CAPACITY UTILIZATION OF SEAFOOD PROCESSING INDUSTRY IN KONKAN REGION OF MAHARASHTRA

THESIS

submitted to the

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

in partial fulfilment of the requirements for the degree

of

MASTER IN FISHERIES SCIENCE

IN

FISHERIES EXTENSION

BY

Mr. Gajbhiye Ajinkya Wasudeo

B. F. Sc.

Under guidance of

Dr. M. M. Shirdhankar

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Department of Fisheries Resources, Economics,

Statistics and Extension Education

COLLEGE OF FISHERIES

SHIRGAON, RATNAGIRI-415629 (MAHARASHTRA STATE, INDIA)

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CONTENTS

LIST OF TABLE

LIST OF FIGURES

ABSTRACT

The study was undertaken to examine the capacity utilization of seafood processing industry and constraints faced by industry in Konkan region of Maharashtra. Information was collected by using interview schedule from 21 seafood processing plants out of 24 functional plants in Konkan region of Maharashtra. All processing plants were well equipped with various kinds of freezers and cold storage. Altogether 5028 employees were observed in processing plant of which 4771 were labours and 257 were technical staff. The total annual installed capacity of processing plants was 541149, 444780 and 403832 tonnes for 365, 300 and 260 working days respectively. The total seafood production during 2016-17 of all the 21 processing plants was 75,819.67 tonnes. The estimated utilization capacity was 14.01, 17.04 and 19.67% with a considering of 365, 300 and 260 working days respectively. The maximum utilization was observed in the month of October (11767.93 tonnes) with a percentage value of 31.70%, while maximum utilization was observed in winter season (36819 tonnes) with percentage value of 24.32%. The major constraint faced by the processing plant was non-availability of raw material and non-availability of labours. The seafood processing plants seems to be under utilization due to non-availability of raw material. The least percentage utilization observed was 1.94%. if this situation persist for longer period, this may lead to closes of industry and subsequently loss of employment.

सारांश

महाराष्ट्र राज्यातील कोंकण विभागातील समुद्री अन्न प्रक्रिया उद्योग क्षमतेचा वापर आणि त्यांना येत असलेल्या अडचणींचा अभ्यास करण्यात आला२ कोंकण विभागातील एकूण .४ समुद्री अन्न प्रक्रिया कारखान्यांपैकी २१ कारखान्यची प्रत्यक्ष मुलाखत घेऊन माहिती गोळा करण्यात आलीय .ा मध्ये एकुण ५०२८ कर्मचाऱ्यांपैकी ४७७१ अकुशल कामगार आणि २५७ तांत्रिक कर्मचारी कार्यरत होतेसर्व प्रक्रिया कारखान्यात . विविध प्रकारच्या गोठवणूक यंत्र आणि शीतगृह या सारख्या सोईसुविधा उपलब्ध होत्या सर्व .उद्योगांची एकुण वार्षिक अन्न प्रक्रिया क्षमता साधारणता ५,४१,१४९, ४,४४,७८० आणि ४,०३,८३२ टन प्रत्येकी अनुक्रमे ३६५, ३०० आणि २६० दिवस अनुसरुत आहे२०१ सन .६ प्रक्रिया २१ मध्ये १७-उद्योगांनी एकत्रित ७५,८१९ ६७. टनएवढे समुद्री अन्न उत्पादन केले .सुमारे ३६५, ३०० आणि २६० दिवसांची कामकाजाचा विचार करून उपयोगिता क्षमता १४०१., १७सर्वात जास्त .इतकी होती %६७.१९ आणि ०४. प्रक्रिया ऑक्टोबर ११),७६७टन ९२.) महिन्यात झालेली आढळून आली आणि त्याची टक्केवारी ३१७.० तसेच .एवढी होती %हिवाळयाच्या मोसमात सर्वात जास्त प्रक्रिया३६) ,८१९ टन (झालेली दिसून आली आणि त्यांची टक्केवारी २४एवढी %३२. होतीस .मुद्री अन्न प्रक्रिया उद्योगांमधील मुख्य अडचण म्हणजे कच्च्या मालाचा पुरवठा कमी असल्यामुळे प्रक्रिया कारखान्यांचा उत्पादन क्षमते पेक्षा कमी वापर होत आहे. २१ पैकी एका समुद्री अन्न प्रक्रिया कारखान्यात फक्त १त आहेएवढाच मालावर प्रक्रिया केली जा %९४. जे इतर समुद्री अन्न प्रक्रिया उद्योग पेक्षा सर्वात कमी आहे. जर अशीच परिस्तिथी दीर्धकाळ टिकून राहिली तर प्रक्रिया उधोग बंद पडण्याची आणि बेरोजगारी वाढण्याची दाट शक्यता आहे.

1.0 INTRODUCTION

Fish from the marine and freshwater bodies of the world have been a major source of food for humankind since before recorded history. Harvesting wild fish from fresh and marine waters and raising cultured fish in ponds were practices of ancient Egyptians, Greeks, and other Mediterranean peoples. Rudimentary processing techniques such as sun drying, salting and smoking were used by these ancient groups to stabilize the fish supply. Modern methods of processing and preservation have encouraged the consumption of many species of fish those are popular throughout the world. The basic procedures used in the processing of fish products are cooking, freezing, smoking and drying. All these procedures increase the shelf life of the fish by inhibiting the mechanisms that promote spoilage and degradation each of these procedures also has an effect on the nutritional properties of the final product. There are many processing methods used to preserve fish, only freezing can maintain the flavour and quality of fresh fish. Freezing greatly reduces or halts the biochemical reactions in fish flesh for instance, in the absence of free water, enzymes cannot react to soften and degrade the flesh. Therefore, freezing is the prime most and widely used method all over the word for presentation of fish.

India export seafood to more than 100 countries in the world. India is having biggest market for the shrimps in the world, Europe is the second largest buyer followed by Japan and US at fourth position. The export of shrimp from India was started in 1953 from processing unit of Cochin (Iyer *et al*., 1983). In the year 2017-18, 570 processing plants were registered under Marine Product Export Development Authority (MPEDA) in India. Marine fish production of India was 13,77,244 t worth ₹ 45,106.89/- crores during the year 2017-18 (Anon, 2018). Fish produced either from capture or culture fishery is utilised in various form in domestic market or else

exported to other country after freezing. Marine fish product export from Maharashtra was 1,80,820 t worth ₹ 4,90,681/-lakh during the year 2017-18 (Anon, 2018). Marine seafood products are generally exported from two major ports of Maharashtra, *viz*. Mumbai Port Trust and Jawaharlal Nehru Port Trust.

Maharashtra state marine fishing industry has grown rapidly due to technical innovations, which have led to rise in seafood production as well as processing industry. Maharashtra is one of the most important maritime states along the west coast of India, having 720 km of coastline, with seven maritime districts *viz*. Palghar, Thane, Mumbai city, Mumbai suburban, Raigad, Ratnagiri and Sindhudurg. Marine fish production of Maharashtra is 4,74,992 tonnes and inland fish production is 1,31,020 tonnes during the year 2017-18. Almost 16,894 fishing boats are operating in Maharashtra, of which 13,548 are mechanized boats and 3,346 are non-mechanized boats (Anon, 2018). Maharashtra ranks fourth in marine fish production in the country. Seven maritime districts of Maharashtra together is known as Konkan region of Maharashtra and 46 manufacturing seafood processing plants are located in Konkan region of Maharashtra.

Capacity utilization refers to the manufacturing and production capabilities that being utilized by a industry at any given time. It is the relationship between the output produced with the input resources (Iyer *et al.,* 1981) conducted survey on the idle capacity of fish processing (freezing) plants in India on the west coast, they reported in 1979 almost 275 fish processing plants were functioning in India.

Capture fish landing from marine as well as inland sector is stagnated or else declining. On the contrary, fish production through inland culture is increasing. India is the top most shrimp landing country in the world, most of the shrimps landed in the country are processed and exported. The processing plant have been established to

process the fish produced through culture and capture fisheries. India is importing very less quantity of the fish for reprocessing. The processing plants have been installed with huge capacity and are facing the problem of shortage of raw material. Therefore, the present work is undertaken to study the gap between installed capacity by actual production of seafood processing industry and to understand the constraints faced by them in capacity utilisation. The seafood processing provides good employment (Nishchith, 2000; Sparling and Cheney, 2014; Jayanthi *et al*. 2015). The underutilization of seafood processing plant will lead to unemployment processing plant will lead to unemployment. Therefore the present research topic was taken with following objectives.

1. To study the installed capacity of seafood processing plants and overall excess capacity
2. To study constraints faced by seafood processing industry in capacity utilization

2.0. REVIEW OF LITERATURE

Meagre work was carried on capacity utilization of seafood processing industry in world or else in India. Very few research articles are available on the capacity utilization of seafood processing plants. The research report available are reviews in this chapter.

2.1 UTILIZATION CAPACITY

Ballard and Blomo (1978) studied the structure of capacity utilisation in the fishing industry of US. They discussed a consistent methodology for estimating the capacity utilisation structure of an industry at various stages of processing. They selected tuna canning and shrimp freezing industry for the study, as tuna and shrimp resources were vulnerable to fishing pressure. They used published secondary data and analysed the effect on changes in capacity utilisation. The main factor that determined the rate of capacity utilisation in the processing sector was fluctuation of the harvesting output. During 1960's, the capacity utilisation rates were generally near 100%, followed by decline during latter 1970. The utilisation rates steadily declined over the 1972-75 period due to establishment of additional new plants as well as reduced demand. Until 1965, the demand for processed shrimp products was relatively stable with the production in the Pacific area at around to 20 million pounds per year. The capacity utilisation rate was normally under 50%. Since 1963, the demand and price for the small shrimp became exceptionally high and processing increased dramatically to a peak of 117 million pounds in 1973. Because of these rapid increase in demand, the capacity utilisation rate for the period after 1964 hovered near or at 100%.

Iyer *et al.* (1981) conducted survey on the idle capacity of fish processing (freezing) plants in India on the west coast. The idle capacity in fish processing

(freezing) plants was estimated by adopting stratified random sampling. The estimates of idle capacity during 1978 and 1979 of the processing plants on the west coast of India were 76.9 and 73.2% respectively with 250 working days per annum and two shifts per day. In 1979 almost 275 fish processing plants were functioning in India and they were processing frozen prawns, frog legs as well as lobster tails and occasionally squid as well as cuttle fish. The strata made according to the installed capacity were 5 tonnes and below, 5 to 10 tonnes and above 10 tonnes per day. Fixing the sampling error at 20% on the total installed capacity, a sample of 93 plants was selected for the study. The technique adopted was stratified random sampling.

Survey of idle capacity of fish processing (freezing) plants on the east coast of India was carried out by Iyer *et al.* (1982a). Idle capacity of the fish processing (freezing) plants on the east coast of India was estimated by adopting stratified random sampling and the factors responsible for the same were reported. The estimates of idle capacity of fish processing plants on the east coast during the years 1978 and 1979 were 75.9 and 72.5% respectively considering 250 working days per annum and double shift per day. The strata made for sampling were plants of under 5 tonnes, 5 to 10 tonnes and above 10 tonnes production capacity per day. The idle capacity estimated for the plants on the east coast on the basis of 250 working days with triple shift per day during 1978 and 1979 was 83.9 and 81.5% respectively.

Iyer *et al.* (1982b) compared the idle capacity of fish processing (freezing) plants on the east and west coast India. There were 276 operational fish processing (freezing) plants in India during the period of survey. Out of these, 94 plants were located on the east coast and the rest were on the west coast of India. Stratified random sampling was used to study the idle capacity of plant. Stratifications were done on the basis of per day processing capacity of plant. The strata were under 5

tonnes per day, 5-10 tonnes per day and above 10 tonnes per day. In all 93 plants were sampled for the study. The data were collected from 1978 to 1981. The idle capacity of the plants was estimated shift wise. The percentage idle capacity of the plants on the two coasts showed decreasing trend over the initial four years. There was a marked reduction in the idle capacity in 1981 as compared to 1978. The idle capacity decreased from 53.7% in 1978 to 34.8% in 1981 in single shift, 76.9% in 1978 to 67.4% in 1981 in two shifts and 84.6% in 1978 to78.3% in 1981 in three shifts along the west coast of India. The idle capacity of plants decreased from 51.7% in 1978 to 38.1% in 1981 in one shift, 75.9% in 1978 to 69.1% in 1981 in two shifts and to 83.9% in 1978 to 79.4% in 1981 in three shifts with 250 working days along the east coast of India. All India estimates of idle capacity showed a decreasing trend from 53.2% in 1978 to 35.7% in 1981 in one shift, 76.6% in 1978 to 67.8% in 1981 in two shifts, 84.4% in 1978 to 78.6% in 1981 in three shifts with 250 working days in the year.

Iyer *et al.* (1983) studied the excess capacity of fish processing (freezing) plants in India. The export of shrimp from India was started as early as in 1953 by a processing unit in Cochin, with a small quantity. The strata made were under 5 tonnes, 5 to 10 tonnes and above 10 tonnes production capacity. The idle capacity of the plants was estimated by taking into account 200 and 250 normal working days in year for single, double and triple shifts per day. The state-wise, coast-wise and all India estimates of idle capacity taking into account 250 normal working days and double shift per day was estimated. Idle capacities of plants estimated for the years 1978 to 1981 were 76.9, 73.2, 71.7 and 67.4% respectively along the west coast of India, indicating substantial under utilisation of plants along the west coast of India. The idle capacities of the plants on the east coast for the four years 1978 to 1981 were 75.9, 72.5, 71.7 and 69.4% respectively.

Annamalai (1995) studied economics of idle capacity. Identification and quantification of idle capacity of fish processing industries was difficult task due to high seasonality of raw material availability. Higher capacity built up plants to absorb the peak availability of raw material during a short season remained unused for better part of the year. Considered period of production was crucial factor in estimation of idle capacity of plants. He reported that volume of production tends to be at peak during season and fall latter in all industries right from sugar to fish processing. He suggested to take into consideration constraints in supply of raw material, while accounting to seasonality in production process. He concluded that ideal capacity estimated took into account all the principal elements those determined capacity creation and utilization.

Unnithan *et al.* (1998) conducted a study on capacity utilisation of 127 fish processing plants in Kerala. The factories were stratified into three strata based on their installed capacity such as up to 10 tonnes, 10-15 and 15-30 tonnes per day. A sample size of 38 factories were selected for the study by adopting stratified random sampling technique. Information was collected through personal interview with the plant authorities or through mail (on the basis of performance). The lower stratum (up to 10 tonnes capacity) was with highest number of plants (61%) followed almost equally by the others two strata (19.5% each). The first stratum contributed installed capacity of 34.2%, while the second and third strata contributed 22.6 and 43.25% respectively of the total installed capacity of 1,581 tonnes per day. The capacity utilisation for the state was only 15.5%. The average capacity utilisation of the first stratum during trawl ban was only 11% and during post ban period the percentage sharply increased to 27.1%. The second and third stratum's capacity increased from 7.5 to 25.7 and 12.7 to 23.6 per cent respectively.

Kirkley and Squires (1999) studied the capacity and capacity utilization in fishing industries. Excess capacity of fishing fleets was one of the most pressing problems faced by the world's fisheries. Vessels operating efficiently could increase their total production by approximately 50.8 per cent between 1987 and 1990. They reported capacity utilization measures on per vessel basis and for each year between 1987 and 1990 at the specified full utilization of days at sea of 285 days.

Anon (2005) surveyed the fish processing industry in Russia. The industrial capacities for fish processing amounted to about 4.5 million tonnes in 2004. Total production capacity changed insignificantly from 2003 to 2004. However, the production capacity for canned and preserved fish increased slightly due to the development of on-shore processing. The total production capacity was 4.5 million tonnes in 2004, of which on board production capacity accounted for 3.3 million tonnes and on-shore production capacity accounted for 1.2 million tonnes. The share between on-board and on-shore production capacity was thus about 70 and 30% respectively. The utilisation rate of canning facilities was about 49%. The far East region accounted for about 65% of total frozen fish processing, followed by the North-West region. Cold storage capacities increased during the last few years and were estimated at five lakh tonnes. This growth was due to new freezing facilities in the North basin whereas, the capacities in the far East, West and Caspian basins remained unchanged. In total, about half of the capacity of the freezing facilities was not used.

Geethalakshmi *et al.* (2011) reported the capacity utilisation of fish processing industry in Gujarat. They used personal interview schedule for collecting data. The sampling adopted was stratified random sampling. The study period was three years from 2006 to 2009. The total installed capacity for processing sea-food in Gujarat during the study period varied from 2981.6 to 4323.4 tonne per day. The idle capacity

of plants with 250 working days was 53% compared to plants with capacity between 30 to 50 t. The overall idle capacity came down by 24% compared to past three decades. The idle capacities in the medium category of plant were as 64.91 and 52.38% during the years 2007-2008 and 2008-2009 respectively. The study revealed that there exist an overall excess capacity of 53 and 57% (during 2008-09) of the fish processing industry in Gujarat, when the number of working days assumed as 250 and 300 days respectively.

Ponnusamy *et al.* (2012) conducted study on production and marketing of fish meal in India. Aquaculture utilized about 43% of global fish meal production and 85% of fish oil. Fish meal and fish oil were the major ingredients for aqua feed production. There were 23 fish meal plants in Karnataka, two in Kerala, three in Gujarat, four in Maharashtra and three in Tamil Nadu. The data were collected from 10 fish meal plants in three states of Karnataka, Kerala and Tamil Nadu. Semi-structured interview schedule was used for data collection. Total fish meal production in all the three states was approximately estimated to be 65,000 t comprising 58,000 t in Karnataka, 6,000 t in Kerala and 500 t in Tamil Nadu.

Biuksane (2015) explored production capacity of processing industry in Latvia. Data used for study were collected from ministry of Agriculture food and Veterinary service and central statistical bureau of Latvia. The survey was conducted from 12th May 2014 to 16th June 2014. The targeted subjects of the survey were 111 Latvia fish processing companies. Thirty-six per cent respondents completed the questionnaires. Capacity utilisation of the Latvia fish processing sector was 56% on an average in 2010. Analysis of data showed that the volume of production in Latvia decreased by 7% from 2005 to 2012. This revealed that the fish processing sector was underutilised and the average production capacity was 65.5%. On an average actual

production capacity of Latvia fish processing companies in 2012 was 256.44 tonnes per day, which was not reaching to average maximum production capacity of 39.41 tonnes per day.

Nyaoga *et al.* (2015) studied management and capacity utilization of tea processing firms from Kenya. Data were collected from both primary and secondary sources. The questionnaires were distributed using the drop and pick method. A research permit and letter of introduction accompanied the questionnaires explaining the purpose of the study and assuring of confidentiality among the respondents. The response rate in this study was improved by sending reminders to the respondents through short messages or making phone calls. Data were collected between January and May 2014. The tea processing companies provided the level of design capacity at factory level and the actual output for a five-year period and it was used to compute capacity utilization as the percentage of the firm's total likely production capacity that was actually utilized was 300.50.

Zili (2015) studied the capacity utilisation and productivity analysis in the Canadian food manufacturing industry. Study aimed to estimate capacity utilisation for each province, and measured the effect of changes in capacity utilisation on each province's productivity growth. The largest food processing province, Ontario experienced a considerable decline in productivity in the post-2000 period with a 2.2% annual rate of decline. To measure aggregate multifactor productivity growth (MFPG) for food processing sector as processing sub sectors (i.e., animal food, meat food, seafood, dairy and grain milling). The average level of capacity utilisation was 92% for seafood preparation sector. The seafood processing industry in Prince Edward Island, Nova Scotia and British Columbia experienced considerable growth in productivity over the study period, with annual growth rates of 3.6, 1.0 and 3.1%

respectively. During the same time, New Brunswick seafood processing sector showed a considerable decline of 2.1% per year, mainly due to the drop in productivity during the pre-2000 period.

Oluwasenu (2018) studied the effect of capacity utilisation on manufacturing firms' production in Nigeria. He report that capacity refer to the maximum outflow which could be achieved from the installed capital stock in a given period. The capacity utilisation can be measured using technical or economic approach. He described capacity utilisation as the ratio of observed output to the capacity of plant. The major conclusion of his study was significant capacity under utilisation in Nigerian manufacturing firms and under utilisation made positive effect of capacity utilisation less significant in explaining manufacturing firms' output growth in Nigeria.

2.2 CONSTRAINTS

Ballard and Blomo (1978) studied the structure of capacity utilisation in the fishing industry of US. They discussed a consistent methodology for estimating the capacity utilisation structure of an industry at various stages of processing. Two constraints faced by the processing sector were fluctuation in harvesting output and price of raw material.

Iyer *et al.* (1981) conducted survey on the idle capacity of fish processing (freezing) plants in India on the west coast. Data on installed capacity of the plants, actual production during the year, factors responsible for the under utilization of the plants, number of personnel employed, sources of raw material as well as ice and cold storage facilities available in the plants were collected from the factories through personal interviews with the plant managers of each state during 1978 and 1979. The factors responsible for under utilization of the plants on the west coast were presented.

The criteria identified for under utilization of plants was non-availability of raw material.

Iyer *et al.* (1983) studied the excess capacity of fish processing (freezing) plants in India. They reported the constraint faced by the fish processing industry in India as non-availability of raw material.

Ramachandran (1988) worked on the production management in the Seafood processing industry in Kerala. He reported that the present method used were the modification or improvement in existing one as per the development of science and technology. The study was based on primary data collected from sea food processing industry. Raw material availability was the foremost problem faced by all the processing plants in Kerala and nearness of plant to the main landing centre assured raw material due to regular monitoring and contact with the suppliers at the landing centre. No plant was receiving sufficient raw material from a single supplier or a landing centre. Plants received raw materials from a large number of landing centres and suppliers.

Unnithan *et al.* (1998) conducted a study on capacity utilisation of 127 fish processing plants in Kerala. The non-availability of raw material was the main reasons of low capacity utilisation. They reported that the 15% capacity utilisation was not healthy sign for the industry.

Kirkley and Squires (1999) studied the capacity and capacity utilization in fishing industries. Overall, they found average capacity utilization per trip, based on observed output and resource constraints, was quite low but is relatively high with technical efficiency. Technical inefficiency appeared to be a major reason why vessels did not operate near optimal capacity. Vessel operators made shorter trips than required to operate at the optimal capacity.

Salim and Aswathy (2010) did constraint analysis on the impediments faced by Indian seafood exporters. The marine products exports from India continued to surge up to new heights and unabated by global recession. During 2010-2011 the quantum of exports surpassed 7.25 lakh tonnes with a earning of 2.6 billion dollar. India's predominated the position in shrimp market eroded due to the sudden spurt in farmed shrimp production in China, Indonesia, Thailand, Vietnam etc. The problem was again complicated with the restriction placed by the USA by the imposition of antidumping duties, which has been discussed at the length in the appellate body but continues to hault the export industry. Situations were not rosy with European Union countries with changing quality standards and cases of rejection and alerts. There were problems related to non-availability of raw material and low capacity utilization of processing plants. The study was conducted on the basis of primary data collected from 60 seafood exporters using a pre-tested interview schedule. The primary data were collected from 60 sample exporters and the results indicated that the irregular supply of raw material, cut throat competition for raw material, heavy competition for target market, low capacity utilization, higher cost of production and low margin of profit, uncertainty in prices, dictatorship of buyers, high cost of investment as well as lack of market and product information. There exists severe paucity of raw material due to depleted landing in marine sector and disease incidence in culture sector. The major exportable species like shrimps, lobsters and high value fishes registered a downward trend in landing over the year. The study revealed that the irregular supply of raw material, cut throat competition for raw material, heavy competition for target market and low capacity utilization were the major impediments faced by exporters.

