




# Potential and Problems of Regional Infrastructure Supporting Fisheries in Urban and Coastal Areas Using GIS of Parigi and Cijulang Districts

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**Abstract.** Parigi and Cijulang sub-districts are coastal areas in Pangandaran Regency that great potential in the fisheries sector. Both sub-districts have strategic geographical characteristics as coastal areas with abundant marine resources. However, the development of this potential is faced with significant challenges related to inadequate supporting infrastructure. This study aims to analyze the potential and problems of the fisheries infrastructure in both areas. The research method used is descriptive qualitative and data collection through interviews, observations, and documentation studies. The results showed that the potential of fisheries in Parigi and Cijulang sub-districts includes freshwater fish farming, and fish product processing. However, the two areas still face various problems such as the lack of supporting infrastructure and basic infrastructure in each fishery pond.

**Keywords:** Basic infrastructure, Potential and problems, Support infrastructure

## 1 Introduction

The fisheries sector in Indonesia plays a vital role in the national economy. As a country that has a very large water area, Indonesia is a maritime country with abundant marine resources diversity in it. In the case, the fisheries sector is one of the sectors that provides many jobs for rural [1] communities and provides food needs for the entire population. But to maximize this potential, requires infrastructure that can support the fisheries sector. Starting from ports, fish auction sites, to processing and marketing facilities, this infrastructure is the main key in supporting fishermen's operations and increasing the added value of fishery products. Nationally, the government continues to improve and develop fisheries infrastructure. Various development programs have been carried out, but the challenges are still great, especially in equitable development and quality of facilities in various regions. This problem is also evident at the regional level, including in West Java Province, especially in Pangandaran Regency [2].

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Pangandaran regency, as one of the marine tourism destinations and fisheries centers in West Java, has enormous fisheries potential. Its strategic geographical location with the Indian Ocean makes this region rich in a variety of marine life [3]. In optimizing this potential, Parigi and Cijulang sub-districts are interesting areas to look at. Both sub-districts are active centers of fisheries activities, with many fishermen depending on this sector for their livelihood. Therefore, the availability and quality of supporting infrastructure in the urban areas of these two sub-districts is crucial. The following is a map of the administrative districts of Parigi and Cijulang (see Fig. 1).

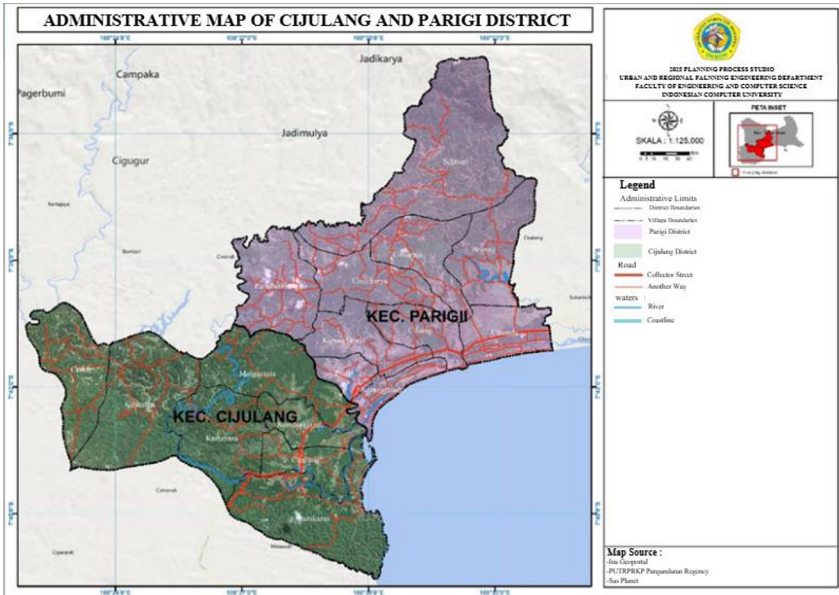


Fig. 1. Administrative Map of Parigi and Cijulang Subdistrict.

## 2 Literature Review

### 2.1 Coastal Area

Coastal areas as transitional areas between terrestrial and marine ecosystems, defined by a 12-mile territorial boundary extending outward from the water and a district/city boundary extending inland [4].

### 2.2 Infrastructure

Infrastructure is a country's main servant that helps economic and social activities to take place through the provision of transportation, public health, educational services, and buildings for community activities, as well as other supporting facilities. Infrastruc-

ture is defined as facilities developed or needed by public bodies for government functions in the provision of water, electricity, waste disposal, transportation, and similar services to facilitate economic and social goals [5].

### **2.2.1 Economic Infrastructure**

Economic infrastructure is a physical asset that provides services and is used in final production and consumption, including public utilities (telecommunications, drinking water, sanitation and gas), public works (dams, irrigation and drainage channels) and the transportation sector (roads, railways, port transportation and airports) [6].

### **2.2.2 Social Infrastructure**

Social infrastructure is an asset that supports the health and skills of the community, including education (schools and libraries), health (hospitals, health centers) and recreation [7].

### **2.2.3 Transportation Infrastructure**

Administrative/Institutional Infrastructure, including law enforcement, administrative control and coordination and culture. Apart from that, there are those who divide infrastructure into basic and complementary infrastructure [7].

