

Strategic policy for small-scale fisheries management in Semarang City, Indonesia

¹Jamaludin Malik, ²Achmad Fahrudin, ²Dietrich G. Bengen, ²Taryono

¹ Study Program of Coastal and Marine Resources Management, Graduate School of IPB University, Bogor, Indonesia; ² Faculty of Fisheries and Marine Science, IPB University, Bogor, Indonesia. Corresponding author: J. Malik, jamesmely@gmail.com

Abstract. Small-scale fisheries in Semarang City play an important role, because the entire fishing fleet is small (< 10 GT). However, its existence received little attention, because the contribution of the fisheries sector to the Gross Regional Domestic Product (GRDP) of Semarang City was relatively small. The development of the number of fishing units in small-scale fisheries in Semarang City every year always increases, while on the other hand the catches or fisheries production begin to decline from 2015 to the present. The continued operation of non-environmentally friendly fishing gear, such as Arad (a type of trawl), and the implementation of legislation policies that have not been effective have made the problem of small-scale fisheries in Semarang City more complex. The purpose of this study is to review the strategic policy of small-scale fisheries management in Semarang City based on the elements of actors, elements of constraints, elements of needs and elements of the program to be sustainable. The data analysis method used in this study is using the Interpretative Structural Modeling (ISM) technique. The results obtained in this study showed that there are four system elements in the strategic policy of small-scale fisheries management in Semarang City, namely actor elements, constraint elements, elements of needs and program elements. As the main actor in small-scale fisheries management in Semarang City are fisher and the Semarang City Fisheries Agency; the main constraints are over-capacity, decreasing catches, environmentally unfriendly arrests and ineffective regulation; the main needs are the need to conserve fish resources and increase fisher's income; and the main program is limitation environmentally unfriendly fishing gear.

Key Words: strategic policy, fisheries management, small-scale fisheries, ISM.

Introduction. The existence of small-scale fisheries in Semarang City is vital. In terms of quantity, based on 2017 of Central Java fisheries statistics, fisheries in Semarang City are 100% small-scale fisheries, namely fisheries with fishers who use fishing fleets up to 10 gross tons. Although the overall fisheries in Semarang City are small-scale fisheries, their presence has received little attention.

According to BPS data, figure of Semarang City in 2017, recorded GRDP at constant 2010 prices according to business fields in Semarang City in 2016, for the fisheries sector along with agriculture and forestry amounting to IDR 1,079.01 billion or 0.94% of total GRDP. This is indeed small for the contribution of the fisheries sector to the economy of Semarang City, but in Semarang City there are as many as 1,501 fishers (Semarang City Fisheries Agency 2017) that need attention. The number of fishers who conduct fisheries business with the number of fishing units, that always increase on one hand, while on the other hand fisheries production or catches since 2015 until now tend to decrease (over-exploited). This is worsened by the use of trawler (Arad) which is not environmentally friendly in fishing activities, so it needs strategic policy for small-scale fisheries management in Semarang City to be sustainable.

Centralized management policies tend to cause uneven distribution of resource rents between regions. While at the local level, decentralization is expected to restore traditional ownership rights which in a centralized system are not well developed. According to Dang et al (2016) formal institutions including government agencies and legislative frameworks have not been effective in managing marine fisheries. Factors that influence the performance of formal institutions include weak capacity of government agencies, non-compliance with fisheries regulations, and policy failures. The failure of the

policy was caused by a conflict between development and conservation goals, and a top-down approach that ignored the socio-economic context and the natural conditions of fishing communities. This study aims to review the strategic policy of small-scale fisheries management in Semarang City based on the elements of actors, elements of constraints, elements of the need and elements of the program. Determining this strategic policy is very important for small-scale fisheries management in Semarang City to be sustainable.

Material and Method

Location and time of study. This study was conducted on the coast of Semarang City, Central Java Province, which is the North Coast of Java, and included as part of the Fisheries Management Area (WPP) 712. Data collection and analysis was carried out for 2 months, November-December 2018.

Types, sources and data collection methods. The types of data collected in this study were primary data which were sourced from the opinions of experts who were representative of stakeholders. The data collection method used was a structured interview technique, using a questionnaire. The total respondents were 4 peoples. This was in accordance with Hora (2004) who states that, the number of experts was adequate and has high precision, amounting to 3 to 6 people. The questionnaire was developed using the pairwise comparison method.

