Mapping of Shrimp Fishing Areas in Cilacap District in Central Java Province

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Abstract

Cilacap still be one of the centers of fisheries in Indonesia at this time. One of its main commodities are shrimp. Shrimp fishing activities in Cilacap waters is conducted using trammel net (three layered nets). This study aims to draw up a map of the location of *Penaeidae* spp shrimp fishing areas in Cilacap waters area using a trammel net. Type of shrimp as a target is catching banana prawn, endeavour prawn, tiger prawn, and tiger cat shrimp. Method of preparation of a map the location of shrimp fishing areas is to use Geographic Information Systems (GIS) and spatial analysis technique is a technique used in studies analysing spatial. Preparation of shrimp fishing area location map using ArcGIS Geographic Information System Software. Shrimp fishing area mapping is useful to know the position or where shrimp is the target of fishing operations. By knowing the shrimp fishing areas, then the fishermen will easily find the point where shrimp congregate. This will cause the shrimp fishing operations become more effective and efficient because shrimp fishing vessels can go directly to shrimp fishing area. Some of the efficiencies that can be obtained by fishermen is the cost of fuel efficiency, the efficiency of material consumption must be issued at any time the arrest operation and efficiency of the operation time of arrest.

Keywords: Cilacap, Shrimp, trammel net, shrimp fishing area map

INTRODUCTION

Cilacap still be one of the centers of fisheries in Indonesia at this time. One of the main commodities are shrimp. Cilacap district has great shrimp resources, and this day remains a shrimp commodities centers in Indonesia. Shrimp fishing activities conducted in the waters Cilacap using trammel net fishing gear (net three layers). Local name in Cilacap trammel net is a ciker net. The fishing gear is quite productive, environmentally friendly and legally classified. Majority of trammel net catch in Cilacap is classified as *Penaidae* spp. *Penaidae* spp resources in Cilacap waters area are banana prawn (*Penaeus merguensis*), endeavour prawn (*Metapenaeus endevouri* and *Metapenaeus ensis*), jumbo tiger prawn (*Penaeus monodon*). Besides *Penaidae* spp, trammel net also catch tiger cat shrimp (*Parapenaeopsis sculptitis*). So it can be said that banana prawn, endeavour prawn, jumbo tiger prawn, and tiger cat shrimp are the majority of trammel net catches in Cilacap.

Fishing areas (including shrimp) or fishing ground is an area of water that is used as the activity of fishing operations. It begins with the allegations that there are cluster of fish in the fishing grounds. It is difficult to predict the direction and location of the fish migration in one fishing area, because the fish is the purpose of fishing effort in the water, and not visible from the surface of the water while the human eye's ability to see into the water is limited. The types of fish that live in the waters is also very diverse and occupy the fishing ground is different, so in an effort to arrests has many variations both in the form of fishing gear, fishing methods, as well as the organizational structure of its business **[1]**.

Fishing area is an area of water where fish as target catch can be caught in the maximum amount that can be operated and fishing gear as well as economical. A marine waters can be described as "fishing areas" where there is interaction between fish resources targeted fishing catching up with technology that is used to catch fish. If there are fish resources in an area of waters but fishing gear cannot be operated due to various factors, such as weather conditions, then that area cannot be said to be a fishing area as well as if the opposite occurs.

Determination of fishing areas must meet various requirements/criteria. One of these criteria is the biophysical characteristics and aquatic ecology. This biophysical characteristic will affect the composition of water organic compounds, nutrient movement, behaviour and migration of fish, abundance of fish, etc. In addition to the requirements that must be fulfilled in the determination of fishing areas, namely: a) there are a lot of fish throughout the year in that area; b) fishing gear can be operated easily without any obstacles; c) located not far from the fish landing ports or can be reached easily by fishing vessel; d) the area is safe from the sea events (such as the strong storm winds, etc.); and e) not forbidden by local laws and regulations are applicable.

Coastal waters area as fishing ground is influenced by many aspects of oceanography such as the seasons, currents, temperature, salinity and etc. The main causes of fish gathered in an area waters, namely: a) the fish has a water suitable for life; b) looking for food; c) looking for a place suitable for nurseries or for the growth of larvae.