- (i) Basic infrastructure encompasses sectors that are public in nature and fundamentally important to other economic sectors, are non-tradable, and cannot be separated technically or spatially. Examples include roads, railways, canals, seaports, drainage systems, dams, and so on.
- (ii) Complementary infrastructure such as gas, electricity, telephone and drinking water supply.

## **2.3 GIS (Geographic Information System)**

Geographic Information System is a system consisting of software and hardware, data and users as well as institutions to store data related to all phenomena that exist on earth. Data in the form of detailed facts, conditions and information are stored in a database and will be used for various purposes such as analysis, manipulation, presentation and so on [8]. The simplest is that GIS can be viewed as software, components used as tools used to enter, manipulate, analyze and output data. In other words, GIS components include: a) Computer systems (hardware and operating systems) b) Software c) Spatial data d) Management and analysis of data procedures e) People to operate GIS [9].

GIS subsystems include data input, data output, data management, data manipulation, and analysis [10-11]. These GIS subsystems are explained below: a) Data Input: This subsystem is responsible for collecting and preparing spatial and attribute data from various sources. This subsystem is also responsible for converting or transforming the original data format into a format used by GIS. b) Data Output: This subsystem

displays or generates output for all or part of the database, either in softcopy or hardcopy, such as tables, graphs, maps, and so on. c) Data Management: This subsystem organizes both spatial and attribute data into a database so that it is easily retrieved and edited. d) Data Manipulation and Analysis: This subsystem determines the information that can be generated by GIS. In addition, this subsystem also manipulates and models' data to produce the desired information. The benefit of GIS is that it accommodates data dynamics, making data updating easier [12].

### **3 Method**

#### **3.1 Data Collection Method**

Data collection was carried out by collecting a number of primary data was obtained from direct surveys in the form of interviews and discussions with relevant parties in Pangandaran Regency. Secondary data came from in documents of relevant agencies in Pangandaran Regency, books, articles, and other sources that can supports this research.

#### **3.2 Data Analysis Method**

Data analysis is data that has been processed so that the results obtained are easily understood by readers of the research. Data analysis in the form of information on the results of data processing, grouping the results of data processing, summarizing the results of data processing so as to form a research conclusion. The qualitative data analysis is more complicated than quantitative; researchers really have to master the theory so that the perceptions created are not subjective but based on scientific knowledge [13]. Qualitative research can be very complicated and overlapping, because the information taken is not only centered on a predetermined problem but can develop depending on field conditions. The analysis used in this research is qualitative data analysis [14].

#### **3.3 Nearest Neighbor Analysis**

Nearest neighbor analysis or better known as nearest neighbor analysis is a quantitative geographic analysis method used to determine settlement distribution patterns. Nearest neighbor analysis is one of the analyses used to explain the distribution pattern of place location points using calculations that consider, distance, number of location point, and area, the final result in the form of an index calculation has a range between 0-2.15. The nearest neighbor parameter T (nearest neighbor statistic T) can be shown with a continuum to facilitate comparison between point patterns. The calculated value is compared with a series of units of the nearest neighbor parameter value (T) for each pattern, so that the pattern formed can be known. (continuum) to facilitate comparison between point patterns. The calculated value is compared with a series of nearest neighbor parameter values (T) for each pattern, so that the pattern formed can be identified (see Fig. 2).

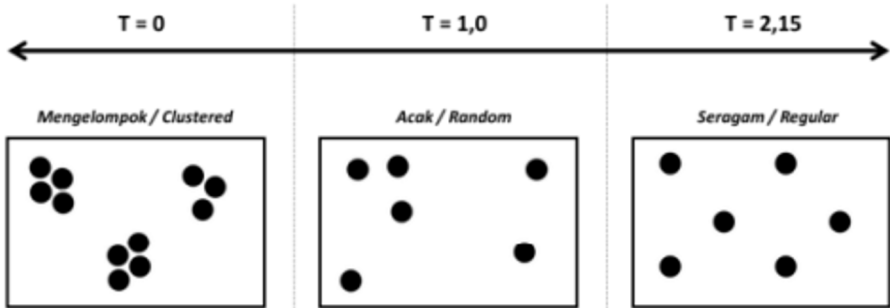


Fig. 2. Types and Distribution Pattern.

If the value of  $T=0$ , then the settlement pattern is clustered. If the  $T$  value  $=1.0$ , then the settlement pattern is random. Meanwhile, if the  $T$  value  $=2.15$ , then the settlement pattern is uniform. The application of the Nearest Neighbor analysis method, besides being used to find patterns of settlement distribution, can also be used to find the index value of the distribution pattern of other phenomena such as the distribution of service centers, the distribution of the intensity of built-up areas in the region, and the distribution pattern of public facilities.

## 4 Results and Discussion

### 4.1 Portrait of Distribution

**Fisheries Distribution Map.** The figure below shows six fisheries in Parigi and Cijulang Districts. Three are located in Parigi District (two Jambusari Fish Fisheries and one Marine Shrimp Pond), and three are located in Cijulang District (one Marine Shrimp Pond, one Tilapia Fish Pond, and one Cijulang Shrimp Pond). The conditions of these six fisheries locations will be assessed based on six main variables: fisheries productivity, fisheries distribution, cultivation facilities, fishing equipment, and institutional arrangements. The distribution of these six fisheries is based on observations. The distribution of fisheries in Cijulang and Parigi sub-districts can be see Fig. 3.