Data analysis method. The data analysis method used in this study was using the Interpretative Structural Modeling (ISM) technique. ISM is a methodology for identifying the relationship between certain items, which defines a problem or issue, used by researchers to identify and analyze the main factors that influence the implementation and relationship of hierarchies between each other (Yunna et al 2012; Attri et al 2013); as supply chain management modeling (Jayant et al 2015); developed to analyze complex problems in a system (Kholil & Tangian 2012; Dewangan et al 2015); the basic principles of theory, concepts, and calculations are used to achieve efficiency through graphics or network representation among ISM elements (Samantaray 2016). Furthermore, Saxena et al (1992), Marimin (2008), Madaan et al (2012), and Rizal et al (2016) explained about the use of ISM as an analysis tool for institutional development; to enrich and start supply chain activities within the organization; to analyze structural elements based on their contextual relationships; and for strategic policy planning.

Results and Discussion. Saxena et al (1992) explained that, the ISM technique has to do with interpretation of a complete object or system representation through the application of systematic and interactive graphical theory. Based on the results of the ISM analysis taken from the opinions of 4 experts as representations from stakeholders, carried out in November-December 2018, obtained 4 system elements in the strategic policy directions of small-scale fisheries management in Semarang City, namely actor elements, constraint elements, elements of needs and program elements.

Actor elements of the small-scale fisheries management strategic policy. The element of the actor intended in this study is the manager, who can be a person or profession or institution involved in small-scale fisheries management in Semarang City. There were 10 sub-elements that become sub-elements of actors in this study, as presented in Table 1.

Table 1

Sub elements of actors in small-scale fisheries management in Semarang City

<i>Code</i>	<i>Sub elements of actors</i>
A1	Fisher
A2	Fisherman institution (KUB/Pokmaswas)
A3	Central Java Province Fisheries and Marine Agency
A4	Semarang City Fisheries Agency
A5	Fisheries controller
A6	Port authority officer (Syahbandar)
A7	University
A8	Fish processing unit
A9	Village unit cooperatives (KUD)
A10	Banking/financial institution

In Table 1, there were 10 sub-elements of actors who were stakeholders in small-scale fisheries management in Semarang City. According to Levontin et al (2017), stakeholder participation was needed in fisheries governance policies. Mardle et al (2004) also stated that the strategic policies in fisheries management need to be accepted by all stakeholders. Fisheries management policies with many informed stakeholders and ecological, socio-economic, political, and scientific complexity can be considered as governance networks (Hartley 2010). This is because the delivery of information and knowledge is very important to share with stakeholders and affected parties (Van der Molen et al 2015; Runhaar et al 2016), as a result of policies made at the national level rarely filtered to provide benefits to fishermen (Ferrol-Schulte et al 2015).

This was certainly different from centralized decision making and concentrated power in government, so there was little exchange and cooperation between groups of fishermen (Marin & Berkes 2010). It was therefore necessary to include local perspectives for the future of small-scale fisheries by adapting to change as the main policy response that adopts an integrated fisheries perspective, strengthening institutions for collaboration and shared learning (Armitage & Marschke 2013). Local governments through decentralization have gained new authority regarding the management of marine fisheries with community-based management systems, which are rooted in traditional fishing communities (Satria & Matsuda 2003).

Based on the results of the determination of driving power and dependence power, the position of the sub-elements of actors could be shown in Figure 1.

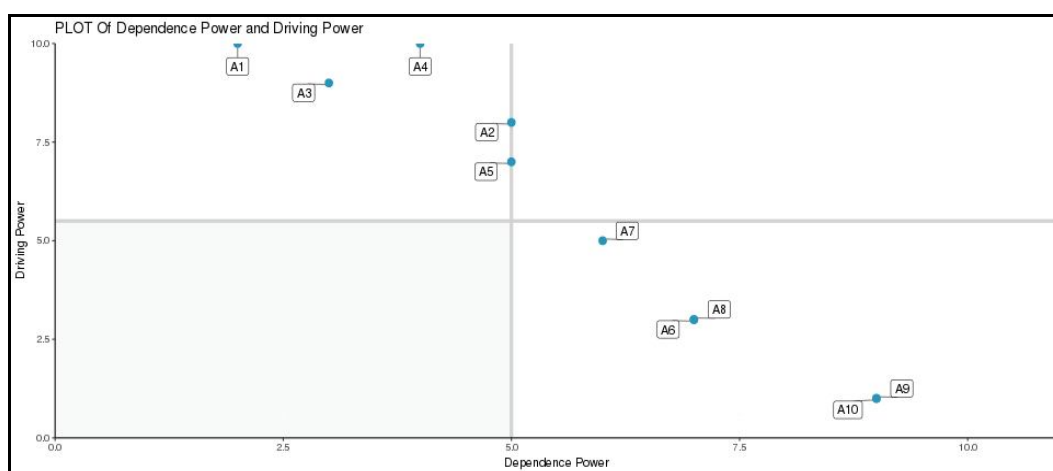


Figure 1. Positions of actors sub-elements.