Geethalakshmi *et al.* (2011) reported the capacity utilisation of fish processing industry in Gujarat. They used personal interview schedule for collecting data. Information on sources of raw material and constraint faced were collected by

interviewing managers of the selected plants. The sampling adopted was stratified random sampling. The study period was three years from 2006 to 2009. The major constraint faced by the industry was non-availability of raw material for processing.

Kaza and Venkataiah (2012) analysed the seafood export trade and projected India in top five exporters countries. The reasons for the projection of India within first five top countries were continued dominance of frozen items, fast spreading of Indian product in developed countries, several sea food processing units with modern machinery for freezing and production of value added products. Frozen items continued to dominate the trade. Markets for Indian products showed fast spread to developed countries from the traditional buyers. Initially, USA was the principal buyer for Indian frozen shrimp but after 1977, Japan emerged as the principal buyer of the product, followed by the West European countries. Low capacity utilization of processing plants was the impediment faced by Indian Seafood Exporters industry due to non availability of raw material.

Mhazo *et al.* (2012) studied the status of the agro-processing industry in Zimbabwe with particular reference to small and medium scale enterprises. The number of agro-processors increased and created employment opportunities, but the prevailing economic environment tend to favour growth of medium-scale enterprises by down-sizing of large-scale processing systems and upgrading of small-scale processing enterprises. Agro-processing sector currently faced many challenges including access to finances, limited research, technical advice, market information, lack of reliable markets and general institutional decline. Agro-processing industry faced a problem of shortage of raw material due to various constraints faced by farmers, such as frequent droughts resulting in crop failure and high costs of

production inputs (seed, fertilizer, chemicals etc.) resulting in a decline in the levels of production.

Ponnusamy *et al.* (2012) conducted study on production and marketing of fish meal in India. The data was collected from 10 fish meal plants in three states of Karnataka, Kerala and Tamil Nadu. Semi-structured interview schedule was used for data collection. The fish meal plants were operating for 6 to 10 months in year, depending upon availability of raw material. Capacity utilization of plants was low due to less availability of raw material.

Biuksane (2015) explored production capacity of processing industry in Latvia. Data used for study were collected from ministry of Agriculture food and Veterinary service and central statistical bureau of Latvia. The survey was conducted from 12th May 2014 to 16th June 2014. The targeted subjects of the survey were 111 Latvia fish processing companies. The raw material requirement was 197.33 tonnes per day to utilise the plant at fullest installed capacity. Production capacity in fish processing companies was not fully utilised. The technological process and un-availability of raw materials and the prices of their purchase were major constraints.

Nyaoga *et al.* (2015) studied management and capacity utilization of tea processing firms from Kenya. The result of the correlation analysis between constrains management and capacity utilization of tea processing firms in Keniya. The significance values of variables at the $p < 0.01$ level (correlation is significant at the 0.05 level 2 –tailed) and $p < 0.05$ level (correlation is significant at the 0.01 level 2 – tailed) level of correlation significance were extracted. There was positive significant relationship observed between constraints management ($r = 0.322$, $p < 0.05$) and capacity utilization.

3.0 MATERIAL AND METHODS

3.1 STUDY AREA

Maharashtra with 720 km of coastline has seven maritime districts *viz*. Palghar, Thane, Mumbai suburban, Mumbai city, Raigad, Ratnagiri and Sindhudurg known as Konkan region of Maharashtra. Konkan region of Maharashtra was selected for the present study. Study area is shown in Map 1. Konkan region of Maharashtra is situated between 20°08’10” N latitude and 72°44’21” E longitude to 15°37’46” N latitude, 74°03’19” E longitude. The data were collected only from Thane, Raigad, Ratnagiri and Sindhudurg districts as none of the seafood processing plant was observed in Palghar, Mumbai suburban and Mumbai city.

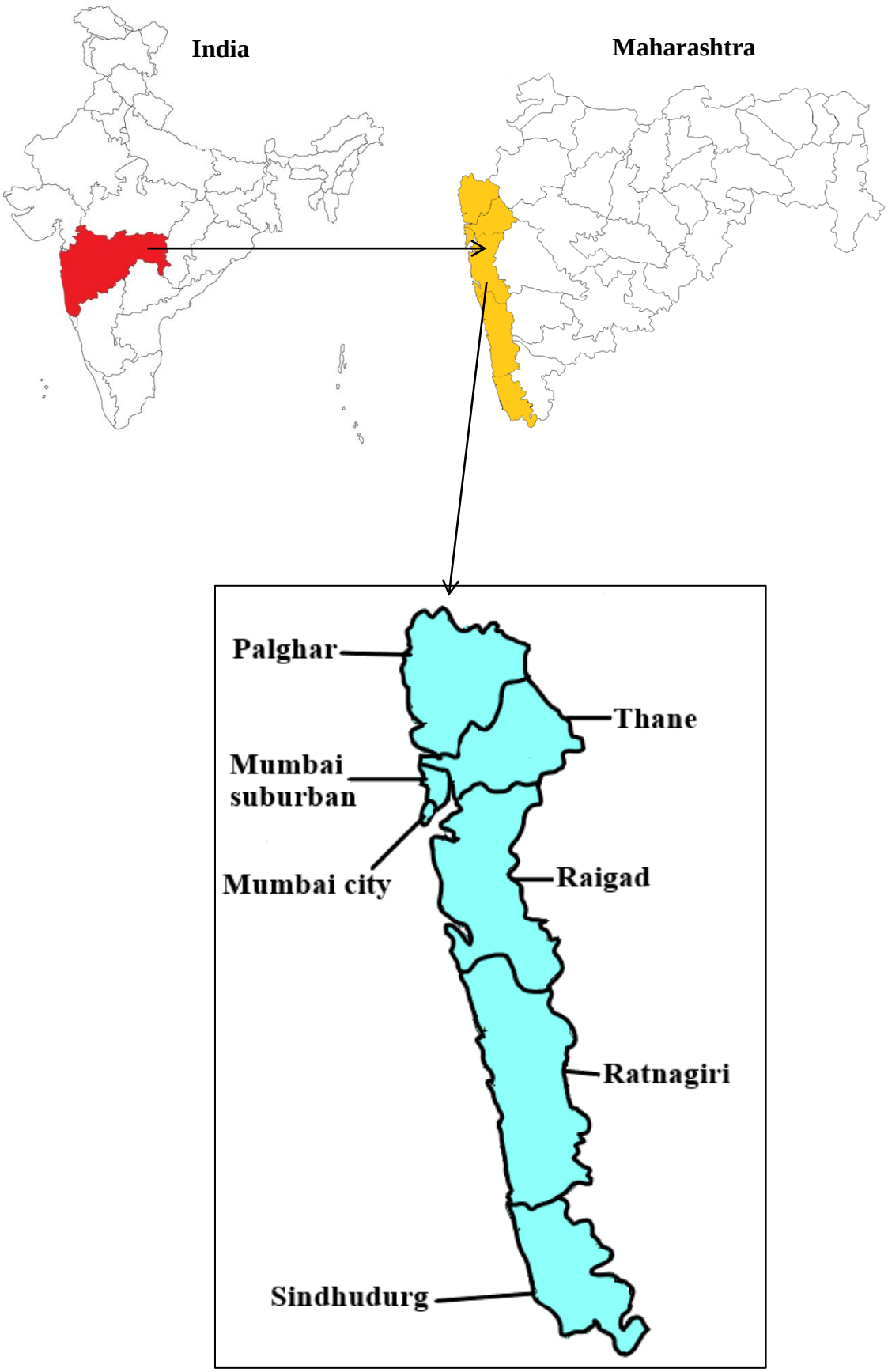
3.1.1 Thane

Nine processing plants were observed in Thane district and sample was collected from one processing plant. The plant was situated in Vasai and geographical location was 19°21’59.88” latitude and 72°48’57.96” longitude. The processing plant was 32 km away from Thane city.

3.1.2 Raigad

The Raigad district is situated between 19°08’52” N latitude and 73°12’18” E longitude to 17°49’40” N latitude and 73°28’49” E. Almost 17 seafood processing plants were sampled in Taloja MIDC (Maharashtra Industrial Development Corporation) area of Raigad district. All 17 plants were adjacent to each other and were situated 12 km away from Panvel city.

Map.1 Study area



3.1.3 Ratnagiri

The Ratnagiri district lie between 18°00’27” N latitude and 73°01’55” E longitude to 16°34’14” N latitude and 73°22’48” E longitude. Two processing plants were sample collected in Ratnagiri district. One processing plant was 4.2 km away in Karla village and another processing plant was 3.5 km away from Ratnagiri city in Mirkarwada area.

3.1.4 Sindhudurg

The Sindhudurg district is situated between 16°35’28” N latitude and 73°19’23” E longitude to 15°37’42” N and 74°04’23” E. One processing plant was observed in Sindhudurg district which was 6.2 km away from Malvan city in Kalethar village.

3.2 SAMPLING UNITS

The information was collected from manufacturer exporter seafood processing industry. The number of registered seafood manufacture exporter, number of plant closed or actually not processing seafood and number of plant processing seafood and number of plant sampled on given in Table 1. The number of registered manufacturer exporter seafood processing plants with Marine Products Export Development Authority (MPEDA) along the Konkan region of Maharashtra was 46 during year 2016-2017. Almost 22 plants were closed or not processing seafood during 2016-17. Altogether 24 plants were approaches but three of them didn’t provided the information, therefore, information was collected from 21 processing plants. It can be seen from Table 1 among the sampled processing plants that 17 processing plants were in Raigad, while two in Ratnagiri and one each in Thane and Sindhudurg

Table 1. Number of processing plants according to coastal district of Maharashtra

Sr. No	Districts	Number of manufacture export plant	Number of plant closed/not processing seafood	Number of processing plant processing seafood	Number of processing plants sampled
1	Palghar	0	0	0	0
2	Thane	9	8	1	1
3	Mumbai city	0	0	0	0
4	Mumbai suburban	0	0	0	0
5	Raigad	29	11	18	17
6	Ratnagiri	7	3	4	2
7	Sindhudurg	1	0	1	1
	Total	46	22	24	21

districts. The relevant information of processing plants was collected from all the 21 manufacture exporter seafood processing plants.

3.3 INTERVIEW SCHEDULE

Interview schedule was used to collect primary data in the present study (Annexure I). Interview schedule for collection of required information from seafood processing plant was formulated (Daivadeenam, 2002). Test run was performed and collected data were analysed for it's correctness. The problems revealed in test run were rectified and final interview schedule was prepared. The interview schedule was designed to collect all relevant information required to fulfil the objectives of the present study. Interview was designed with two sections, the first section contained five subsections and the second section was to collect the information about the quantity of material processed. The five subsections of first part of interview schedules were samples details, information of respondent, information of owner, information of processing plant and constraints.

3.4 SAMPLING PROCEDURE

Altogether 24 plants were visited to collect the information three out of them denied to provide the required information. Therefore, information was collected from 21 processing plants after taking appointment with manager of plant. The information collected was assets, installed capacity per day, amount of material processed, non-recurring cost, recurring cost and constraints faced by processing plants.

3.5 PRODUCTION AND UTILIZATION CAPACITY OF PROCESSING PLANTS

3.5.1 Production capacity

The per day production capacity of processing plants under study was recorded. The number of days in each month from January to December, were

considered to calculate total days in year and total days were multiplied by the per day production capacity in tonnes to raise the annual production capacity of a processing plant. Similarly, month wise and season wise total production capacity of processing plants were estimated according to number of days in each month and total day in monsoon, winter and summer seasons. The months considered in monsoon were June, July, August and September, while months considered in winter were October, November, December and January, and rest of the months were considered in summer season. In addition to this, annual capacities with 300 and 260 working days were also calculated.

3.5.2 Utilization capacity

The month wise actual utilization of processing plants was recorded under study. Actual utilization data of processing plants were collected during the year 2016-17. The data was collected month wise from August 2016 to July 2017. The actual production was calculated month wise, season wise and annual. In additional to this, percentage utilization capacity was also calculated.

3.5.3 Comparison of utilization capacity

The installed capacity and utilization capacity of each processing plants was calculated separately. The installed capacity was calculated for 365, 300 and 260 working days. The utilization of processing plants in 365, 300 and 260 working days was same. The percentage utilization capacity was also calculated for 365, 300 and 260 working days. Utilization capacity according to 365, 300 and 260 working day were compared.

3.6 COSTS AND EARNING ANALYSIS FOR PROCESSING PLANTS

The information required for costs and earing analysis was not provided by all the plants. Only nine plants provided the required information. Therefore, the costs and earning analysis was performed on the basis of the data provided by nine processing plants.

3.6.1 Capital cost

One time expenditure on assets was included in capital cost (Dewey, 1975). Expenditure on construction and purchase of machinery were included in capital cost. Capital cost for each processing plant was calculated and average capital cost of processing plant was calculated by averaging the capital costs of all processing plants.

3.6.2 Variable cost

The expenses on salary of staff, electricity bill, water bill, maintenance cost, cost of raw material, chemical/ consumables and office expenses were the major components of variable cost. The variable costs per annum of each items were calculated for each processing plant as suggested by Dewey (1975). The average variable costs of each items were raised from these variable costs of each plant. The average variable costs of each items were used in costs and earning analysis.

3.6.3 Fixed cost

The average fixed cost per annum of processing plants was calculated as suggested by Dewey (1975). The 10% deprecation on average capital cost plus the 15% interest on loan were used in costs and earning analysis.

3.6.4 Total cost

The average total expenditure per annum of processing plants was calculated as suggested by Dewey (1975). The addition of average variable cost and average fixed cost of processing plants raised the total cost and same was used in costs and earning analysis.

3.6.5 Total revenue

The average total revenue was estimated of processing plants as suggested by Dewey (1975). Total revenue was calculated by multiplying the average annual production with the average export rate per tonne.

3.6.6 Net profit

The annual net profit of processing plant was calculated by subtracting the total expenditure from the total revenue in year.

Annual net profit = Revenue – Total expenditure

3.7 STATISTICAL ANALYSIS

Appropriate statistical methods were applied wherever required to analyse the data (Zar, 2006). Percentages were calculated wherever required and data was represented by appropriate graphical methods. Simple correlations between the variable were estimated and correlation coefficients were tested for its significance at 5% level of significance by using ‘t’ test. Simple and multiple relationship was established between the variables, which showed significant correlations. The regression coefficients established were tested for its significance by ‘t’ test of 5% level of significance.

3.7.1 Simple linear regression

Simple linear regression analysis was carried out to relate the dependent variable (Y) with independent variable (X), The equation used to establish relationship was $Y = b_0 + b_1X$.

3.7.1.1 Relationship between constructed area on total area

$$Y = b_0 + b_1X$$

Where,

Y = Constructed area

X = Total area

b_0 = Y intercept

b_1 = Regression coefficient of total area

3.7.1.2 Relationship between capacity of cold storage on constructed area

$$Y = b_0 + b_1X$$

Where,

Y = Capacity of cold storage

X = Constructed area

b_0 = Y intercept

b_1 = Regression coefficient of constructed area

3.7.1.3 Relationship between technical staff on total area

$$Y = b_0 + b_1X$$

Where,

Y = Technical staff

X = Total area

b_0 = Y intercept

b_1 = Regression coefficient of total area

3.7.1.4 Relationship between technical staff on capacity of cold storage

$$Y = b_0 + b_1X$$

Where,

Y = Technical staff

X = capacity of cold storage

b_0 = Y intercept

b_1 = Regression coefficient of capacity of cold storage

3.7.1.5 Relationship between technical staff on constructed area

$$Y = b_0 + b_1X$$

Where,

Y = Technical staff

X = Constructed area

b_0 = Y intercept

b_1 = Regression coefficient of constructed area

3.7.1.6 Relationship between labour on total area

$$Y = b_0 + b_1X$$

Where,

Y = Labour

X = Total area

b_0 = Y intercept

b_1 = Regression coefficient of total area

3.7.1.7 Relationship between labour on capacity of cold storage

$$Y = b_0 + b_1X$$

Where,

Y = Labour

X = Capacity of cold storage

b_0 = Y intercept

b_1 = Regression coefficient of capacity of cold storage

3.7.1.8 Relationship between labour on constructed area

$$Y = b_0 + b_1X$$

Where,

Y = Labour

X = Constructed area

b_0 = Y intercept

b_1 = Regression coefficient of constructed area

3.7.1.9 Relationship between installed capacity on capacity of cold storage

$$Y = b_0 + b_1X$$

Where,

Y = Installed capacity

X = capacity of cold storage

b_0 = Y intercept

b_1 = Regression coefficient of capacity of cold storage

3.7.1.10 Relationship between installed capacity on constructed area

$$Y = b_0 + b_1X$$

Where,

Y = Installed capacity

X = Constructed area

b_0 = Y intercept

b_1 = Regression coefficient of constructed area

3.7.1.11 Relationship between installed capacity on technical staff

$$Y = b_0 + b_1X$$

Where,

Y = Installed capacity

X = Technical staff

b_0 = Y intercept

b_1 = Regression coefficient of technical staff

3.7.1.12 Relationship between installed capacity on Labours

$$Y = b_0 + b_1X$$

Where,

Y = Installed capacity

X = Labours

b_0 = Y intercept

b_1 = Regression coefficient of labours

3.7.2 Multiple regressions

Multiple regression relationship was established between one dependent variable (Y) with multiple independent variables (X), which were large in number multiple regression established.

3.7.2.1 Relationship between technical staff with capacity of cold storage and constructed area

The relationship was established of technical staff with capacity of cold storage and constructed area. The model used was as given below.

$$Y = b_0 + b_1X_1 + b_2X_2$$

Where,

Y = Technical staff

X_1 = Capacity of cold storage

X_2 = Constructed area

b_0 = Y intercept

b_1 = Regression coefficient of capacity of cold storage

b_2 = Regression coefficient of constructed area

3.7.2.2 Relationship between installed capacity with capacity of cold storage, constructed area and technical staff

The multiple regression relationship was established of installed capacity with capacity of cold storage, constructed area and technical staff. The model used was as given below.

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3$$

Where,

Y = Installed capacity

X_1 = Capacity of cold storage

X_2 = Constructed area

X_3 = Technical staffs

b_0 = Y intercept

b_1 = Regression coefficient of capacity of cold storage

b_2 = Regression coefficient of constructed area

b_3 = Regression coefficient of technical staff

4.0 RESULTS

Altogether 46 processing plants were observed to be registered with Marine Products Export Development Authority as manufacturer exporter. Out of 46 registered manufacturer exporters the required information for the study was collected from 21 manufacture seafood exporters from the Konkan region of Maharashtra. The interview schedule (Annexure I) was used to collect the information. Data were analysed and results are presented.

4.1 GROWTH OF SEAFOOD PROCESSING

Growth of processing plants along with annual processing capacity is given in Table 2 and is depicted in Fig 1. Collected information on number of plants was analysed to understand growth in seafood processing over successive five years of period and increment in processing capacity of seafood processing plants over five years period was calculated. It can be seen from Table 2 that during 1980-85 only one plant with annual 22,630 tonnes processing capacity was observed in Konkan region. The number of plants increased to nine during 1995-2000 with annual processing capacity of 2,30,169 tonnes, while it reached to 21 plants with annual processing capacity of 5,41,149 tonnes during 2015-2018.

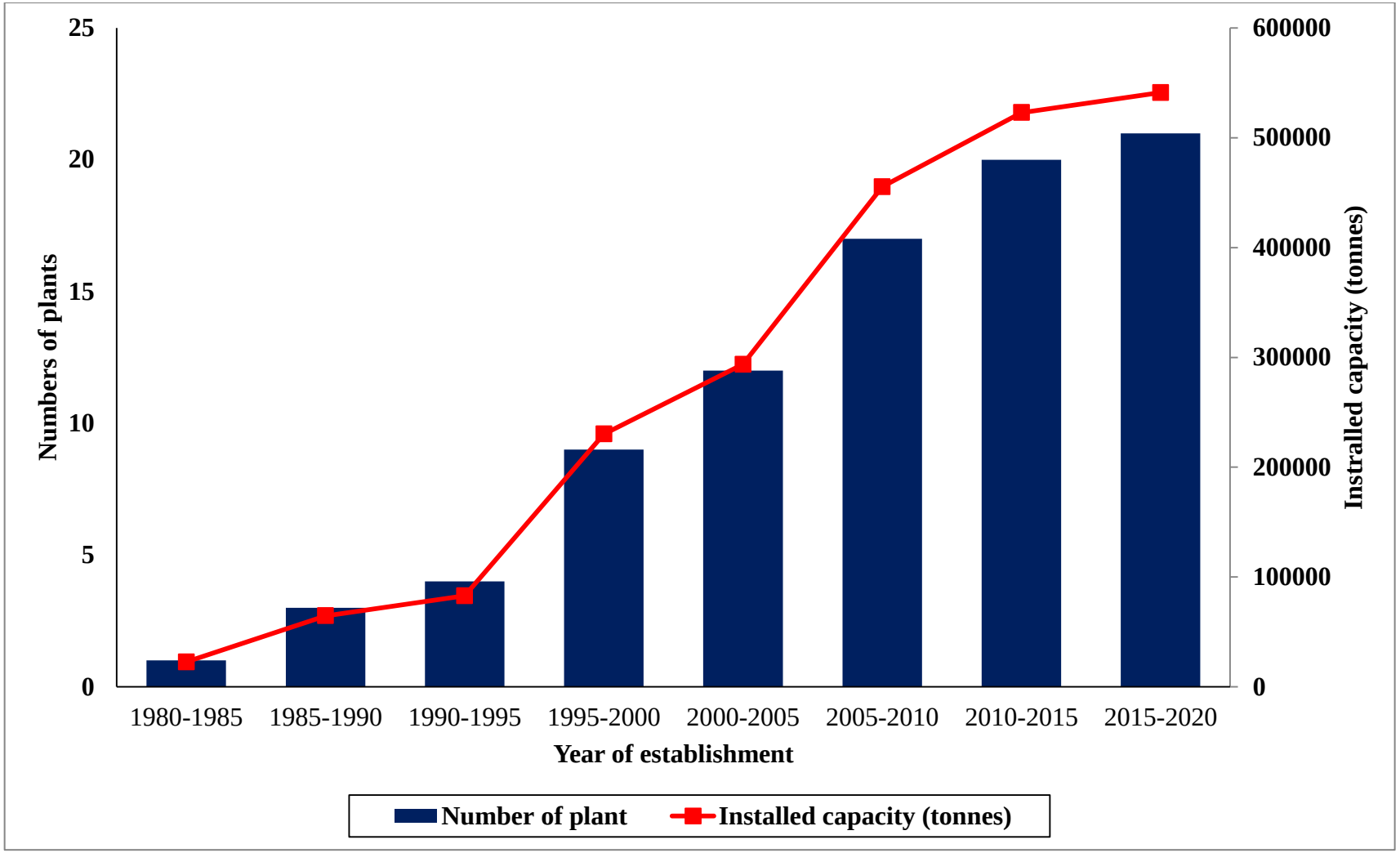
4.2 DISTRICT-WISE PROCESSING PLANTS

District wise distributions number of processing plants in Maharashtra having 720 km of coastline, with seven maritime districts *viz.* Palghar, Thane, Mumbai city, Mumbai suburban, Raigad, Ratnagiri and Sindhudurg was studied. Raigad district was with maximum number of processing plants (17), two processing plants were observed in Ratnagiri and one processing plant was observed in Thane as well as in

Table 2. Establishment year-wise classification of seafood processing plants and annual processing capacity

Sr. No	Establishment year	Number of plants	Installed capacity (tonnes)
1	1980-1985	1	22630
2	1985-1990	3	64605
3	1990-1995	4	82855
4	1995-2000	9	230169
5	2000-2005	12	293679
6	2005-2010	17	455374
7	2010-2015	20	522899
8	2015-2018	21	541149

Fig.1. Number of plants and installed capacity of sea food processed according to year



Sindhudurg district. District wise details of processing plants are given in Table 3 and is depicted in Fig 2.

