide the price and take Rs. 25 as commission for a bag of 75kg that sells at Rs. 200. The farmers are not permitted to sell their produce directly to the industry.”

Ayyasamy, P.M. et al., (2008)\textsuperscript{37} in their study, which two investigational systems: one is treatment sago industry effluent by aerobic bacterial consortium and the other is impact of treated and untreated effluent on seed germination. For the treatment system, the starch degrading bacteria were isolated from sago industry effluent and effluent contaminated soil. The general, Alcaligenes, Bacillus and corynebacterium were found efficient in starch degradation. Sago and starch production from tapioca is one of the major food industries in South East Asia. There are nearly about 1,000 sago and starch processing factories operation in Salem district of Tamilnadu, India. The tapioca tubers one the raw material and it converted into commercial sago through indigenous technology. During the process on an average from 30,000 to 40,000 litre of effluent is generated per tonne of sago processed and it takes about 10 days for the water to be let out of the factory as effluent. The results reveal that effluent treated by aero microorganisms has no negative impact on the seed germination and can be effective used for irrigation.

Duraismay, S. (2008)\textsuperscript{38} in his report, has stated that the sago and starch industries were struggling to operate in the state due to various problems. The number of sago units had come down to 400 from 1000 in the recent past. The frequent power disruptions in the state had also adversely
effected the operations is the existing units. The producers demanded that the government announce moratorium and also waive the interest on the loans. The government should extend necessary assistance for the revival of the sick units. The producers, employees and tapioca farmers would be forced to launch a series of agitations, if the government tailed to fulfil these demands.

Har Sahay meena, (2008)\(^{39}\) in her report, has found that the starch and sago manufacturers and farmers should work to gather to ensure the growth to the industry and high quality in production. Salem and Namakkal districts contribute a major share in the production of sago in the country. A number of starch and sago factories were functioning in the district for the past several years. But many units were yet to adopt modern methods of production. As a result the sago and starch produced were not getting good prices. A few manufactures were utilising chemicals to improve the colour of the products. The manufacturers should stop such practices. Instead, they should adopt modern methods of production and enhance quality, which would help them face competition.

Janagam, D. et al., (2008)\(^{40}\) in their article, have revealed that the study focuses on the impact arising from the cassava production and processing at Salem district in Tamil Nadu. The outcome of the result revealed that 80 per cent of the workers complained of headache, dizziness, vomiting eye irritation, breathing difficulties and chest pain in various
combinations, as reported earlier 20 per cent of the workers had no complaints. Salem is one of the major city was involved in cassava processing, producing sago and its products. Cassava is an important raw material for the starch and sago industry. Tapioca sago production is one of the major food industries in Southeast Asia. The Sago industry was an agro based seasonal industry using cassava root as the basic raw material. Currently the plant was cultivated in about 90 countries throughout the world. Several reports indicate that chronic low exposure to hydrogen cyanide can cause neurological, respiratory, cardiovascular, and thyroid effects.

Mohamed. D, et al., (2008)\textsuperscript{41} in their article, have concluded that the sago and starch had high swelling power and low gelatinization temperature. When it was heated in water mixture with addition of salts, or sucrose or hydrocolloids, an increment in the gelatinization temperature had been noticed. Alkali treatment at higher concentration and longer duration effectively inhibited retrogradation of this starch. This review research revealed that the physicochemical as well as the thermorheological properties of sago starch presented make it to be considered as an excellent starch resource with possible applications in many food processing.

Vaiyapuri, (2008)\textsuperscript{42} in his article, has concluded that evolving the import of tapioca starch continues to hurt the domestic tuber growers and starch producers, despite the centre imposing safeguard duty. The
association felt the safeguarded duty failure to check imports as it was extended only to tapioca starch whereas import of modified starch was not brought under the levy. There is no mechanism to find out the extent of import of starch taking place in the garb of modified starch there is a need for the centre to undertake an appraisal on the effect of the safeguard duty mechanism as imports of tapioca starch construed unabated and it has affected both the growers and the domestic industry.

**Har Sahay Meena, January 31, (2009)** in her article, has stated that the sago serve, the industrial cooperative marketing society here will initiate action against the manufacturers, who are selling the wet starch processed with unpeeled tubers to sago producers. The sago processed with wet starch has loose the original tasted and affect the health of the sago consumers. Action have initiated against the manufacturers who are selling the wet starch, purchasers, lorry owners and drivers transporting the product under the prevention of food and adulteration. Stating that such practice was against the development of sago and starch industry, he advised the starch manufacturing members of the society to avoid wet starch sale.