In Figure 1, the position of each sub-element of actors in 4 sectors is shown by the results where the sub-elements of actors who have the most powerful driving power are sub-elements of actors A1 (fisher) and A4 (Semarang City Fisheries Agency). While for the most dependence power are sub-elements of actors A9 (KUD) and A10

(banking/financial institutions). Furthermore, to determine the structure/level of sub-elements of the main actors that are key in small-scale fisheries management in Semarang City can be determined based on the results of ranking and level determination which refers to the driver power and dependence values as shown in Figure 2.

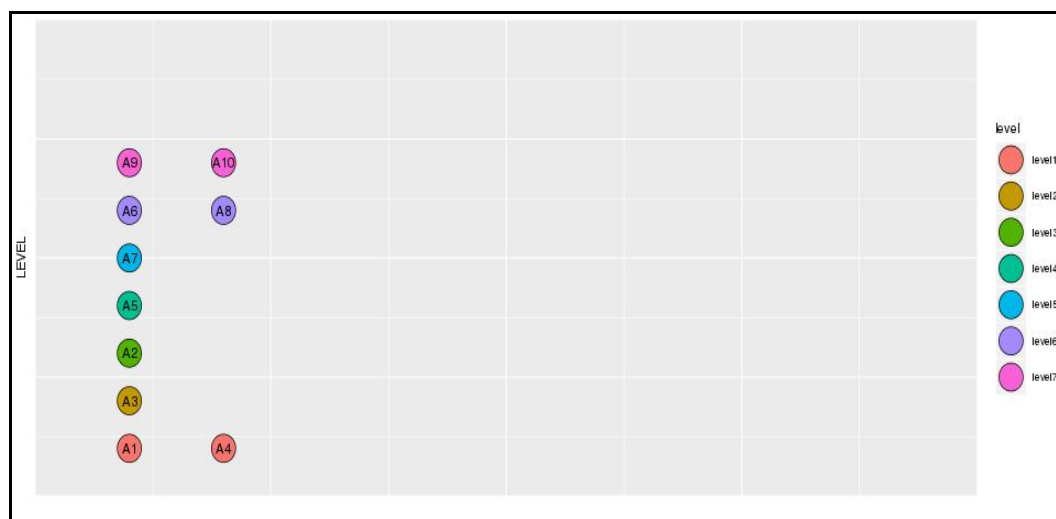


Figure 2. Structure/level sub elements of actors.

In Figure 2, it can be seen that the sub-elements of actors occupying level 1 are sub-elements of actors A1 (fisher) and A4 (Semarang City Fisheries Agency), so that the main actors in small-scale fisheries management in Semarang City are fisher (A1) and Semarang City Fisheries Agency (A4).

Constraint elements of small-scale fisheries management strategic policy. The obstacle elements intended in this study are the constraints or problems found in small-scale fisheries management in Semarang City. There were 11 sub-elements of constraints found in this study and can be seen in Table 2 below:

Table 2

Sub elements of constraints on small-scale fisheries management in Semarang

Code	Sub-elements of constraints
A1	Over-capacity
A2	Over-fishing
A3	Decreasing catches
A4	Environmentally unfriendly arrests
A5	Coastal damage (rob and abrasion)
A6	Lack of fisher's income
A7	Limitations on adequate facilities and technology
A8	Lack of handling fishery products
A9	Lack of institutional mechanisms
A10	Ineffective regulation
A11	Ineffective fisheries governance

In Table 2 there were 11 sub-elements which become obstacles in small-scale fisheries management in Semarang City. The eleven sub-elements of the constraints were interrelated with each other, so the main constraints need to be determined which are the key issues in small-scale fisheries management in Semarang City. Based on the results of driving power and dependence power, the position of the sub-elements of the main constraints can be obtained as shown in Figure 3.