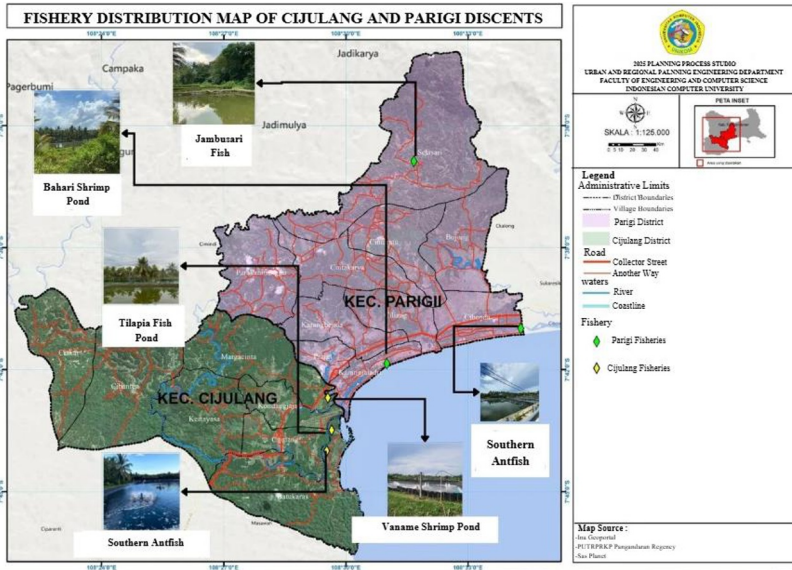


Fig. 3. Map of fisheries distribution.

**Map of the Distribution of Fish Auction Locations.** Fish Auction Place is a place that functions as a location where fishermen can sell their fish catches to traders or consumers. In this region, there are three main TPI (Fish Auction Places) locations: TPI Bojong Salawe, TPI Minakarya, and PPI Batukaras. TPI Minakarya and PPI Batukaras are located in the Cijulang area, while TPI Bojongsalawe is located in Parigi.

These locations are supported by collector road connectivity, facilitating the distribution of catches to local and regional markets. The TPI and PPI play a crucial role in supporting the fisheries value chain, including the auction process, temporary storage, and transportation of seafood.

Distribution of fish auction locations in Parigi sub-district and Cijulang sub-district can be seen in Fig. 4.

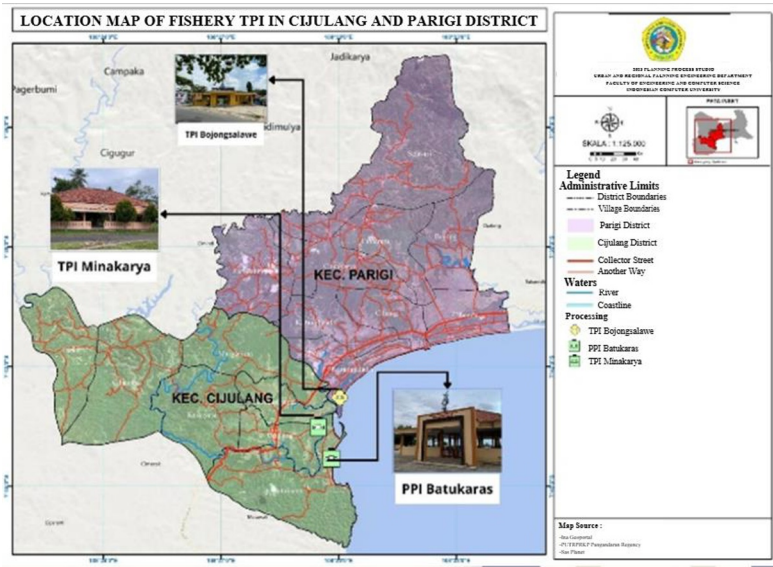


Fig. 4. Map of The Distribution of Fish Auction Locations.

**Fisheries Productivity Map.** Fisheries productivity includes harvest period, harvest frequency per year, and the amount of catch or cultivation produced in a certain period [15]. Within the Cijulang and Parigi Districts, there are six fisheries processing locations spread across the two sub-districts. Cijulang District has three processing locations: the Cijulang Shrimp Pond, the Vaname Shrimp Pond, and the Tilapia Fish Pond. Meanwhile, Parigi District has three processing locations: the Jambusari Fish and South Ant Fish Cultivation, and the Genting Bahari Shrimp Pond. The distribution shows a higher concentration in Cijulang, which is closer to the coastal zone, indicating that this area is more dominated by brackish water and marine pond cultivation.

Furthermore, the harvest period, which is every four months and a harvest frequency of three times a year, indicates a relatively high production intensity. Fisheries productivity in Parigi sub-district and Cijulang sub-district can be seen in Fig. 5.

