



## Fishery, production and marketing of mud crab (*Scylla serrata*) of Coringa Mangroves, Kakinada district, Andhra Pradesh, India

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**Abstract :** Mud crab, *S. serrata* is caught by the crab fishers with wide varieties of indigenous devices. The methods and gear depend on the fishing grounds and the time of fishing. The size of the crab caught also depends on the gear used by the fishers. Even though the crab fishery is the livelihood to many fishers no information is available on the fishery, production and marketing. To fill the gap, the present study has taken up to assess the present status of mud crab fishery, craft and gear used in Coringa mangroves, Andhra Pradesh, India. The crab fishing villages in the study area were Pedavalasala, China valasala, Gadimoga, Kothuru, Lakshmipathi puram, Pedda Boddu Venkataya Palem, China Boddu Venkataya Palem, Ramanna palem, Chollangi peta in Tallarevu Mandal. The main landing centers are Chollangipeta, Chinavalasala and Pedavalasala. The use of a particular gear varies from village to village in the study area. The main gear used in the mud crab fishery was the Long Lines, Rods, Rings, Gill nets and Stake Nets. The craft used by the crab fishermen was locally called as "Nava". The long lines, hooks, ring nets were the main crab targeted fishing gear in the study area. 95% of the landings were contributed by these three types of gear. The number of boats engaged for crab fishing was 716. Out of the total 2897 number of gear used for crab fishing, the number of hooks operated were 1939 (67%), lines 536 (18%), rings 195 (7%), stake nets 163 (6%), gill nets 68 (2%). In the total landings, 80-90% comprises small sized crabs of < 200gm, 10 -20% are crabs of size >200gm. In a peak season i.e., October-December in the post monsoon period there are heavy landings @ 15 kg per nava. In a lean season i.e., March- May there is an average of 4 or 5kg crabs per boat. In the intermediary season (wet season/monsoon season) i.e., from July to October average landings are 8 to 10kg per nava. During the study period from Chollangipeta and Chinavalasala landing centres, on an average daily 10 navas and 80 navas from Pedavalasala were operated. A total number of 46,257 kg of mud crabs were exported from the collection points to the Chennai market during the study period. Out of that, Red big variety (>350gm male & > 200gms of female) was 29286kg and Red small variety (>250gm to 340gms male & >150gms to 190gms) was 17071 kg.

**Key words:** Mud crab, Fishery, Coringa mangroves, Gear, Marketing

### Introduction

Fishing is one of the means of survival of the coastal inhabitants. Of late many nations depend on the fishery for exploiting food from the seas with the

modern fishing craft and gear. Small-scale fisheries constitute an important socio-economic component of the Indian Fisheries and provide high quality food generate employment and income to



artisanal communities. Mud crab fishery is a small-scale fishery in the mangrove regions and gained a good share in the export market due to its delicacy and demand. The mud crab, *S. serrata* is much in demand in the domestic market as well as in export markets and commands good price, compared to the other crab species. But in spite of increasing innovations and modern technology in the fishing industry, crab fishery remains in its old traditional form even today. Shanmugam and Bensam (1980) have opined that due to its large size and high quality meat, *S. serrata* has gradually opened up new horizons for its export in the world market. Crabs are extensively fished and marketed in all maritime states of India and abroad (Rao *et al.*, 1973; Angell, 1992; John Samuel *et al.*, 2004).

The mud crabs, *Scylla* spp., represents a valuable component of small-scale coastal fisheries in many countries in tropical and subtropical Asia, for which there has been a general trend of increased exploitation in recent years (Angell, 1992; Keenan, 1999). Commercial exploitation is usually carried out when the crabs are about a year old in the inshore coastal waters. Some adults are caught in the open sea during reproductive migration of female crabs (Sivasubramaniam and Angell, 1992). In recent years, mud crab fishery has been expanding in India because of its high economic value and its potential as an export commodity. The increasing demand for the commodity is indicated by the increasing price in the local and international market. Prasad (1990) has expressed the probability of increase in the production is due to its demand.

*S. serrata* (Forsk.) popularly known as *Manda peeta* in vernacular language appears to be the most

important edible crab species in Andhra Pradesh for food and trade. Mud crabs are mostly found in estuarine and sheltered coastal habitats and in general large populations are usually associated with established mangroves, particularly in estuaries. The mangrove biotope offers mud crab production of about 2t/km<sup>2</sup> (Sivasubramnaiam and Angell, 1992). The Kakinada mangrove area of 237sq kms of the Godavari estuary with its innumerable estuarine creeks and canals, offers a potential resource for lucrative mud crab fishery, indicating the importance of mud crab to small-scale fisher folk for increasing exploitation. A good number of crab fishers of the villages nearer to mangrove area are involved in this flourishing trade to earn their livelihood. Indigenously devised crafts and gears are successfully employed by these local crab fishers to tap the vast resources of crab. These crabs live in the burrows of the mangrove swamps. Crabs take shelter in burrows during the day when tides are low. According to Nandi and Pramanik (1994) the species of the *S. serrata* generally burrow in the mud for concealment during their moulting and mating. During high tides at night they swim around in search of food. Fishermen adopt a peculiar type of fishing method *i.e.*, iron hooks to catch the crab, basing on its mud burrowing habit.

Mud crabs are easily caught in traps or nets and remain alive for considerable periods after capture (Gillespie and Burke, 1992; Wickins and Lee, 2002). Fishing can provide an important source of income to rural communities (Keenan, 1999) and small-scale fisheries exist wherever there are mud crab populations (Le Vay, 2001; Barnes *et al.*, 2002). Exploitation of mud crabs worldwide is increasing constantly



(Le Vay, 2001; Le Vay *et al.*, 2001). In South East Asia where fishing pressure is high, the number and average size of the crabs being caught is declining (Kosuge, 2001) and because the fishery is extremely difficult to manage the decline in landings is expected to continue (Le Vay, 2001). There is a wide seasonal variation in the mud crab fishery. Indeed, a close watch on the exploited stock in major fishing areas is necessary to ensure a sustained yield in future. The species has shown a preference for a crustacean diet in its feeding habits (Hill, 1978). The species is to be a continuous breeder, with peak breeding activity in May-June and October-February in the Kakinada region (CIBA, 2009).

Traditional fisherman community used to exploit the crab for their own consumption in the past because of low price and market demand when compared to the other seafood fish and prawn. Gradually, the mud crab has entered the local markets and gained importance. An organized fishery has been developed only recently with the opening-up of foreign markets. In recent years, the demand for shrimp, lobsters, crab meat and live crab for export has been increasing along with the local marketing. At present, the mud crab fishery in India is not an organized activity, with indiscriminate fishing. Published information is also not available on marketing. The export of live mud crab from India has started in the early and mid 80's (Mohapatra, 2008). The fact that mud crab survive in air for about 4-5 days (under optimum conditions) has enabled their shipment to distant markets. Mahesh Raj (1992) has reported that the crabs stay alive out of water only for a maximum of about 72 hr. Improved handling techniques have also significantly contributed towards the

increase in regional trade. Increasing production through culture and fattening also contribute to a more stable situation.