4.3 ASSETS

Total land possessed in hectors and constructed area in square meters of processing plants is given in Table 4. Least land used for construction of processing plant in Raigad district was 0.1 ha and largest land used for construction of processing plant was 1.5 ha. Least land used for construction of processing plant in Ratnagiri district was 0.4 ha and largest land used was 0.5 ha. In Sindhudurg district, only one processing plant was observed and was established on 2.5 ha area. Only one processing plant was observed in Thane district and was established on 0.5 ha. The least constructed area in Raigad district was 607 sq. m, while largest constructed area of processing plant in Raigad district was 13385 sq. m. The least area constructed observed in Ratnagiri was 700 sq. m, while highest was 960 sq. m. One processing plant in Sindhudurg district was with 800 sq. m constructed area and one processing plant in Thane district was with 1500 sq. m constructed area.

The relationship between constructed area (Y) with the total area (X) was established excluding the processing plant in Sindhudurg district. The correlation coefficient was 0.7134 and was highly significant ($P < 0.01$). The estimated regression equation was $Y = -965.5 + 6166.2 X$. The relationship between the constructed area and total area is depicted in Fig 3. In Raigad and Thane district construction area was more as compared to total area possessed, while in Sindhudurg and Ratnagiri district constructed area was less as compared to total area possessed.

4.4 FREEZING FACILITY

Type of freezer available according to processing plants is given in Table 5. All the plants were observed with plate freezer, blast freezer and IQF. IQF freezer and blast freezer

Table 3. District-wise classification of processing plants in Maharashtra state

Sr. No	Districts	Number of processing plants
1	Palghar	0
2	Thane	1
3	Mumbai city	0
4	Mumbai suburban	0
5	Raigad	17
6	Ratnagiri	2
7	Sindhudurg	1

Fig.2. Number of processing plants according to coastal district of Maharashtra

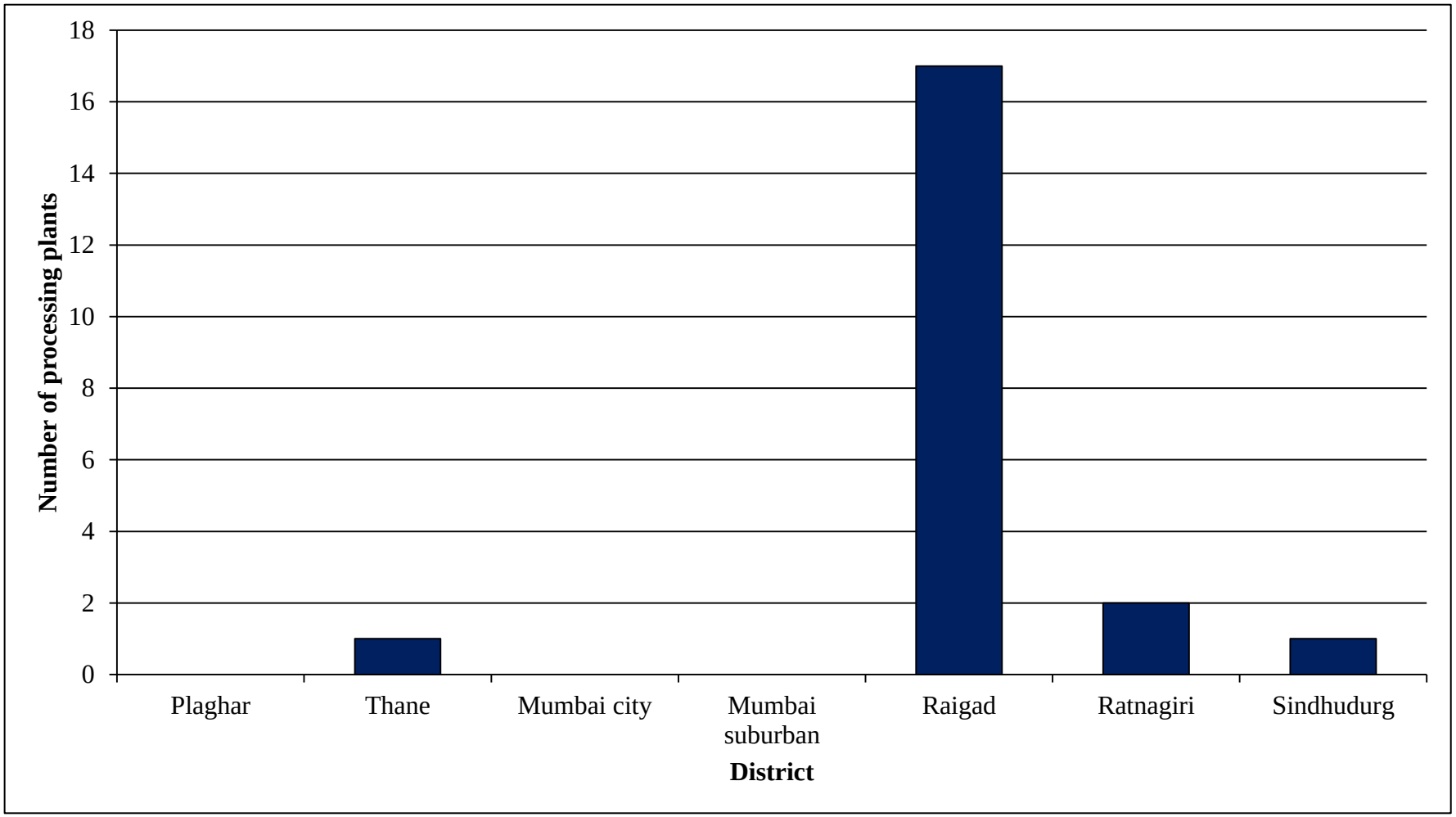


Table 4. Total land area (ha) and constructed area (sq.m) of processing plants

Sr. No	Code of processing plant	Total land area (ha)	Constructed area (sq.m)
1	Raigad A	0.1	607
2	Raigad B	1	7000
3	Raigad C	1	3000
4	Raigad D	0.5	2100
5	Raigad E	0.5	3000
6	Raigad F	0.7	4500
7	Raigad G	0.5	1734
8	Raigad H	1.5	13385
9	Raigad I	0.8	5980
10	Raigad J	0.3	1800
11	Raigad K	0.4	1800
12	Raigad L	0.87	7500
13	Raigad M	1.5	2000
14	Raigad N	0.73	1500
15	Raigad O	1.5	10000
16	Raigad P	0.8	1500
17	Raigad Q	0.8	2000
18	Thane A	0.5	1500
19	Ratnagiri A	0.4	700
20	Ratnagiri B	0.5	960
21	Sindhudurg A	2.5	800
	AVERAGE	**0.82**	**3493.61**

Fig.3. The relationship between the constructed area and total area

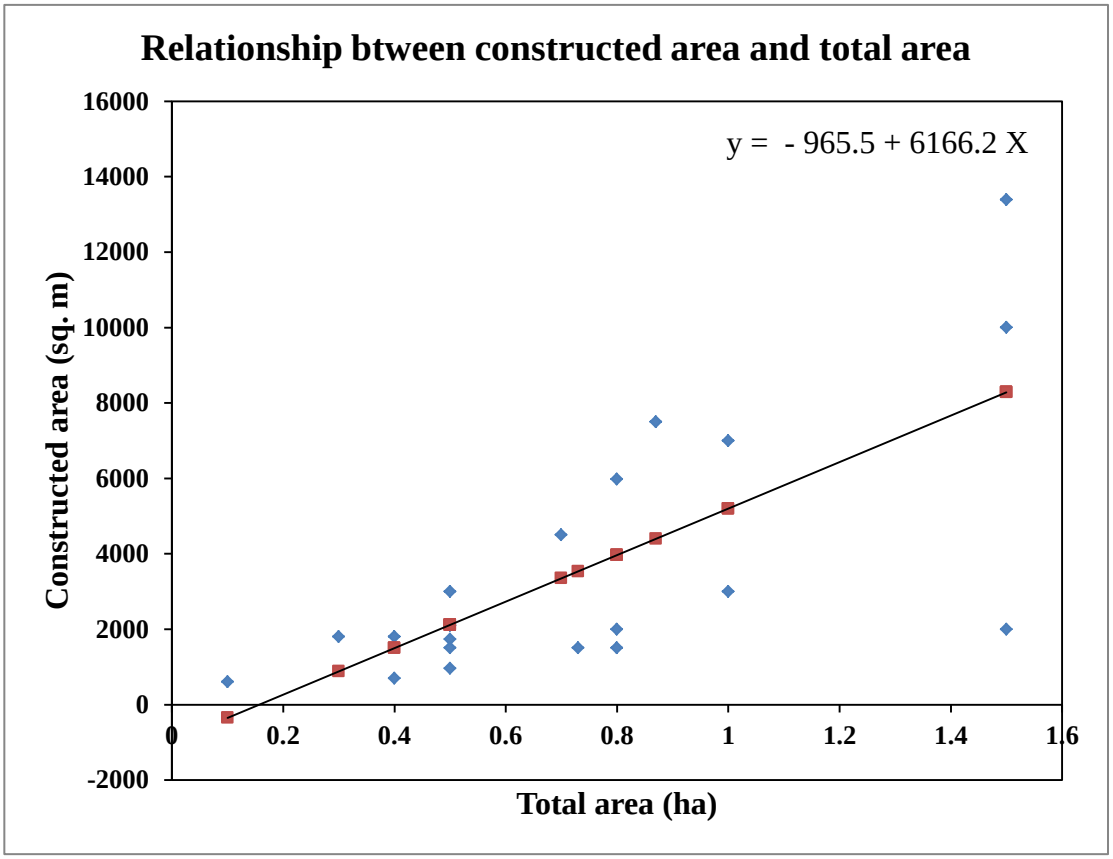


Table 5. Availability type of freezers in processing plants

Sr. No.	Code of processing plant	Plate freezer	Blast freezer	Tunnel freezer	IQF
1	Raigad A	*	*		*
2	Raigad B	*	*		*
3	Raigad C	*	*		*
4	Raigad D	*	*		*
5	Raigad E	*	*		
6	Raigad F	*	*		*
7	Raigad G	*	*		*
8	Raigad H	*	*	*	*
9	Raigad I	*	*		*
10	Raigad J		*		*
11	Raigad K	*	*		*
12	Raigad L	*	*		*
13	Raigad M	*	*		*
14	Raigad N	*	*		*
15	Raigad O		*		*
16	Raigad P	*	*		*
17	Raigad Q	*	*		*
18	Thane A	*	*		*
19	Ratnagiri A	*		*	*
20	Ratnagiri B	*	*		*
21	Sindhudurg A	*	*		*

was available in almost 20 processing plants while plate freezer was available in 19 processing plants out of 21 processing plants. Tunnel freezer was observed in the two plants. One plant in Raigad was observed with four types of freezer Plate, blast, tunnel and IQF freezers. One plant in Sindhudurg and one plant in Ratnagiri observed with three type of freezer plate, blast and IQF freezers were observed in processing plant of Sindhudurg, while plate, tunnel and IQF freezer were observed in processing plant of Ratnagiri. Two plants of Raigad observed with two types of freezer blast and IQF. Rest all the plants were with only three types of freezers such as plate, blast and IQF.

4.5 COLD STORAGE CAPACITY

Cold storage facility available in sea food processing plant is given in Table 6. Cold storage was observed in all the processing plants. The least size of cold storage observed was 150 tonnes, while maximum capacity cold storage observed was 3000 tonnes in Raigad district. Cold storage capacity of processing plant in Thane was 1400 tonnes, while that of in Sindhudurg district was 900 tonnes. Minimum and maximum cold storage capacity of processing plant in Ratnagiri district was 500 and 600 tonnes. Cold storages were classified by their capacity in three groups, first group was below 1000 tonnes, second was between 1000-2000 tonnes and third was above 2000 tonnes. The classification of cold storages according to capacity are given in Table 7 and same is depicted in Fig 4. Almost 38.09% of cold storages were below 1000 tonne capacity, while 42.86% were between 1000 to 2000 tonne storage capacity and only 19.05% cold storages were with more than 2000 tonnes of storage capacity.

The relationship between capacity of cold storage (Y) and constructed area (X) was established. The correlation coefficient was 0.5120 and was significant ($P < 0.05$). The estimated regression equation was $Y = 941.47 + 0.1185\ X$ and relationship is depicted in Fig 5. The relationship established was significant ($P < 0.05$).

Table 6. Cold storage capacity (tonnes) according to processing plants

Sr. No.	Code of processing plant	Cold storage capacity (tonnes)
1	Raigad A	500
2	Raigad B	1200
3	Raigad C	1800
4	Raigad D	1800
5	Raigad E	900
6	Raigad F	900
7	Raigad G	150
8	Raigad H	2118
9	Raigad I	900
10	Raigad J	1200
11	Raigad K	1000
12	Raigad L	2948
13	Raigad M	3000
14	Raigad N	1224
15	Raigad O	2590
16	Raigad P	1200
17	Raigad Q	1500
18	Thane A	1400
19	Ratnagiri A	500
20	Ratnagiri B	600
21	Sindhudurg A	900
	Total	**28330**

Table 7. Classification of processing plants according cold storage capacity

Particulars	Below 1000 tonnes	Between 1000-2000 tonnes	Above 2000 tonnes	Total
Number of plants	8	9	4	21
Percentage	38.09	42.86	19.05	100

Fig.4. Classification of processing plants according to cold storage capacity

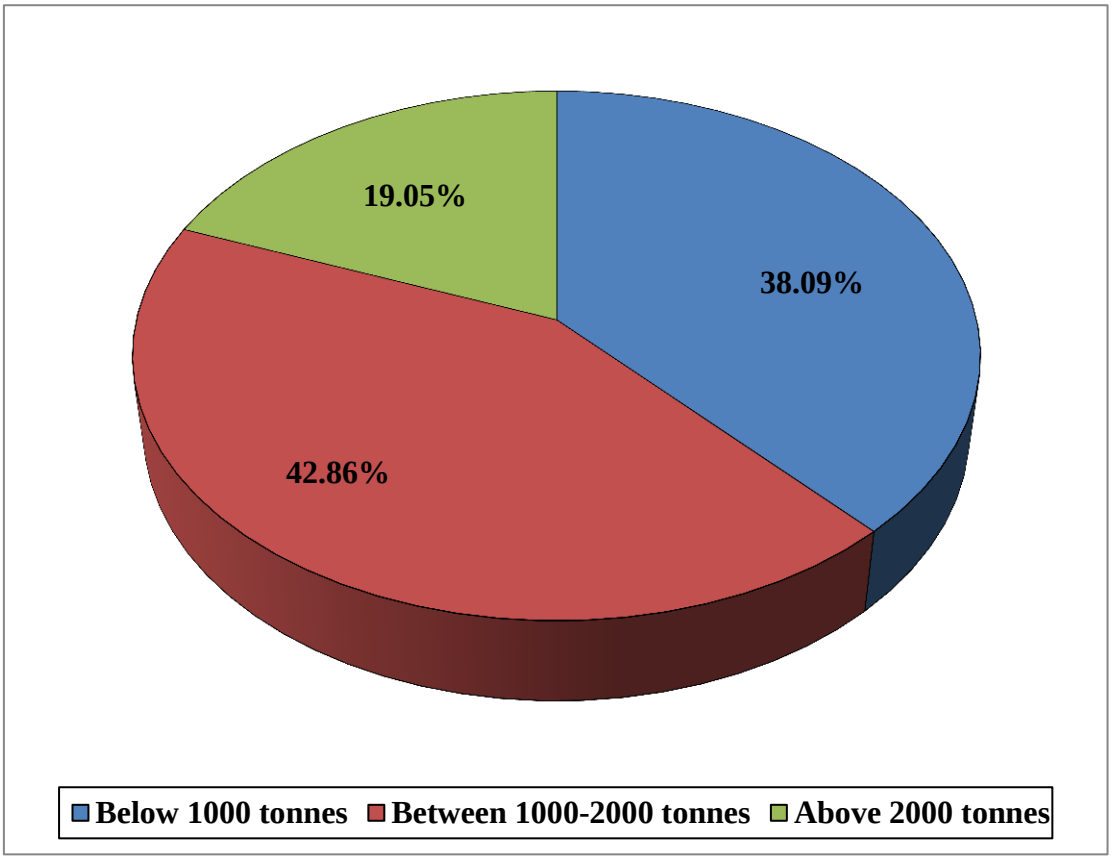
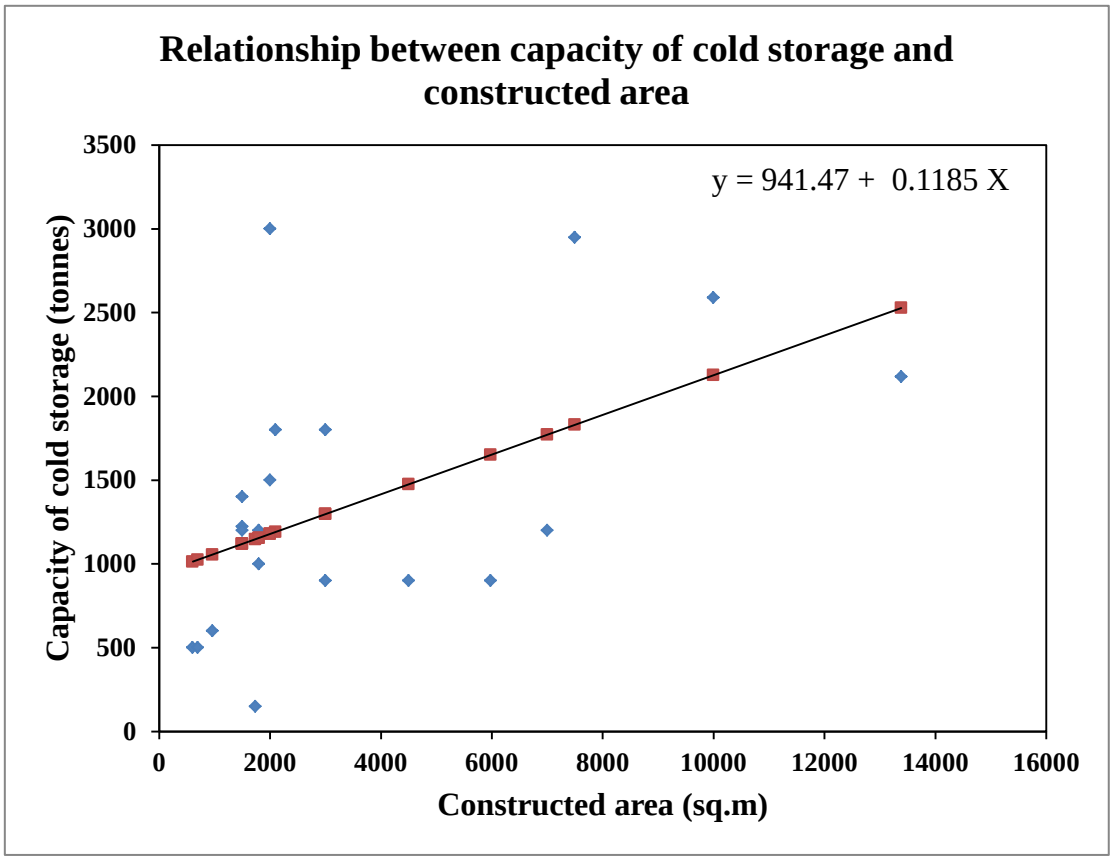


Fig.5. The relationship between capacity of cold storage and constructed area



4.6 HUMAN RESOURCE

Number of technical staff and labour working according to plant is given in Table 8**.** Altogether, 257 number of technical staff and 4771 labours were employed in 21 processing plants. Technical staff employed in 17 processing plants of Raigad were 210, while working labours were 3896. Twenty nine technical staff and 575 labours were seeming in two processing plants of Ratnagiri. Almost 15 and 3 technical staff was employed in one each processing plant in thane and Sindhudurg district, while 200 and 100 labours were employed in processing plant of Thane and Sindhudurg districts respectively. Least number of technical staffs were two in number in processing plants of Raigad district, while that of highest number of technical staffs working in processing plant were 30 in Raigad district. The highest number of labours employed were 800 in one plant and least number of labours were observed in two plants (60 numbers) in Raigad district. Only one plant was observed in Thane district with 15 technical staffs and 100 labours. Minimum technical staffs appointed in processing plant of Ratnagiri district were 11, while maximum technical staff appointed were 18. The least number of labours appointed in processing plant of Ratnagiri were 200 and that of maximum were 375. In the processing plant of Sindhudurg district only three technical staffs and two hundred labours were appointed.