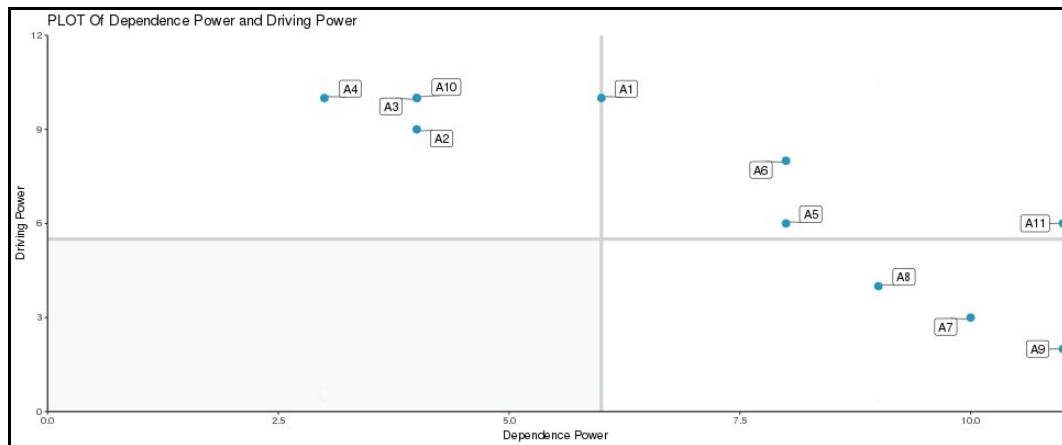


Figure 3. Positions of constraints sub-elements.

In Figure 3 we showed the position of sub elements of the constraints A1 (over-capacity); A3 (decreasing catches); A4 (environmentally unfriendly arrests) and A10 (ineffective regulation) have the greatest driving power, which is more than value 9. While based on the results of ranking and level determination which refers to the driver power and dependence values to determine structure/level the main sub element of constraints or key are shown in Figure 4.

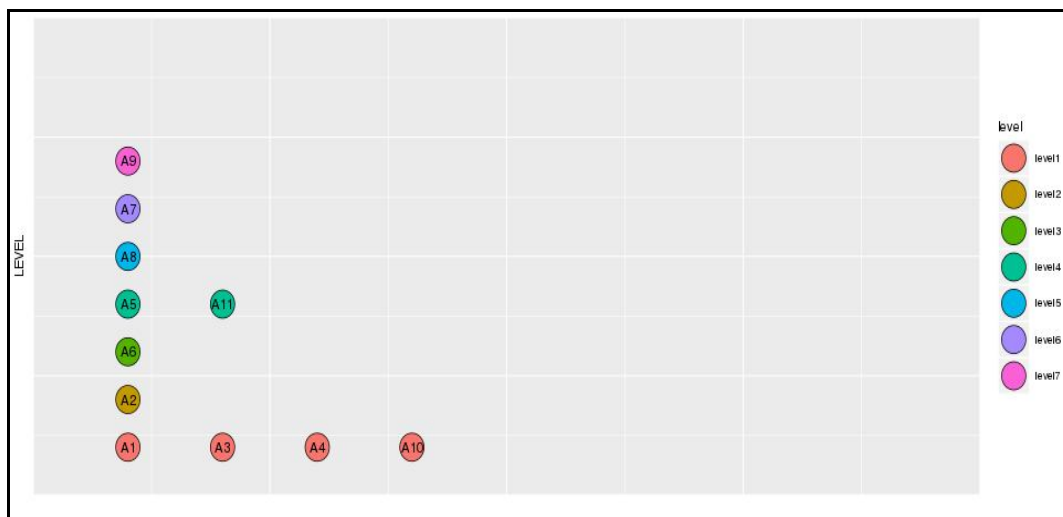


Figure 4. Structure/level sub elements of constraints.

In Figure 4 is explained the sub-element constraints that occupy level 1 are sub-elements of the constraint A1 (over-capacity); A3 (decreasing catches); A4 (environmentally unfriendly arrests) and A10 (ineffective regulation), so that the main obstacle in small-scale fisheries management in Semarang City is the presence of over-capacity (A1); decreasing catches (A3); environmentally unfriendly arrests (A4) and ineffective regulation (A10).

There was an obstacle to over-capacity in small-scale fisheries in Semarang City in accordance with Pomeroy et al (2008), which conveys the need for small-scale fisheries policies by restructuring fisheries near the coast to overcome over-capacity. Quetglas et al (2016) further explained that small-scale fisheries management is carried out to reduce over-capacity and improve the health of fish stocks (catches). Whereas the constraints related to fisheries regulations that have not been effective, among others, are supported by Moon & Conway (2016), which states fishermen's compliance with regulations remains high because they have little choice but to follow these rules; fisheries regulation is expected to respond effectively to environmental dynamics that reflect social and political complexity which creates difficulties in planning and policy

implementation (Song et al 2013); corruption of public officials can damage willingness to comply with fisheries regulations (Sundstrom 2012).

The need elements of small-scale fisheries management strategic policy. The elements of need intended in this study are all necessary needs related to policies that will be applied in small-scale fisheries management in Semarang City, which are then presented in Table 3.