The increase trend in export market of seafood items has motivated the stake holders to augment fishing efforts for mud crabs. The development of the export market has improved the income of professional crab fishermen in these areas but it is still below acceptable standard. The wholesalers/ middlemen pay advances to crab fishermen and in turn the crab fishers have to sell their catch to the middlemen at the discretion of the middlemen. 95% of the crab fishers are professional fishermen and majority of them from fishing community. The crabs caught by the fishers have been sold to the retailers from them to daily market in the Kakinada town and nearby towns and villages prior to 1980s.

The mud crab trade in India has started in the early 1980's. The export of mud crabs in the study area has been started in the midst of 1980s with the entry of many export companies who export to the South East Asian countries like Singapore, Malaysia, Thailand etc. The demand for mud crabs has been increasing day by day. The entry of export companies of Chennai have been deputing their agents to mud crab landing centres. Gradually change has come in the marketing system. Along with the retailers and local commission agents (Intermediate collectors), agents of the export companies, middle men have come into the scenario of the mud crab marketing. With the increasing demand the price has also been raised, in turn escalated fishing pressure on the resources with increasing crab fishers.

Several researchers have studied the different fishing methods employed in crab fishery, production and the marketing strategies. Rai (1933) has



reported the use of hooked iron rods for crab fishing in Bombay coast. Hora (1935) has elaborated the crab fishing at Uttarbhag of lower Bengal, India while Chopra (1939) has reported some food prawns and crabs of India and their fishery. Fishery and fishing methods for *Neptunus pelagicus* near Mandapam coast have been described by Prasad and Tampi (1951). The crab fishery of Chilka Lake has been reported by Jones and Sujansinghani (1952). Chhapgar (1958) has described the crab fishing at Bombay. Thomas (1971) has recorded the crab fishery in Pulicat Lake. Rao *et al* (1973) have described the crab fishery resources in India. Shanmuganm and Bensam (1980) have reported fishery of the crab *S. serrata* at Tuticorin. Crab Fishery of Pulikat Lake is reported by Srinivasagam and Raman (1985). Mud crab, *S. serrata* is caught by the crab fishers with wide varieties of indigenous devices in the study area. The methods and gear depend on the fishing grounds and the time of fishing. The size of the crab caught also depends on the gear used by the fishers. Even though the crab fishery is the livelihood to many fishers no information is available on the fishery, production and marketing. To fill the gap, the present study has taken up. The objective of this study is to assess the present status of mud crab fishery, craft and gear used.

### Material and methods

The crab fishing villages were Pedavalasala (16° 46' 45.55" N; 82° 15' 47.26" E), China valasala (16° 46' 51.31" N; 82° 15' 34.84" E), Gadimoga (16° 45' 00.33" N; 82° 15' 53.83" E), Kothuru (16° 45' 30.49" N; 82° 17' 18.46" E), Lakshmipathi puram (16° 45' 48.55" N; 82° 16' 19.68" E), Pedda Boddu Venkataya Palem (16° 48' 23.20" N; 82° 14' 52.99" E), China Boddu Venkataya Palem (16° 48' 15.80" N; 82° 14' 57.52"

E), Ramanna palem (16° 48' 11.99" N; 82° 14' 58.02" E), Chollangi peta (16° 54' 35.84" N; 82° 14' 23.69" E) in Tallarevu Mandal, East Godavari District, Andhra Pradesh in the study area and the main landing centers are Chollangipeta, Chinavalasala and Pedavalasala. All these main crab fishing villages and the landing centers were surveyed. The information was collected from the crab fishers of the concerned villages by conducting interviews, group discussions (Semi-structured interviews) and field observations for a period of two years *i.e.*, 2007 and 2008. The different kinds of gears and methods used by the crab fishers were observed throughout the year and at the time of low tide and high tide fishing. The landing centers were visited fortnightly and through the informal interviews with the professional crab fishers to get the information about the number of gears and craft engaged in crab fishery.

Crab fishing in the study area was carried out with simple gear designed and developed by the fishermen themselves. Most often, crab fisheries relied on the adoption of local technologies particularly, in the making of different implements for catching the crabs. There were several types of fishing gear used in collection of crabs. The use of a particular gear varied from village to village in the study area. The craft used in crab fishing area was "Nava" (Fig.1) and the different types of gear used in the study area was the long lines (Fig.2), rings (Fig. 3), gill nets (Fig.4) and rods/hooks (Figs. 5 & 6). Three landing centers were present for the mud crab *S. serrata* fishery in the study area. The production estimates were on the basis of the surveys at three landing centers using structured interviews with the fishers. The crabs caught by different gears were usually



brought to the three landing centers Chollangipeta, Chinavalasala and Pedavalasala (Figs. 7 to 9). Chollangipeta village is about 6 kms away from the Kakinada town and the crabs collected mainly from the Kakinada bay region by the adjacent villagers of this landing centre *i.e.*, from Chollangipeta, Ramannapalem, Kothuru were brought to this landing centre. Chinavalasala landing centre, is about 22 kms far from Kakinada town. The crab catches from Peda Boddu Ventakatayapalem, China Boddu Ventakatayapalem and a portion of Chinavalasala village were brought to Chinavalasala landing centre. These two minor landing centers contribute about 20-30% of the total annual catches. The third landing centre is Pedavalasala village, 25kms away from Kakinada town. It is the main landing centre for mud crab fishery.

The entire villagers of the Pedavalasala village are traditionally depending on this fishery. More than 70% of the catches from the study area lands at Pedavalasala landing centre. It covered the main crab fishing villages like Gadimoga, Pedavalasala, Laxmiphipuram, partly Chinavalasala villages comes to Pedavalasala landing centre. The crab fishers of all these villages did not confine themselves to one particular fishing ground. The fishermen choose any part or any channel of the mangrove region based on the season and availability of the crabs. The landings of crab from the study area were differentiated into four quarters depending on the season - 1<sup>st</sup> quarter (January, February & March), 2<sup>nd</sup> quarter (April, May & June) 3<sup>rd</sup> quarter (July, August & September) and 4<sup>th</sup> quarter (October, November & December). The average catch noticed during the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> quarters of the year 2007 is

10kg, 5kg, 8kg and 15kg/nava/day respectively whereas in the second year *i.e.*, in 2008, the catch was 8kgs, 4kg, 6kgs, and 12kgs respectively in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> quarters. In the total landings, 80- 90% comprises small sized crabs of < 200g, 10 -20% are crabs of size >200g. The production of mud crab fishery in the Coringa mangroves were procured by the survey and the response from fishers, vendors, retailers, middle men, market agents of the three export companies with the help of a questionnaire. The catch procured was categorized into two - Red Big *i.e.*, male with >350g and females with >200g; Red Small *i.e.*, male weighing 250-340g and females with 150-190g (Figs. 10 & 11).