**Har Sahay Meena, June 29, (2009)** in her article, has found that the sago serve, an industrial co-operative society here, has appealed to the manufacturers of sago and starch to send their entire production to the society for sale as the price of the two products has registered a sharp increase in the recent past. The prices of sago and starch have been showing
an upward trend since April 2009. The maximum rate offered for sago is Rs.3,039 a bag and for starch Rs.2,074, which is the highest price offered in the last 27 years. The manufacturers had sold 17.26 lakh bags of starch and sago for Rs.248.52 crore through the society is 2008-2009, which was the highest in the last 27 years. Manufacturers from Salem, Dharmapuri, Erode, Namakkal, Perambalur, Tiruchi, Villupuram and Tiruvannamalai districts supplied 17.48 lakh bags of sago and starch to the society in the last fiscal. The managing director also appealed to the manufacturers to peel the tapioca tuber, completely before processing and ensure quality, which would help maintain the price level.

Jaishankar, et al., (2009) in their article, have stated that the high prices fixed by Thai tapioca exporters, Indian buyers have decided to back tapioca growers in Tamilnadu to increase their acreage from this season. Sago and tapioca starch prices in India increased sharply in the past one year because of low supply in the Salem, Tamil Nadu spot markets. Salem is the Country’s biggest tapioca trading centre. Prices went through the root because of shortage of Tapioca tubers compounded by increased sago demand. Tapioca starch is used as a raw material for industrial purposes. Industries like textile, paper, adhesives, confectionaries dyes and chemicals, pharmaceuticals and corrugated boxes use tapioca starch as a raw material. The international demand for tapioca products has been reflected in Thailand’s domestic market too.
Orathai Chavalparit, et al., (2009) in their study, have stated that the tapioca processing industry was considered to be one of the largest food processing industrial sectors in Thailand. The production of native starch from cassava root involves seven major stages. These include root washing, chopping, and grinding, fibrous residue separation, dewatering and protein separation, dehydration, drying, and packaging. The production facilities expect a number of environmental problems such as the consumption of large volumes of water and energy, and the generation of high organic-loaded wastewater and solid waste. The starch extraction process requires a vast volume of water which in turn produces large amount of wastewater. The study focuses mainly on water conservation, reduction in raw material loss, and energy conservation. The result revealed that implementation on real-world tapioca starch plants were shown in terms of cost savings.

Ramesh, (2009) in his study, has revealed that only a shortage in the supply of tapioca tuber is posing a serious threat to the survival of tapioca starch and sago manufacturing units in Salem region, with farmers switching over to short-term cash crops such as sunflower and maize in many parts of Salem and neighbouring districts, including Namakkal and Dharmapuri the area under tapioca cultivation is shrinking, creating difficulties to the starch and sago units in procuring the agricultural product. The created a shortage in the supply of tuber to starch mills and affected the production. The price of starch has increased many folds. The price of a
90 – kg bag of starch, which stood at Rs.1,100 a month ago, is priced at Rs.1.956 in the fourth week of May. “The price will increase further as the starch units are not getting adequate of tapioca tuber”. Starch and sago industry in Salem region has begun to shrink owing to heavy imports since 2000-2001. About 300 factories have already been closed. Only about 450 are functioning. “If the remaining starch manufacturing units are closed because of shortage of tubers, the livelihood of a large number of people employed in these units will be affected.

Decha pimpisuth, (2010) in his study, has concluded that the tapioca starch industry produces considerable amount of by products the environmental impact of which arises from the processes of cleaning, peeling and extracting. Sound environment was essential to tapioca starch industry. Thailand was currently the largest exporter of tapioca starch in the world, and tends to have the productivity increase to reach four million tons per annum in the near future. The sharply increased numbers of tapioca starch factories in recent decades to fulfil consumers’ need had resulted in an increased competitiveness. In the current circumstance of competition, private sector, particularly the industry that depends largely on agricultural products as raw materials, needs to adjust itself to be to deal with competition, both domestically and globally. Application of information technology system for development of eco-efficiency is one way to help tapioca starch industry in assessing its production efficiency, in order to
analyze cause of losses, improve production process for higher efficiency, use appropriate raw materials and energy and reduce losses.