The relationship between number of technical staff (Y) and total area (X) was established. The correlation coefficient was 0.1835 and was not significant ($P > 0.05$). The relationship between technical staff (Y) and capacity of cold storage (X) was established. The correlation coefficient was 0.4438 and was significant ($P < 0.05$). The estimated regression equation was $Y = 6.5247 + 0.0042\ X$ and relationship is depicted in Fig 6. The relationship between technical staff (Y) and constructed area (X) was established. The correlation coefficient was 0.5724 and was significant ($P < 0.05$). The estimated regression equation was $Y = 7.8554 + 0.0013\ X$ and relationship is given in Fig 7. Relationship between the number of technical staff (Y) and capacity of cold storage (X_1) as well as constructed area (X_2) was established. The correlation coefficient

Table 8. Numbers of technical staff and labour

Sr. No	Code of processing plant	Technical staff	Labours
1	Raigad A	5	100
2	Raigad B	10	150
3	Raigad C	17	700
4	Raigad D	13	300
5	Raigad E	2	200
6	Raigad F	7	126
7	Raigad G	20	120
8	Raigad H	20	800
9	Raigad I	20	250
10	Raigad J	6	80
11	Raigad K	4	60
12	Raigad L	20	130
13	Raigad M	15	350
14	Raigad N	11	100
15	Raigad O	30	300
16	Raigad P	6	70
17	Raigad Q	4	60
18	Thane A	15	100
19	Ratnagiri A	18	375
20	Ratnagiri B	11	200
21	Sindhudurg A	3	200
	Total	**257**	**4771**

Fig.6. The relationship between number of technical staff and capacity of cold storage

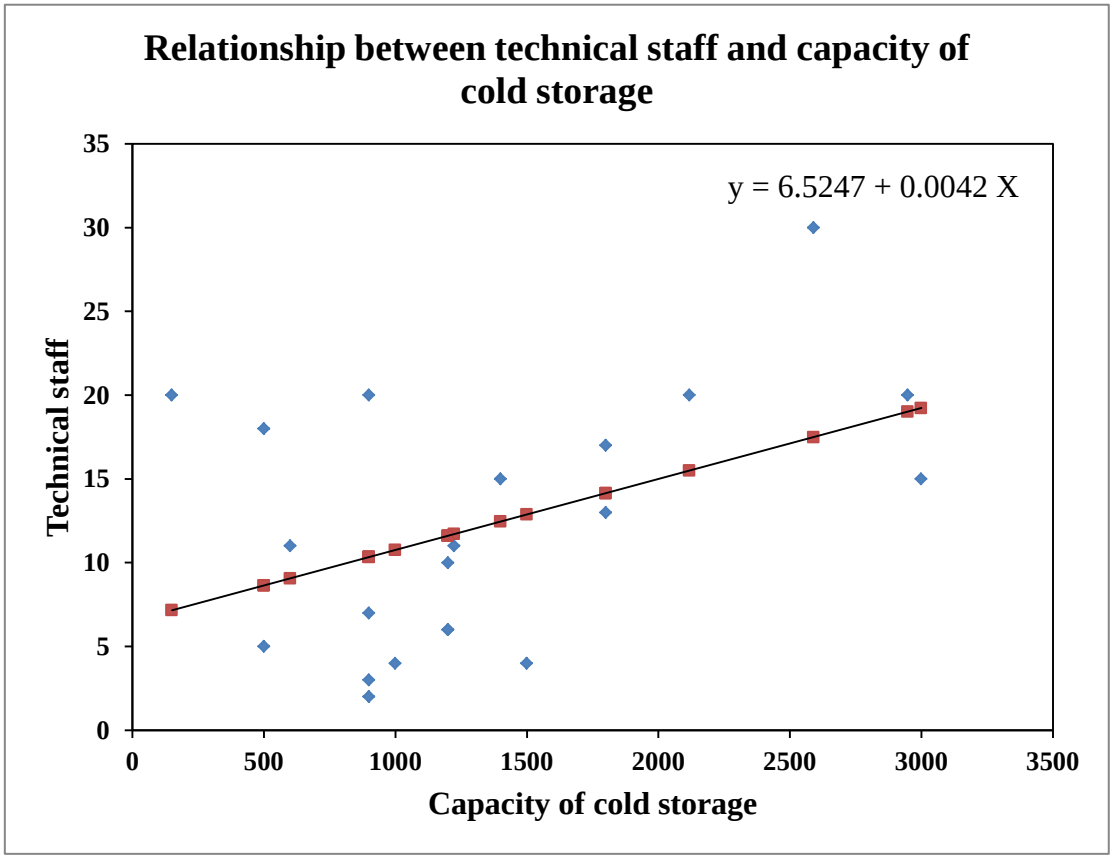
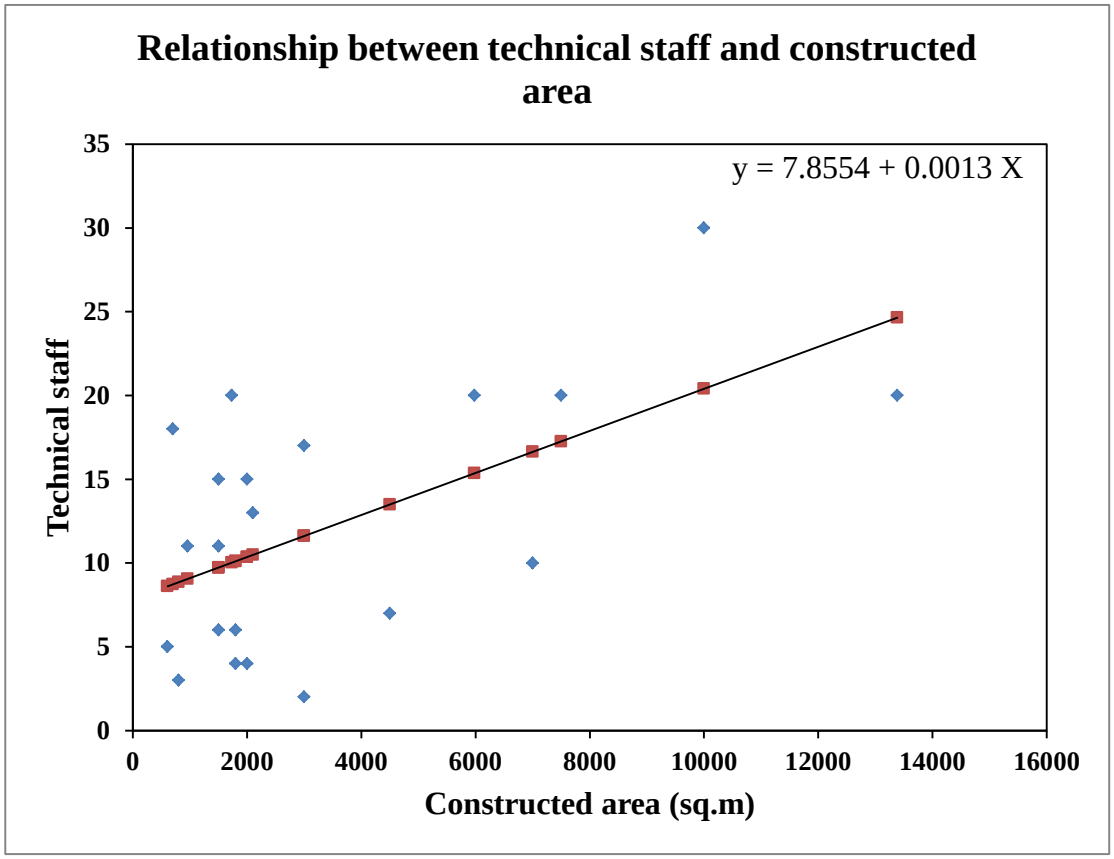


Fig.7. The relationship between number of technical staff and constructed area



was 0.5970 and was significant ($P < 0.05$). The relationship established was $Y = 6.0919 + 0.0018 X_1 + 0.0010 X_2$. The relationship established was significant ($P < 0.05$).

The relationship between number of labour (Y) and total area (X) was established. The correlation coefficient was 0.3773 and was not significant ($P > 0.05$). The relationship between labour (Y) and capacity of cold storage (X) was established. The correlation coefficient was 0.3576 and was not significant ($P > 0.05$). The relationship between number of labour (Y) and constructed area (X) was established. The correlation coefficient was 0.5023 and was significant ($P < 0.05$). The estimated regression equation was $Y = 125.05 + 0.0292 X$ and relationship is depicted in Fig 8. The relationship established was significant ($P < 0.05$).

4.7 INSTALLED CAPACITY

Installed capacity per day of processing plants is given in Table 9. Least installed capacity per day processing plant was observed in Raigad district (27 tonnes), while maximum installed capacity observed was 208 tonnes per day. Installed capacity per day of processing plant in Thane district was 80 tonnes, while that of in Sindhudurg district it was 76 tonnes per day and in Ratnagiri district least installed capacity of processing plant per day observed was 76 tonnes, while maximum installed capacity observed was 92 tonnes per day.

The processing plants were classified in three groups based on their installed capacity per day. The first group was below 50 tonnes processing capacity per day, second was between 50-100 tonnes processing capacity per day and the third was above 100 tonnes processing capacity per day. The six numbers of processing plants were in below 50 tonnes with the percentage value of 28.57%. The maximum numbers of processing plants were in 50-100 tonnes group with percentage value of 57.14, while minimum numbers of plants were in above 100 tonnes processing capacity group with percentage value of 14.29. Classification of processing plants according to capacity of processing plants is given in Table 10 and is depicted in Fig 9.

Fig.8. The relationship between number of labour and constructed area

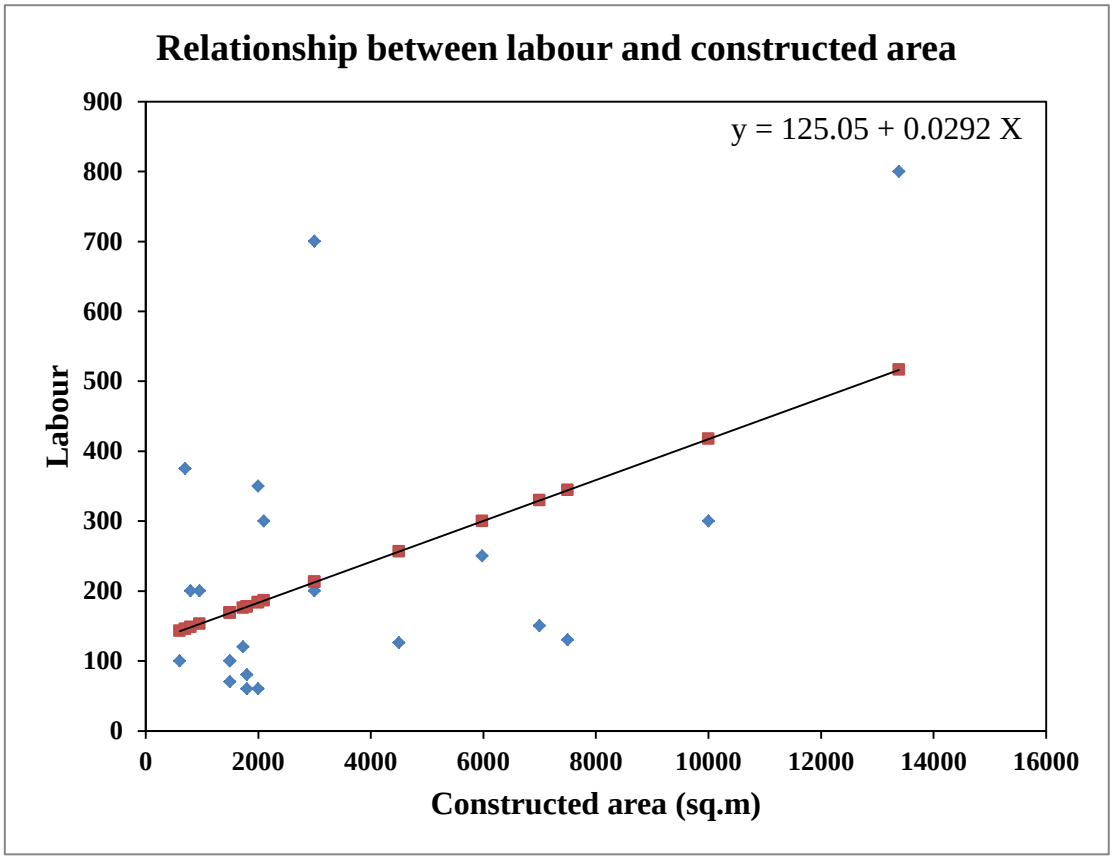


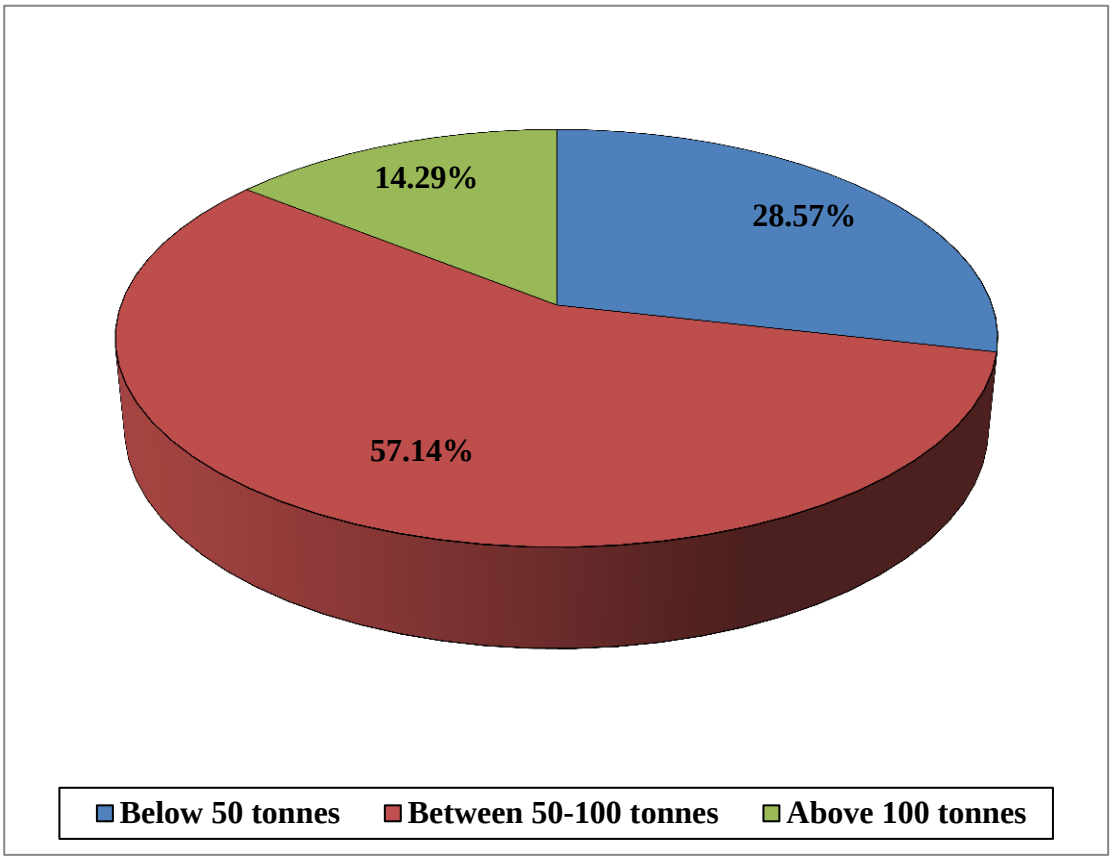
Table 9. Installed capacity of processing plants per day

Sr. No.	Code of processing plant	Installed capacity per day
1	Raigad A	35
2	Raigad B	89.6
3	Raigad C	50
4	Raigad D	40
5	Raigad E	57
6	Raigad F	80
7	Raigad G	27
8	Raigad H	108
9	Raigad I	45
10	Raigad J	50
11	Raigad K	42
12	Raigad L	101
13	Raigad M	50
14	Raigad N	69
15	Raigad O	208
16	Raigad P	45
17	Raigad Q	62
18	Thane A	80
19	Ratnagiri A	92
20	Ratnagiri B	76
21	Sindhudurg A	76
	Total	**1482.6**

Table 10. Distribution of processing plants according to per day installed capacity

Particulars	Below 50 tonnes	Between 50-100 tonnes	Above 100 tonnes	Total
Number of plants	6	12	3	21
Percentages	28.57	57.14	14.29	100.00

Fig.9. Distribution of processing plants according installed capacity per day



On the basis of installed capacity per day, total annual production capacity in year, total annual production capacity considering 300 working days and total annual production capacity considering 260 working days was estimated. The results are presented below.

4. 7. 1 Total annual production capacity considering 365 working days

Total annual production capacity of processing plant was calculated considering 365 working days in a year. The total annual production capacity of processing plants in year is given in Table 11. All 21 plants together were capable to process 5,41,149 tonnes of seafood per year. The least installed capacity per year of processing plant observed in Raigad district was 9,855 tonnes, while maximum installed capacity observed was 75,920 tonnes per year. Installed capacity per year of processing plant in Thane district was 29,200 tonnes, while that of in Sindhudurg district it was 27,740 tonnes per year. Least production capacity of processing plant per year observed in Ratnagiri was 27,740, while maximum production capacity observed was 33,580 tonnes.

The relationship between installed capacity (Y) and capacity of cold storage (X) was established. The correlation coefficient was 0.4533 and was significant ($P < 0.05$). The estimated regression equation was $Y = 14704 + 8.1757 X$ and relationship is depicted in Fig 10. The relationship between installed capacity (Y) and constructed area (X) was established. The correlation coefficient was 0.6468 and was significant ($P < 0.05$). The estimated regression equation was $Y = 16409 + 2.6792 X$ and relationship is depicted in Fig 11. The relationship between installed capacity (Y) and technical staffs (X) was established. The correlation coefficient was 0.5597 and was significant ($P < 0.05$). The estimated regression equation was $Y = 12822 + 1058 X$ and relationship is depicted in Fig 12. The relationship between installed capacity (Y) and labours (X) was established. The correlation coefficient was 0.2318 and was not significant ($P > 0.05$). Relationship between the installed capacity (Y) and capacity of cold storage (X_1), constructed area (X_2), as well as technical staffs (X_3) was established. The correlation coefficient

Fig.10. The relationship between 365 days installed capacity with capacity of cold storage

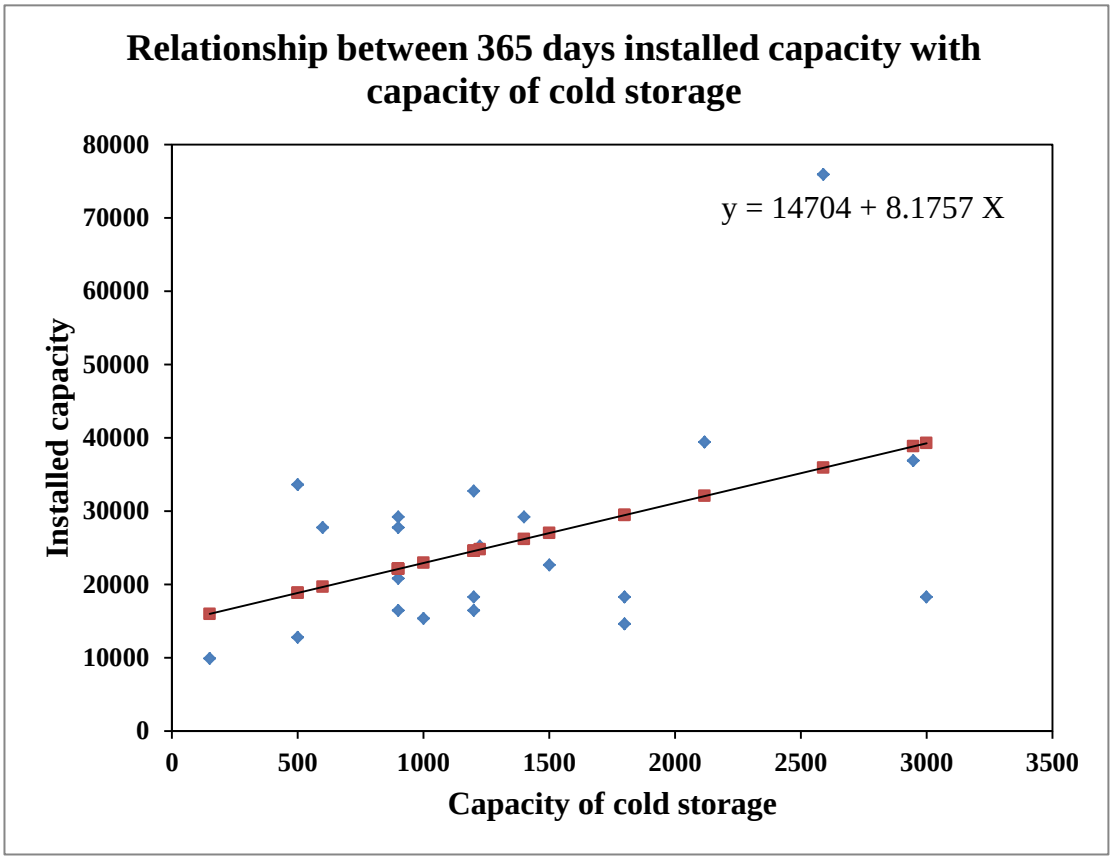


Fig.11. The relationship between 365 days installed capacity with constructed area

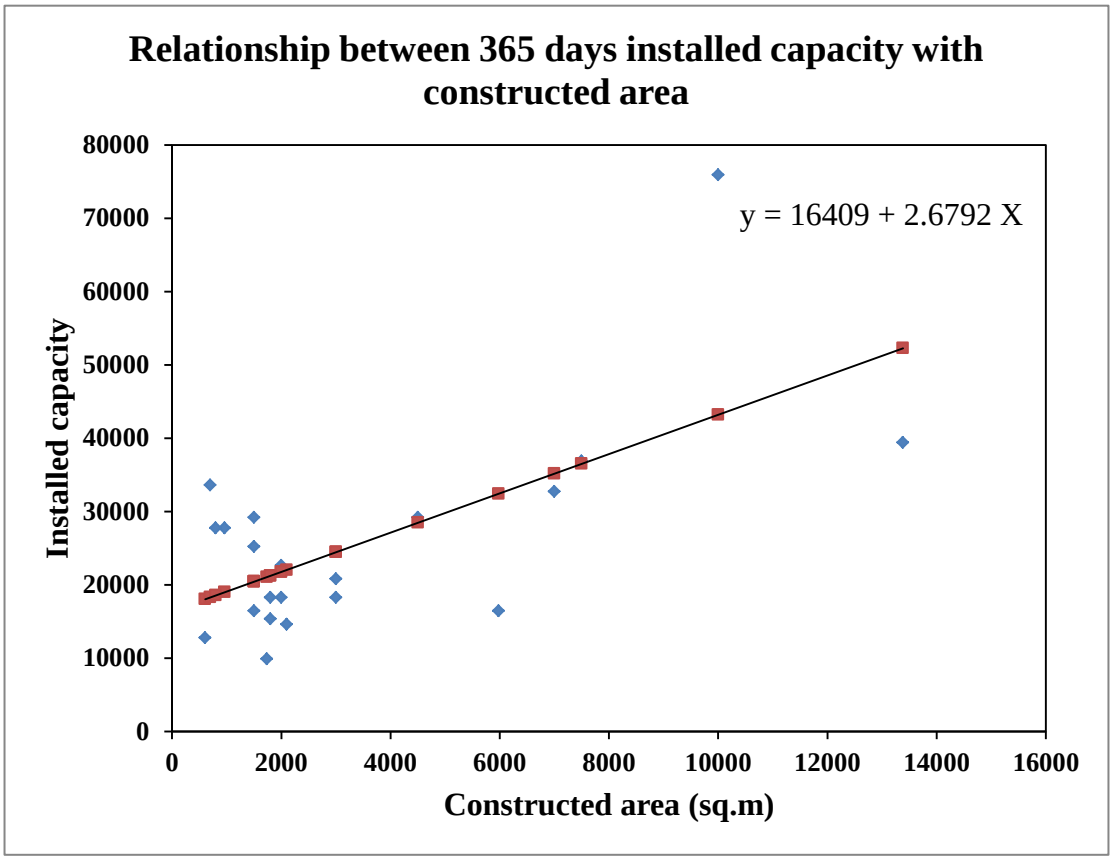
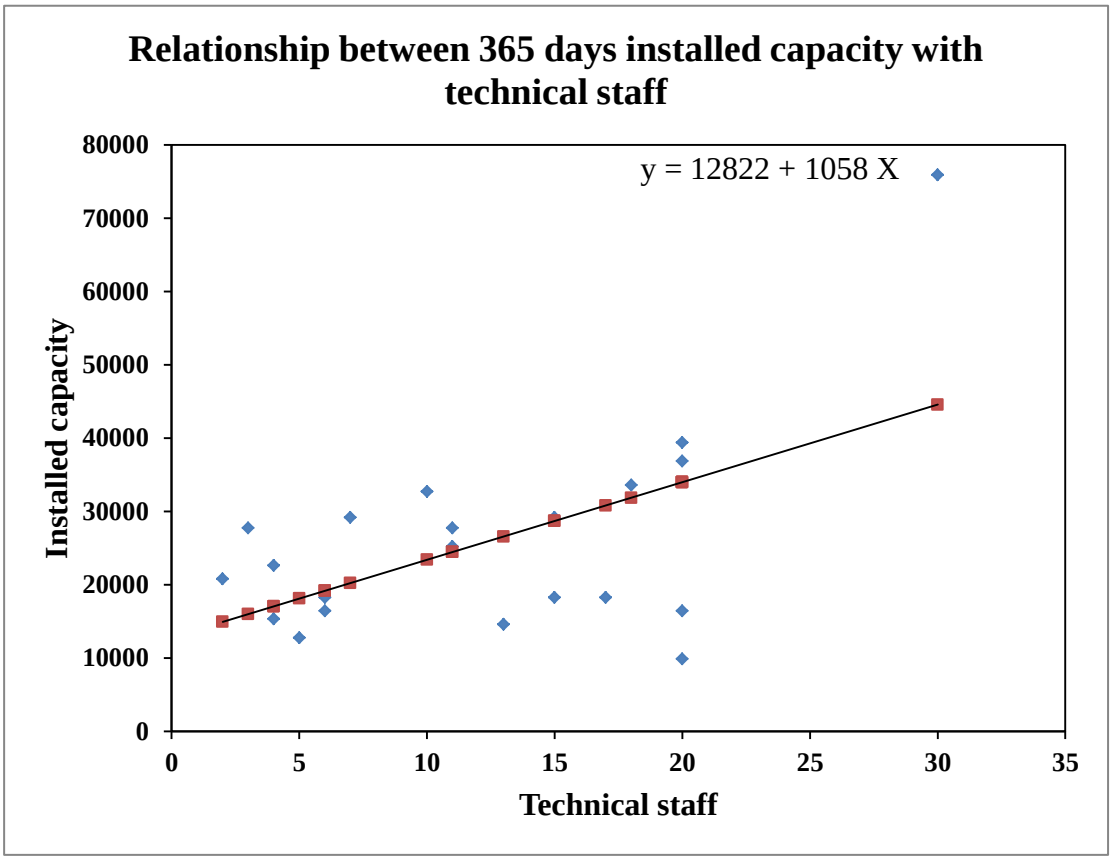


Fig.12. The relationship between 365 days installed capacity with technical staff



was 0.6926 and was significant ($P < 0.05$). The relationship established was $Y = 10774 + 1.9271 X_1 + 1.8339 X_2 + 489.26 X_3$. The relationship established was significant ($P < 0.05$).