### Results

The results of the study on fishing craft, gear used by the crab fishers were presented. In I year the number of boats engaged for crab fishing was 395, whereas in II year it was 321. In the I year, out of the total 1443 number of gear used for crab fishing, the number of hooks operated were 941 (65%), lines 291 (20%), stake nets 85 (6%), rings 91 (6%), gill nets 35 (3%). In the II year, out of the total 1454 number of gear operated for fishing, the number of hooks, long lines, stake nets, ring nets and gill nets were 998 (69%), 245 (17%), 78 (5%), 100 (7%), 33 (2%) respectively (Fig. 12 a, b & c).

### Quarter wise landings

During the I year, the total landings from three stations were 2,00,640 kg of which the 1<sup>st</sup> quarter accounted for 52,800 kg (26.32%), the 2<sup>nd</sup> quarter about is 26,400 kg (13.16%, the 3<sup>rd</sup> quarter 42,240 kg (21.05%) and the 4<sup>th</sup> quarter accounts about 79,200 kg (39.47%). In the II year, the total landings from three stations was 1,44,000kg of which the contribution of



1<sup>st</sup> quarter period was 38,400 kg (26.67%), the 2<sup>nd</sup> quarter 19,200kg (13.33%), the 3<sup>rd</sup> quarter 28,800kg (20%) and that of the 4<sup>th</sup> one was 57,600kg (40%).

#### **Production at landing centre** (Fig.13)

##### *Chollangipeta*

In the I year, the total landing from Chollangipeta centre was 18,240 kg and the landings in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> quarters were 4,800kg, 2,400kg, 3,840kg and 7,200kg respectively. In the II year, the total landing from Chollangipeta centre was 14,400kg and landings were 3840kg in 1<sup>st</sup> quarter, 1,920 kg in 2<sup>nd</sup>, 2,880kg in 3<sup>rd</sup> and 5,760kg in the 4<sup>th</sup> quarter.

##### *Chinavalasala*

In the I year, the total landing from Chinavalasala centre was 36,480 kg spreading 9,600kg in 1<sup>st</sup>, 4,800kg in 2<sup>nd</sup>, and 7,680kg in 3<sup>rd</sup> and 14,400kg in 4<sup>th</sup> quarter. In the II year, the total landing from Chinavalasala centre was 28,800kg. The landings in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> quarters were 7,680 kg, 3,840 kg, 5,760kg and 11,520 kg respectively.

##### *Pedavalasala*

In the I year, the total landings from Pedavalasala centre was 1,45,920 kg with 38,400kg in the 1<sup>st</sup> quarter, 19,200kg in the 2<sup>nd</sup> quarter, 30,720 kg in the 3<sup>rd</sup> quarter and 57,600kg in the 4<sup>th</sup> quarter. In the II year, the total landing from Pedavalasala centre is 1,00,800kg. The landings in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> quarters are 26,880 kg, 13,440 kg, 20,160 kg and 40,320 kg respectively.

#### **Year wise landings** (Fig.13)

In the I year, the total landings from three stations were 2,00,640kg (200.64 tons) with the leading Pedavalasala landing centre followed by Chinavalasala and Chollangipeta. Similar situation was observed in II year; with the total landings from three stations was

1,44,000 kg (144 tons). The lead contributor was Pedavalasala with 1,00,800 kg (70%) followed by Chinavalasala with 28,800 kg (20%) and Chollangipeta with 14,400 kg (10%).

#### **Marketing and Export** (Fig's 14 & 15)

Export quality mud crabs were procured from three collection points at Kakinada. A total number of 46,257 kg of mud crabs were exported from the collection points to the Chennai market during the study period. Out of that, Red Big variety (>350g male & > 200g of female) was 29,286kg and Red Small variety (>250g to 340g male & >150g to 190g) was 17,071 kg.

During the I year, the total export from three points was 19,601kg out of which the Red Big variety (>350g male & > 200g of female) was 12,729 kg and the Red Small variety (>250g to 340g male & >150g to 190g) was 6,872 kg. In II year, the total export from all the three points was 26,656 kg, out of which the Red Big variety (>350g male & > 200g of female) was 16,557kg and the Red Small variety (>250g to 340g male & >150g to 190g female) was 10,099kg.

#### **Company wise procurement** (Fig's 14 & 15)

*Company -I:* In I year, 6,138kg of crabs were sent to the Chennai market, out of which Red Big was 4,040kg and Red Small was 2,098kg. In the II year, 7,387kg of crabs were sent to the Chennai market, out of which Red Big constitutes 4,691kg and Red Small was 2,696kg.

*Company- II:* During the I year, 5,782kg of crabs were sent to the Chennai market, out of which Red Big constituted 3,792 kg and Red Small was 1,990 kg. In the II year, 9,518 kg of crabs were sent to the Chennai market, out of which Red Big and Red Small constituted 5,428 kg and 4,090 kg respectively.



*Company- III* : In I year, 7,753 kg of crabs were procured for Chennai market, out of which Red Big share was 4969 kg and Red Small was 2,784kg. In the II year, 9,113kg of crabs were sent to the Chennai market, out of which Red Big constituted 5,800 kg and Red Small is 3,313kg.

**Season wise procurement**

During the I year, the total export from all the three export companies' was 19,673kg. Out of which the total exports during the 1<sup>st</sup> quarter landing period both Red Small and Big constituted 3,516kg (17.87%), the 2<sup>nd</sup> quarter it was 1,639kg (8.61%). The 3<sup>rd</sup> & 4<sup>th</sup> quarters constituted 3,185kg (16.19%) and 11,279 kg (58.33%) respectively.

In the II year the total export from all the three export points is 26,018 kg. Out of the total exports both Red Small and Big constituted 8,027kg (30.85%) in the 1<sup>st</sup> quarter, 3,439 kg (13.45%) in the 2<sup>nd</sup>, 3,648 kg (14.02%) in 3<sup>rd</sup> and 10,845 kg (41.68%) in 4<sup>th</sup> quarter.

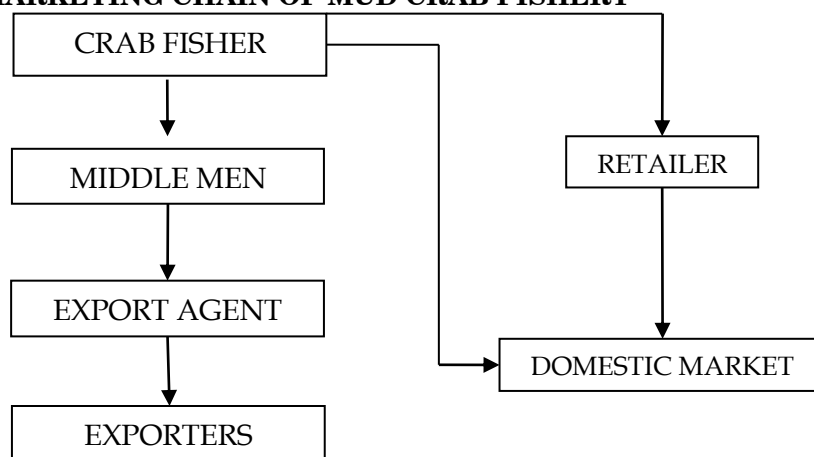
**Marketing**

Red Big and Red Small crabs were only procured by the local agents of the three export companies of the Chennai

market were transported (Fig. 105-107) from the collection points by extending Rs. 40-50/kg to the fishermen by the middle men in I year and Rs 65-90/kg in II year. For Red Small variety the middle man used to get a profit of about Rs. 15 to 25/kg from the commission agent of the local agent of the export company. From the export company based at Chennai the local agent used to get an amount of around Rs. 15/kg to that grade. In Red Big category, the fisherman share was Rs.80-120/kg in both years from the middleman, who used to get a profit of Rs.10-45/kg.