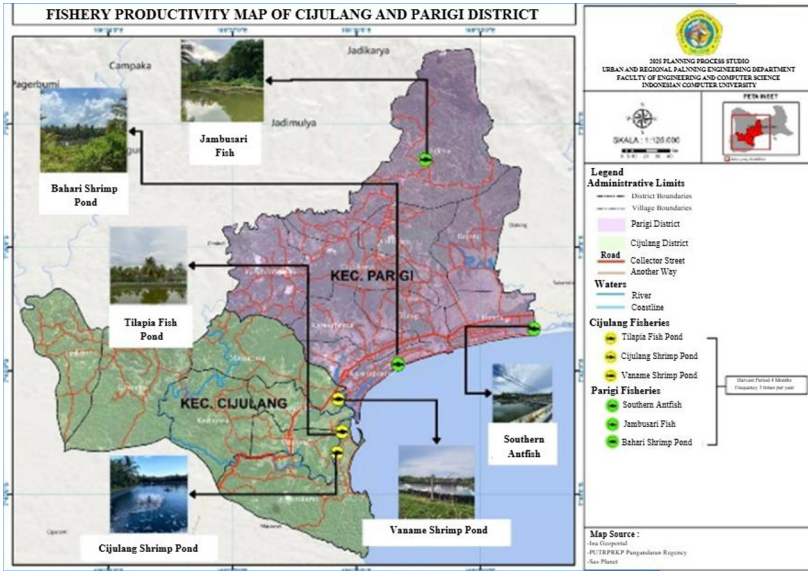


Fig. 5. Fisheries productivity map.

**Fisheries Distribution Map.** Fisheries distribution is the process of delivering catches from the location of capture or cultivation to the market or consumer.

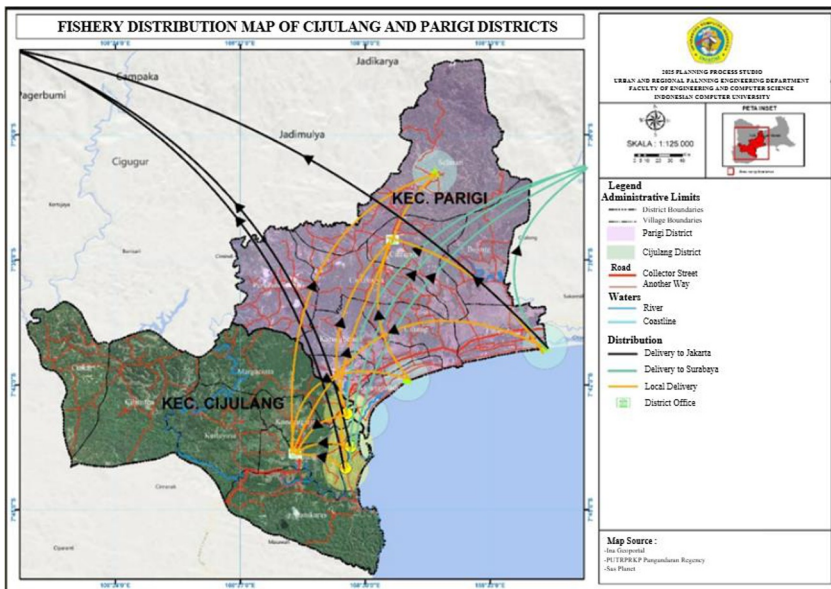


Fig. 6. Fisheries Distribution Map.

The distribution of fishery products reflects the competitiveness of local products and the effectiveness of the regional logistics system. This distribution map shows the direction and destination of fishery product shipments from Cijulang and Parigi Districts to major cities such as Jakarta and Surabaya, as well as to local markets. This information demonstrates the extent of the connection between production areas and consumer markets, which is an important foundation for designing an efficient and market-oriented distribution system.

The distribution of fishery products from this region is directed to three main destinations: Jakarta, Surabaya, and the local market. Distribution to Jakarta and Surabaya generally originates from large processing facilities such as the Vaname Shrimp Farm, the Tilapia Fish Farm, and Semut Selatan Aqua culture, indicating a large enough production scale to meet intercity demand. Meanwhile, local distribution is centered within the Parigi and Cijulang Districts. Fisheries distribution in Parigi sub-district and Cijulang sub-district can be seen in Fig. 6.

**Fishing Facilities and Equipment Map.** Fishing facilities and fisheries equipment are tools used in the in the fishing process such as nets, boats, and other tools. Fishing activities are inseparable from the existence of adequate fishing facilities and supporting equipment. This map shows the locations of piers and fishpond areas equipped with supporting facilities for fishing operations. The location of these facilities is very strategic because they are close to the coastline (see Fig. 7).