This study aims to draw up a map of the location of *Penaeidae* spp shrimp fishing areas in Cilacap district waters area using trammel net. Types of shrimp as a target catch are banana prawn, endeavour prawn, jumbo tiger

prawn, and tiger cat shrimp.

The benefits of shrimp fishing area location map is know the position or where shrimp is the target of fishing operations. By knowing the shrimp fishing areas, then the fishermen will easily find the point where shrimp congregate around the water without having to look for the hordes of shrimp. Some of the efficiencies that can be obtained by fishermen are the efficiency of fuel costs, and consumption of materials to be issued at any time the arrest operation and efficiency of the operation time of arrest. With the arrest of an efficient operation it is expected that the catch can be maximal.

METHODS

Method of preparation of a map the location of shrimp fishing area is to use Geographic Information Systems (GIS) and spatial analysis technique is a technique used in studies analyzing spatial of shrimp fishing area location map using ArcGIS (Geographic Information System Software).

The data were collected from surveys and literature. The survey was conducted with some respondents using purposive sampling method. Respondents are shrimp fishermen that use ciker net (trammel net). Others respondents are Syahbandar that the harbour master at the Tanjung Intan Cilacap General port and the harbour master at Cilacap Ocean Fishing Port. Respondents Syahbandar well as to assist in the preparation of a map of the location of shrimp fishing area.

Penaeidae spp Shrimp Habitat

More shrimps are caught in shallow waters, especially in the estuaries. This is because estuaries are a meeting point of river and sea water which caused it rich in food. In addition, water bay with a big river basin is also a potential shrimp area. Banana prawn as main catches lives in the bottom of waters and there was almost total in the waters of Indonesia, especially in areas where large river flows into the sea **[2]**.

Penaeidae spp is a decapod that releases its eggs to the demersal sea right after fertilization, whereas other types of decapods carry the eggs until they hatch into larvae. Life cycle of *penaeid* shrimp is divided into two phases, namely oceans phase and estuaries phase. Female shrimp spawn in the open shore. The eggs then will hatch into *nauplius* after 24 hours. Furthermore, after 3-8 times of moulting, it will turn into *protozoea, mysis* and post-larvae. Post-larvae is a level where it has been reached nursery area on the beach and started to move to seabed. Larvae moves from spawning areas in the ocean into bays and estuaries. It then turns into juvenile, feeding and growing in the nursery area for 3-4 months and turns into young shrimp, set out to sea and turns into adult shrimp, mating with females then spawning. Juveniles are found in estuaries and are usually on mangrove waters. Shrimp migration is known as inshore-offshore migration namely from shore to sea and vice versa, along the coast and vertically in the water column, and after hatching, the larvae shrimp moves passively from spawning areas towards the coast and estuaries, and then leaves estuary and enters deeper coastal waters area in the phase of juvenile **[3]**.

Banana prawn is divided into two phases; 1) phase of the sea and 2) phase of estuaries (Figure 1) with the following stages **[4]**:

1) Banana prawn spawns and hatches into larvae in the sea.

   Banana prawn eggs will hatch into *nauplius* stage larvae according to Teng (1971) in Dall et al. (1990) **[5]** in a time of 0.48 days and according to Raje and Ranade (1972) in Dall et al. (1990) **[5]** in a time of 0.88 days and according to Motoh and Buri (1979) in Dall et al. (1990) **[5]** in less than 1 day.

2) The larvae then grows into post larvae and move into the estuary of the river.

   The growth of penaeid shrimp larvae consists of several stages starting from *nauplius* to *protozoea* and grows into a *mysis* and then into post larvae **[4]**. According to Garcia and Le Reste (1981) in Naamin (1984) **[6]**, the time required for growth of the *nauplius* into post larvae is about 3 weeks, according to Raje and Ranade (1972) in Dall et al. (1990) **[5]** it will takes about 13.88 days and according Motoh and Buri (1979) in Dall et al. (1990) **[5]** it will takes about 9.24 days.