Table 3

Sub elements of the needs for small-scale fisheries management in Semarang

Code	Sub-elements of needs
A1	Arrest capacity setting
A2	Conservation of fish resources
A3	Coastal damage management
A4	Fisher's income increase
A5	Availability of adequate facilities and technology
A6	Fulfillment of animal protein and nutrition
A7	Effectiveness of legislation
A8	Effectiveness of fisheries governance

In Table 3, there were 8 sub-elements that are needed in small-scale fisheries management in Semarang City. The eight sub-elements of these needs are interrelated with each other, so it is necessary to determine the main needs that are key in small-scale fisheries management in Semarang City. Based on the results of the determination of driving power and dependence power, the position of the sub elements of the main needs can be obtained as shown in Figure 5.

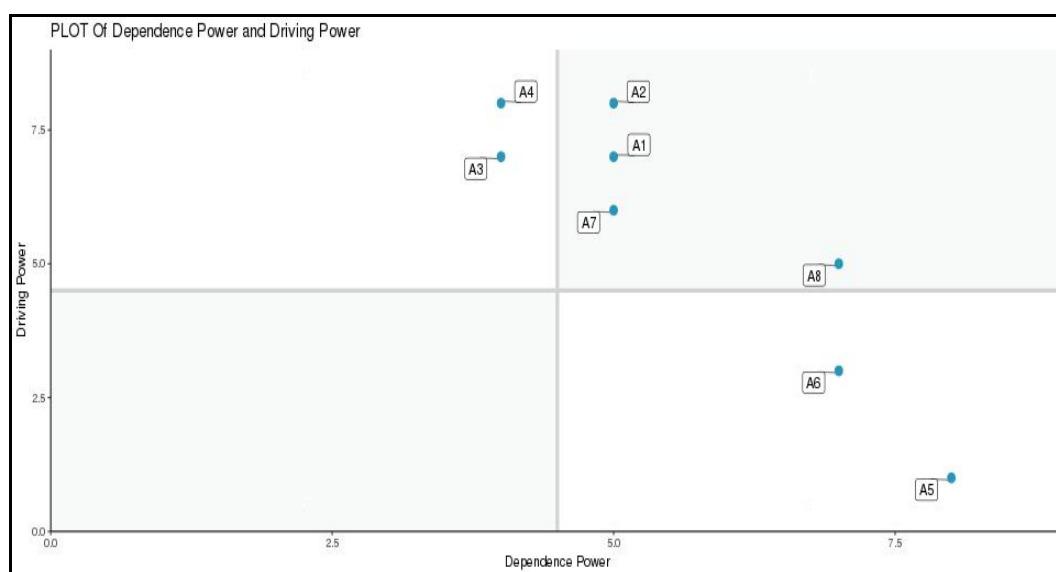


Figure 5. Positions of needs sub-elements.

In Figure 5, it can be seen that the position sub-elements of needs A2 (conservation of fish resources); and A4 (fisher's income increase) have the highest driving force or driving power, which is more than 7.5. While based on the results of ranking and level determination that refers to the power and dependence driver values in order to determine the structure/level of the sub element of the main needs or key is shown in Figure 6.

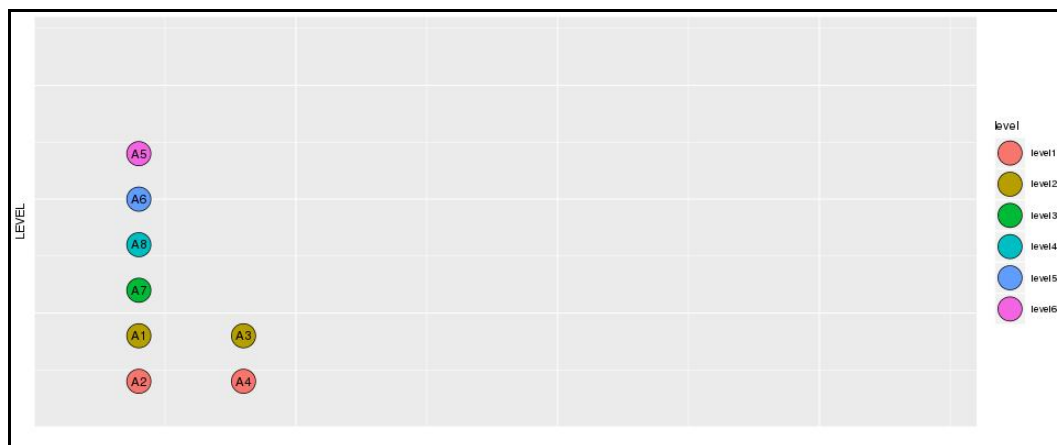


Figure 6. Structure/level sub elements of needs.

