The mapping and analysis of minapolitan innovation network-based on capture fisheries, Pekalongan City

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Abstract. Pekalongan City is one of the cities appointed by the Ministry of Marine Affairs and Fisheries to be developed as a capture fisheries-based minapolitan area. In order to boost production during the Minapolitan Area development, it is required to establish Production Development Activities packages, and one of them is Research and Development Package. Furthermore, to dynamize the flow of knowledge, innovation, and diffusion, and to learn within the framework of the Innovation System, an innovation network is needed. The initial step in developing an innovation network is by mapping and analyzing innovation networks. The purpose of this study is to map and analyze the minapolitan innovation network based on capture fisheries in Pekalongan City. Innovation network analysis is conducted using Social Network Analysis (SNA) method developed by Analytic Technologies Harvard. This SNA method is used to get a general picture of the interaction patterns of actors/institutions/actors that occur in innovation networks. The results of the analysis show that the density value of the capture fisheries-based minapolitan innovation network is 0.15 for the knowledge flow and 0.04 for the business flow. Hence it can be concluded that it is not a complete innovation network (the value of complete network density = 1). The level of connectivity between actors in this innovation network is still small, thus shows the social cohesion or solidarity among actors is still weak.

1. Introduction

1.1. Background

One of the leading themes/priorities in the development of Pekalongan City is a service city based on fisheries. The location of Pekalongan City on the North coast makes Pekalongan City as one of the fish producing cities that can penetrate the international market.

Currently, Pekalongan City's capture fisheries production continues to decline. This is due to the decrease in fish resources, an increase in production costs that are not matched by an increase in the selling price of fish, a conflict between fishermen in the fishing ground, the sale of fish at sea and difficult natural conditions, and management problems in fishing ports.

The crisis that hit the capture fisheries sector in Pekalongan City impacted other business sectors, such as the decrease in demand for ice, salt, and other fisheries service sectors. Also, the Regional Original Revenue (PAD) of Pekalongan City from fisheries had declined dramatically. Many fisheries
services sectors closed their businesses; hence unemployment also increased. Regarding this, the Department of Agriculture, Animal Husbandry, and Maritime Affairs of Pekalongan City Government has taken steps to empower groups and professional organizations in the skills development activities of coastal communities. This activity is expected to reduce the unemployment rate, and coastal communities could increase family income.

The development of fisheries in Pekalongan City is currently directed to the development of aquaculture, both brackish water culture and freshwater culture. In general, the steps taken are pond diversification and extensification.

Another alternative is by developing minapolitan, where Pekalongan City is one of the cities appointed by the Ministry of Maritime Affairs and Fisheries as a capture fisheries-based minapolitan area based on the Decree of the Minister of Maritime Affairs and Fisheries Republic of Indonesia No. KEP.32 / 2010 dated May 14th, 2010, on the Establishment of the Minapolitan Area.

Minapolitan General Guidelines states that one of the requirements for developing the Minapolitan Region is the availability of supporting facilities in the form of accessibility to markets, capital, production, processing and/or marketing facilities and infrastructure, the presence of business institutions, appropriate technology and extension and training facilities.

Increased production in the development of the Minapolitan Region is required to provide Production Development Activities packages, among them is the Research and Development Package. The research and development activities packages should at least include (1) seed production and enlargement technology package, (2) fish handling and processing technology packages, (3) fishing technology packages, and (4) business development technology package. Therefore, the innovation network needs to be developed to support all these things.

The innovation network is the interaction of universities, industry, and government (Triple Helix Interaction) supported by infrastructure, both technical, commercial, social, and financial, to increase competitiveness [1]. The form of interaction shows the linkages and networks for strengthening innovation systems to support innovation and business activities.

Minapolitan innovation networks based on capture fisheries in Pekalongan City need to be developed to increase the flow of science and technology and the competitiveness of industries within the region. And the first step in developing this innovation network is by performing map and analyze the innovation network.

1.2. Purpose and target
The purpose of the study is to map and analyze the Pekalongan City capture fisheries-based minapolitan innovation network.
Targets to be achieved are:
1. Understanding the innovation network actors related to capturing fisheries-based minapolitan in Pekalongan City.
2. Understanding the general condition of the innovation network between actors based on the number of actors and the density of relations between these actors.
3. Identify the main actors or that has a big influence in an innovation network.
4. Identify actors who occupy strategic positions in the dissemination/flow of knowledge and technology (actors who act as a liaison for other actors).