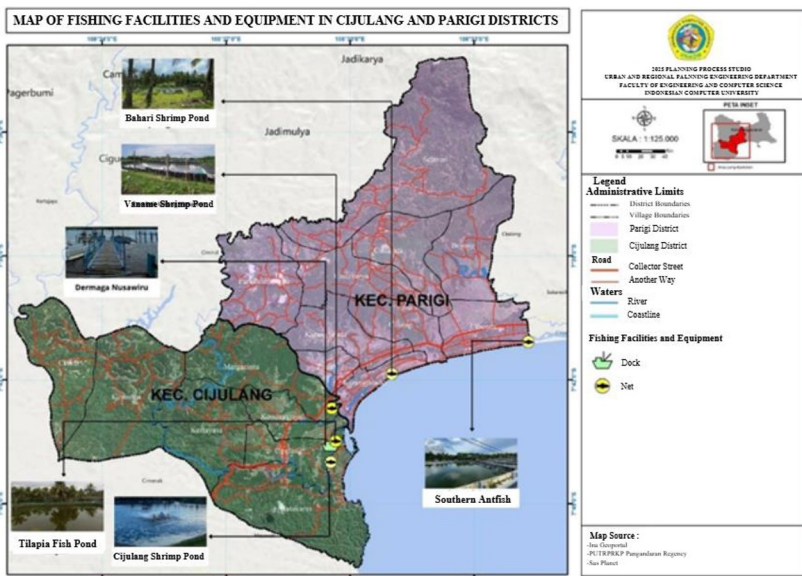
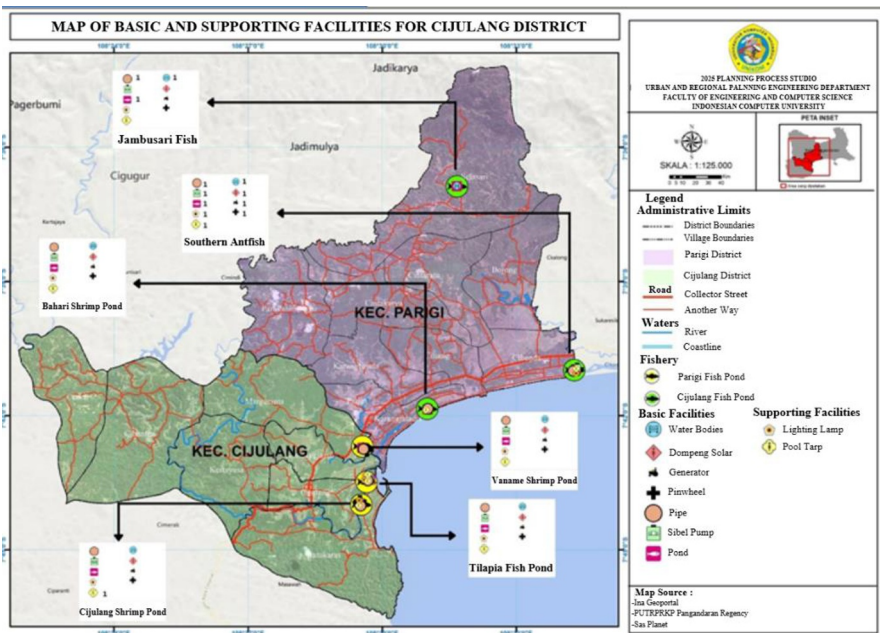


Fig. 7. Map of Fishing Facilities and Equipment.

There is one fishing facility, the Nusawiru pier in Cijulang, and six facilities equipped with nets, each with its own fishpond. The facilities are dominated by fishponds, which serve as cultivation areas, while the pier serves as a distribution and landing center for fish. These locations are strategically located near the coastline, facilitating the distribution of catches and aquaculture products to local and international markets. Fishing facilities and fisheries equipment in Parigi sub-district and Cijulang sub-district can be seen in Fig. 7.

**Map of Aquaculture Facilities.** Aquaculture facilities are places where fish and other aquatic organisms are cultivated in a controlled environment. Aquaculture facilities in Parigi sub-district can be seen in Fig. 8.



**Fig. 8.** Aquaculture Facilities.

The map of basic and supporting facilities identified at least seven types of basic facilities (such as pipes, pumps, generators, ponds, water, waterwheels, and solar panels) and three types of supporting facilities (lighting, pond tarpaulins) spread across six key fishery locations. Cijulang District has more supporting facilities, particularly at ponds such as those for whiteleg shrimp and Cijulang shrimp. This indicates a more comprehensive supporting infrastructure in Cijulang District than in Parigi District.

**Fisheries Ownership Map.** Ownership in the fisheries sector consists of organizations and institutions involved in the management of fisheries resources, including fisheries,

fishermen associations, and the private sector. Institutions/ownership of fisheries in Parigi Sub-district and Cijulang Sub-district can be seen in Fig. 9.

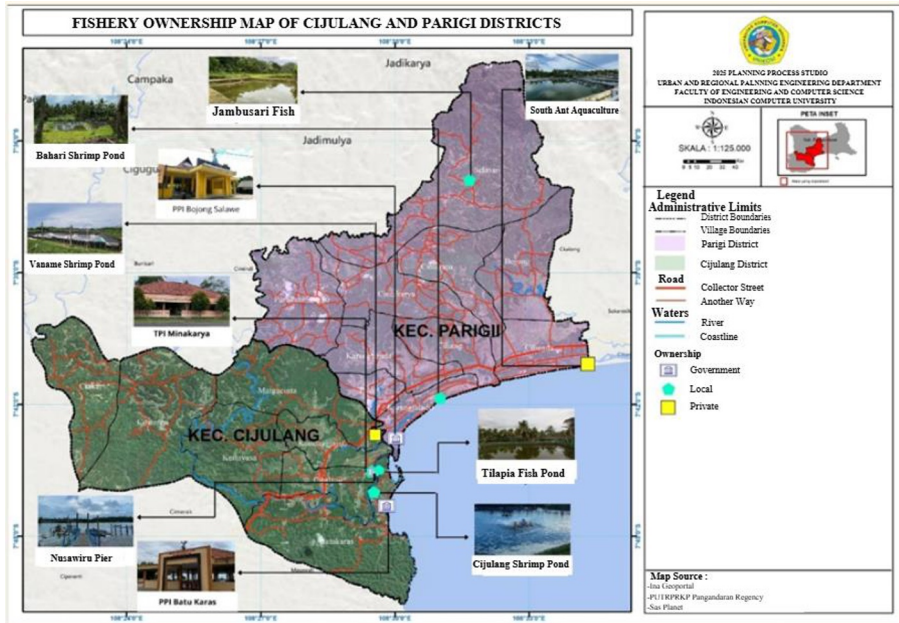


Fig. 9. Ownership Map.