The Figure 6 showed that the sub-elements of needs that occupy level 1 are sub-elements of needs for A2 (conservation of fish resources) and A4 (fisher's income increase), so that the main need for small-scale fisheries management in Semarang City is the need for conservation of fish resources (A2) and fisher's income increase (A4). Conservation of fish resources and fisher's income increase are two things that tend to be contradictory, because conservative parties are usually at odds with economic parties. According to Okemwa et al (2017), balancing sustainability and conservation concerns with the socio-economic needs of small-scale fisher is a dilemma usually faced by fisheries managers. However, these managers can determine the regulatory steps agreed upon by stakeholders, including restrictions on fishing gear or fishing units that are not environmentally friendly.

Fish resource conservation in small-scale fisheries management in Semarang City is intended to protect fish resources from the use of fishing equipment that is not environmentally friendly. This is related to the selectivity of the fishing gear used which tends to be destructive to the ecosystem and the existing environment, because it is in the form of trawl (Arad) which can capture almost all existing species, include all juvenile.

Fisheries management policies are related to increasing fisher's income, there has been a paradigm shift in small-scale fisheries management, namely from approaches that are mostly resource-centered to approaches that are more people or community centered, and recognize the rights of fishermen as humans (Sowman et al 2013). In small-scale fisheries in Semarang City, this policy can be applied in the form of economic empowerment to coastal communities or fishers. According to Febri et al (2017), fisher's wife can also participate and have an important role in helping the family economy, especially in household, productive and social activities. Furthermore, Suharno et al (2018) explained that fishers can increase their income by diversifying their businesses, such as fish processing, ship-building, and strengthening the management of fisheries resources by forming groups.

Program elements of small-scale fisheries management strategic policy. The program elements that can be applied as alternatives in the strategic policy of small-scale fisheries management in Semarang City are presented in Table 4.

Table 4

Sub-elements of programs in small-scale fisheries management in Semarang

Code	Sub-elements of programs
A1	Limitation environmentally unfriendly fishing gear
A2	Mangrove planting
A3	Fisher empowerment
A4	Availability of alternative livelihoods
A5	Revitalization of TPI, PPI and hygienic fish market
A6	Value added fish products
A7	Regional regulation on fisheries management
A8	Fisheries governance according to regulations

In Table 4, it explained that there were 8 sub-elements that become the programs in small-scale fisheries management in Semarang City. The eight sub-elements of the programs are interrelated with each other, so the main program needs to be determined which is the key in small-scale fisheries management in Semarang City. Based on the results of the determination of driving power and dependence power can be obtained the position of the main program sub elements as shown in Figure 7. Whereas based on the results of ranking and level determination that refers to the driver power and dependence values to determine the structure/level sub element of the main program that is key is shown in Figure 8.



Figure 7. Positions of the programs sub-elements.

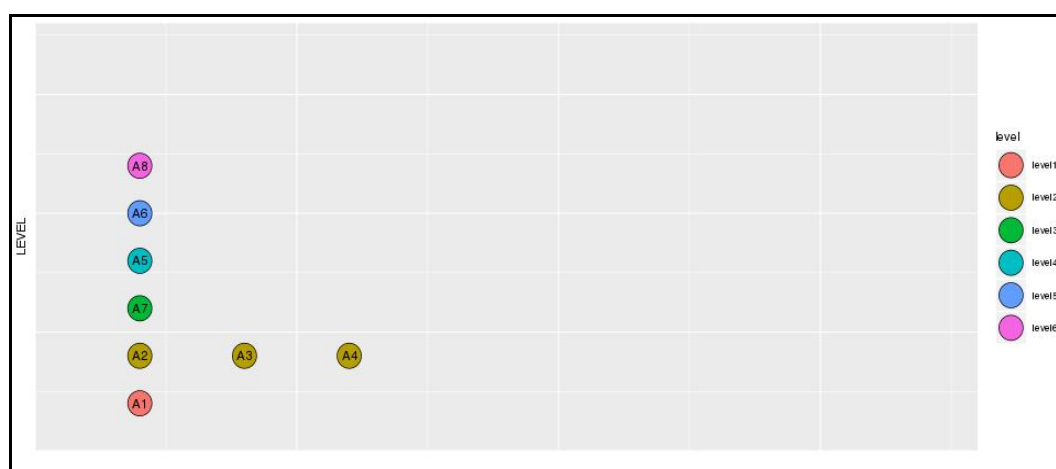


Figure 8. Structure/level sub-elements of the programs.