1.3. Methodology
The data used in this study include primary and secondary data. Primary data were obtained from direct observation of actors related to Minapolitan based on capture fisheries in Pekalongan City, both through direct interviews and through questionnaires. While secondary data obtained from the results of studies, related institutions, periodic or annual reports, journals, and various literature relating to the study.

The method used to analyze innovation networks is Social Network Analysis (SNA), a software method developed by Harvard Analytic Technologies. The SNA method aims to get a picture of the
patterns of interaction of actors that occur in innovation networks. Analysis of innovation networks using the SNA method is:

1. **Network density analysis**: This analysis aims to determine the general state of the network and the density of the relationship between actors/institutions. The density of a network describes how fast the spread of knowledge (diffusion of information) among actors in the network.

2. **Actor individual analysis**: This analysis aims to identify the main actors or that has a large influence in a network. The parameters used in this analysis are (a) Degree centrality, which is the number of relationships an actor/institution has; (b) The closeness centrality, namely the distance owned by one actor/institution towards all other actors by considering the distance of each actor to all other actors; (c) Intermediary centrality (betweenness centrality) to see whether an actor/institution occupies a strategic position.

3. **Intermediary analysis (brokerage)**: This analysis aims to identify actors/institutions that occupy strategic positions in the dissemination/flow of knowledge, which analyzed by the Bi-Component approach or blocks in the UCINET software and visualized innovation networks using NetDraw software.

Whereas the mapping of the relationship/relatin pattern/linkage conducted in mapping the capture fisheries-based minapolitan innovation network in Pekalongan City is grouped into 2 (two) relationships/relations, namely:

a. Relationships of knowledge flow that includes activities of (1) Coordination; (2) Facilitating technology access; (3) Facilitation of access to HR development; (4) Management and organization; (5) Legal access; (6) Product design; (7) IPR / patent rights management; (9) Research;

b. The business relationship which includes activities of (1) Facilitating market access; (2) Facilitating access to finance/funding/capital.

2. **Literature review**

Innovation cannot be run partially, but through collaboration between actors interacting with each other in a system or often referred to as an innovation system; namely unity of a group of actors, institutions, interaction relationship and productive processes that influence the direction of development and speed of innovation and its diffusion (including technology and good / best practice) and the learning process [2]. The essence of the innovation system is networking.

Some notions of innovation networks are as follows:

1. Interaction between individuals or institutions/organizations.
2. Interaction between universities, industry, and government (Triple Helix Interaction), which is supported by infrastructure, whether it is technical, commercial, social, or financial [3].
3. Interaction between actors in the innovation system, so that the flow of knowledge, innovation, diffusion, and learning takes place between them to increase the economic competitiveness and social cohesion [1].

Innovation networks not only connect innovation actors but also strengthen social cohesion and eliminate the silo effect. Technology infrastructure support, knowledge content support, and quality information sharing that are managed well at all levels; Micro, Meso, and macro are needed.

The development of innovation networks aims to build linkages and partnerships between actors, as well as to dynamize the flow of knowledge, innovation, diffusion, and learning as a strategic initiative of innovation system strengthening in Indonesia as an integral part of development.

And the main objectives of the development of innovation networks are (1) The development of "infrastructure and innovation network infrastructure"; (2) The development of a "thematic superstructure of innovation systems"; (3) The development of innovative partnership models; (4) The improvement of innovation potential and innovation outcome.

National Innovation System (SIN) is a concept of network arrangement that is conducive among actors/institutions of innovation in a collective system of creation, dissemination (diffusion), and the use (utilization) of science to achieve innovation [4].
The main actors of innovation can be grouped into 3 (three) subsystems, namely (1) The political subsystem consists of government actors (legislative, executive and judiciary); (2) Education, research and development (innovation provider) subsystems which may consist of professional education and training actors, higher education and industrial/private research institutions and government research; (3) The industrial subsystem consists of companies (large, medium and MSME).

While the supporting actors are (1) Actors involved in the development of supporting infrastructure such as banking institutions and IPR and information institutions, (2) Actors involved in the intermediary process are independent institutions engaged for linking research activities with productive/industrial activities.

The operational level of the national innovation system moves interactively and mutually synergizes among the actors so that they can produce innovative technology products and have competitiveness (competitive) in the world market [5]. There is a tendency to see networks in the narrow sense that is the interaction between universities, industry, and government [3].