The analysis shows that there are 10 fishing locations classified according to ownership: government (4 locations), local (3 locations), and private (3 locations). Meanwhile, local ownership is generally located near residential areas and fishing activity centers, indicating high levels of local community participation. Privately owned facilities, such as the Whiteleg shrimp pond and the Semut Selatan fish farm, are located near the coast, indicating the involvement of the private sector on an industrial scale. This demonstrates a relatively balanced distribution of ownership between the public, community, and private sectors.

#### 4.2 Observation Result Table

**Table of Observation Results in Cijulang and Parigi District.** The results of observations in this study are based on the approach of looking at quantity and quality of basic and supporting infrastructure in areas that have fisheries potential such as Parigi and Cijulang Sub-districts.

- (i) Table of Observation Results in Cijulang District can be presented in Table 1.

**Table 1.** Recap table of availability of supporting infrastructure in Cijulang.

Variabel	Supporting infrastructure Parameters	Analysis	
		Quantity	Quality
Processing Facilities	=There is an ice factory	0	0
	Fish processing plant	0	0
	Fish Auction Place	2	2
Fishery Productivity	Harvest Period	3	3
	Frequency per year	4	4
Fishery Distribution	Distribution Channel	2	2
Ownership	Business Entity	3	3
Cultivation facilities	Support facilities	1	6
	Basic facilities	1	5
Catch Facilities and Equipment	Boat Workshop	0	0
	Dock	1	1
	Net	1	1

(ii) Table of Observation result in Parigi Sub-district can be presented in Table 2.

**Table 2.** Recap table of availability of supporting infrastructure and basic infrastructure in Parigi sub-district.

Variable	Supporting Infrastructure Parameters	Analysis	
		Quantity	Quality
Processing Facilities	There is an ice factory	0	0
	Fish processing plant	0	0
	Fish Auction Place	1	1
Fishery Productivity	Harvest Period	3	3
	Frequency per year	4	4
Fishery Distribution	Saluran Distribusi	2	2
ownership	Business Entity	3	3
Cultivation facilities	Support facilities	1	1
	Boat Workshop	1	5
Catch Facilities and Equipment	Dock	0	0
	Dermaga	0	0
	Net	1	1

### Results of observation and parameter analysis in Parigi and Cijulang Sub-districts.

*Fisheries Processing Facilities.* From the observation results, the parameter analysis of fish processing facilities is presented in Table 3.

**Table 3.** Fisheries Processing Facilities.

No	Parameters	Analysis
1.	There is an ice factory	There are no ice factories in Parigi and Cijulang sub-districts
2.	There is a fish processing plant	There is no factory for processing fish in Parigi and Cijulang Sub-districts, it is still done in a simple way, namely drying under the sun
3.	Tempat Pelelangan Ikan	Terdapat 2 TPI di Kecamatan Cijulang dan 1 TPI di Kecamatan Parigi

*Fisheries Productivity.* From the observation results, the analysis of fisheries productivity parameters is presented in Table 4.

**Table 4.** Fisheries productivity.

No	Parameters	Analysis
1.	Harvest Period	There is a fish and shrimp harvest period every 4 months in Parigi and Cijulang sub-districts.
2.	Harvest frequency per year	Harvest frequency is 3 times per year in Parigi and Cijulang sub-districts

*Fisheries Distributions.* From the observation results, the fishery distribution parameter analysis is then obtained which is presented in Table 5.

**Table 5.** Fisheries distribution.

No	Parameters	Analysis
1.	Distribution Channel	There is fisheries distribution to outside cities such as Jakarta and Surabaya, and delivery to local communities.

*Fishing Facilities and Fisheries Equipment.* From the observation results, an analysis of the parameters of fishing facilities and fisheries equipment is obtained which is presented in Table 6.

**Table 6.** Fishing facilities and equipment.

No	Parameters	Analysis
1.	There is a dock as a fishing facility	There is already a nusawiru pier in cijulang sub-district and it is functioning properly
2.	There is a net as equipment used by fishermen	There
3.	There is a boat workshop	There are no boat repair shops in Parigi and Cijulang sub-districts

*Aquaculture Facilities.* From the observation results, an analysis of the parameters of fisheries distribution parameters is then obtained which is presented in Table 7.

**Table 7.** Cultivation facilities.

NO	Parameters	Analysis
1.	There are supporting facilities	Still uneven provision of supporting facilities such as feed stroge warehouse, waste management.
2.	The are basic facilities	Uneven provision of basic fisheries facilities in Parigi and Cijulang sub-districts

*Ownership.* From the observation results, an analysis of fisheries distribution parameters is the obtained which is presented in Table 8.