Decha Pimpisuth (2010),\textsuperscript{49} in his article, has revealed that the marketing trend, tapioca starch factories were forced to develop their product and service quality, as well as to allow low cost production at the same time. Therefore, the development of eco-efficiency by promoting product packaging improving proper uses of resources, and reduction of waste and pollution could increase marketing needs and stimulate competitiveness at the same time.

Gangwar Satyam \textit{et al.}, (2010)\textsuperscript{50} in their study, have revealed that the starch obtained from the sago palm was used as a binder in different concentrations in paracetamol tablets. Sago palm was a rich source of starch. Sago palm contains high amount of starch. Starch from different source was a well known tablet binder. Potato starch, corn starch and cassava starch were most commonly used. Binders were agents used to impart cohesive qualities to the powdered material during the production of tablets. They impart cohesiveness to the tablet formulation, which ensures that the tablet remains infect after compression as well as improving the tree flowing quality. Binders have been used as solutions and in dry form depending on the other ingredients in the formulations and the method of preparation. The choice of a particular binding agent depends on the binding force required to form granules and its compatibility with the other ingredients particularly
the active drug. Starch from different sources have been evaluated and used as excellent binders in either mucilage or the dry powdered form. Maize and potato starches have been common use and recently cassava starch appeared in the British pharmacopoeia as an official starch for use as binder. The prepared tablets of paracetamol with sago starch as binder were evaluated for parameters such as average weight variation, hardness, friability, disintegration, and drug content. The result revealed that tablets prepared using the Sago starch as binder showed significant hardness and friability. So it can be used as tablet binder in pharmaceutical formulations.

Jain Chandrakanth (2010)\textsuperscript{51} in his report, has suggested that the sago is a powdery starch made from the processed pith found inside the trunks of the sago palm. The genus name is derived from Greek and means heart wood, while the species name sagu is from a local name for the food. Sago forms a major for the lowland peoples of and the where it is often cooked and eaten as a form of pancake with fish. Sago look like and both are pearly grains of starch, but tapioca is made from the root of the plant. They are similar but are not identical when used in recipes. Because sago flour made from Metroxylon is the most widely used form.

Henrylito, et al., (2010)\textsuperscript{52} have made a study with multifarious uses, the unexploited sago has the potential to uplift economic and social conditions in the countryside, especially in the Visayas and Mindanao regions. Technologies to enhance the cultivation of the plant can lead to the
development of the sago industry. But more importantly, sago can help curb the food shortage in rural areas. In comparison with other starch crops in the Philippine like rice, corn, wheat, and potato productivity of sago per land area is the highest. Scientists considered sago is the world’s biggest producer of starch. The sago palm has enormous starch deposit in its trunk. The starch is made through the following process: the sago palm is felled process. The trunk is split lengthwise and the pith is removed. The pith is crushed and known to release the starch. The pith is washed and strained to extract the starch from the fibrous residue. The raw starch suspension is collected in a settling container. The sago starch can be stored for weeks or months, although it is generally eaten soon after it is processed. In South East Asia, Sago starch is used as a staple food. Before rice came into existence, sago was the main source of carbohydrates of people in Indonesia, where it was known as the “staff of life”.

Andrew Westby (2010) in his article, has stated that the evolving some 60 per cent of the water used in producing starch from cassava can be recycled using a hydrocyclone. The savings from water extraction offset production costs and technology can prove especially useful in areas with growing water shortages low concentrations of acetic acid (2%) can also help cassava processors to protect their profit, preventing the growth of micro-organisms in stored starch and thereby helping to maintain its quality.
This knowledge addresses two of the major constraints to the cassava starch industry in India and can be applied in other cassava-producing countries.

Andrew Westby (2010) in his study, has suggested that there are over 1000 small scale starch extraction factories in south India providing a significant market for poor cassava farmers. Two major sets of constraints to the industry, established through process audits were low efficiency of starch extraction, high water consumption during the processing and the adverse environmental problems created from the discharge of effluent from processing units, and quality problems associated with wet starch storage. Approaches to overcome these constraints were developed and validated.

The use of hydrocyclones were investigated for their application within the process to reduce water consumption and minimise effluent generation. Trials showed that over 60 per cent of the water used could be re-cycled, which led to a reduction of the total water consumption and the volume and loading of effluent by over 50 per cent whilst there is no financial benefit to be obtained by operating the hydrocyclone, it is recognised that the cost of operation maybe offset by the savings made from extracting water. The inability to dry all the starch (and sago prepared from the starch) extracted from cassava at the height of the season in India means that up to 40 per cent of annual starch production is stored for 4-5 months. There is a loss of quality during storage that results in a 20 per cent loss in
income. Field trials have shown that low concentrations of acetic acid (2\%) can be used to prevent the growth of microorganisms.