4. 7. 2 Total annual production capacity considering 300 working days

The total annual processing capacity of all 21 plants together considering 300 working days was 4,44,780 tonnes. The least production capacity of processing plants considering 300 working days in Raigad district was 8,100 tonnes, while maximum production capacity considering 300 working days was 62,400 tonnes. Total annual production capacity considering 300 working days of processing plant in Thane district was 24,000 tonnes, while that of in Sindhudurg district it was 22,800 tonnes. Annual least production capacity considering 300 working days in Ratnagiri district was 22,800 tonnes and maximum annual production capacity was 27,600 tonnes. Annual total production capacity considering 300 working days is given in Table 11.

The relationship between installed capacity (Y) and capacity of cold storage (X) was established. The correlation coefficient was 0.4533 and was significant ($P < 0.05$). The estimated regression equation was $Y = 12115 + 6.7198 X$ and relationship is depicted in Fig 13. The relationship between installed capacity (Y) and constructed area (X) was established. The correlation coefficient was 0.6468 and was significant ($P < 0.05$). The estimated regression equation was $Y = 13487 + 2.2021 X$ and relationship depicted in Fig 14. The relationship between installed capacity (Y) and technical staff (X) was established. The correlation coefficient was 0.5597 and was significant ($P < 0.05$). The estimated regression equation was $Y = 10538 + 869.56 X$ and relationship is depicted in Fig 15. The relationship between installed capacity (Y) and labours (X) was established. The correlation coefficient was 0.2318 and was not significant ($P > 0.05$). Relationship between the installed capacity (Y) and capacity of cold storage (X_1), constructed area (X_2), as well as technical staffs (X_3) was established. The correlation coefficient

Table 11. Installed capacity of processing plants

Sr. No.	Code of processing plant	Installed capacity per year (tonnes)	300 working days installed capacity	260 working days installed capacity
1	Raigad A	12775	10500	9100
2	Raigad B	32704	26880	23296
3	Raigad C	18250	15000	13000
4	Raigad D	14600	12000	10400
5	Raigad E	20805	17100	14820
6	Raigad F	29200	24000	20800
7	Raigad G	9855	8100	7020
8	Raigad H	39420	32400	28080
9	Raigad I	16425	13500	11700
10	Raigad J	18250	15000	13000
11	Raigad K	15330	12600	10920
12	Raigad L	36865	30300	26260
13	Raigad M	18250	15000	13000
14	Raigad N	25185	20700	17940
15	Raigad O	75920	62400	54080
16	Raigad P	16425	13500	11700
17	Raigad Q	22630	18600	16120
18	Thane A	29200	24000	20800
19	Ratnagiri A	33580	27600	23920
20	Ratnagiri B	27740	22800	19760
21	Sindhudurg A	27740	22800	19760
	Total	**541149**	**444780**	**403832**

Fig.13. The relationship between 300 days installed capacity with capacity of cold storage

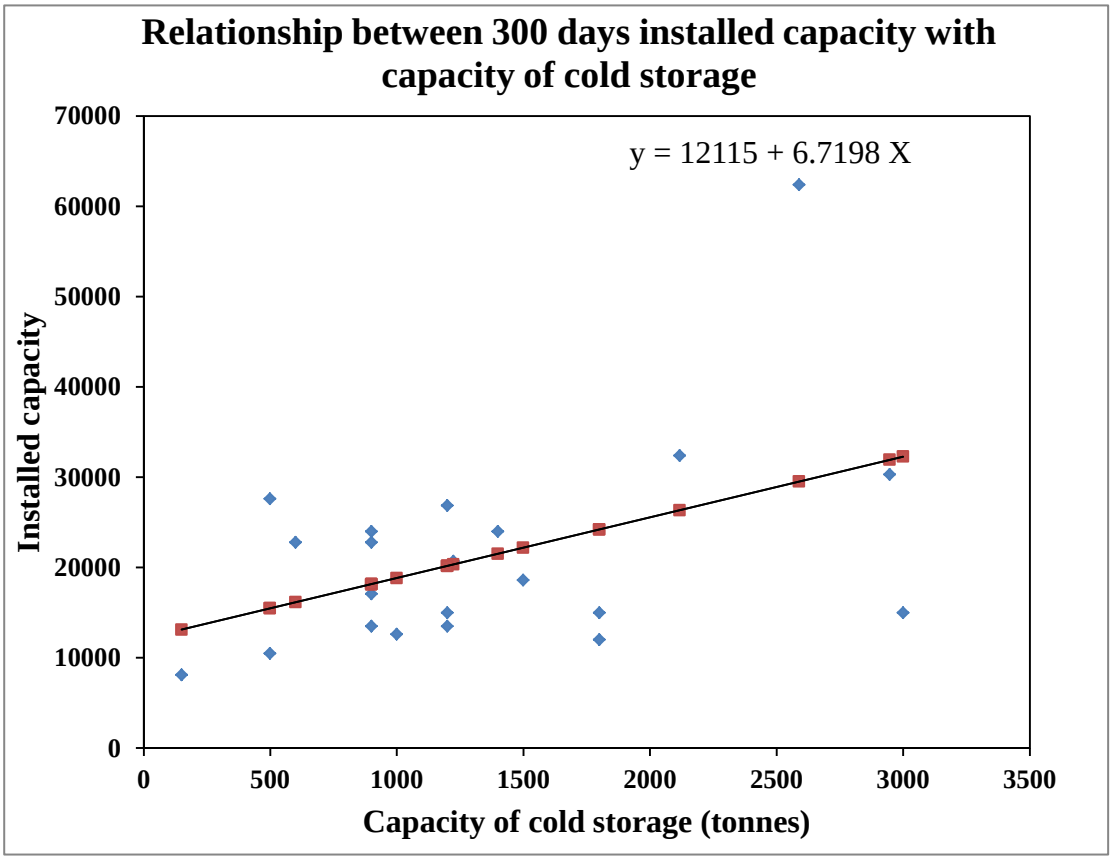


Fig.14. The relationship between 300 days installed capacity with constructed area

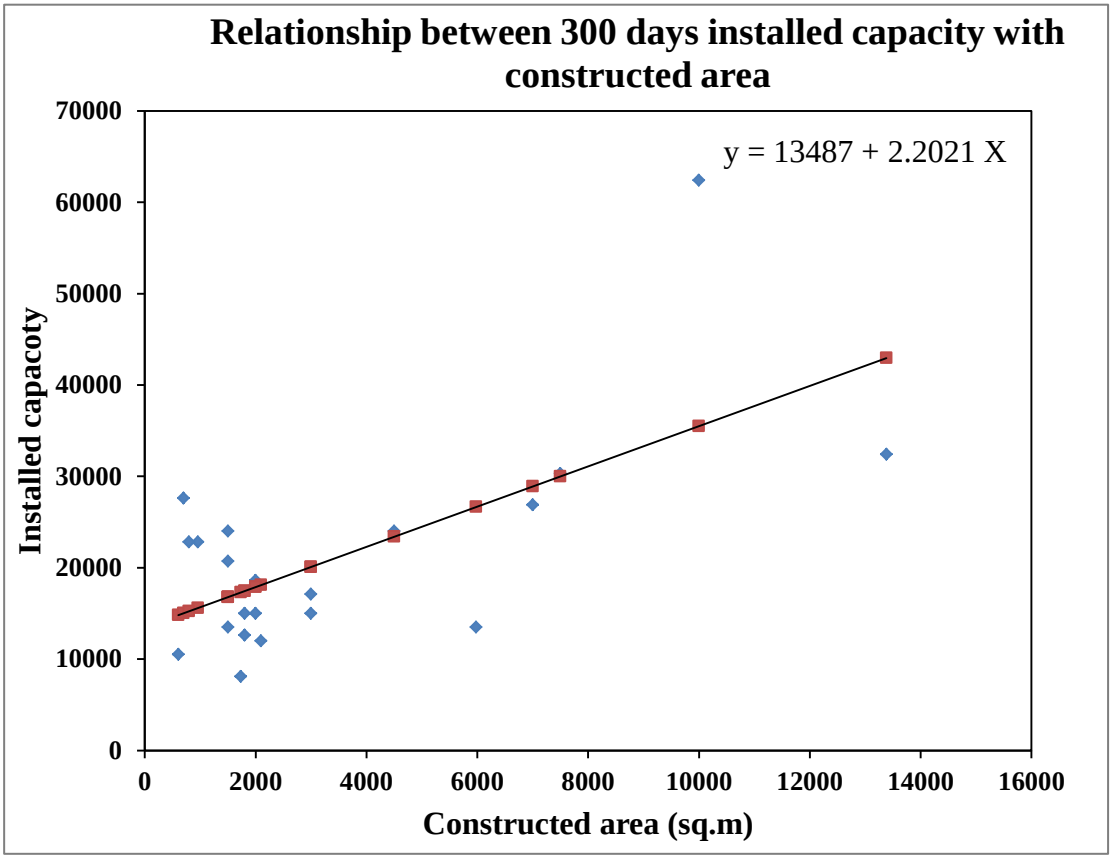
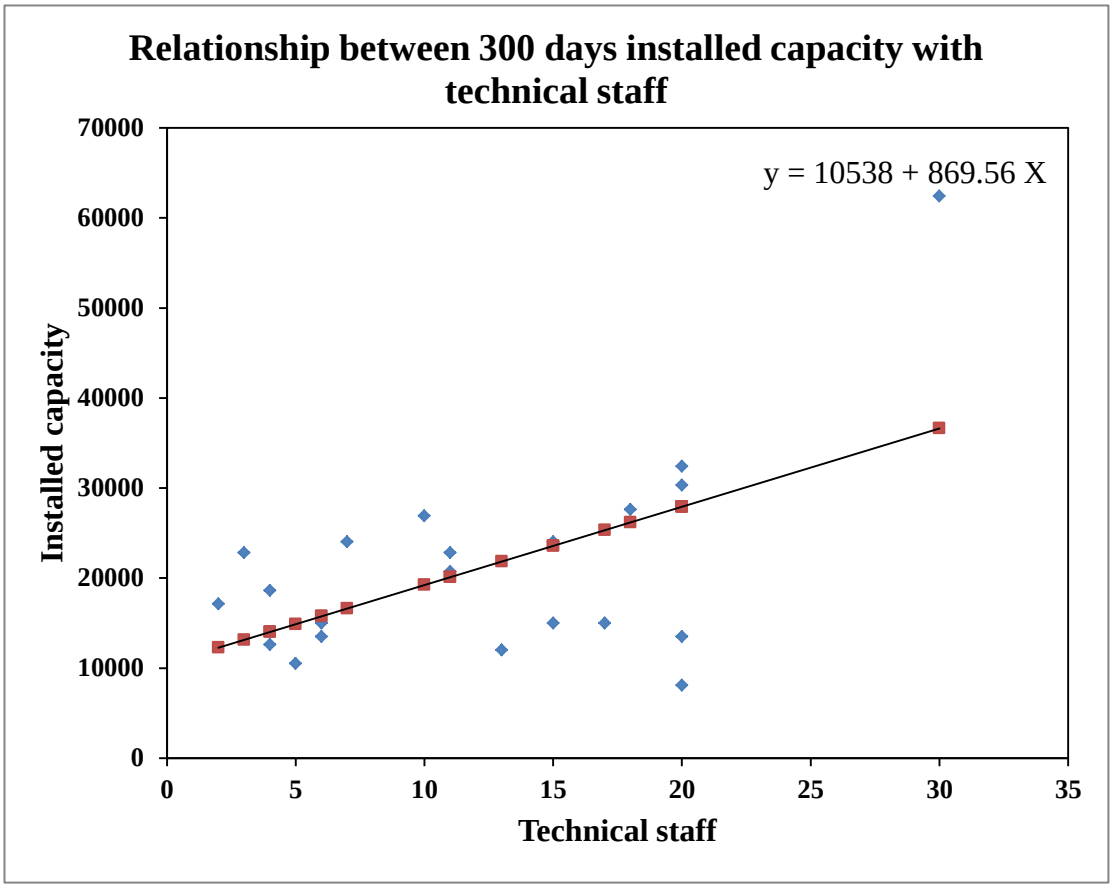


Fig.15. The relationship between 300 days installed capacity with technical staff



was 0.6926 and was significant ($P < 0.05$). The relationship established was $Y = 8855 + 1.5839 X_1 + 1.5073 X_2 + 402.13 X_3$. The relationship established was significant ($P < 0.05$).

4.7.3 Total annual production capacity considering 260 working days

The total annual processing capacity of all 21 plants together considering 260 working days was 4,03,832 tonnes. The least production capacity of processing plants considering 260 working days in Raigad district was 7,020 tonnes, while maximum production capacity considering 260 working days was 54,080 tonnes. Total annual production capacity considering 260 working days of processing plant in Thane district was 20800 tonnes, while that of in Sindhudurg district it was 19,760 tonnes. Annual least production capacity considering 260 working days in Ratnagiri district was 19,760 tonnes. Annual total production capacity considering 260 working days is given in Table 11.

The relationship between installed capacity (Y) and capacity of cold storage (X) was established. The correlation coefficient was 0.4533 and was significant ($P < 0.05$). The estimated regression equation was $Y = 10499 + 5.8238 X$ and relationship is depicted in Fig 16. The relationship between installed capacity (Y) and constructed area (X) was established. The correlation coefficient was 0.6468 and was significant ($P < 0.05$). The estimated regression equation was $Y = 11688 + 1.9085 X$ and relationship depicted in Fig 17. The relationship between installed capacity (Y) and technical staff (X) was established. The correlation coefficient was 0.5597 and was significant ($P < 0.05$). The estimated regression equation was $Y = 9133.2 + 753.62 X$ and relationship is depicted in Fig 18. The relationship between installed capacity (Y) and labours (X) was established. The correlation coefficient was 0.2318 and was not significant ($P > 0.05$). Relationship between the installed capacity (Y) and capacity of cold storage (X_1), constructed area (X_2), as well as technical staffs (X_3) was established. The correlation coefficient was 0.6926 and was significant ($P < 0.05$). The relationship established was $Y = 7674 + 1.3727 X_1 + 1.3064 X_2 + 348.51 X_3$. The relationship established was significant ($P < 0.05$).

Fig.16. The relationship between 260 days installed capacity with capacity of cold storage

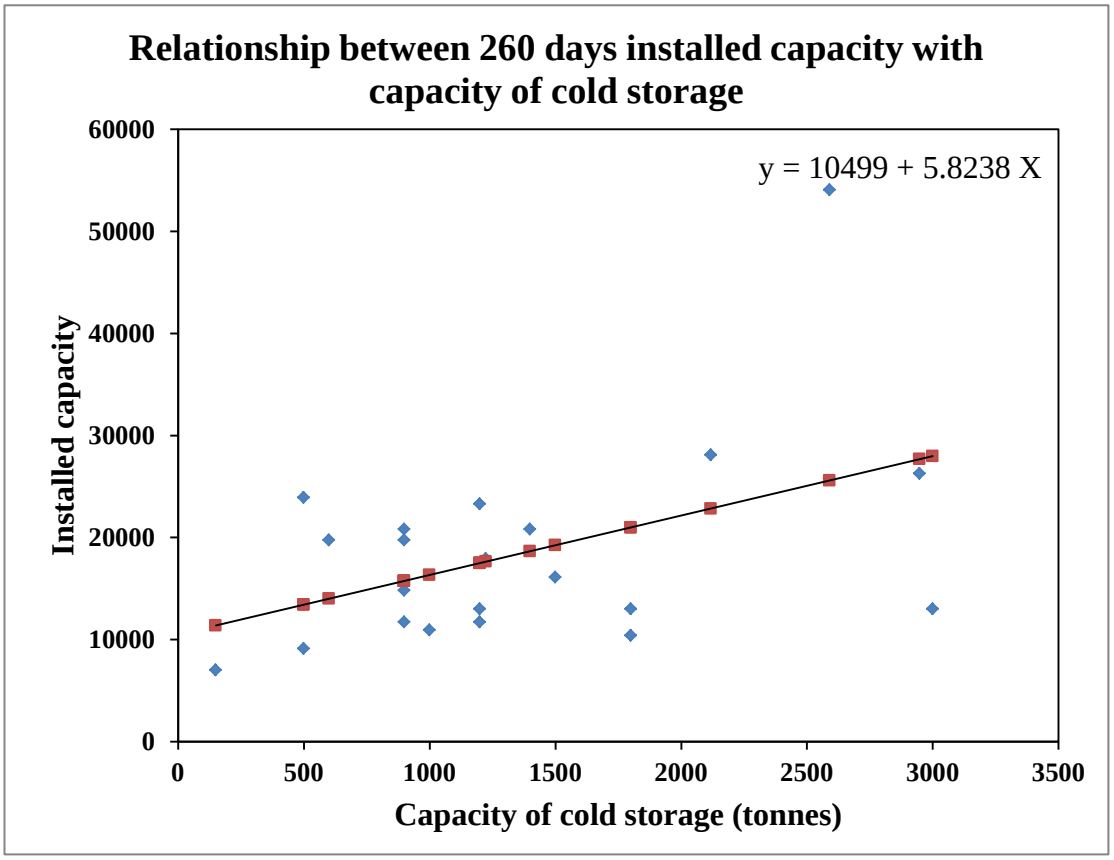


Fig.17. The relationship between 260 days installed capacity with constructed area

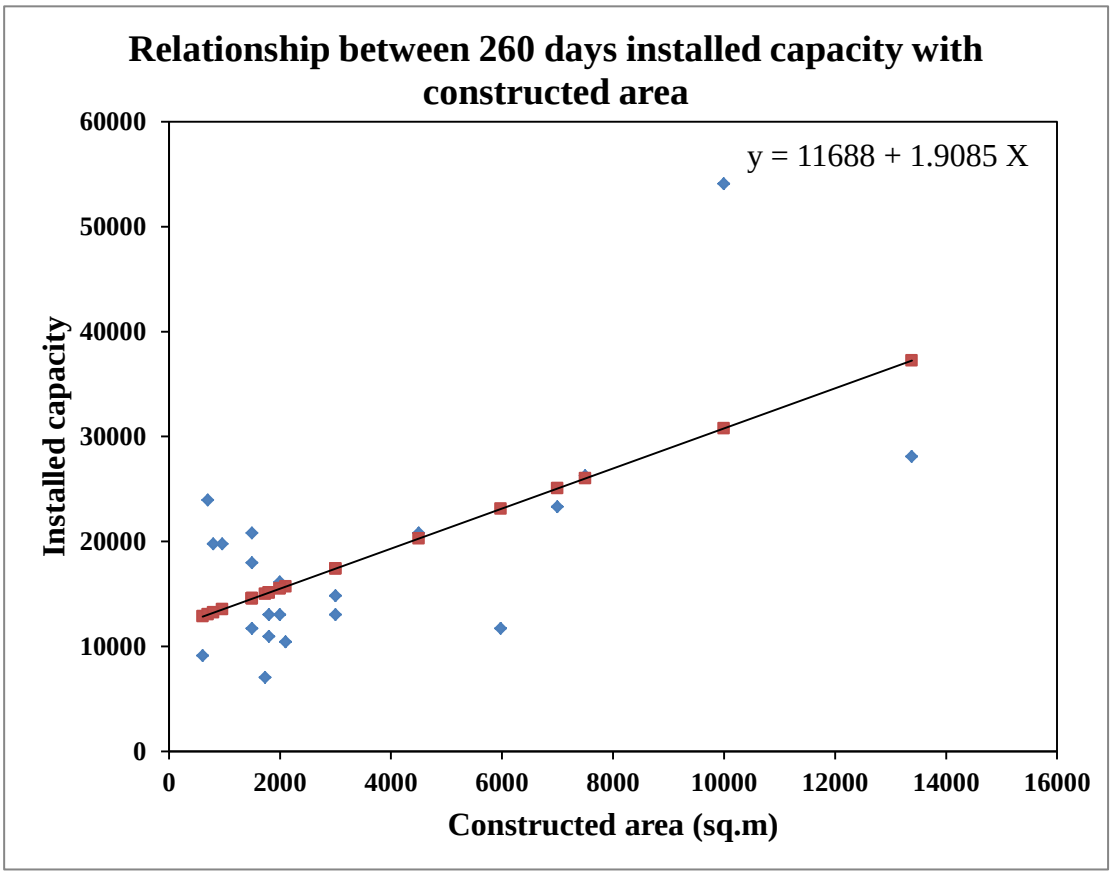
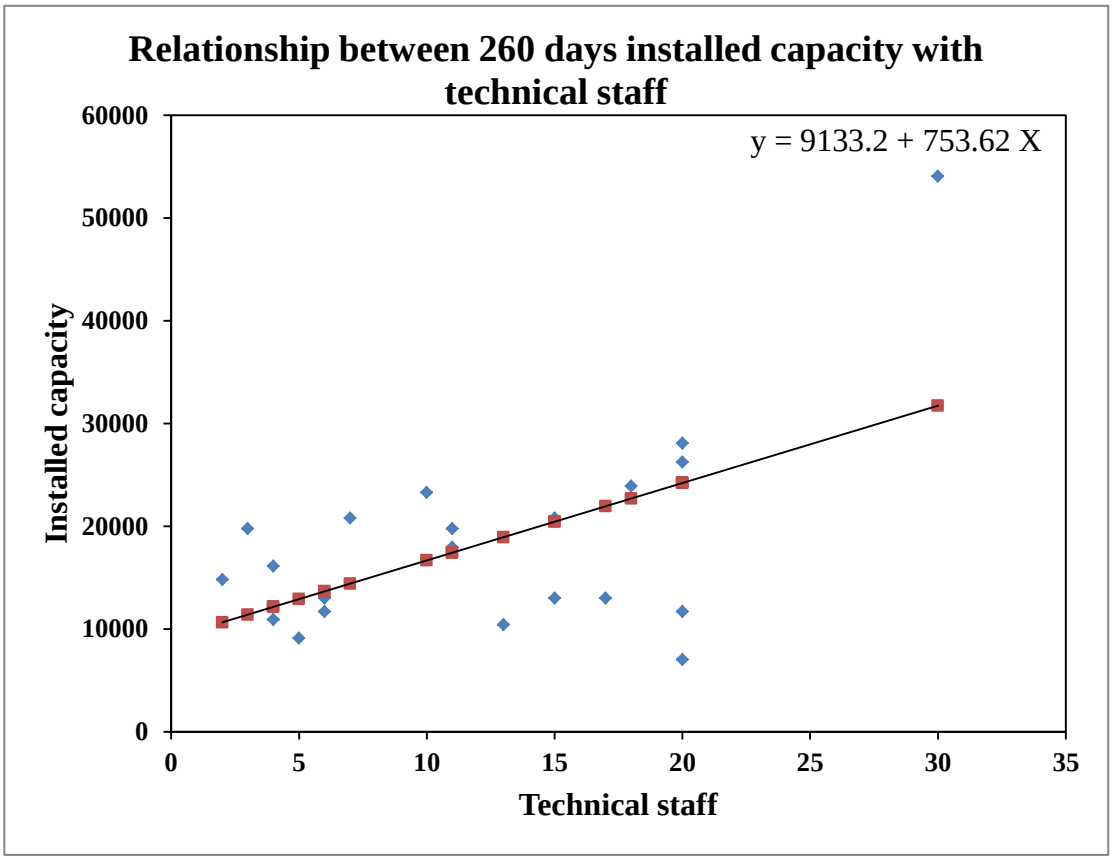


Fig.18. The relationship between 260 days installed capacity with technical staff



4.8 UTILIZATION CAPACITY

4.8.1 Month-wise seafood production

Total seafood production (tonnes) of various processing plants in Konkan region of Maharashtra during 2016-17 according to months is given in Table 12. Total highest production of 11,767.93 tonnes was recorded in the month of October 2016, while that of lowest production of 1,573.46 tonnes was recorded in the month of July 2017. From August 2016 to December 2016 all 21 plant were functional, while from January 2017 to April 2017 20 plants were functional and during May 2017, June 2017 and July 2017 only 16, 10 and 6 plants were functional respectively. It clearly indicated that processing of seafood was completely halted by most of the processing plants. Total seafood processed during June 2017 and July 2017 was only 1712.24 and 1573.46 tonnes respectively. Average production of processing plant varied between 171.09 tonnes in the month of May 2017 to 560.38 tonnes in the month of October 2016. The month wise seafood production is shown in Fig 19.