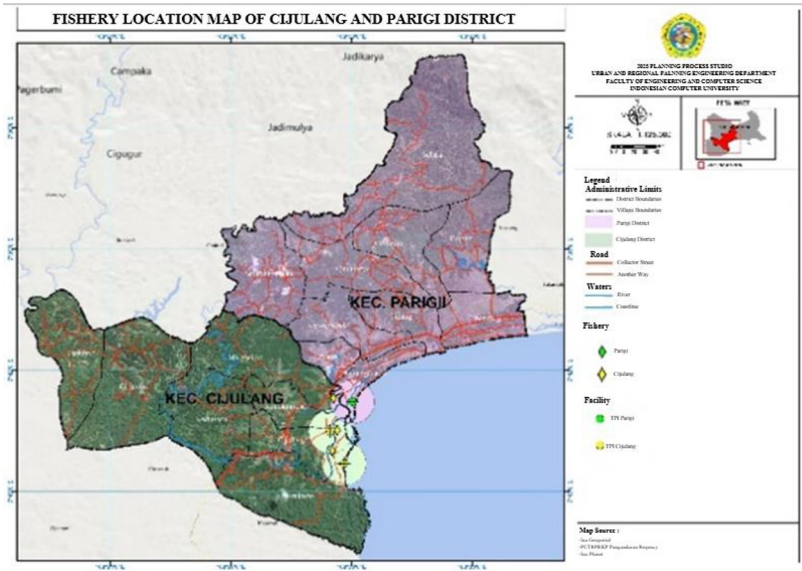
**Table 8.** Ownership.

NO	Parameter	Analysis
1.	Ownership	Managed by the government private sector, local residents

### 4.3 Analysis

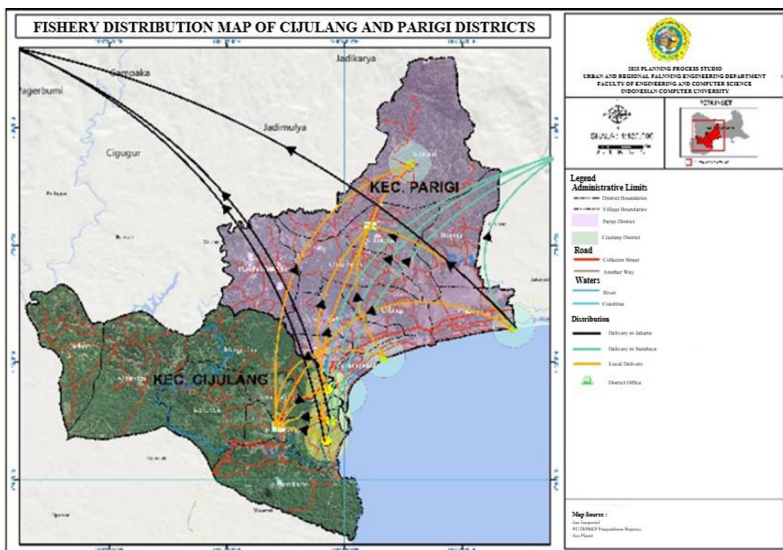
#### Buffer Analysis.

*Fisheries Processing Facilities.* In the indicator of fisheries processing facilities, it turns out that the existence of which is considered very important is the presence of Fish Auction Place which is not far from the pond. The distance from the Fish Auction Place to the pond about 1km. The fisheries included in This distance is considered appropriate in order to facilitate the access of vehicles harvested ponds to Fish Auction Place for sale and auction. The fisheries included in Fish Auction Place Batu Karas Cijulang range are Cijulang shrimp ponds. The largest number of Fish Auction Place are Batu Karas Fish Auction Place in Batu Karas Village and Minakarya Fish Auction Place Cijulang Village, Cijulang sub-district. The following will present a map of the Fish Auction Place buffer location in see Fig. 10. Fisheries Processing Facilities see in Fig. 10.



**Fig. 10.** Fish Auction Place Buffer Location Map.

*Fisheries Distribution.* In the fisheries distribution indicator, it turns out that there is already a fisheries distribution channel with a delivery range to the local community of only 1 km so the villages included in the range are Cijulang village, Kondangjajar Village, Margacinta Village. The following will present a distribution buffer map image see Fig. 11.



**Fig. 11.** Fisheries Distribution Buffer Map.

*Fishing Facilities and Fisheries Equipment.* In the indicators of fishing facilities and fisheries equipment, it turns out that there is only one dock in Cijulang Village, Cijulang Sub-district and there are already nets in each pond as equipment for catching fish.

*Aquaculture Facilities.* In indicator of cultivation facilities in each pond is still incomplete supporting cultivation facilities and basic cultivation facilities. The most complete aquaculture facilities in Cijulang sub-district are shrimp ponds and incomplete are mu-jaer fish ponds while in Parigi sub-district are southern ant ponds aquaculture and incomplete are jambusari fish farms.

*Ownership.* In the ownership indicator if it is associated with the distribution of fisheries the the most frequently distributed to the outside are privately owned pond. But if the most often receive distribution from within are Fish Auction Place and fish landing base.