Andrew Graffham et al., (2010)\textsuperscript{55} in their article, have revealed that the hydrocyclone technology was developed and tested because of its environmental benefits. Factory studies indicated that, effluent generation is reduced by the same quantity as the saving in water. The characteristics of the effluent produced in terms of their polluting potential as measured by the biological oxygen demand (BOD) chemical oxygen demand (COD) and solids concentrations, are similar to that of the effluent produced during regular processing, indicating the overall pollution load emanating from factories can be reduced by over 50 per cent. The only impact relates to eater shortages as a consequence of climate change and climate variability can be mitigated against by the efficient use of water. The adoption of hydrocyclones by the starch industry in India and elsewhere contributes to the impact on poor people is however indirect since they benefit by improved access to market.

1. Ground water quality – pollution of open wells and bore wells due to untreated effluents are also likely to be significant in localised areas. 17 complaints against the starch and sago industries were received during the season.
2. Air pollution and adverse social impacts – these are self evident from odours emitted from stagnating which increase in intensity as the season progresses.

Sarawak cuisine (2010)\(^{56}\) in his article, has found that there was any food that can transcend social status, it is sago. As a staple food or gourmet dessert sago was fondly dubbed the “Tree of life”. Nowadays, many foreign tourists know about sago and its many uses-food, as well as industrial ingredients and high end products in the pharmaceutical industry. Where there was a thriving sago industry. Sago is a good food for both the rich and poor.

Thanuskodi, S. et al (2010)\(^{57}\) in their article, have stated that the tapioca is a storehouse of starch and energy and is ideal for processing into a large number of diverse value-added products. With India’s population reaching around 1.5 billion by 2020, it is projected that there will be a net shortage of around 26 million metric tons of food grains. Tuber crops like tapioca can help bridge the gap in cereal production, by expanding the cultivation to non-traditional areas and realizing more yields from traditional or industrial belts. In the global scenario of tapioca production, India ranks 13\(^{\text{th}}\) in area, 7\(^{\text{th}}\) in production, and 1\(^{\text{st}}\) in productivity. Tapioca is cultivated in an area of 2.6 lakhs (260,000) hectares in India, with a total production of 6.06 million tons. The results reveal further that information is available to tapioca processors at a reasonable price. Price instability of starch and sago
plays a dominant role in the field. Tender reports are the most common method of receiving information. Information is received daily in the form of these tender reports. Sagoserve is regarded widely as the best mode of receiving information. A majority receive information with 1-2 days and most consult Daily Thanthi to know the day-to-day price of sago and starch. Most take steps to preserve information.

From the above reviews, the researcher found the sago industries have held up on the problems of functional management and some other field that environmental pollution and power problems at factories. Thus, only few of the previous study alone have studied in a particular field as survey reports. But the present study alone carried all the problems prevailed the sago and starch industry in Salem and Namakkal districts of Tamilnadu to give a prospected view on this industry.
END NOTES


17. Montri chulavatnatol, 2001.“Starch utilization in Asia”.


24. Srinivas, and Anantharman 2005.”Cassava marketing system in India” central tuber crops research institute.

25. Andrew Graffham and Richard Marder, 2006. “Salem strach and sago manufacturers” Current situation, Sagoserve, Natural Resources Institute, University of Greenwich, Centre Avenue, Chatham, United Kingdom.


33. Sundaramurthi, G 2007.”Role of middlemen will be eliminated in tapioca tuber procurement process”, The Hindu, News paper articles with reference to tapioca industry.


42. Vaiyapuri, 2008. ‘Raise import tariff on tapioca starch’ “These is no mechanism to find out the extent of import of starch taking place in the garb of modified starch”, The Hindu Business Line.


44. Har Sahay Meena, June 29, 2009. “Prices of sago and starch go up since”, The Hindu, Newspaper articles with reference to tapioca industry.


49. I bid., 2010. 066.


53. Andrew Westby 2010. “Small – scale starch extraction and storage to improveprocess efficiency”, Crop Post Harvest programme, UK.


55. Andrew Graffham and Richand Marder, 2010. “Small – scale starch extraction and storage to improveprocess efficiency” Environmental Impact, Natural Resources Institute, University of Greeenwich, Centre Avenue, Chatham, United Kingdom.
56. Sarawak Cuisine, October 03, 2010. “Good old sago”.