Mud crabs with less than 150g were utilized only in the domestic market at a rate of Rs.30-40/kg and the variety was not all accepted by the middleman or commission agent. The Red Big and Red Small varieties commanded Rs. 85-100/kg and Rs. 40-90/kg respectively in I year and II year. It was found that the market value increased from I year to II year both in the domestic and export market for mud crabs. The marketing chain of the mud crab fishery was given below:

**MARKETING CHAIN OF MUD CRAB FISHERY**





## Discussion

The mud crab fishery in Coringa mangroves mainly includes nine villages that border the Kakinada bay, Coringa and Gaderu channels viz., Gadimoga, Pedavalasala, Lakshmipathipuram, China valasala, China Boddu Venkataya Palem, Peda Boddu Venkataya Palem, Ramanna palem, Kothuru and Chollangipeta. The entire area is rich in mud crab fishery potential. This crab fishery supports a huge number of fishermen community near the vicinity of Coringa mangrove area. Depending on the fishing grounds and the type of tide, indigenously devised craft and gear are successfully employed by the local fishermen to tap the vast resources of mud crab. No scientific technology is involved, the practices developed from the experiences of fishers.

The present study is region-specific and derives importance due to the fact that ideal size of the stock and limited geographical area and the fishing methods are unique and specific which cannot be undertaken by other than the existing crab fishers easily. Mahesh Raj (1992) has noticed that the crab fishing is the main livelihood of the fisherman population of Pedavalasala, Chinavalasala, Gadimoga, Laximpathipuram. The importance of crab fishery for livelihood in these villages has also been observed in the present study in Pedavalasala, Chinavalasala, Gadimoga and Laximpathipuram villages.

Pedavalasala is the major crab fishery village. Majority of the village population eke out their livelihood through crab fishing only. The types of crab fishing differ from village to village and vary with the fishing ground in the study area. Pedavalasala fishers use traditional country craft, *nava* for fishing and the main gear used by these crab

fishers are long lines. Some fishers use hooks also. The crab fishers of Chinavalasala village use hook as the main gear for fishing. Some fishermen go by stake nets and lines. The fishers of Kothuru carryout crab fishing by hooks. Occasionally they use lines and stake nets. The main gear of Gadimoga crab fishery is hook. A few crab fishers of this village do fishing by lines, stake nets and rings. Hooks and stake nets are the main gear for Laxmipathipuram villagers for crab fishing. The fishers of China Boddu Venkataya Palem and Pedda Boddu Venkatayapalem mainly use long lines and hooks. Long lines and rings are the implements for catching crabs by Chollangipeta villagers. Ramannapalem crab fishers go for fishing with rings and gill nets. Some times at low tide the crabs are handpicked in the study area also.

Many of the fishermen of these villages have been employed as manual labour in the nearby industries. In spite of that, it has been observed that the number of crab fishery is increased from 2007 to 2008 from 1350 to 1500. This is mainly due to general population increase and easy fishing methods. In the present study, it is observed that a total number of 395 boats are engaged during the year 2007 for crab fishing whereas in the year 2008, the number of boats engaged have been decreased to 321. The decrease in number from 2007 to 2008 may be attributed to the scarcity of the natural wood for construction of boats due to degradation of mangrove forests by the rapid industrialization and urbanization and also the price hike in the construction of *navas*. The crab fisher may also incur huge amounts for boat repairs also.

The long lines, hooks, ring nets are the main crab targeted fishing gear in the study area. 95% of the landings were





contributed by these three types of gear. The remaining gears namely stake net, gill net, shore seine are ancillary gear contributing to very minute portions, may be as by-catch. The number of lines has shown a decreasing trend from 291 (2007) to 245 (2008). The stake nets used are decreased in number from 85 (2007) to 78 (2008). The number of rings have been increased from 91(2007) to 100 (2008). The number of gill nets used are static around 35 (2007) and 33 (2008). The hooks have been increased in number from 941 (2007) to 998 (2008). The low investment cost for the procurement of these simple types of gear when compared to that of fin fishery is one of the reasons for shifting of majority of fishers towards crab fishery in villages and the capture activity has been carried throughout the year in this study area.

The contribution of craft is only to reach the fishing ground without much effort and to cover the distant fishing areas. In crab fishing, both the craft and gear plays an important role in the landings. Mud crab fishing with lines requires good craftsmanship and experience. In the present study, it is noticed that the number of traditional crab fishers involved in line fishing has decreased gradually as the younger generation is opting to operate easy fishing gear such as single hook with two lines (without craft). Lalitha Devi (1985) has reported that line fishing exclusively for crabs are carried out in the backwaters of Kakinada bay during November to March. The line (coir rope) has been laid out with dried fish as baits, up to about 10 times a day each time catching 15-20 crabs. Boats with two men working on each, landed on an average about 150 crabs per trip. Mahesh Raj (1992) has observed that about 100 *navas* are involved in the crab

fishing at Pedavalasala with long line as the main gear. In the present study the number of *navas* doubled in Pedavalasala landing centre showing a pressure on the resources.

Thomas (1971) has described line fishing method in Pulicat Lake with 250 mts long coir rope with loops at interval of 1 m with rays, sharks, catfish and eels as baits. Khan and Alam (1992) have reported that a gear (bamboo trap) “boom” is baited with shark, skate, ray, eel or low priced (trash) fish is operated at low tide and lifted during the succeeding low tide after a soaking time of 5-6 hours. Kador Ahmed (1992) has also reported the use of rope lines of about 100-200 m with bricks as sinkers, eel or green mussel as baits. Mahapatra *et al* (1996) have reported the equal kind of long line *Harr suthi*, for trapping *S. serrata* in Sundarbans, whose length varies from 275 to 686 m made up of strong nylon material with sinkers. Azam *et al* (1998) have found that the crab fishermen of Sundarbans used bamboo trap or “boom/chai/tonga”; rope line or “don” (rope with stick, angling with hook); long metal hook and nets. Zafar and Ahsan (2010) have reported that most (245) of the crab collectors in Bangladesh used bait stick for crab collection whereas 173, 109, 291, 75, 11 and 88 numbers of crab fishermen used scoop net, don, rope line, boom, hook and other gears respectively. They have also reported that live frog, eel and tilapia have been used as baits for crab harvesting. The major bait is dry bay sharks advantage of its tough skin cannot easily be cut by the crab. In the present study, it is observed that coir rope is being used as it gains weight by absorbing of water to sink the line to the bottom of the fishing ground and no sinkers are used. The crab fishers of this



area use dried eels as baits. This may be due to the increased economic importance of sharks than eels, low cost and more availability of eels throughout the year than the sharks.