3) *Post larvae* turns into juvenile and moves back into the sea.

   According to Garcia and Le Reste (1981) in Naamin (1984) **[6]**, shrimp grow from the stage of post larvae into juvenile stage in estuary and takes approximately 3 months and then just started to leave the estuaries and enter coastal waters as young shrimp (juvenile) and then migrate to the sea.

4) The juvenile shrimp grows into adult shrimp and bear its mature eggs and then spawn in the sea.

   The young shrimp (juvenile) will migrate to deeper waters, mature, mating and spawning. The time required for the shrimp to be an adult/parent is around 8-20 months **[5]**.

Briefly growth of shrimp life cycles are eggs, *nauplius, protozoea, mysis*, post larvae, juvenile, young shrimp (juvenile), and adult shrimp. The cycle from eggs to adult shrimp takes 1 to 2 years long.
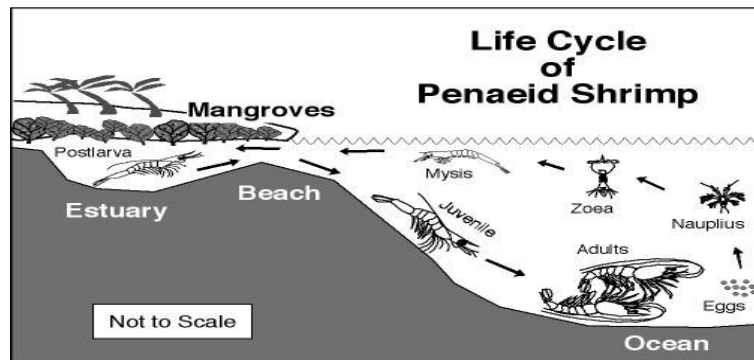
Figure 1 *Penaeid* life cycle [7]

Penaeid shrimp habitat and biology, benthic lives in various types of environments on the ocean floor like a stone, mud, sand etc. On *Penaeus* species, the spawning process takes place in offshore, at a depth of between 10 and 80 m. Female sperm sac is at *thelycum* (genitals located on the back of the leg) that is used when the whole egg. After fertilization, the eggs will hatch within a few hours. Planktonic larvae, with a size of 6 to 14 mm, will be carried by currents to the coast for about 3 weeks. Progress towards adults will take place in the brackish water, river mouths, lakes, mangrove areas and ends with the offshore migration for spawning back [8].

Penaeid spp shrimp is a type of heterosexual shrimp. Gender can be differentiated from the outside after the last completed level of post-larvae. Male *petasma* genitalia is located between the first pair of swimming legs, while the female genitalia *thelycum* is located between the fourth and fifth pairs of walking feet. Adult shrimp showed a clear difference in the size of age, since prawns shrimp females is larger than males of the same age. *Penaeid* shrimp does not have a particular sexual partner (*promiscuos*). Fertilization occurs outside, female shrimp needs to be in a state of soft skin, while male shrimp skin must be in a hard state to stick (impregnation) sperm pouch (*spermatophores*). The number of eggs released by a shrimp is estimated to be 100,000 eggs at each spawning [9].

Trammel Net (Ciker Net)

Ciker nets or trammel net is a fishing gear to catch shrimp with three layers of nets with rectangular shape. The gear specification is 1.20 metre width and 35 metre height, this gear usually consists of 6 pieces. Two outer nets are located on the left and right side with 5 inch mesh size made of nylon monofilament, while inner net (middle net) has a mesh of 1.5 inch.

The operation of trammel net in Cilacap implemented by way of semi-circle. Operation can be done using a motor boat (inboard engine) or external motor boat (outboard engine). One unit of trammel net fishermen operated by 5-8 people. Trammel net operations carried out in the bottom waters with nets wrapped up in a semicircle.Then pulled into the boat and shrim/fish caught are released.

Geographic Information Systems (GIS)

Geographic Information Systems (GIS) is a computer system that has the ability to entry, retrieval, data analysis and display of geographic data that is extremely useful for decision making. Geographic Information System is designed to efficiently enter, store, update, manipulate, analyse and present all types of geographically-oriented information [10].