4.8.2 Season-wise seafood production

Total seafood production of various processing plants in Konkan region of Maharashtra according to seasons is given in Table 13. Highest quantity of seafood was processed in Winter (36,819 tonnes) followed by Monsoon (21,294 tonnes) and Summer (17,707 tonnes). The minimum quantity of 114 tonnes and was processed by Raigad Q plant during monsoon, while highest quantity processed during monsoon was 2,950 tonnes by Raigad C plant. The minimum quantity processed was 242 tonnes by plant Raigad Q during winter and maximum quantity processed was 3,600 tonnes during winter. The minimum and maximum quantity processed during summer was nil (Ratnagiri A) and 1,304.56 tonnes (Raigad H) respectively. Total quantity processed in percentage according to seasons is shown in Fig 20.

Table 12. Month-wise seafood processed by processing plants

Sr. No	Code of processing plant	August	September	October	November	December	January	February	March	April	May	June	July
1	Raigad A	12	220	260	290	300	200	190	100	80	0	0	0
2	Raigad B	166.19	544.26	498.7	660.44	456.19	304.06	250.86	215.97	302.52	291.06	211.33	201.36
3	Raigad C	1550	1400	1350	600	550	300	300	250	300	0	0	0
4	Raigad D	1200	1100	1000	350	280	250	200	150	150	0	0	0
5	Raigad E	600	900	1150	1000	700	750	600	500	500	450	0	0
6	Raigad F	78.9	74.06	136.42	209.27	118.26	125.5	43.12	116.51	76.6	127.96	151.63	0
7	Raigad G	70	85	68	120	100	70	80	125	100	80	70	95
8	Raigad H	301.31	455.99	448.46	411.31	414.03	302.76	223.23	260.5	379.39	441.44	447.39	747.99
9	Raigad I	195.71	345.17	601.23	388.71	201.15	190.33	179.42	173.99	219.54	192.92	206.51	150.11
10	Raigad J	650	1350	1250	1300	1100	1050	850	700	500	450	0	0
11	Raigad K	300	700	750	700	500	400	350	350	300	200	0	0
12	Raigad L	776.2	767.44	728.64	710.28	562.01	376.48	225.96	271.17	215.06	180.65	0	0
13	Raigad M	625	590	650	635	600	580	510	460	400	370	300	289
14	Raigad N	61.2	153.99	123.5	81.12	61.82	63.22	80.5	70.2	94.36	210.61	0	0
15	Raigad O	138	54	56	146	275	235	163	130	124	82	70	0
16	Raigad P	66	80	52	74	60	95	89	51	50	42	0	0
17	Raigad Q	60	54	62	65	70	45	42	44	40	0	0	0
18	Thane A	250	302	350	345	450	300	330	210	210	150	125	0
19	Ratnagiri A	75	605	700	650	150	0	0	0	0	0	0	0
20	Ratnagiri B	150	400	550	650	500	400	350	400	300	280	120	90
21	Sindhudurg A	129.57	371.99	982.98	1307.07	721.37	150.22	44.53	52.21	40.94	44.24	10.38	0
	Total	7455.08	10552.9	11767.93	10693.2	8169.83	6187.57	5101.62	4630.55	4382.41	3592.88	1712.24	1573.46
	Average	355.00	502.52	560.38	509.20	389.04	294.65	242.93	220.50	208.69	171.09	81.54	74.93

Fig.19. Month wise seafood production (tonnes) according to months during 2016-17

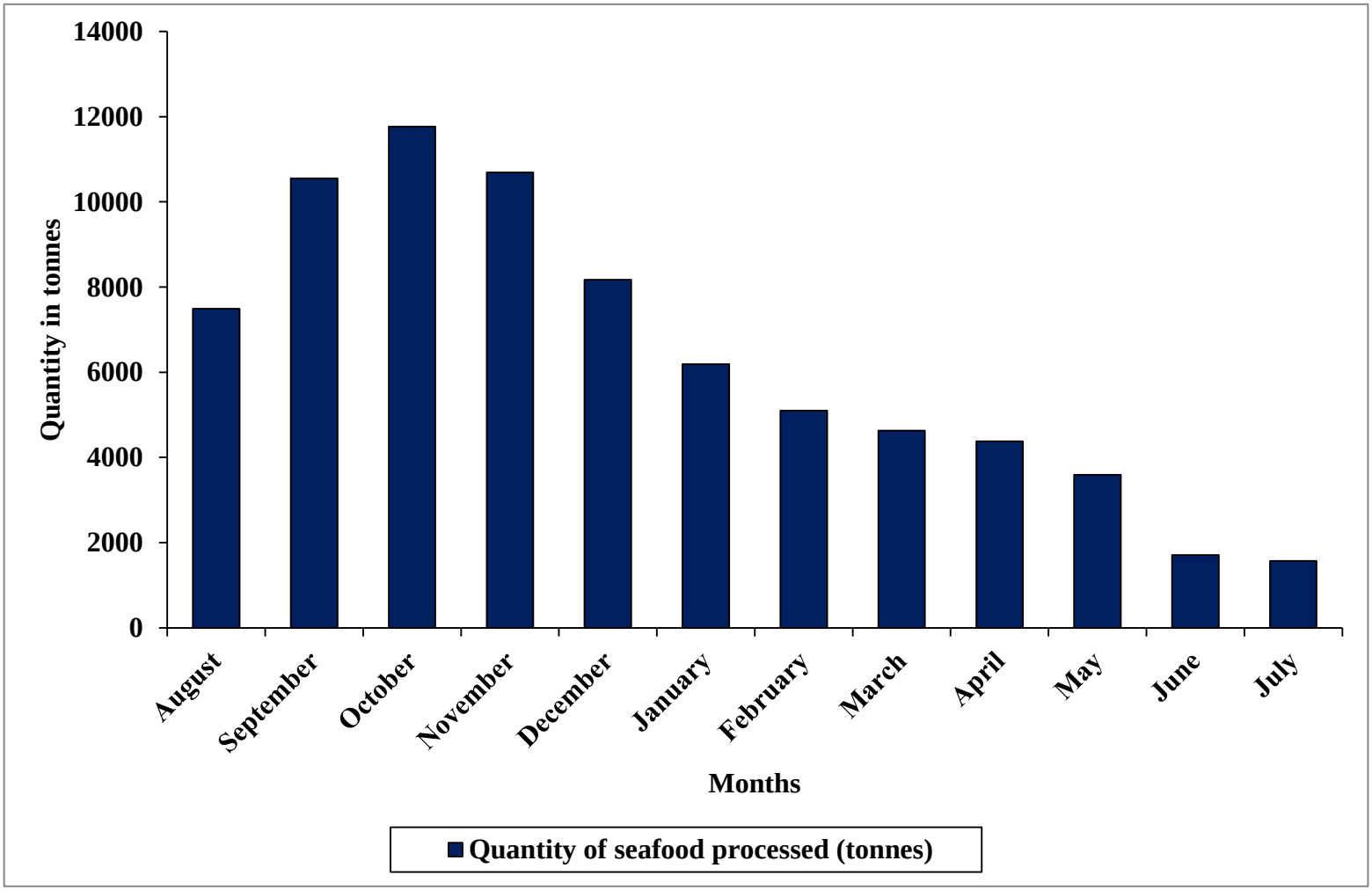
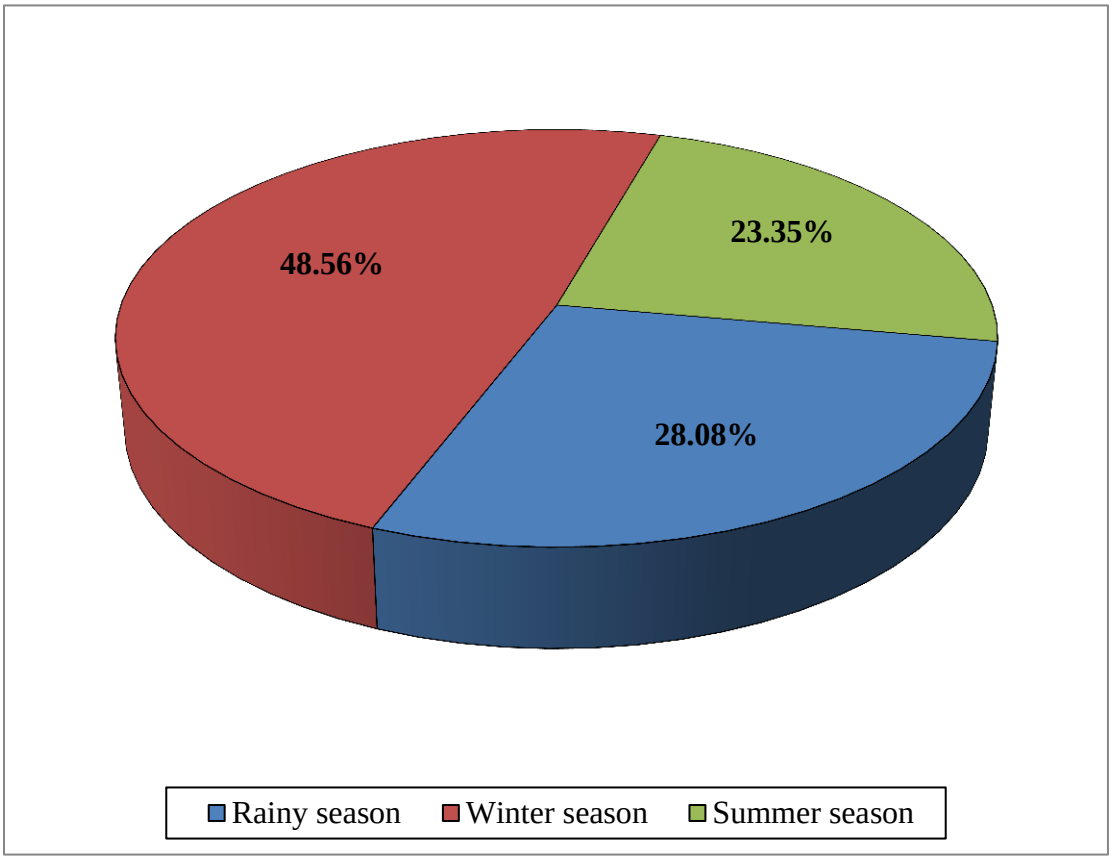


Table 13. According to season seafood processed (tonnes) by processing plants

Sr. No	Code of processing plant	Season		
		Monsoon	**Winter**	**Summer**
1	Raigad A	232	1050	370
2	Raigad B	1123.14	1919.39	1060.41
3	Raigad C	2950	2800	850
4	Raigad D	2300	1880	500
5	Raigad E	1500	3600	2050
6	Raigad F	304.59	589.45	364.19
7	Raigad G	320	358	385
8	Raigad H	1952.68	1576.56	1304.56
9	Raigad I	897.5	1381.42	765.87
10	Raigad J	2000	4700	2500
11	Raigad K	1000	2350	1200
12	Raigad L	1543.64	2377.41	892.84
13	Raigad M	1804	2465	1740
14	Raigad N	215.19	329.66	455.67
15	Raigad O	262	712	499
16	Raigad P	146	281	232
17	Raigad Q	114	242	126
18	Thane A	677	1445	900
19	Ratnagiri A	680	1500	0
20	Ratnagiri B	760	2100	1330
21	Sindhudurg A	511.94	3161.64	181.92
	Total	**21294**	**36819**	**17707**

Fig 20. Total quantity processed in percentage according to season



4.8.3 Annual seafood production

Annual seafood production in tonnes according to processing plant is given in Table 14. Total seafood production recorded during 2016-17 of Konkan region was 75,819.67 tonnes. The lowest production recorded was 482 tonnes from a plant of Raigad district, while maximum production recorded was 9,200 tonnes of plant from Raigad district. Processing plants from Thane, Ratnagiri and Sindhudurg together contributed 13,147.5 tonnes and rest contribution was by the plants from Raigad district. It clearly indicated that the maximum seafood was processed in Raigad district.

4.8.4 Month wise percentage utilization

The percentage seafood production of processing plants in Konkan region of Maharashtra according to months is given in Table 15. Only one processing plant was utilized to cent per cent capacity among the all 21 processing plants only in month of August from Raigad district. Only C, D, E and J plant from Raigad district processed comparatively higher percentage of seafood than other rest of the processing plant in Raigad or else plants from other districts. The plant C and D were utilized more than 80% capacity in August, September and October months, while that of E and J were utilized more than 50% capacity in the month of September, October and November 2016. The one processing plant in Ratnagiri did not processed any seafood from January 2017 to July 2017. Utilization capacity was too poor of most of the processing plants during March 2017 to July 2017. Only six plants out of 21 processing plants were processing seafood during July month.

4.8.5 Season wise percentage utilization

The season wise percentage utilization of processing plants in Konkan region of Maharashtra is given in Table 16. Out of 21 processing plants, altogether 18

Table 14. Total seafood processed (tonnes) during 2016-17 according to processing plant

Sr. No	Code of processing plant	Annual production during 2016-17
1	Raigad A	1652
2	Raigad B	4102.94
3	Raigad C	6600
4	Raigad D	4680
5	Raigad E	7150
6	Raigad F	1258.23
7	Raigad G	1063
8	Raigad H	4833.8
9	Raigad I	3044.79
10	Raigad J	9200
11	Raigad K	4550
12	Raigad L	4813.89
13	Raigad M	6009
14	Raigad N	1000.52
15	Raigad O	1473
16	Raigad P	659
17	Raigad Q	482
18	Thane A	3022
19	Ratnagiri A	2180
20	Ratnagiri B	4190
21	Sindhudurg A	3855.5
	Total	**75819.67**

Table 15. Month-wise percentage capacity utilization of processing plants

Sr. NO	Code of processing plant	August	September	October	November	December	January	February	March	April	May	June	July
1	Raigad A	1.11	20.95	23.96	27.62	27.65	18.43	19.39	9.22	7.62	0.00	0.00	0.00
2	Raigad B	5.98	20.25	17.95	24.57	16.42	10.95	10.00	7.78	11.25	10.48	7.86	7.25
3	Raigad C	100.00	93.33	87.10	40.00	35.48	19.35	21.43	16.13	20.00	0.00	0.00	0.00
4	Raigad D	96.77	91.67	80.65	29.17	22.58	20.16	17.86	12.10	12.50	0.00	0.00	0.00
5	Raigad E	33.96	52.63	65.08	58.48	39.62	42.44	37.59	28.30	29.24	25.47	0.00	0.00
6	Raigad F	3.18	3.09	5.50	8.72	4.77	5.06	1.93	4.70	3.19	5.16	6.32	0.00
7	Raigad G	8.36	10.49	8.12	14.81	11.95	8.36	10.58	14.93	12.35	9.56	8.64	11.35
8	Raigad H	9.00	14.07	13.39	12.69	12.37	9.04	7.38	7.78	11.71	13.19	13.81	22.34
9	Raigad I	14.03	25.57	43.10	28.79	14.42	13.64	14.24	12.47	16.26	13.83	15.30	10.76
10	Raigad J	41.94	90.00	80.65	86.67	70.97	67.74	60.71	45.16	33.33	29.03	0.00	0.00
11	Raigad K	23.04	55.56	57.60	55.56	38.40	30.72	29.76	26.88	23.81	15.36	0.00	0.00
12	Raigad L	24.79	25.33	23.27	23.44	17.95	12.02	7.99	8.66	7.10	5.77	0.00	0.00
13	Raigad M	40.32	39.33	41.94	42.33	38.71	37.42	36.43	29.68	26.67	23.87	20.00	18.65
14	Raigad N	2.86	7.44	5.77	3.92	2.89	2.96	4.17	3.28	4.56	9.85	0.00	0.00
15	Raigad O	2.14	0.87	0.87	2.34	4.26	3.64	2.80	2.02	1.99	1.27	1.12	0.00
16	Raigad P	4.73	5.93	3.73	5.48	4.30	6.81	7.06	3.66	3.70	3.01	0.00	0.00
17	Raigad Q	3.12	2.90	3.23	3.49	3.64	2.34	2.42	2.29	2.15	0.00	0.00	0.00
18	Thane A	10.08	12.58	14.11	14.38	18.15	12.10	14.73	8.47	8.75	6.05	5.21	0.00
19	Ratnagiri A	2.63	21.92	24.54	23.55	5.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Ratnagiri B	6.37	17.54	23.34	28.51	21.22	16.98	16.45	16.98	13.16	11.88	5.26	3.82
21	Sindhudurg A	5.50	16.32	41.72	57.33	30.62	6.38	2.09	2.22	1.80	1.88	0.46	0.00
	Average	20.95	29.89	31.70	28.18	21.03	16.50	15.48	12.51	11.96	8.84	4.00	3.53

Table 16. Season-wise percentage capacity utilization of processing plants

Sr. No	Code of processing plant	Monsoon	Winter season	Summer season
1	Raigad A	5.43	24.39	8.81
2	Raigad B	10.27	17.42	9.86
3	Raigad C	48.36	45.53	14.17
4	Raigad D	47.13	38.21	10.42
5	Raigad E	21.57	51.35	29.97
6	Raigad F	3.12	5.99	3.79
7	Raigad G	9.71	10.78	11.88
8	Raigad H	14.82	11.87	10.07
9	Raigad I	16.35	24.96	14.18
10	Raigad J	32.79	76.42	41.67
11	Raigad K	19.52	45.49	23.81
12	Raigad L	12.53	19.14	7.37
13	Raigad M	29.57	40.08	29.00
14	Raigad N	2.56	3.88	5.50
15	Raigad O	1.03	2.78	2.00
16	Raigad P	2.66	5.08	4.30
17	Raigad Q	1.51	3.17	1.69
18	Thane A	6.94	14.68	9.38
19	Ratnagiri A	6.06	13.26	0.00
20	Ratnagiri B	8.20	22.46	14.58
21	Sindhudurg A	5.52	33.82	1.99
	Average	14.55	24.32	12.12

processing plants processed maximum in winter season, while rest three plants processed maximum in monsoon season. Almost 12 processing plants were

processing more seafood in other season than that of they processed in monsoon season and rest nine processing plants processed more material in monsoon than that of summer season.

The relationship between utilization capacity (Y) and total area (X) was established. The correlation coefficient was 0.0062 and was not significant ($P > 0.05$). The relationship between utilization capacity (Y) and constructed area (X) was established. The correlation coefficient was 0.0041 and was not significant ($P > 0.05$). The relationship between utilization capacity (Y) and capacity of cold storage (X) was established. The correlation coefficient was 0.2199 and was not significant ($P > 0.05$). The relationship between utilization capacity (Y) and technical staff (X) was established. The correlation coefficient was 0.1697 and was not significant ($P > 0.05$). The relationship between utilization capacity (Y) and labours (X) was established. The correlation coefficient was 0.3211 and was not significant.

4.9 COMPARISON OF UTILIZATION CAPACITY

Annual percentage utilization capacity was calculated. Most of the plants do not process during the month of June and July as they were shut down for annual maintenance work. Therefore, annual percentage utilization by considering 300 working days was calculated. Considering one day holiday per week in remaining 10 months, annual percentage utilization for 260 days also was calculated. The annual percentage utilization, annual percentage utilization for 300 working days and annual percentage utilization considering 260 working days was calculated and same is given in Table 17.

Table 17. Comparison of utilization capacity and utilization capacity percentage working days-wise

Sr. No.	Code of processing plant	Utilization production per year (tonnes)	Annual percentage utilization capacity	Annual percentage utilization capacity for 300 working days	Annual percentage utilization capacity for 260 days
1	Raigad A	1652	12.93	15.73	18.15
2	Raigad B	4102.94	12.55	15.26	17.61
3	Raigad C	6600	36.16	44.00	50.77
4	Raigad D	4680	32.05	39.00	45.00
5	Raigad E	7150	34.37	41.81	48.25
6	Raigad F	1258.23	4.31	5.24	6.05
7	Raigad G	1063	10.79	13.12	15.14
8	Raigad H	4833.8	12.26	14.92	17.21
9	Raigad I	3044.79	18.54	22.55	26.02
10	Raigad J	9200	50.41	61.33	70.77
11	Raigad K	4550	29.68	36.11	41.67
12	Raigad L	4813.89	13.06	15.89	18.33
13	Raigad M	6009	32.93	40.06	46.22
14	Raigad N	1000.52	3.97	4.83	5.58
15	Raigad O	1473	1.94	2.36	2.72
16	Raigad P	659	4.01	4.88	5.63
17	Raigad Q	482	2.13	2.59	2.99
18	Thane A	3022	10.35	12.59	14.53
19	Ratnagiri A	2180	6.49	7.90	9.11
20	Ratnagiri B	4190	15.10	18.38	21.20
21	Sindhudurg A	3855.5	13.90	16.91	19.51
Overall percentage utilization			14.01	17.04	19.67

4.9.1 Annual percentage utilization

The annual percentage seafood processed according to processing plants is given in Table 17. The average annual percentage utilization was 14.01% during year 2016-17. The minimum annual percentage utilization in Raigad district observed was 1.94%, while maximum annual percentage utilization observed was 50.41%. Annual percentage utilization of Thane district was 10.35%, while that of in Sindhudurg district it was 13.90% and in Ratnagiri district minimum annual percentage utilization observed was 6.49%, while maximum annual percentage utilization was 15.10%. Production capacity, actual production and percentage capacity utilization according to months in a year is given in Table 18 and depicted in Fig 21.