Jayamanne (1992) has reported the use of baited trap to catch crabs in Sri Lanka. This is similar to the ring nets of Ramannapalem crab fishers in the present study area. Among the indigenous gear used for crab fishing, the bottom set gillnets contribute significantly and their operation is restricted to shallow grounds with minor modifications upto 15m depth (Josileen and Menon, 2007). Similar method of operation of gill nets by the villagers of Ramannapalem has been observed where they mainly operate in shallow bay region. The crab fishers use one or more gear to catch the crabs and fish about 14-20 days in each month and catch about 5 kg-12 kg per day depending on season. Information from the fishers reveals that there has been a reduction in catch per unit effort for the last 5 or 6 years. This can be attributed to increased number of fishers and the canals that have been dug in the mangroves by Forest Department aimed at mangrove rehabilitation, but the fishers feels that the aim is posed destruction of the crabs' nursery areas.

The mud crabs, *Scylla* spp., represent a valuable component of small scale coastal fisheries in many countries in tropical and subtropical Asia and there has been a general trend of increased exploitation in recent years (Angell, 1992; Keenan, 1999). In the present study, a raise in the exploitation of crab fishery has been observed with the concurrent increase in the crab fishers and fishing units. Sivasubramniam and Angell (1992) indicated the production capacity of crabs in mangrove biotope as 2t/km<sup>2</sup>. As a result of high fishing pressure, the

average size of mud crab caught in Southeast Asian countries appears to be decreasing (Macintosh, 1982; Harvey, 1990; Overton, 1997). This is also true from the observations of the present study where the average size of the export crab has decreased from 2007 to 2008.

Mahesh Raj (1992) has reported 300 kg of landings each day from Pedavalasala landing centre, mostly comprising of small crabs in normal fishing days and 500-600kg of landings in peak season from this area. Lalitha Devi (1985) has reported 169.66t of *S. serrata* landings from Kakinada region contribute to 22.19% of total crab landings. Back waters accounted for the major portion (78.80%) the size classes ranged from 15mm to 139mm. Babu (2005) has reported that there is an increased landing of red mud crab. There was a setback after December 2004 Tsunami, resulting in a significant fall in crab landings along the Kakinada coast. It has been reported that coastal habitats and environment have been altered in various degrees due to the effect of Tsunami. Padmavathi (2007) has reported a total landing of 191 tonnes from April 2005 to March 2006 and 145 tonnes from April 2006 to March 2007 of all size classes of mud crabs from the landing station of Pedavalasa.

In the present study, it was observed that out of the total landings of 200.70 tonnes in the year 2007, the crab landings of Pedavalasala are 146 tonnes, followed by Chinavalasala and Chollangipeta which contributed 36.5 tonnes and 18.2 tonnes respectively. In the year 2008, out of the total landings of 144.20 tonnes, the crab landings of Pedavalasala are 101 tonnes, followed by Chinavalasala and Chollangipeta which contributed 28.80 tonnes and 14.40



tonnes respectively. The decrease in landings of the crabs at these three centres may be due to decreased number of boats and increased fishing pressure on the resource as well as habitat destruction due to rapid industrialisation in the study area. The fishermen population has been growing, but the crab fishery resources in the study area are dwindling rapidly due to escalating fishing pressure.

The production during the study period from the three stations indicates that crab resources are under threat as there is an increase in the collection of smaller sized crabs. Despite the benefit of economic value, the crab fishery is under threat and getting degraded due to pressure from over-fishing, industrialisation, degradation of distributaries of the estuary, siltation of the feeder canals. The preference for ovigerous female crab and the high price they command, as compared to immature females and males in countries like Malaysia, Singapore, Thailand and Indonesia is of serious concern due to its implications for recruitment to natural populations (Macintosh, 1982).

The discharged effluents from the shrimp farms also cause serious threat to crab population. So increase in pollution around mangrove ecosystem by manmade chemicals due to aquaculture practices is now adding pressure on crab population (Subramanian, 2000). A vast mangrove area is converted into shrimp ponds, discharging untreated water into the ecosystem causing severe adverse conditions throughout the year. It may also be a cause for the depletion in the production level indirectly. Hence conservation of mangrove crabs is of paramount importance. In a peak season *i.e.*, October-December in the post monsoon period there are heavy landings

@ 15 kg per *nava*. In a lean season *i.e.*, March- May there is an average of 4 or 5kg crabs per boat. In the intermediary season (wet season/monsoon season) *i.e.*, from July to October average landings are 8 to 10kg per *nava*. During the study period from Chollangipeta and Chinavalasala landing centres, on an average daily 10 *navas* and 80 *navas* from Pedavalasala were being operated. As the average number and size of crabs caught is decreased due to the over exploitation and environment degradation, the number of boats for crab fishing is decreased from year 2007 to 2008.

The Marketing Grades of Mud Crab, *S. serrata* for export in Kakinada are as follows: Gade- I: Red Big (RB) Male >350g and Female >200g. Grade-II: Red Small (RS) Male > 250 to 340gm and Female >150 to 190g. In the domestic market, mixed sizes of less than 150 g are sold. Similar type of grading in mud crab fishery, based on the quality and sex was noticed by Faud Choli and Adi Hanafi (1992) in Jakarta and in Chilaka lake (Mahapatra *et al.*, 2008). Tongdee (2001) has observed 3 different categories small (<100g), medium (100to 170g) and large crabs (>170g). Zafar (2010) has also reported different grades for males and females. Five grades for male crabs XXL(500g+), XL(400g+),L(300g+), M(250g+) and SM (200g+) and four grades for females F1(200g+ to180g+), F2(150g+), F3(120g+) and KS-1(180g+), KS-2(150g+), KS-3(120g+) both sexes in descending order of weight of the crab.

Mud crab marketing was considered as a profitable and feasible business by most of the marketing operators (Ferdoushi *et al.*, 2010) and is the main reason for the gradual entry of several intermediaries / middle men in the marketing field. The marketing



system of mud crab *S. serrata* of the study area involves three intermediaries crab fishers, middlemen and export agent/commission agent at the gross root level. Zafar (2010) has also reported the corresponding involvement of intermediaries in the marketing system of mud crab in Bangladesh. Most of the small sized mud crabs, are sold locally in the domestic market. These crabs are with low meat content weigh less than 250 g in male and females with less than 150g. These crabs are consumed locally in households, hotels and restaurants being procured through intermediate vendors. Of late, there is very little availability of large, meaty crab in the local market owing to high prices offered by exporters. In the domestic market channel, the retailers are of two types: some collect a limited quantity of about 10-20 kg daily from the landing centre and sells in the local market of Kakinada. Mostly the fisherwomen of the near-by villages are of this kind. The second type of retailers collects the crabs directly from landing centres from crab fishers in huge quantity of about 50 to 200 kg, weekly or twice in week and takes the material to the distant town markets by buses, auto rickshaws, particularly during shandies. Nearly 100 members from the crab fishing villages are engaged as retailers of the crab fishery from all the three landing centres. The marketing pattern is same in all the three landing centres.