The benefits of innovation networks in theory and empirical evidence (OECD, 2001) are as follows:

1. Expanding the customer base. The ability of an SME can be improved if it can achieve synergies between different technological competencies and between technological innovation and organizations.
2. Joint costs and risks. Innovation costs are exceptionally high. By joining an innovation network, the high costs and risks of innovation can be shared based on cooperation agreements.
3. Ability improvement. The innovation network helps SMEs to deal with the complexities of various sources and forms of technology. This reinforces the need for skills to collaborate with other members in various fields of expertise.
4. Learning improvement. Continuously changes in the market and technology make UKM must be adaptive through continuous learning. Collaboration in innovation networks can enhance learning about new technologies that can help existing businesses.
5. Flexibility and efficiency in knowledge management. Innovation networks can facilitate the exchange of all kinds of knowledge based on mutual trust, including between large and small companies.
6. Speed. An innovation network can collect a package of resources to capture opportunities that may be beyond the capacity of the company.

3. Study results

3.1. The mapping of the Pekalongan city's minapolitan innovation network based on captured fisheries

The percentage actors/institutions composition that was mapped is central government actors/institutions/actors at 27%, local government at 18%, research and development institutions and universities at 23%, financial institutions at 8%, the industry at 8%, intermediary institutions at 6%, and associations at 10%. In general, the central government and R&D institutions are the most mapped institutions.

The percentage analysis results of innovation network linkage patterns for knowledge flow relationships are coordination at 39.7%, research at 13.7% and access to technology, access to human resource development (HRD), and legal access at 13.1% for each. The results of the analysis for the relationship of knowledge flow can be seen in Figure 1.
Figure 1. The linkage pattern of Minapolitan knowledge flows relationship based on capture fisheries in Pekalongan City (Source: Primary data processed).

Whereas, the highest business relationship is market access, which is at 58.65% and access to finance at 41.35%.

The most widely given information from actors/institutions is the regional development program, which is at 26.09%. Second is regional potentials, business/market networks, and others at 13.04%, respectively. The third is technology design, sources of financing, and quality standardization at 8.7%, respectively. And the fourth is the development of HR and Intellectual Property Rights (IPR)/patents, each at 4.35%. The results of the analysis for the relationship of knowledge flow can be seen in Figure 2.

Figure 2. Information submitted by the actor/institution to partners (Source: Primary data processed).

The flow of information and knowledge is sufficient, but a more in-depth study must be conducted to see whether the information and knowledge provided is following what is needed by actors/institutions. Data percentage of technology design knowledge flow must be enlarged, especially for technological designs needed by the Small and Medium Enterprises (SME) fisheries industry.

The facilities and infrastructure that have been prepared in the context of the interaction between actors/institutions/actors in the innovation network are Information and Communication Technology
(ICT), which is at 41.17%. Second is an institution, namely at 29.41%, databases, and others at 23.53% and 5.88%, respectively. This data shows that the innovation network infrastructure prepared for knowledge transfer is sufficient and sophisticated because the largest percentage is ICT. The biggest procurement of ICT network infrastructure is technology equipment, which is at 33.34%, software and hardware data at 22.22%, then databases and others at 11.11%, respectively.

This indicates that the City Government (Pemkot) of Pekalongan is very serious about improving ICT facilities and infrastructure to facilitate the flow of knowledge.

Regarding the media promotion and marketing of fishery products, the largest percentage (56.25%) is through the Development Exhibition, which is usually conducted once a year. The second-largest percentage is through the local government website, which is at 31.25%. The results of the analysis show that the promotion and marketing activities of fishery product frequency are mostly done once/year (55.56%), the second is done more than three times/year, which is 33.33% and twice a year is at 11.11%.

For policies that support the innovation network, the survey results show that currently, there is no policy support from the Pekalongan City Government that is related to the capture fisheries-based minapolitan innovation network.

3.2. Analysis of capture fisheries-based minapolitan innovation networks

3.2.1. Network density analysis. The analysis result of the innovation network – knowledge flows relationship shows that only 502 knowledge flows relationships were found. Thus provide a network density value of 0.15. This density value gives information that the observed innovation network is not complete (complete network density value = 1). The level of connectivity between actors in this network is still small and shows weak social cohesion or solidarity between actors/institutions. The results can be seen in Figure 3.