4.9.2 Annual percentage utilization considering 300 working days

The average annual percentage utilization observed was 17.04% with consideration of 300 working days of all 21 processing plants together in Konkan region of Maharashtra. The lower annual percentage utilization observed was 2.36% in Raigad district, while higher annual percentage utilization for 300 working days was 61.33%. Thane district and Sindhudurg district annual percentage utilization of processing plant with 300 working days was 12.59 and 16.91% respectively. Lower annual percentage utilization of processing plants in Ratnagiri district observed was 7.90, and highest percentage utilization observed was 18.38. Annual percentage utilization capacity with 300 working days is given in Table 17.

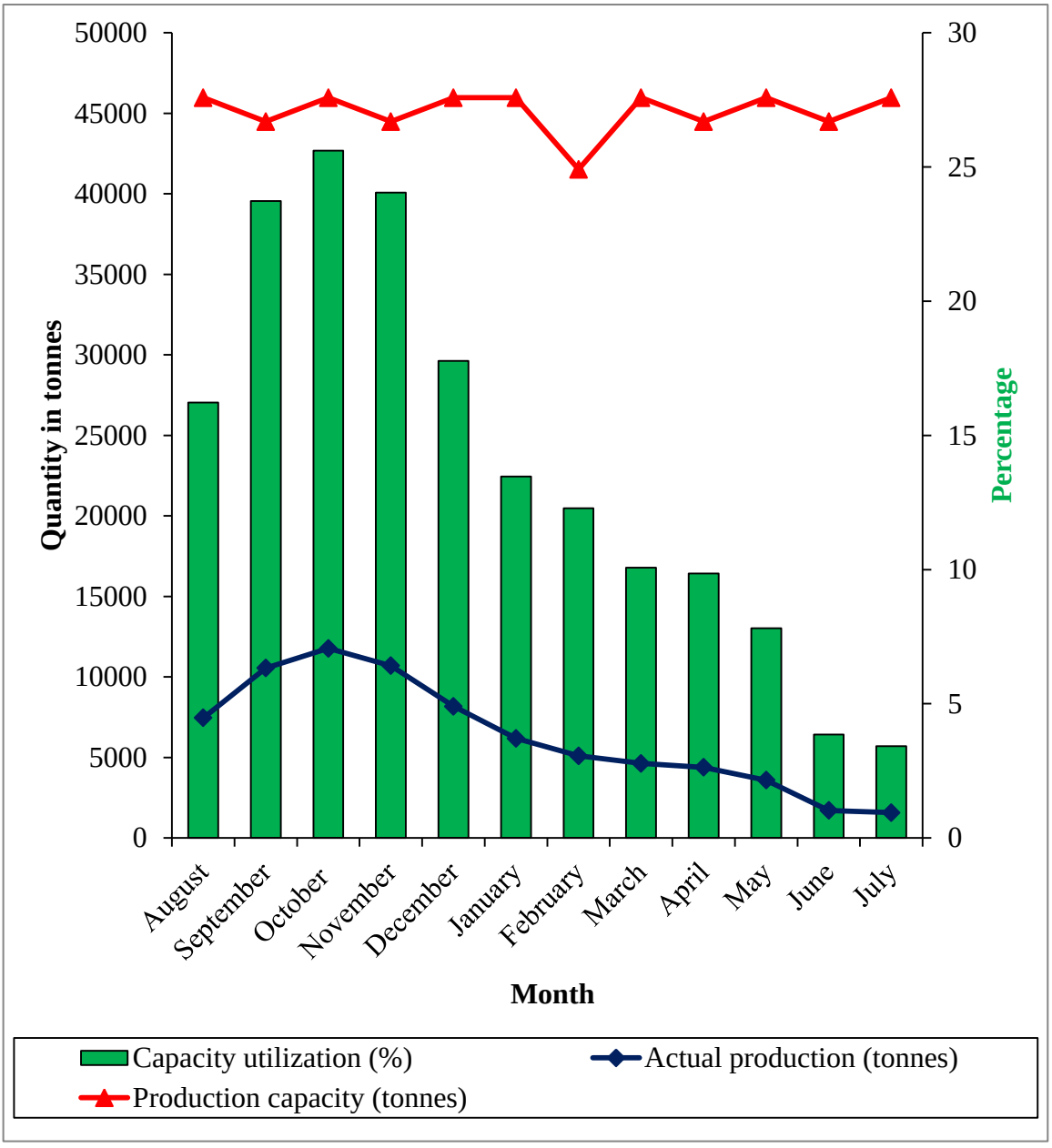
4.9.1 Annual percentage utilization considering 260 working days

The average annual percentage utilization was 19.67% with 260 working days in Konkan region of Maharashtra. Lower annual percentage utilization of processing plant in Raigad district was 2.72%, while higher annual percentage utilization was 70.77%. Annual percentage utilization of processing plant was 14.53% in Thane district, while that of in Sindhudurg district it was 19.51%. Lower percentage

Table 18. Production capacity actual production and capacity utilization of processing plant

Sr. No	Month	Installed capacity (tonne)	Actual production (tonne)	Capacity utilization (%)
1	August	45961	7455.1	16.22
2	September	44478	10552.9	23.72
3	October	45961	11768	25.60
4	November	44478	10693.2	24.04
5	December	45961	8169.83	17.77
6	January	45961	6187.6	13.46
7	February	41513	5101.6	12.28
8	March	45961	4630.6	10.41
9	April	44478	4382.4	9.58
10	May	45961	3592.9	7.81
11	June	44478	1712.2	3.84
12	July	45961	1573.5	3.42
	Total	541149	75819.67	14.01

Fig.21. Production capacity, actual production and capacity utilisation of processing plants



utilization of processing plant in Ratnagiri district was 9.11%, while higher percentage utilization observed was 21.20%. Annual percentage utilization of processing plants considering 260 working days in given in Table 17.

4.10 COSTS AND EARNING ANALYSIS FOR SEA FOOD PROCESSING PLANTS

The costs and earing analysis of seafood processing plant is given in Table 19. Estimated average capital investment for processing plant was ₹ 11,38,88,888/-. The major share of capital investment was on land cost (46.83%), followed by construction cost (29.27%) and machinery cost (23.90%). The percentage expenditure on the various cost components of the capital cost is depicted in Fig 22a. The variable cost estimated for operation of processing plant for one year was ₹ 44,51,25,553/-. The maximum expenditure in variable cost was on cost of raw material (96.00%), electricity bill (1.27%), salary of staff (1.06%), water bill (0.69%), maintenance cost (0.35%), chemical/consumables (0.02%) and office expenses (0.01%). Same is depicted in Fig 22b. The total project cost, fixed cost and total cost of production per annum was ₹ 55,90,14,441/-, ₹ 8,99,07,721/-, ₹ 53,50,33,274/- respectively. The total estimated revenue of year was ₹ 1,23,69,17,801/- and estimated net profit was ₹ 70,18,84,527/-.

4.11 CONSTRAINTS

Total 21 respondents were interviewed during the data collection out of 46 manufacturing seafood exporters in Konkan region of Maharashtra. The percentage wise classification of constraints face by processing plants, the 100% processing plants constraint faced by less availability of raw material and rest constraints was less than 50% faced by processing plants is given in Table 20. The 4.76% processing plant claimed lack of storage space maybe this problem face in peek season. All the

Table 19. Costs and earning analysis for processing plants in Konkan region of Maharashtra

	Items		Amount (₹)
A.	**Capital cost**		
	1. Land cost		5,33,33,333
	2. Construction cost		3,33,33,333
	3. Machinery cost		2,72,22,222
	Total capital cost		**11,38,88,888**
B.	**Variable cost**		
	1. Salary of staff		47,33,333
	2. Electricity bill		56,66,666
	3. Water bill		30,53,333
	4. Maintenance cost		15,56,666
	5. Cost of raw material		43,00,00,000
	6. Chemical/Consumables		71,111
	7. Office expenses		44,444
	Total variable cost		**44,51,25,553**
C.	**Total project cost (A+B)**		**55,90,14,441**
D.	**Fixed cost**	a. Deprecation on Capital cost @ 10%	60,55,555
		b. Interest on total project cost @ 15%	8,38,52,166
			8,99,07,721
E.	**Total cost (B+D)**		**53,50,33,274**
F.	**Revenue**	a. Export rate @₹ 372715.25 per tonne	**1,23,69,17,801**
G.	**Profit/loss**		**70,18,84,527**
H.	**Profit**		**70,18,84,527**

Fig.22a. Proportion of constituent component of capital cost for processing plant

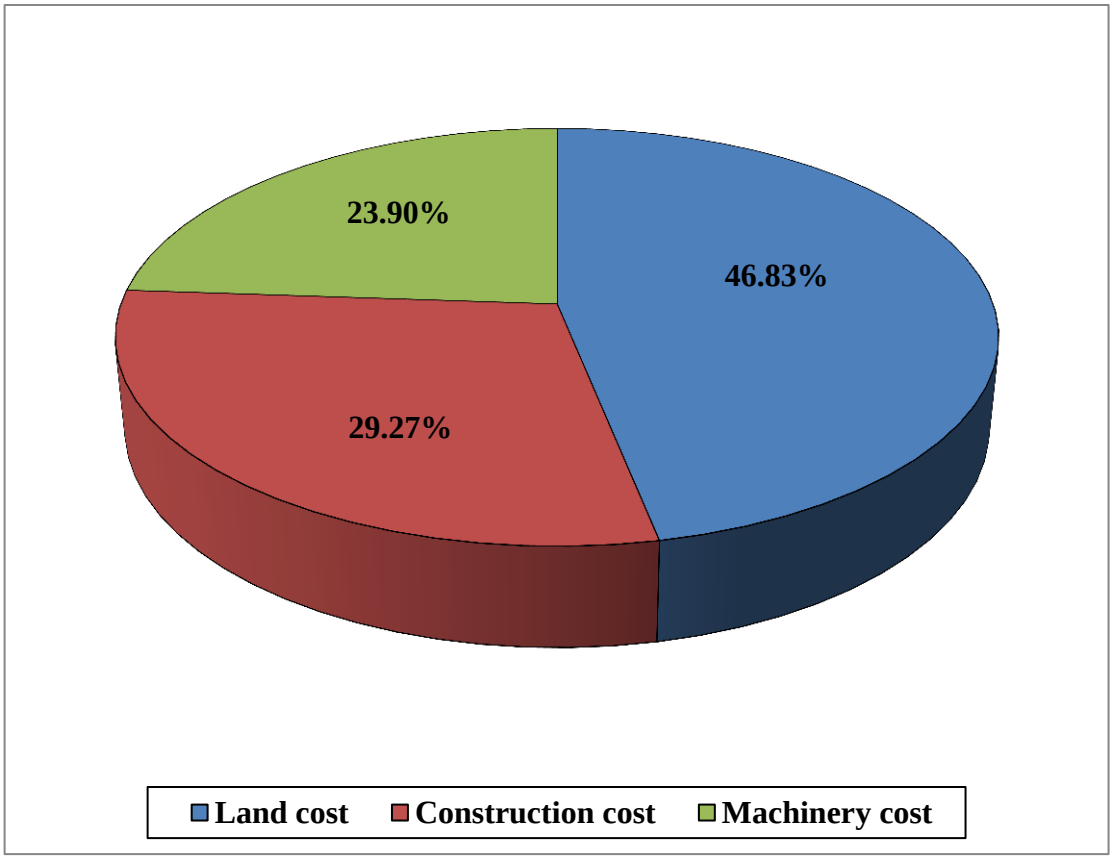


Fig.22b. Proportion of constituent components of variable cost for processing plant

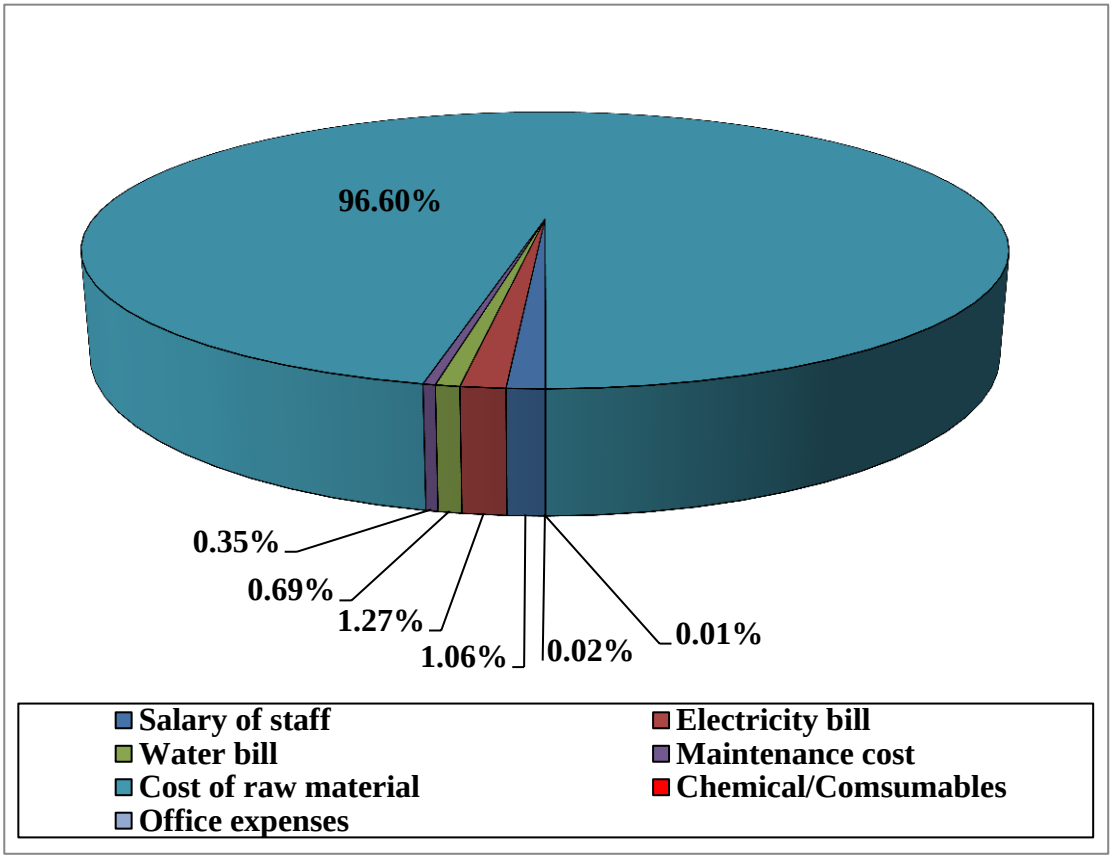


Table 20. Percentage wise classification of constraints faced by processing plants

Sr. No	Constraints	Percentage
1	Less availability of raw material	100.00
2	Availability of labours	23.81
3	Electricity failure	4.76
4	Water supply/quality of supply water	4.76
5	Lack transportation	0.00
6	Lack of skilled workers	4.76
7	Lack of other inputs	0.00
8	Lack of storage space	4.76
9	Marketing problem	9.52
10	Financial problem	0.00
11	Social problem / political	0.00

observed plants were under-utilized, as the plants were not fully utilizing at their installed capacity.

5.0 DISCUSSION

Major input of raw material for seafood processing plants is from marine capture fisheries, therefore, most of the seafood processing plants were established in coastal districts of Konkan region of Maharashtra. The second factor, which contributed in the establishment of seafood processing plants in costal districts, is that these processing plants process seafood mainly for export and the products are exported from sea Port. Considering these facts all the seafood processing plants were established in coastal districts of Maharashtra. Similarly, Geethalaksmi *et al.* (2011) have also reported that most of the seafood processing plants in Gujarat were located near major sea ports such as Veraval, Mangrol and Porbander. Iyer *et al*. (1981) have claimed that there were 275 seafood processing plants in India during 1979, of which 181 were on the west coast and 94 were on the east coast of India. They have further reported that, out of 181 processing plants on the west coast of India, 32 seafood processing plants were in Maharashtra; but now 46 processing plants were observed in Maharashtra as the website of Marine Products Export Development Authority during the year 2016-17.

5.1 GROWTH OF SEAFOOD PROCESSING

Altogether, 46 plants were observed in Maharashtra as against 32 plants reported by Iyer *et al.* (1982b) during 1981. Iyer *et al.* (1982b) claimed 32 processing plants during 1981, as against only one plant was observed with processing capacity of 22,630 tonnes during 1980-85 period in the present study. Actually, Marine Product Export Development Authority (MPEDA) web site showed 46 registered plants in the year 2016-17 in Maharashtra but actually only 31 plants were observed to be processing seafood, of which seven were closed. It is interesting to note down that only one plant was functional out of processes plant established during 1980-85 as recorded in the present study. It means that processing plants reported by Iyer *et al.*

(1982b) have been closed and were not observed during the present study. Therefore, the processing capacity recorded as 22,630 tonnes during 1980-85 may be wrong, as the other processing plants operational during that period are not functional now-days. The numbers of plants recorded during 1995-2000 were nine with 2,30,169 tonnes of processing capacity, while it reached to 21 with 5,41,149 tonnes processing capacity during 2015-18. Iyer *et al.* (1983), while working at all India level have claimed 47 processing plants in 1969 with annual processing capacity of 69.4 tonnes and have reported the increase in number of plants to 276 after 10 years with processing capacity of 457 tonnes. They have not reported the separate plants or processing capacity therefore, the results of the present study can't be compared with their study.

5.2 DISTRICT WISE PROCESSING PLANTS

Maharashtra is the most important maritime state along the west coast of India, with 720 km of coast line. The information was collected from 21 processing plants, out of total 46 processing plants in Konkan region of Maharashtra. Altogether 29 plants were present in Raigad district as per the record of MPEDA, out of these 11 were closed and only 18 were processing seafood. The required information was collected from 17 plants as one processing plant denied to give required information. Seven plants were present in Ratnagiri district as per MPEDA record, of which three plants were closed. Two processing plants denied to give information, therefore, information was collected from only two plants. As per the record of MPEDA nine plants were present in Thane district, of which eight processing plants were non-functional and therefore, information was collected from one processing plant. Only one plant was observed in Sindhudurg district required information was collected from this processing plant. Iyer *et al.* (1982b) has reported 32 plants in Maharashtra during 1981, but they have not given the district wise distribution of plants, therefore

the number of processing plants recorded district wise in the present study can not be compared with the claimed made by them.

5.3 ASSETS

The least total area of 0.1 hector was observed in Raigad district and maximum total area of 2.5 hector was observed in Sindhudurg district. Land holding of processing plants in Raigad, Thane and Ratnagiri were less than the land holding of processing plants in Sindhudurg district. The possible factor for such difference recorded may be the cost of land. The least constructed area was observed in Raigad district and was 607 sq.m, while the largest constructed area observed was 13385 sq.m in Raigad district. Minimum and maximum constructed area of processing plant was observed in the Raigad district. The relationship of total constructed area (sq.m) was established with the total land (ha) excluding the information processing plant of Sindhudurg district. The established relationship showed that on an average approximately 50% area was constructed out of total available land. None of the hitherto research paper has attempted to analyze the assets of the processing plants in India or else in the world, therefore, the results of the present study can't be compared with the results of other studies.

5.4 FREEZING FACILITY

Almost 20 processing plants were observed with Individual quick freezing (IQF) and blast freezer facility, while 19 processing plants were observed with one types of freezers such as plate freezer, out of 21 processing plants studied. Tunnel freezer was observed in two plants. Only one processing plant was observed with Plate, blast, tunnel and IQF freezer. One processing plant observed with plate, tunnel and IQF freezer. It is observed that the processing plants were well equipped with various kind of freezer to handle the different kind of seafood. Similar kind of

information is not collected by any other researcher, therefore, the result of the present study can not be compared.

5.5 COLD STORAGE CAPACITY

The cold storage facility was observed in all seafood processing plants. The least size of cold storage observed was 150 tonnes, while maximum capacity cold storage observed was 3000 tonnes in Konkan region of Maharashtra. The almost 38.09% of cold storage were below 1000 tonnes capacity, while 42.68% were between 1000 to 2000 tonnes storage capacity and 19.05% cold storage were with more than 2000 tonnes of storage capacity. The total cold storage capacity of 21 processing plants was 28,330 tonnes. Unnithan *et al*. (1998) reported 127 fish processing plant in Kerala with 23,087 tonnes of cold storage capacity. The cold storage capacity of 21 processing plants was more as compared to 127 processing plants studied in year 1998. The relationship of capacity of cold storage (tonnes) was established with the constructed area (sq.m). The established relationship showed that on an average capacity of cold storage 11 tonnes increased per 100 square meter of constructed area.

5.6 HUMAN RESOURCE

The 21 processing plants provided jobs to 5028 peoples of which 4771 were labours and 257 were technical staff. The seafood processing industry mainly provide jobs to local people. Sparling and Cheney (2014) have also reported that Canadian food processing industry provided jobs to 2,36,000 people. Jeyanthi *et al*. (2015) have also claimed more than 75% of the work force in the seafood processing sector in India was women. This study explored the employment status of women in seafood processing sector in Gujarat, which is one of the largest states in terms of number of seafood processing plants and quantity of seafood exports. Nishchith (2000) have reported that the majority of employee in seafood processing plants were women. The

various relationship between the technical staff and labours with cold storage capacity and constructed area were established and relationship were significant. It clearly indicated that the employment increased with in increase in cold storage capacity and constructed area. The percentage utilization of seafood processing plant recorded in the present study was 14.01, 17.04 and 19.67% for 365, 300 and 260 working days. This clearly indicates that the seafood processing plants are under utilized. The total employment recorded in the present study as 5028 is as per the utilization capacity. If the seafood processing plants functions to it's fullest capacity then employment may increase, but due to non-availability of raw material seafood processing plants are under utilized. If this continues, this will lead to loss of jobs. The installed capacity, percentage utilization and employment in seafood processing plants is given in Table 21. The processing plant with highest installed capacity (75920 tonnes) was utilized least (1.94%) and number of employee was in accordance with installed capacity. The processing plant with least installed capacity was utilized to a extend of 10.79% and number of employee was moderate. The highest utilized processing plant (50.41%) was also with moderate number of employee. The employee maintained by a processing plants were on the basis of installed capacity and percentage capacity utilization, if the capacity utilization decreases ahead, it will be non-affordable to owner to maintain the employment. Therefore, under utilization of processing plant have to be thought sincerely to avoid losses of employment. Nishchith (2000), Sparling and Cheney (2014) and Jeyanthi *et al.* (2015) showed the important of employment in processing industry. Similarly, employment is observed in the present study, but with the background of least utilization, the employment is at risk.