The middle men daily collect the large sized crabs meant for export from the crab fishers directly from the landing centre itself. At the Pedavalasala landing centre, 6 to 10 middlemen, operate daily whereas two members each at Chinavalasala and Chollangi landing centre perform the same. As some of the middlemen are the crab fishers, they can easily identify the fully/partially berried

female crabs based on the carapace coloration abdomen bulging etc. They can identify the soft crabs also. The middlemen give loan to the crab fishers to a tune of Rs. 2000 to 5,000/- and mortgage the catch. The amount offered as loan depends on the skill of individual operator. Indubitably the crab fishers have to give their catch to these middle men. This type of arrangement enables them to recover the loan from their sale proceeds. Mohapatra (2008) has also observed the similar money lending system to the crab fishermen of Chilika Lake. In the lean season when the crab fishers find no way to earn then taking loan from the local middle men (*aratdar*) in a condition that they sell their entire catch to the middle men at a pre-fixed price was also noticed by Zafar and Ahsan (2010) in Bangladesh mud crab marketing system. The intervention of the middle men in the marketing is one of the reasons for not getting actual market price by the crab fishers. Generally the rates varied from Rs.20/- to Rs.30/- to a pair of red small grade crabs, and Rs. 35/- to Rs. 50/- to a pair of red big grade crabs. The crab fishers, who do not have any loans, directly sell the catch to the retailers or to the middlemen who offers maximum price in the open market at the landing centre.

The middlemen collects the exports sized crabs from the fishers each day up to 2 pm and send them in gunny bags or the plastic bags to the export collection points at Kakinada. The agents weigh the crabs and settle the amount daily or monthly to the middlemen basing on that particular day's market rate. The market price fluctuates basing on the export demand. The commission agents and export agents meet twice/thrice a week and fix the rate on export demand market. If any export company at



Chennai has great demand, that company's agent at the collection point raises the cost of Rs. 5 to 10/- per kg and procures the entire catch. The middle men also sometimes take loan from these export agents. In such cases the middle men inevitably sell the collection to the export agent to a less rate Rs.5/- per kg. One root cause of increase in landings of export sized mud crabs from 2007 to 2008 is the increased exploitation of crab from burrows by hook fishing. This is clearly indicated with the increase in the number of hooks by 941 to 998 from 2007 to 2008. It has made them to catch generally bigger sized and pre mating crabs in burrows. Selection of gear plays an important role in the fishing of mud crab resources. It may raise the landings temporarily, but there will be depletion of catch by size and quantity in the long run. According to Tongdee (2001) the entry of collapsible traps which can capture mud crabs of all size classes in Ranong province of Thailand has resisted over and indiscriminate exploitation of mud crab population.

Local marketers and exporters of live crabs have observed significant fluctuations in the market price of mud crab due to seasonal variations in the landings and on the festive days in the exported countries. The spurt in the demand for export variety crabs has increased the price of the crabs. This coincides with the increase in the rate of mud crab during the months of January and February, in which the rate of red big fetched Rs. 130 to 140/- in 2007 and Rs. 165/- in 2008. The price of mud crabs was found to vary with season as well as international market demand. The mud crab price and demand was higher in winter season (Zafar and Ahsan, 2010) when the catch was minimum.

The crabs are being packed and transported in light weight; two different sized bamboo baskets can accommodate 12 to 18 kgs of crabs for export. Zafar and Ahsan (2010) have also reported the main use of bamboo made baskets, besides jute bags, plastic buckets and small nets for transportation of crab. As dehydration has a significant effect on survival, handling conditions after catching should be such that the crabs are not subject to wind drying or direct sunlight. Hence before being transported to their destination, they sprinkle water on the baskets. Mohapatra (2008) has observed the use of common weed (*Patamogeton sp.*) in packing the live crabs in bamboo baskets (about 10 kg of crabs/ basket) in order to keep them moist during transport. The transportation charges and the cost of bamboo basket will be borne by the exporters of the Chennai market. In Kakinada, about three companies are exporting crabs to Chennai market throughout the year. In peak landing seasons on an average 20 to 30 baskets are being exported from Kakinada daily. In lean seasons 8 to 10 baskets are being marketed daily.

In the present study seasonal variation in the landings and exports has been observed. Peak landings have been observed at all three centres during the fourth quarter in the year 2007 and 2008. All three companies exported about 50% of total export of crabs in the 4<sup>th</sup> quarter. This also coincides with the observations made in the chapter II where the population density is high in the fourth quarter. The total landings from the study area of Coringa mangroves during the year 2007 is 2,00,640 kg which was valued (@ rate of 50/- per Kg crab) Rs. 1,00,32,000/-. During the year 2008, it is 1,44,000 kg which was valued (@ rate of 70/- per Kg crab) Rs. 1,00,80,000/-. The



per capita income of each crab fisher taking an average number of 1000 crab fisher is Rs.10,032/- during 2007 and Rs.10,080/- during 2008. A total value of Rs. 44,79,445/- export variety (Red Big and Red Small) mud crab *S. serrata* has been exported in two years of the study period. The value of Red Big and Red Small variety exported from Kakinada market to Chennai during 2007 is Rs. 18,54,195/- whereas during the year 2008 it is Rs.26,25,250/-.

From this study, it is evident that there is an alarming situation in the mud crab fishery as there is an increasing trend in the larger sized crabs as well as quantitative increase in the smaller sized crabs. Since more numbers of ovigerous crabs are caught, it will have a deleterious effect on the recruitment in the fishery. The increased catch of small sized crabs is a clear indication of overfishing in the area. This is a precarious situation will have an adverse impact on trade as well as fishery in future. There is an urgent need to formulate certain management strategies to streamline the mud crab fishery.