Map is a picture of the appearance of the earth on a flat surface using the scale. The map is a picture of the earth minimized appearance of the actual reality and described in the form of symbols. Maps can be used to describe the environmental conditions of a place. Map is also used to obtain the extent of an area (region) for example: forests area.

The map will have higher utilization rates when the map is then converted into a Geographic Information System (GIS). With GIS, the map is not only understood as a two-dimensional picture, but maps can be maximized as a tool for coordination, synchronization, and integration development between sectors, institutions, and stakeholders.

The data entry into a geographic information system is done by digitization and tabulation. Data management covering all storage operations, activation, back storage, and printing all the data obtained from the input data. Manipulation process and analysis of spatial interpolation of data from non-spatial data into spatial data, the data relate to the tabular raster data, overlaying maps that include folder crossing, overlaying with the aid of two-dimensional matrix or table, and map calculation. The main output of geographic information system is new spatial information that can be presented in two forms namely; stored in raster format and printed into hardcopy, so it can be used operationally.

The structure of spatial data in Geographic Information Systems (GIS) can be divided into two, namely the structure of vector and raster data. The appearance of the spatial structure of vector data will be generated in

the form of dots and dashes that make up a particular appearance, while the appearance of the spatial structure of raster data will be presented in the form of the configuration of the cells that form the image [10].

Geographic Information Systems (GIS) consists of three integrated parts: 1) Geography; the real world, or spatial reality, or geography; 2) Information; data and information, including the meaning and their role; and 3) System; computer technology and supporting facilities. In other words, GIS is a collection of three aspects in the life of our modern world, and offers a new method to understand.

RESULTS AND DISCUSSION
Cilacap waters area is dominated by Penyu Bay waters area. That area is also partially used as shipping routes for landing purpose at Tanjung Intan General Port, Cilacap Ocean Fishing Port and Steam Power Plant Port.

Shipping lanes in Cilacap waters area is based on the results of ocean depth survey by Navy Hydro Oceanography Department. For Penyu Bay waters area, part of Segara Anakan and surrounding areas is show on the map 108 namely Cilacap Shipping Lanes Map (Fig 2). As for the waters around the island of Nusakambangan and Port of Cilacap Power Plant is shown on the Map 108A namely Map of Shipping Lanes of Pananjung Bay and island of Nusakambangan (Fig 3).
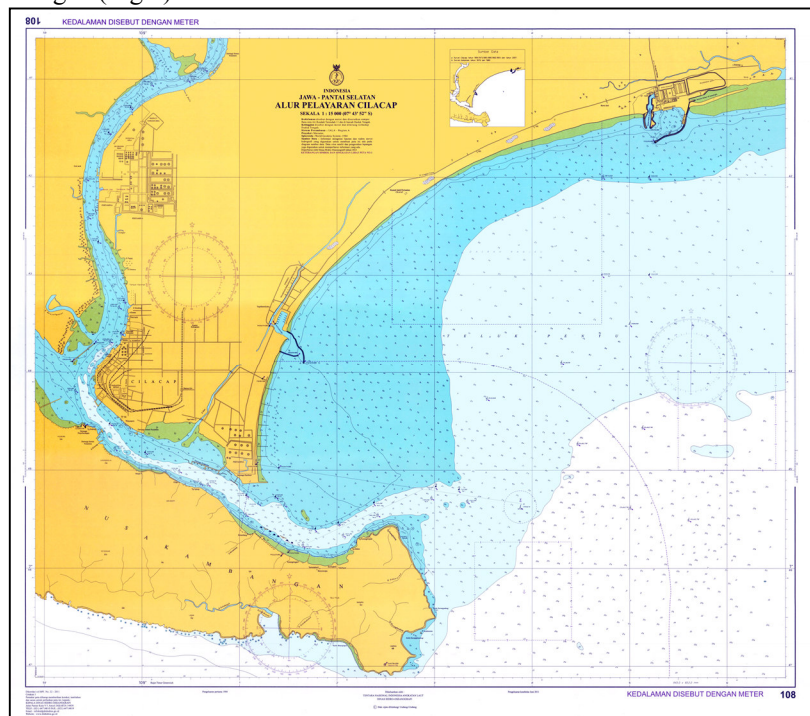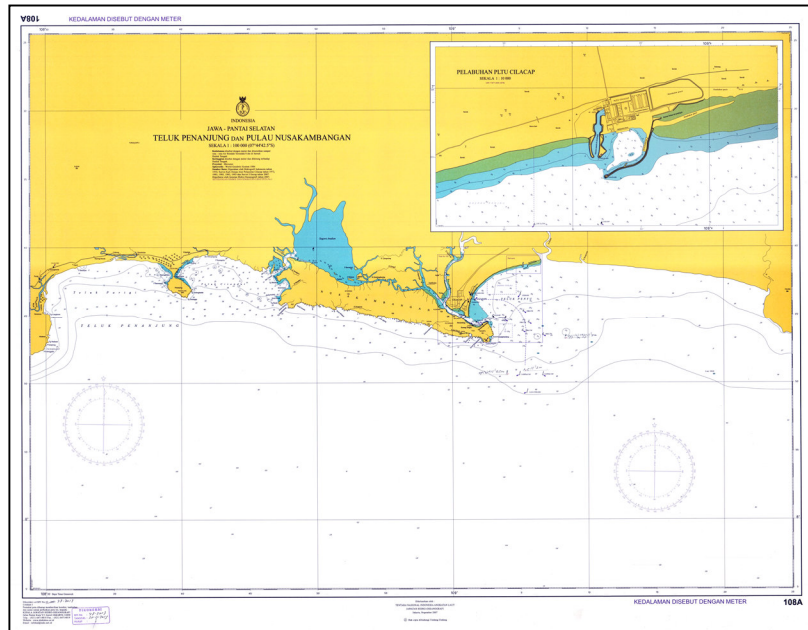