5.7 INSTALLED CAPACITY

Estimated annual installed capacity of processing plants was 5,41,149, 4,44,780 and 4,03,832 tonnes considering 365, 300 and 260 working days

Table 21. Installed capacity, percentage utilization and employment in seafood processing plants

Sr. No	Code of processing plant	Installed capacity	Percentage utilization	Human resource	
				Technical staff	Labours
1	Raigad A	12775	12.93	5	100
2	Raigad B	32704	12.55	10	150
3	Raigad C	18250	36.16	17	700
4	Raigad D	14600	32.05	13	300
5	Raigad E	20805	34.37	2	200
6	Raigad F	29200	4.31	7	126
7	Raigad G	9855	10.79	20	120
8	Raigad H	39420	12.26	20	800
9	Raigad I	16425	18.54	20	250
10	Raigad J	18250	50.41	6	80
11	Raigad K	15330	29.68	4	60
12	Raigad L	36865	13.06	20	130
13	Raigad M	18250	32.93	15	350
14	Raigad N	25185	3.97	11	100
15	Raigad O	75920	1.94	30	300
16	Raigad P	16425	4.01	6	70
17	Raigad Q	22630	2.13	4	60
18	Thane A	29200	10.35	15	100
19	Ratnagiri A	33580	6.49	18	375
20	Ratnagiri B	27740	15.10	11	200
21	Sindhudurg A	27740	13.90	3	200

respectively. The annual installed capacity 94 processing plants as reported by Iyer *et al*. (1982a) considering 250 working days was 1,20,000 tonnes, while the annual installed capacity of 276 fish processing plants as reported by Iyer *et al*. (1982b) considering 250 working days was 4,57,00 tonnes. The installed capacities reported by them were too low as compared to the installed capacities recorded in the present study. The difference recorded in installed capacity may be because the Iyer *et al.* (1982a) and Iyer *et al.* (1982b) have carried out the studies too early in year 1979. Earlier the individual fish processing plant was with too small installed capacity but now a days installed capacities of plants seems increased due to use of advanced technologies and atomization of processing plants.

The processing plants were classified in three groups during the present study based on their installed capacity per day. The first group was below 50 tonnes processing capacity per day, second was between 50-100 tonnes processing capacity per day and the third was above 100 tonnes processing capacity per day. It is interesting to note down that Iyer *et al.* (1982a) stratified plants in the range of less than 5 tonnes to more than 10 tonnes processing capacity per day during 1979 and Unnithan *et al*. (1998) classified plants up to 10 tonnes to 15-30 tonnes processing capacity per day, while it is classified as less than 50 to more than 100 tonnes processing capacity per day in the present study. It clearly indicated that the per day processing capacity has increased almost 5 to 10 fold as compared to the processing capacity claimed by Iyer *et al*. (1982a). The total per day installed capacity of 21 processing plants was estimate at 1482.6 tonnes, while the per day installed capacity of 127 processing plants as claimed by Unnithan *et al*. (1998) was 1581. Per day installed capacity as reported by Unnithan *et al*. (1998) seems to be too low than the per day installed capacity of processing plants recorded in the present study. Maximum number of processing plants were recorded with 50-100 tonnes processing capacity per day during the present study as against Unnithan *et al.* (1998) recorded

maximum number of processing plants in category of up to 10 tonnes per day. This clearly indicated that the capability of processing plants have increased from 10 tonnes per day to 50-100 tonnes per day.

The relationship of total installed capacity considering 365 working capacity was established with capacity of cold storage. The established relationship revealed that on an average installed capacity was 81 tonnes per 10 tonnes of storage place of cold storage. The relationship between installed capacity and constructed area indicated that the processing plants were having annual installed capacity of 268 tonnes per 100 sq. meter of constructed area. The relationship of installed capacity considering 365 working days was established with technical staff. The relationship revealed that the annual installed capacity of processing plant was 1058 tonnes per technical staff. Multiple relationship of installed capacity on capacity of cold storage, constructed area and number of technical staff indicated that the annual installed capacity increased by 1.92 tonnes per tonne of cold storage capacity, annual installed capacity increased by 1.83 tonnes per square meter constructed area and annual installed capacity increased by 489 tonnes per technical staff.

The relationship of installed capacity considering 300 working days was established with cold storage capacity. The established relationship showed that on an average installed capacity was 67 tonnes per 10 tonnes of storage place of cold storage. The relationship of installed capacity considering 300 working days was established with constructed area. The established relationship showed that processing plants were having annual installed capacity of 220 tonnes per 100 square meter of constructed area. The relationship of installed capacity considering 300 working days was established with technical staff. The established relationship showed the annual installed capacity considering 300 working days of processing plant was 869 tonnes per technical staff. Multiple relationship of installed capacity considering 300

working days with cold storage, constructed area and number of technical staff indicated that annual installed capacity increased by 1.58 tonnes per tonne of cold storage, annual installed capacity increased by 1.50 tonnes per square meter constructed area and annual installed capacity increased by 402 tonnes per technical staff.

The relationship of installed capacity considering 260 working days was established with capacity of cold storage. The established relationship showed that on an average installed capacity considering 260 working days was 58 tonnes per 10 tonnes of storage place of cold storage. The relationship of installed capacity considering 260 working days established with constructed area. The relationship between installed capacity considering 260 working days and constructed area indicated that the processing plants were having annual installed capacity of 190 tonnes per 100 square meter of constructed area. The relationship installed capacity considering 260 working days was established with technical staff. The relationship revealed that the annual installed capacity of processing plant was 753 tonnes per technical staff. Multiple relationship of installed capacity with capacity of cold storage, constructed area and number of technical staff indicated that the annual installed capacity increased by 1.37 tonnes per tonne of cold storage capacity, annual installed capacity increased by 1.30 tonnes per square meter constructed area and annual installed capacity increased by 348 tonnes per technical staff.

5.8 UTILIZATION CAPACITY

The total utilization capacity of processing plants was 75819.67 tonnes. Highest production of 11767.93 tonnes was recorded in month of October (31.70%) and lowest production 1573.46 tonnes was recorded in the month of July (3.53%). Unnithan *et al*. (1998) reported maximum production during January to May and minimum during rest of the months in a year. The results of the present study seems

to contradictory for highest producing months as compared to the result of Unnithan *et al*. (1998). Almost 36819 tonnes (24.32%) of seafood was processed during Winter season while 17770 tonnes of the seafood was processed during Sumner season (12.12%) and least was processed during monsoon. The variation observed was due to availability of raw material. The result of the present study can not be compered with the result of the other study as none of the hitherto research report has analysed the production season wise.

The percentage utilization capacity was categorised on the basis of working days of processing plant and are classified as 365, 300 and 260 days. The overall average percentage utilization considering 365 working days was 14.01%, overall average percentage utilization considering 300 working days was 17.04% and average percentage utilization considering 260 working days was 19.07%. Iyer *et al*. (1982a) reported the idle capacity of processing plants in 1978 and 1979 as 69.4 and 64.5% respectively in Tamil Nadu, 77 and 70.1% respectively in Andhra Pradesh and 83.5 and 84.0% respectively in west Bengal and Orissa together considering 250 working days. The average utilization capacity of seafood processing plants as reported by Iyer *et al*. (1983) was 27.7% with 250 working days. The utilization capacity reported by them are high as compared to utilization capacity recorded in the present study. The one of the probable reason may be the availability of raw material was comparatively none during their repertory time than that of period of the present study. Second probable reason may be the installed capacity during their reporting time was too low, as discussed somewhere else, as compared to the installed capacity recorded in the present study.

5.9 COSTS AND EARING ANALYSIS

Costs and earning analysis was performed on the basis of averages estimated from nine processing plants. The average capital cost of plant was 11,38,88,888/-,

while the average variable cost was 44,51,25,553/- and average project cost was 55,90,14,441/-. The major expenditures among the variable costs were on salary of staff, electricity bill, water bill, maintenance cost, cost of raw material etc. The annual average revenue of nine processing plants 1,23,69,17,801/- the net profit calculated for processing plants were 70,18,84,527/-. Jadhav (2006) and Gupta *et al*. (1984) have performed the costs and earing analysis of ice plants, but none of hitherto researcher has performed the costs and earing analysis of seafood processing plants. Therefore, the results of the present study can he compered with other studies.

5.10 CONSTRAINTS

Twenty one seafood processing plants owners/manager were interviewed to understand the constraints faced by seafood processing plants. Percentage analysis was performed of constraints faced by processing plants. The constraints were arranged in descending orders on the basis of percentage. The most faced constraint was less availability of raw material followed by non-availability of labour. In earlier part of discussion, under utilization capacity section it is already observed that the seafood processing plants are under utilized as cent percent processing plant faced a constraints of less availability of raw material. Similar observation are also reported by Iyer *et al*. (1982a & b) as well as Iyer *et al*. (1983) that non-availability of raw material has led to under utilization of seafood processing plants. Unnithan *et al*. (1998) have also claimed low utilization capacity of processing plants due to non-availability of raw material. Geethalakshmi *et al*. (2011) have also reported the major constraints faced by the fish processing plants as non-availability of raw material. It can be concluded from the result of the present study and from the observation of other studies that the seafood processing industry is facing a serious problem of non-availability of raw material.

The present study was carried out to estimate the utilization capacity of seafood processing plants and to know the constraints faced by seafood processing plants in Konkan region of Maharashtra. Total 21 seafood processing plants were observed in the study area of which 17 were observed in Raigad district, two in Ratnagiri, one each in Thane and Sindhudurg district. The seafood processing plants were well furnished with various kind of freezers e.g, Individual Quick Freezing (IQF), blast freezer, plate freezer and tunnel freezer. All processing plants were observed with cold storage facility. Altogether 5028 employees were observed in processing plants of which 257 were technical staff and 4771 were labours. The total annual installed capacity of processing plants was 5,41,149, 4,44,780 and 4,03,832 tonnes for 365, 300 and 260 working days respectively. The total annual utilization capacity of processing plants was 75,819.67 tonnes which was 14.01% with 365 working days. The less availability of raw material was the prime constraint faced by all processing plants due to all plants were observed under utilized.

6.0 SUMMARY

The study was carried out to know the capacity utilization of seafood processing industry and to understand the constraint faced by the seafood processing industry in Konkan region of Maharashtra. The results obtained are summarised.

6.1 GROWTH OF SEAFOOD PROCESSING

Out of 21 processing plants, only one processing plant with 22,630 tonnes annual processing capacity was observed during 1980-85. The plants increased to nine number during 1995-2000 with 2,30,169 tonnes annual processing capacity and it reached to 21 plants during 2015-2018 with 5,41,149 tonnes annual processing capacity.

6.2 DISTRICT-WISE PROCESSING PLANTS

Processing plants were observed only in four maritime districts out of seven maritime district of Konkan region. The maximum 17 plants were observed in Raigad, two in Ratnagiri and One each in Thane and Sindhudurg.

6.3 ASSETS

The minimal land holding of seafood processing plant was 0.1 ha in Raigad, while maximum was 2.5 ha in Sindhudurg. The minimum constructed area of seafood processing plant was 607 sq.m in Raigad and maximum of 13385 sq.m was also observed in Raigad. The regression equation of established relationship between constructed area and total area was $Y = -965.5 + 6466.2 X$.

6.4 FREEZING FACILITY

The four types of freezer were observed in seafood processing plants, such as Individual quick freezing (IQF), plate freezer, blast freezer and tunnel freezer.

Individual quick freezing (IQF) and blast freezer was available in 20 processing plants, while plate freezer was available in 19 processing plants. Tunnel freezer was available in two plants.

6.5 COLD STORAGE CAPACITY

Almost 42.68% of seafood processing plants were with cold storage of 1000-2000 tonnes storage capacity, while 19.05% were with more than 2000 tonnes of storage capacity and rest were with less than 1000 tonnes storage capacity. The regression equation established relationship between cold storage capacity and constructed area was Y = 941.47 +0.1185 X.

6.6 HUMAN RESOURCE

Altogether, 5028 people were working in 21 processing plants of which 4771 were labours and 257 were technical staff. The regression equation of relationship established between technical staff and capacity of cold storage was Y = 6.5247 + 0.0042 X. The regression equation of relationship established between technical staff and constructed area was Y = 7.8554 + 0.0013 X. The regression equation of established relationship between labour and constructed area was Y = 125.05 + 0.0292 X.

6.7 INSTALLED CAPACITY

Total per day installed capacity of 21 processing plants was 1482.6 tonnes. The maximum per day installed capacity of seafood processing plant in Konkan region was 208 tonnes and minimum per day installed capacity was 27 tonnes. Almost 57.14% of processing plants were observed in 50-100 tonnes per day installed capacity group and 14.29% of processing plants were observed in above 100 tonnes per day installed capacity group.

6.7.1 Annual production capacity considering working days

The annual processing capacity of 21 processing plants with all 365 working days was 5,41,149 tonnes, while with 300 working days it was 4,44,780 and with 260 working day 4,03,832 tonnes.

Various relationships were established between variable of processing plants with the total installed capacity considering 365 working days. The regression equation of relationship established between installed capacity and capacity of cold storage was Y = 14704 + 8.1757 X. The regression equation of established relationship between installed capacity and constructed area was Y = 16409 + 2.6792 X. The regression equation of established relationship between installed capacity and technical staff was Y = 12822 + 1058 X.

Various relationships were established between variable of processing plants with the installed capacity was considering 300 working days. The regression equation of established relationship between installed capacity and capacity of cold storage was Y = 12115 + 6.7198 X. The regression equation of established relationship between installed capacity and constructed area was Y = 13487 + 2.2021 X. The regression equation of established relationship between installed capacity and technical staff was Y = 10538 + 869.56 X.

Various relationships were established between variable of processing plants with the installed capacity was considering 260 working days. The regression equation of established relationship between installed capacity and capacity of cold storage was Y = 10499 + 5.8238 X. The regression equation of established relationship between installed capacity and constructed area was Y = 11688 + 1.9085

X. The regression equation of established relationship between installed capacity and technical staff was Y = 9133.2 + 753.62 X.

6.8 UTILIZATION CAPACITY

The total seafood production of 21 processing plants during 2016-17 was 75,819.67 tonnes. Maximum production of 11,767.93 tonnes was observed in October month and minimum production of 1,573 tonnes was observed in July. The highest quantity of seafood was processed in winter season and the lowest quantity of seafood processed in was summer season.

6.8.1 Percentage utilization of plants

The maximum percentage utilization was recorded in August, September and October months and the minimum percentage utilization was recorded in March and July months. Maximum utilization was observed in winter season and minimum utilization was observed in summer season. Average annual percentage utilization was 14.1, 17.04 and 19.67% for 365, 300 and 260 working days respectively.

6.9 COSTS AND EARNING ANALYSIS

The annual average net profit earned by seafood plants was ₹ 70,18,84,527/- with the initial capital investment of ₹ 11,38,88,888/- and variable cost of ₹ 44,51,25,553/-.

6.10 CONSTRAINTS

The non-availability of raw material and non-availability of labour were the two main constraints faced by the seafood processing plants of Konkan region of Maharashtra.

Total 21 seafood processing plants were observed in Konkan region of Maharashtra of which 17 were observed in Raigad district, two in Ratnagiri, one each in Thane and Sindhudurg districts. All the processing plants were well equipped with various kind of freezers and cold storage. Altogether 5028 employees were observed in processing plant of which 257 were technical staff and 4771 were labours. Total installed annual processing capacity of 21 plants was more than 4 lakh tonnes. The annual utilization capacity of processing plants was 75819.67 tonnes, which was 14.01% with 365 working days. It can be concluded that the seafood processing plants are underutilized due to shortage of raw material, which may negatively impact on the employment of human resource in the seafood processing plants.

REFERENCES

Annamalai, V., 1995. Economic of idle capacity an exercise in methods. *Technological advancements in fisheries* (1). : 538-542.

Anon, 2005. Survey of the fish industry in Russia. Ministry for foreign affairs & Ministry of Fisheries, Iceland. Eurofish, 238p.

Anon, 2018. Fish production report, Government of Maharashtra. 2017-2018: 141p.

Ballard, K. and Blomo, V., 1978. Estimating the structure of capacity utilisation in the fishing industry. *Marine fisheries review*, 40 (1): 29-34

Biuksane, I., 2015. Production capacity of fish processing in Latvia. *Research for rural development*, 2 (1): 269-275.

Daivadeenam, P., 2002. Research Methodology in Extension Education., Agrotech Publishing Academy, Udaipur, 463p.

Dewey, D., 1975. *Microeconomics- The analysis of prices in market*. Oxford University Press: 65p.

Geethalakshmi, V., Gopal, N. and Murthy, L. N., 2011. Capacity utilisation in fish processing plant industry – A case study of Gujarat. *Fishery Technology*, 48 (2): 171-174.

Gupta, V. K., George, P. S., Gupta, G. S., Khurana, R., Raghavachari, M., Sreenivas Rao, S., Srivastava, U. K., Reddy, M. D., Singh, A. and Subrahmanyam, B., 1984. *Marine Fish Marketing in India*, Volume IV, Centre for Management in Agriculture, Indian Institute of Management Ahmedabad: 695p.

Iyer, H. K., Srinivasa Rao, P., Unnithan, G. R., Nair, A. K. and Nair, R. G., 1981. Survey on the idle capacity of fish processing (freezing) plant in India – I. west coast. *Fishery Technology*, 18 (1): 109-115

Iyer, H. K., Srinivasa Rao, P., Unnithan, G. R., Nair, A. K. and Nair, R. G., 1982a. Survey on the idle capacity of fish processing (freezing) plant in India – II. East coast. *Fishery Technology*, 19 (1): 9-14

Iyer, H. K., Rao, P. S., Unnithan, G. R., Nair, A. K. K. and Nair, R. G., 1982b. Idle capacity of fish processing (freezing) plants in India a comparative study of plants in East and West coasts. *Harvest and post-harvest technology of fish.*724-729

Iyer, H. K., Srinivasa Rao, P., Unnithan, G. R., Nair, A. K. and Nair, R. G., 1983. Is there any excess capacity in our fish processing (freezing) plant? *Seafood Export Journal,* 15 (2): 5-11.

Jadhav, S. S., 2008. Production of ice and it's extent of utilisation in fishery industry of Ratnagiri. M. F. Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. 54p

Jeyanthi, P., Gopal, N., Murthy, L. N. and Geethalakshmi,V., 2015. Employment status of women in the seafood processing sector of Gujarat. *Fishery Technology*, 52: 135-139.

Kaza, S. Y. and Venkataiah, CH., 2012. Exports of Indian marine products with special reference to reefer container operations: a case study of vctpl. *AMET International journal of management.,*: 38-43.

Kirkley, J. and Squires, D., 1999. Capacity and capacity utilization in fishing industries. *Department of economics, University of California, san diego, 99-16*

Mhazo, N., Mvumi, B. M., Nyakudya, E. and Nazare, R. M., 2012. The status of the agro processing industry in Zimbabwe with particular reference to small and medium scale enterprises. *African journal of agricultural research.* 7(11). : 1607-1622.

MPEDA, 2017. Marine product export directory, Maharashtra. Retrieved from http://mpeda.gov.in/MPEDA/exporter-directory/index.html

Nishchith, V. D., 2000. Role and status of women employed in seafood processing units in India. In Proceeding of the *Global Symposium on Women in Fisheries, Six Asian Fisheries Forum*, 29 November 2001, Taiwan, World Fish Centre, Penang, Malaysia. p.127-135.

Nyoaga, R. B., Wang, M. and Magutu, P. O., 2015. Testing the relationship between constraints management and capacity utilization of tea processing firms: Evidence from Kenya. *Future Business Journal*. 35-50.

Oluwasenu, O. S., 2018. Effect of capacity utilisation on manufacturing firms' production in Nigeria. *Global Journal of Management and Business research: B Economics and Commerce.* 29-38.

Ponnusamy, K., Ambasankar, K., and Ponniah, A. G., 2012. Production and marketing of fish meal in India- a study. *Indian Journal of Fisheries*., 59 (1): 147-149.

Ramachandran, A., 1988., Studies on the production management in the seafood processing industry in Kerala. Ph.D. thesis submitted to The Cochin university of science and technology. 299p.

Salim, S. S., and Aswathy, N., 2010. Constraint analysis on the impediments faced by India seafood exporters. *Export journal* :31-34.

Sparling, D., and Cheney, E., 2014. *The Performance of Canada's Food Manufacturing Industry*, CAPI Processed Food Research Project 3a, The Canadian Agri-Food Policy Institute, Ottawa

Unnithan, G. R., Nair, A. K., Iyer, K. H. and Annamalai, V., 1998. Capacity utilisation in the fish processing plant in Kerala. *Fishery Technology*, 35(2): 120-126.

Zili, L., 2015. Capacity utilisation and productivity analysis in the Canadian food manufacturing industry. M. Sc. Theses, The University of Guelph, Canada. 145p.

Zar, J. H., 2006. Biostatistical analysis, Fourth edition, Pearson Education, Pet. Ltd., Indian Branch, Delhi, 663p.

Annexure I

INTERVIEW SCHEDULE FOR CAPACITY UTILISATION OF SEAFOOD INDUSTRY IN KONKAN REGION OF MAHARASHTRA

INTERVIEW SCHEDULE FOR PROCESSING PLANT

A.		**Sampling Detail**		
	1	Sample code	:	
	2	Sampling day	:	
	3	Date of sampling	:	
	4	Position (latitude & longitude)	:	
B.		**Information of respondent**		
	1	Name	:	
	2	Address	:	
	3	Designation	:	
	4	Age	:	
	5	Gender	:	
	6	Work experience	:	
	7	Education	:	
	8	Mobile No. / Phone No.	:	
	9	Email	:	
C.		**Information of Owner**		
	1	Name	:	
	2	Address	:	
	3	Age	:	
	4	Gender	:	
	5	Experience	:	
	6	Education	:	
	7	Mobile No. / Phone No.	:	
	8	Email	:	
D.		**Processing plant detail**		
	1	Name of processing plant	:	
	2	Address of plant	:	
	3	Year of Establishment	:	
	4	Registration number	:	
	5	Have you borrowed any loan	:	Yes/No
	6	Insurance	:	Yes/No
	7	Installed capacity of plant (tonnes)/per day	:	
	8	Working days in a year 2016-17	:	
		2015-16	:	
		2014-15	:	
	9	Closed day of plants	:	
	10	Working hour of plant/per day	:	
	11	No. of shifts per day	:	

	12	What do you process	:	
	13	Raw material purchase from	:	
	14	Number of staff		
		a) Technical staff	:	
		b) Workers	:	
	15	Where do you sale your product		
		a) Domestic market	:	
		b) International market	:	
	16	Details of plants		
		a) Total land (ha)	:	
		b) Area of processing plant sq. m	:	
		c) Types of freezer	:	
		d) No. of cold storages	:	
		e) Capacity of cold storages	:	
	17	Non-recurring cost		
		a) Land cost	:	
		b) Construction cost	:	
		c) Machinery cost	:	
		d) Cost of company vehicles	:	
	18	Recurring cost		
		a) Salary of staff	:	
		b) Electricity bill	:	
		c) Water bill	:	
		d) Maintenance cost	:	
		e) Cost of raw material	:	
		f) Transportation cost	:	
		g) Chemical/ consumables	:	
		h) Office expenses	:	
		i) Taxes/ insurance	:	
		j) Instalment of loan	:	
		k) Others	:	
E.		**Constraints**		
	1	Less availability of raw material	:	
	2	Availability of labours	:	
	3	Electricity failure	:	
	4	Water supply/quality of supply water	:	
	5	Lack of transportation	:	
	6	Lack of skilled workers	:	
	7	Lack of other inputs	:	
	8	Lack of storage space	:	
	9	Marketing problem	:	
	10	Financial problem	:	
	11	Social problem/ political	:	

Quantity of material processed in processing plant (tonnes)

Name of processing plant: ……..

Processing plant capacity: …….

Sr. No	Month & year	Total production	Working days of plant
1	August 2016		
2	September 2016		
3	October 2016		
4	November 2016		
5	December 2016		
6	January 2017		
7	February 2017		
8	March 2017		
9	April 2017		
10	May 2017		
11	June 2017		
12	July 2017		

Quantity of finished product produced (tonnes)

Name of processing plant: ……

Processing plant capacity: …….

Sr. No	Month & year	Total production	Working days of plant
1	August 2016		
2	September 2016		
3	October 2016		
4	November 2016		
5	December 2016		
6	January 2017		
7	February 2017		
8	March 2017		
9	April 2017		
10	May 2017		
11	June 2017		
12	July 2017		