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**Fig. 1 Craft “Nava”**



**Fig.2 Long lines with baits**



**Fig. 3 Ring nets**



**Fig. 4 Gill net**



**Fig.5 Hooks**



**Fig. 6 Hook fishing in operation**



**Fig. 7 Landing centre - Pedavalasala**



**Fig. 8 Landing centre - Chollangipeta**



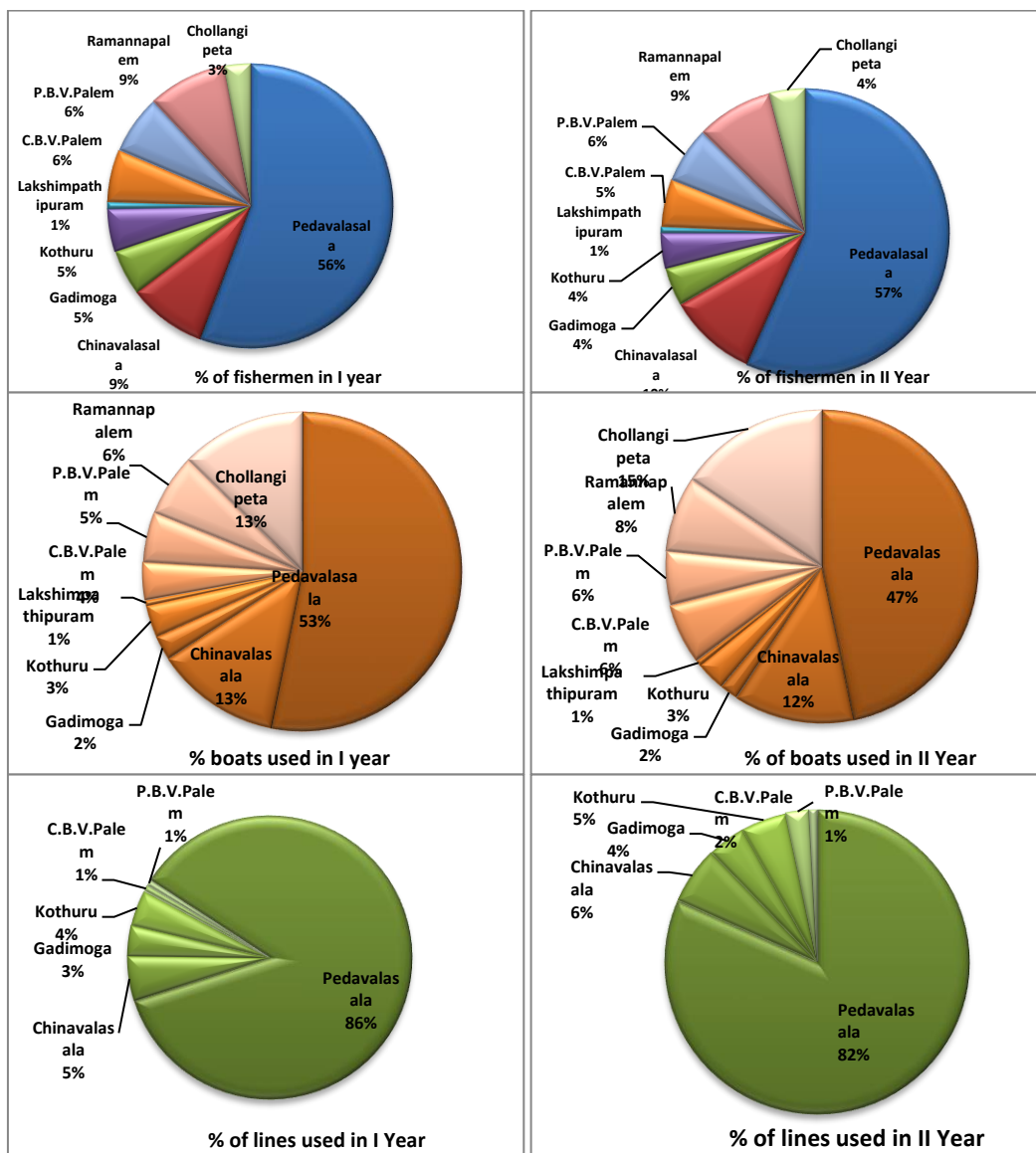
**Fig. 9 Landing centre - Chinavalasala**



**Fig. 10 Smaller mud crabs for domestic use**

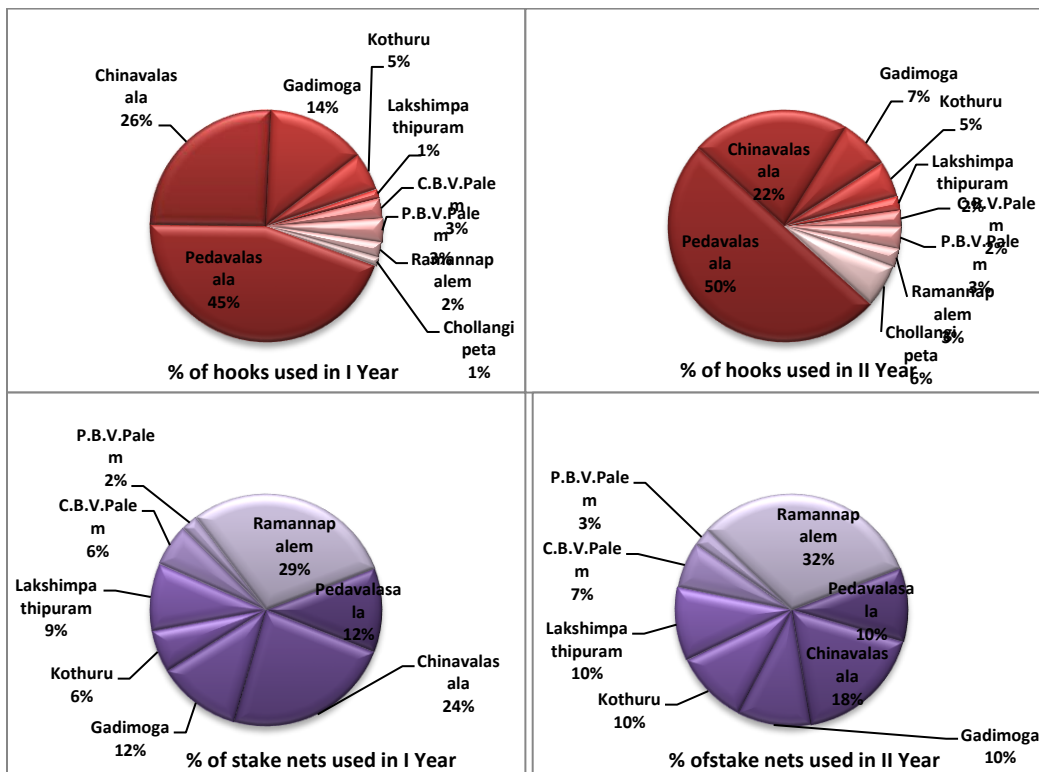


**Fig. 11 Large mud crabs for export**



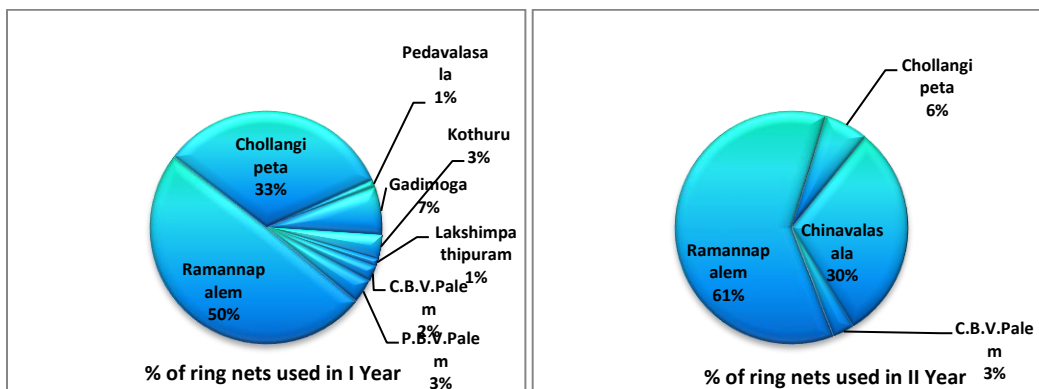
P.B.V. Palem: Peda Boddu Venkatayapalem, C.B.V. Palem: China Boddu Venkatayapalem.