Figure 2 Map 108 [11]

Figure 3 Map 108A **[12]**

Shipping lanes area is an area where fishing operation is forbidden to perform. Fishermen are not allowed to set their net in that area. They are only allowed to use these areas for accessing fishing ground and returning to fishing base.

Cilacap government has prepared Spatial Plan of Cilacap district for 2011-2031. The spatial plan has set Administrative Map (Fig 4) and Space Pattern Planning Map (Fig 5).
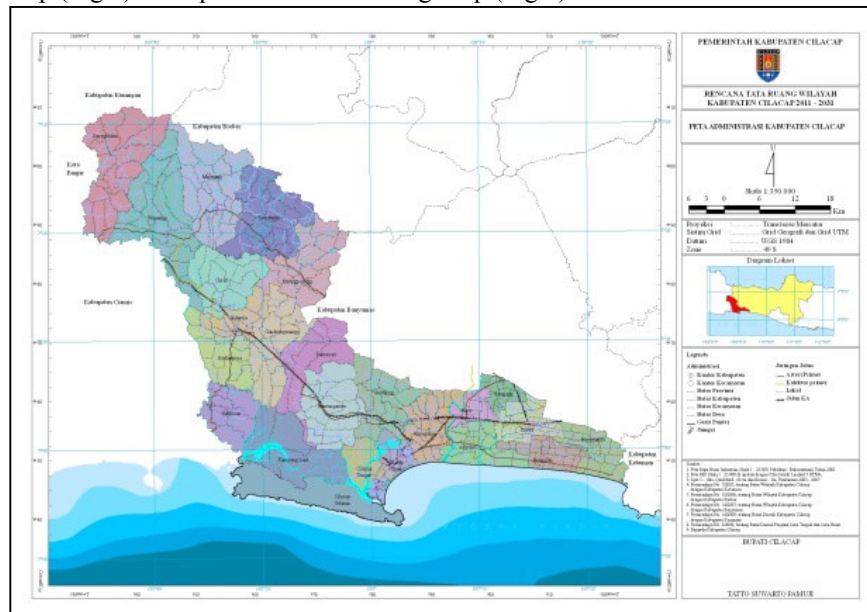