In Figure 7 it is showed that the position of sub-element program A1 (limitation environmentally unfriendly fishing gear) has the highest driving force or driving power

that is more than 7.5. Whereas in Figure 8, it can be seen that the sub-elements of the program that occupy level 1 are sub-elements of the program A1 (limitation environmentally unfriendly fishing gear), so that the main program in small-scale fisheries management in Semarang City is the limitation environmentally unfriendly fishing gear (A1).

According to Song et al (2013), fisheries governance can respond to environmental dynamics that pose difficulties in planning and implementing policies. These environmental dynamics influence the impact of fisheries management strategies on stocks and fleets (Garcia-Carreras et al 2015). Fisheries management based on effort can use the limits of allowed fishing gear (Motos & Wilson 2006). Innes & Pascoe (2010) explained, fishing gear has many impacts on the marine environment, and policies are implemented to reduce the impact on environmental damage. Arrests that adversely affect the environment such as the capture of non-target species, including small fish with fishing gear such as trawlers, need a recommendation for policy makers to base their decisions on situations where the use of fishing equipment that is not environmentally friendly is unacceptable (Sala et al 2018).

Conclusions. There are four system elements in the strategic policy of small-scale fisheries management in the Semarang City, namely actor elements, elemental constraints, elements of needs and program elements. As the main actor in small-scale fisheries management in Semarang City are fisher and the Semarang City Fisheries Agency; with the main constraints are over-capacity, decreasing catches, environmentally unfriendly arrests and ineffective regulation; the main needs are the need to conserve fish resources and increase fisher's income; and the main program is limitation environmentally unfriendly fishing gear.

References

- Armitage D., Marschke M., 2013 Assessing the future of small-scale fishery systems in coastal Vietnam and the implications for policy. *Environmental Science and Policy* 27:184-194.
- Attri R., Dev N., Sharma V., 2013 Interpretive Structural Modelling (ISM) approach: an overview. *Research Journal of Management Sciences* 2(2):3-8.
- Dang N. B., Momtaz S., Zimmerman K., Nhung P. T. H., 2016 Effectiveness of formal institutions in managing marine fisheries for sustainable fisheries development: a case study of a coastal commune in Vietnam. *Ocean Coastal Management* 137:175-184.
- Dewangan D. K., Agrawal R., Sharma V., 2015 Enablers for competitiveness of Indian manufacturing sector: an ISM-Fuzzy MICMAC analysis. *Procedia - Social and Behavioral Sciences* 189:416-432.
- Febri S. P., Wiyono E. S., Wisudo S. H., Haluan J., Iskandar B. H., 2017 The role of women in small-scale fisheries of Langsa City, Aceh, Indonesia. *AACL Bioflux* 10(2):402-409.
- Ferrol-Schulte D., Gorris P., Baitoningsih W., Adhuri D. S., Ferse S. C. A., 2015 Coastal livelihood vulnerability to marine resource degradation: a review of the Indonesian national coastal and marine policy framework. *Marine Policy* 52:163-171.
- Garcia-Carreras B., Dolder P., Engelhard G. H., Lynam C. P., Bayliss-Brown G. A., Mackinson S., 2015 Recent experience with effort management in Europe: implications for mixed fisheries. *Fisheries Research* 169:52-59.
- Hartley T. W., 2010 Fishery management as a governance network: examples from the Gulf of Maine and the potential for communication network analysis research in fisheries. *Marine Policy* 34:1060-1067.
- Hora S. C., 2004 Probability judgments for continuous quantities: linear combinations and calibration. *Management Science* 50:597-604.
- Innes J. P., Pascoe S., 2010 A multi-criteria assessment of fishing gear impacts in demersal fisheries. *Journal of Environmental Management* 91:932-939.