**Nearest Neighbor Analysis.**

*Fisheries Processing Facilities in Cijulang District.* Analysis of Cijulang Fisheries Neighbors (see Table 9). Based on the calculation, it is known that the number of facility points analyzed is 3 points of Cijulang District Fisheries Processing Facilities with a research area of 77.13 km. The average observed distance (Dobs) is 1193333. From these results, the nearest neighbor index (Rn) value is 0.44056742. The Rn value is much smaller than 1 indicating that the distribution pattern of facilities in the Cijulang Fisheries Area is clustered. This illustrates that various tourism facilities tend to be concentrated in certain areas around the Cijulang Fisheries (see Fig. 12).

**Table 9.** Analysis of Cijulang Fisheries Neighbors.

No	Name	Point	Distance
1.	Cijulang Shrimp Pond	1-2	1070
2.	Tilapia fish pond	2-1	10870
3.	Vaname shrimp ponds	3-1	1440
Total			3580
D(Obs)			1193,333
a			88040000

$a/n=29346667$

$a/n=5417,3 Rn=1193,3333/0,5*5417,3=0,44056742$  (Clustered).

Distribution Pattern of Nearest Neighbor Analysis (see Fig. 12).

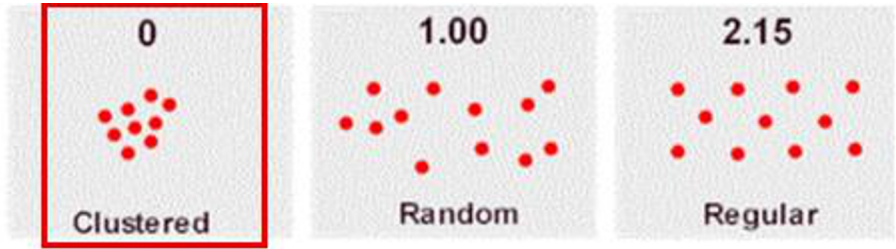


Fig. 12. Distribution pattern of nearest neighbor analysis.

*Fisheries Processing Facilities in Parigi District.* Based on the calculation, it is known that the number of facility points analyzed is 3 Fisheries Processing Facility points in Parigi District with a research area of 100.1 km. The average observed distance (Dobs) is 7260. From these results, the nearest neighbor index (Rn) value is 2.539. The Rn value is greater than 1 indicating that the distribution pattern of facilities in the Parigi fisheries area is even (see Table 10).

Table 10. Analysis of Parigi fisheries neighbors.

No	Name	Point	Distance
1.	Southern ant aquaculture	1-2	6330
2.	Cultivation of Jambusari Fish	2-1	9120
3.	Genting Bahari Crab Shrimp Farm	3-1	6330
Total			21780
D(Obs)			7260
a			98040000

$n=3$

$a=88040000$

$a/n=29346667$

$\sqrt{a/n}=5417,3$

$Rn=7260/0,5*5417,3=2,539$  (Regular)

Distribution Pattern of Nearest Neighbor Analysis (see Fig. 13).

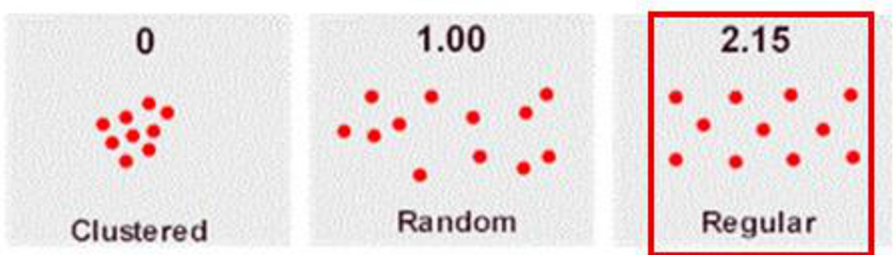


Fig. 13. Distribution Pattern of Nearest Neighbor Analysis.

## 5 Conclusion and Recommendations

### 5.1 Conclusion

Based on an analysis of the nearest neighbors, it appears that:

- (i) The subdistrict of Cijulang has two fishing facilities, namely a fish auction site and a fish landing base, while the subdistrict of Parigi has only one fishing facility, namely the Bojongsalawe fish auction site.
- (ii) The fish ponds within the range of the fish auction site and permitted to sell at the Batu Karas fish auction site are the Cijulang shrimp ponds.
- (iii) The fish farm within the range of the fish auction site and permitted to sell at the Minakarya Batu Karas fish auction site is the Mujaer fish farm.
- (iv) The fish farm within the range of the Bojongsalawe fish auction site and permitted to sell at the Batu Karas Bojongsalawe fish auction site is the Vaname shrimp farm.
- (v) The most complete supporting and basic aquaculture facilities in the Cijulang sub-district are the shrimp farms, while in the Parigi sub-district, the most complete are the Semut Selatan Aquaculture facilities. The fisheries distribution that receives is managed by the government. Meanwhile, the distribution that goes out is managed by the private sector.

### 5.2 Recommendations

- (i) The recommendations that can be given are:
- (ii) Providing a fish auction site in Parigi sub-district
- (iii) Providing complete basic and supporting aquaculture facilities.

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