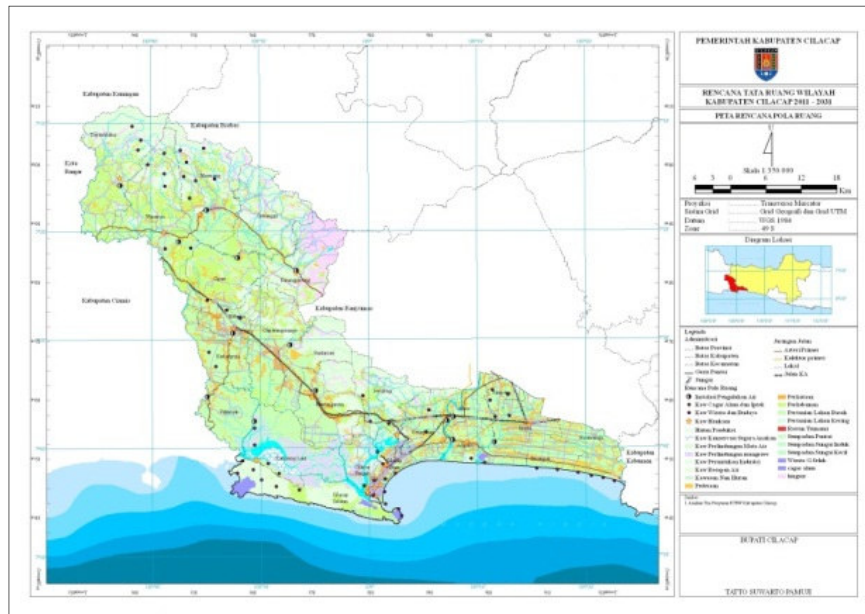
Figure 4 Administration Map **[13]**

Figure 5 Spatial Planning Map **[14]**

The scope of spatial area plan Cilacap is the entire region that is geographically located between 108º4 '30 "-109º30'30" East Longitude and 7º30'-7º45'20 " South Latitude, with an area of 213 850 ha, and administratively bordered by: 1) Eastern side is Kebumen and Banyumas; 2) the southern side is the Indian Ocean; 3) The western side is Ciamis and Banjar Regency (West Java Province); and 4) Northern side is Kuningan Regency (West Java Province) and Brebes.

Cilacap Spatial Planning Map is a base map that will be used to construct a Shrimp Fishing Area Map. Based on the survey results from shrimp fishermen who use ciker nets (trammel net) of area waters as a place to conduct fishing operations shrimp poured on the map. The information can then be checked again with the harbour master/Syahbandar, administrator of KUD, administrator of Cilacap Fishermen Association (HNSI), Port authority and other stakeholders to get feedback and suitability to obtain complete information. Results of the above informations, showed on the polygon map given information which shrimp catching area. *Penaeidae* spp shrimp fishing area that has been poured on the Map Location Areas Catching Shrimp are at two areas, namely:

1) Penyu Bay area which is around Serayu and Tipar river estuary with the distance of 1 mil to 5 miles from the beach. The position of the area starts from the estuary of Serayu River to southern area of Mount Srandil area. However, since the area around Serayu estuary is currently a shipping route of Cilacap power plant, the fishing area then shifted eastward from around the estuary of Tipar river.

2) Nusakambangan island area in southern area around Nusakambangan isle with 1 to 3 miles distance from the beach.