The average distance analysis results that need 2,073 steps to reach the actors/institutions target shows that the information can flow fairly quickly on this network. So most of actors/institutions inflowing the information are not more than three steps from other actors/institutions. It means that it is quite efficient in inflowing information. But based on the results of the analysis, there is still a small number that needs to do it in 3-4 steps.
The analysis result of innovation networks - business relationships in Figure 4 above shows that 120 business relationships were found, giving a network density value of 0.04. This density value gives information that the network formed is not complete. The level of connectivity between actors in this network is still small, and this also shows weak social cohesion or solidarity among actors institutions.

The result of a large average distance analysis of 3,572 steps needed to reach the target actor/institution shows that information flows slowly on this network. Actors/institutions must take more than four steps from other actors/institutions. This means that the network of business relationships is not efficient. Even based on the results of the analysis, many actors/institutions have to do it in 5-9 steps.

3.2.2. Actor individual analysis. The results of the analysis show that the PPK Office, Bappeda, and the Regional Secretariat of Pekalongan City are the central institutions that have the most relationships compared to other institutions. These three institutions have very important functions.

a. The institution that has the most (central) relationship with other institutions is the DPPK, which has 30 relationships, and the second most are Bappeda [6] and HNSI of Pekalongan City, each with 23 relationships.
b. The total number of relationships that occurred from 51 mapped institutions was 502 relationships.
c. The average number of relationships that occur is as much as 9,843 relationships. It can be seen in Figure 5.

Figure 4. Visualization of innovation networks - business relationships

Figure 5. Visualization of innovation networks-degree centrality for knowledge flows relationship.
For the analysis of business relationship/relationships networks, the results showed that Bappeda, DPRD, PPK Office of Pekalongan City are the institutions that have the most business relations/relationships compared to other institutions. Bappeda and DPRD are very reasonable if they have the most business relations. This is due to the main tasks and functions of these two institutions for development planning and regional budget issues.

The PPK Office has the third-largest number of business relationships. This also following its function as an agency that deals directly with minapolitan activities and budgeting.

The results of the network analysis of business relationships are:

a. The institutions that have the most (central) business relationship with other institutions are Bappeda, which is 12 relationships, and the second most are the DPRD, PPK Office, and Pekalongan City LPM / LPPM, each with 9 relationships.

b. The total number of business relationships that occurred from 51 mapped institutions was 160 relationships.

c. The average number of business relationships is 3,137 relationships. It can be seen in Figure 6.

![Figure 6. Visualization of innovation networks - degree centrality for the business relationship.](image)

4. Conclusions and suggestions

4.1. Conclusions

1. The results of the analysis show that the number of relationships of innovation networks for the flow of knowledge and business the average is at 2.09-19.69% of the maximum number of relationships that should occur.

2. If the value of the innovation network density that occurs is smaller than 1 (one) based on the information of the density value, then it can be concluded that the innovation network formed is not complete (complete network density value = 1).

3. In general, the level of connectivity between actors/institutions in business innovation networks is still small. This shows that there is weak social cohesion or solidarity among actors/institutions.

4. The actors/institutions that have the most relations (central) with other institutions in terms of knowledge flow innovation network are the Agriculture, Animal Husbandry, and Maritime Services (PPK Office), with 30 relationships. And the second most are Bappeda and HNSI Pekalongan City, each as many as 23 relationships.

5. Actors/institutions that have the most (central) relationship with other institutions in the business innovation network are Bappeda, which is 12 relationships, and the second most are DPRD, PPK Office, and Pekalongan City LPM/LPPM, each with as many as 9 relationships.
4.2. Suggestions

1. To increase the level of connectivity between actors/institutions in the business innovation network can be done through (a) the establishment of a special forum that is held periodically as a medium of interaction/communication/coordination for actors/institutions in a business innovation network; (b) the implementation of OMC (Open Method of Coordination).

2. To increase the connectivity pattern of knowledge flow relationships by aligning technology availability with needs, which means trying to increase the role of R&D and tertiary institutions and opening up access to technology outside Pekalongan.

3. To expand/enhance business networks in the following steps: (a) by creating/building conducive business conditions (regulations that support and eliminate thuggery); (b) Improve business facilities (prepare facilities and infrastructure); (c) Build business facilities through e-markets; (d) Increase the use of local government websites.

4. It is necessary to improve conducive business environment conditions such as (a) by improving port management as a center for business transactions to become more conducive; (b) by increasing security and convenience in fishery products business transactions.

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