- Jayant A., Azhar M., Singh P., 2015 Interpretive Structural Modeling (ISM) approach: a state of the art literature review. *IJRMET* 5(1):15-21.
- Kholil, Tangian D., 2012 Institutional models of Bunaken National Park (BNP) management to ensure sustainability of ecological and economic functions. *International Journal of Development and Sustainability* 1(2):391-401.
- Levontin P., Baranowski P., Leach A. W., Bailey A., Mumford J. D., Quetglas A., Kell L. T., 2017 On the role of visualisation in fisheries management. *Marine Policy* 78:114-121.
- Madaan J., Mangla S., Gupta M. P., 2012 Multi-objective decision modeling using Interpretive Structural Modeling (ISM) for Green Supply Chains. POMS 23rd Annual Conference, Chicago, Illinois, USA.
- Mardle S., Pascoe S., Herrero I., 2004 Management objective importance in fisheries: an evaluation using the Analytic Hierarchy Process (AHP). *Environmental Management* 33(1):1-11.
- Marimin, 2008 [Decision making on multiple criteria: techniques and applications]. Second Edition, Grasindo Widiarsana Indonesia, Jakarta. [in Indonesian]
- Marin A., Berkes F., 2010 Network approach for understanding small-scale fisheries governance: the case of the Chilean coastal co-management system. *Marine Policy* 34:851-858.
- Moon R., Conway F., 2016 Does the relationship between fishermen and enforcers impact regulatory compliance? *Marine Policy* 74:316-322.
- Motos L., Wilson D. C., 2006 The knowledge base for fisheries management. Elsevier Science, Oxford, 454 pp.
- Okemwa G. M., Maina G. W., Munga C. N., Mueni E., Barabara M. S., Ndegwa S., Thoya P., Ntheketha N., 2017 Managing coastal pelagic fisheries: a case study of the small-scale purse seine fishery in Kenya. *Ocean and Coastal Management* 144:31-39.
- Pomeroy R., Nguyen K. A. T., Thong H. X., 2008 Small scale marine fisheries policy in Vietnam. *Marine Policy* 33:419-428.
- Quetglas A., Merino G., Ordines F., Guijarro B., Garau A., Grau A. M., Oliver P., Massuti N., 2016 Assessment and management of western Mediterranean small-scale fisheries. *Ocean and Coastal Management* 133:95-104.
- Rizal M., Wiryawan B., Wisudo S. H., Solihin I., Haluan J., 2016 Institutional development strategy through Interpretive Structural Modelling (ISM) for gillnet fisher group in Barsela Aceh, Indonesia. *AACL Bioflux* 9(4):802-814.
- Runhaar H. A. C., van der Windt H. J., van Tatenhove J. P. M., 2016 Productive science-policy interactions for sustainable coastal management: conclusions from the Wadden Sea area. *Environmental Science and Policy* 55:467-471.
- Sala A., Lucchetti A., Sartor P., 2018 Technical solutions for European small-scale driftnets. *Marine Policy* 94:247-255.
- Samantaray L. L., 2016 The feasibility of reverse migration in Odisha: an application of ISM. *Imperial Journal of Interdisciplinary Research* 2(2):22-23.
- Satria A., Matsuda Y., 2003 Decentralization of fisheries management in Indonesia. *Marine Policy* 28:437-450.
- Saxena J. P., Sushil, Vrat P., 1992 Hierarchy and classification of program plan elements using ISM. *Systems Practice* 5(6):651-670.
- Semarang City Fisheries Agency, 2017 [Fisheries in the figure of Semarang City in 2017]. Disperik Semarang, 62 pp. [in Indonesian]
- Song A. M., Chuenpagdee R., Jentoft S., 2013 Values, images, and principles: what they represent and how they may improve fisheries governance. *Marine Policy* 40:167-175.
- Sowman M., Sunde J., Raemaekers S., Schultz O., 2013 Fishing for equality: policy for poverty alleviation for South Africa small-scale fisheries. *Marine Policy* 46:31-42.
- Suharno, Anwar N., Saraswati E., 2018 Do fishers need to diversify their source of income? A special reference in vulnerable fishers of Cilacap Waters, Indonesia. *AACL Bioflux* 11(5):1605-1615.

- Sundstrom A., 2012 Corruption and regulatory compliance: experimental findings from South African small-scale fisheries. *Marine Policy* 36:1255-1264.
- Van der Molen F., Floor J., Van Enst W., Seijger C., Giebels D., Puente Rodriguez D., Van Tatenhove J., Runhaar H., Van der Windt H., 2015 From frustration to integration: action strategies for a better fit between knowledge and policy on the Wadden Sea. Deltares, Utrecht.
- Yunna W., Qing B., Ping L., 2012 The ISM analysis on influence factors of cost control in the wind power construction project. *Physics Procedia* 24:587-590.

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Authors:

Jamaludin Malik, Study Program of Coastal and Marine Resources Management, Graduate School of IPB University, Bogor, Indonesia; Central Java Province Fisheries and Marine Agency, Imam Bonjol Street No. 134, Semarang 50132, Indonesia, e-mail: jamesmely@gmail.com

Achmad Fahrudin, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, IPB University, Bogor 16680, Indonesia, e-mail: fahrudina@pksplipb.or.id

Dietrich Geoffrey Bengen, Department of Marine Science and Technology, Faculty of Fisheries and Marine Science, IPB University, Bogor 16680, Indonesia, e-mail: dieter@indo.net.id

Taryono, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, IPB University, Bogor 16680, Indonesia, e-mail: tkodiran@yahoo.com

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