Based on various information obtained then shrimp catching area is compiled using ArcGIS software. The result of shrimp catching area map is shown in Fig 6.
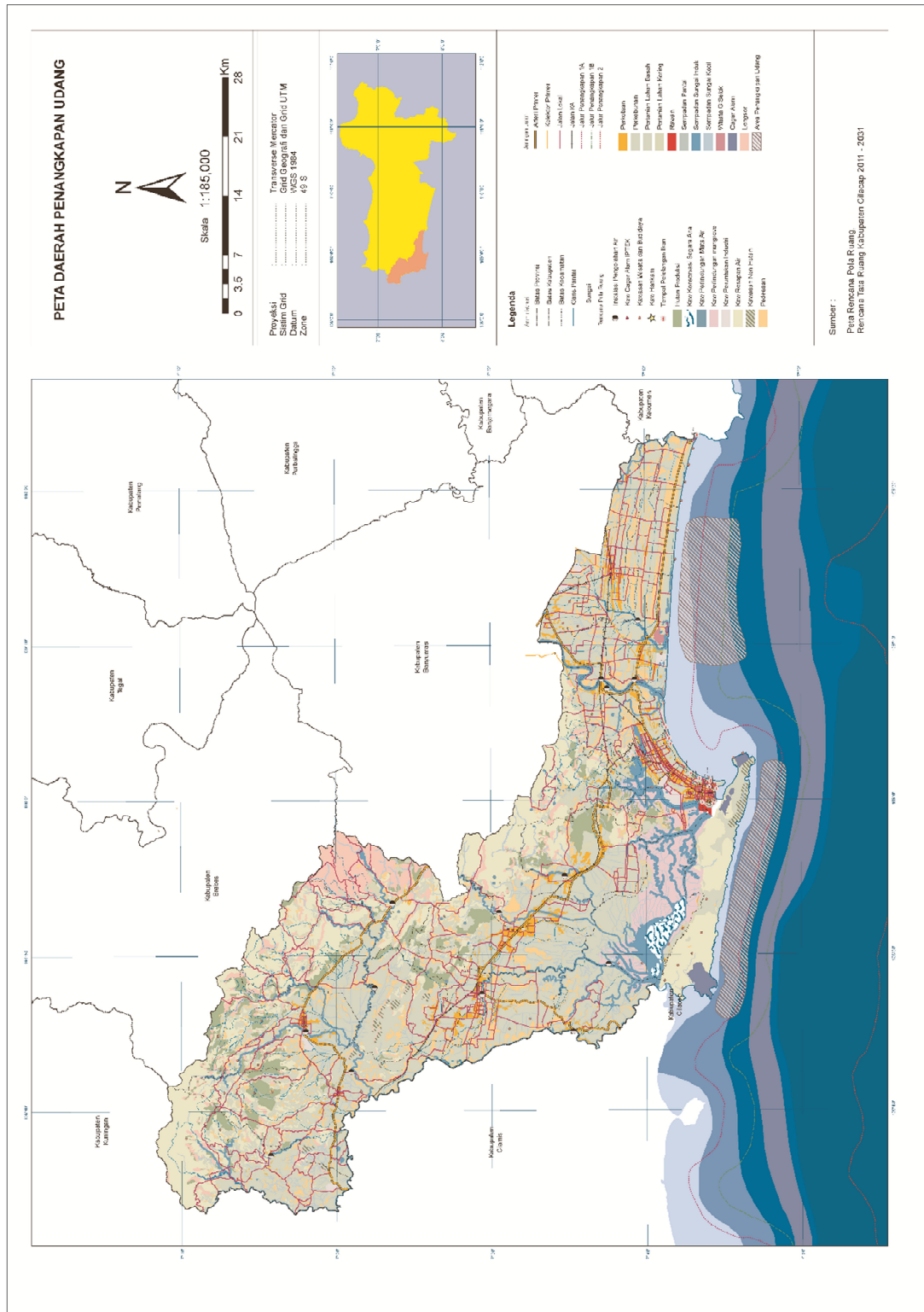
Figure 6 Shrimp Fishing Areas Map in Cilacap District

CONCLUSIONS AND SUGGESTIONS

Shrimp fishing areas map is alleged to be *Penaeidae* spp shrimp fishing areas using trammel net. This map provides information about geographical position to do shrimp fishing operations. By knowing this information, fishermen will find shrimp location easier without having to look at wider area. This could save the cost of fuel, cost of material consumption and the operation time arrest, so the catch is expected to be maximum.

To improve accuracy, the map location of the shrimp fishing areas need to be distributed to all fishermen who use trammel net fishing gear in order to obtain feedback for improvement of the map. The spread of map

should be carried out by the relevant authorities such as the Department of Marine and Fisheries, KUD Mino Saroyo and Cilacap Fishermen Association (HNSI).

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