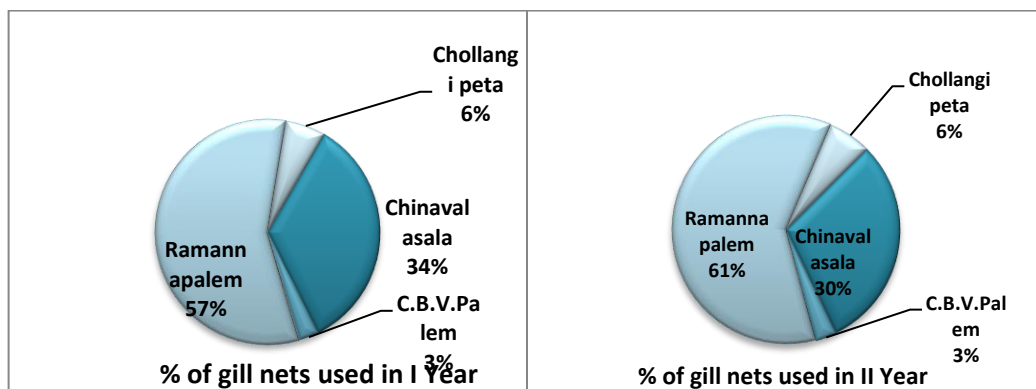
**Fig. 12(a) Mud crab fishing activity in different villages during the study period.**



P.B.V. Palem: Peda Boddu Venkatayapalem, C.B.V. Palem: China Boddu Venkatayapalem.

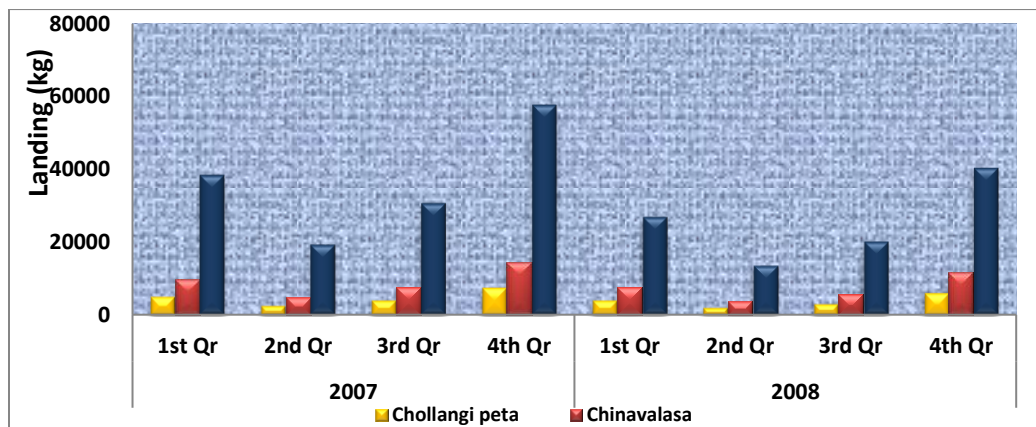
**Fig. 12(b) Mud crab fishing activity in different villages during the study period.**



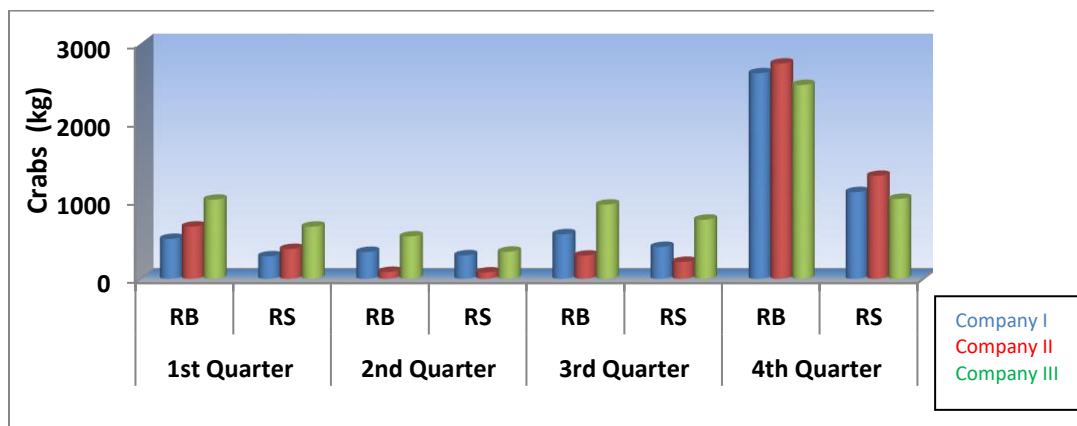


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**Fig. 12(c) Mud crab fishing activity in different villages during the study period.**

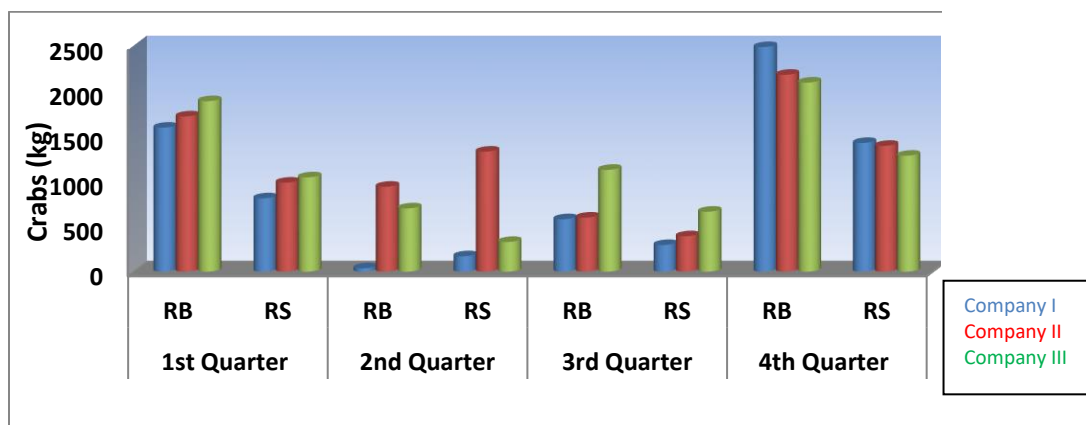


**Fig. 13 Mud crab *S. serrata* landings at three centers of Coringa mangroves during the study period.**



RB : Red Big, RS : Red Small

**Fig. 14 Procurement of mud crab *S. serrata* from Coringa mangroves by three companies in I Year of study period.**



RB : Red Big, RS : Red Small

**Fig. 15 Procurement of mud crab *S. serrata* from Coringa mangroves by the three companies in II year of study period.**