



Sustinere

Journal of Environment and Sustainability

Volume 1 Issue 1 (2017) 37–47

Print ISSN: 2549-1245 Online ISSN: 2549-1253

Website: <https://sustinerejes.com> E-mail: sustinere.jes@iain-surakarta.ac.id

RESEARCH PAPER

Carrying capacity and institutional analysis of floating net cages in Jatiluhur Reservoir

Nurmala Fitri Simangunsong*, Aceng Hidayat

Dept. of Natural Resource and Environmental Economic, Faculty of Economic and Management, Bogor Agricultural University, Indonesia

Article history:

Received 26 November 2016 | Accepted 30 March 2017 | Available online 24 July 2017

Abstract. The cultivation of freshwater fish with floating net-cages system in the area of Jatiluhur Reservoir, Purwakarta Regency has increased in quantity. It results in the pollution and sedimentation because of development of floating net-cages business which exceeds the carrying capacity of the reservoir. This research aimed to analyze the carrying capacity of Jatiluhur Reservoir, conduct the institutional analysis, and analyze the perception of stakeholders involved in floating net-cages management in Jatiluhur Reservoir. Interview and literature review were used as the primary and secondary data collection methods. The results showed that the number of floating net-cages units in accordance with the carrying capacity of Jatiluhur Reservoir was amounted to 6,838 floating net-cages. For the management of floating net-cages in Jatiluhur Reservoir, the Department of Animal Husbandry and Fisheries of Purwakarta Regency and Perum Jasa Tirta II have important roles in formulating regulations and providing guidance to the fish farmers. The transaction costs spent on formulating regulations and providing guidance by the Regional Government of Purwakarta Regency was amounted to Rp 689,400,000 per year while Perum Jasa Tirta II spent amounted to Rp 70,107,900 per year. Although stakeholders have common perception on ecological and economic aspects, they have different perception on the management aspects of floating net-cages.

Keywords: Carrying capacity; perception; regulation; stakeholder; transaction cost; floating net-cages

1. Introduction

Jatiluhur Reservoir has several functions in its construction purpose. One of its functions is as a location for the development of floating net-cages to give economic benefits to the communities around the reservoir. It is supported by the statement of Bramana (2015), "Aquaculture is one form of resource utilization that can be used as an alternative to improve living standards of society". Economic benefits which are obtained by people with the existence of KJA are including the increase in income and living

*Corresponding author. E-mail: nurmala@gmail.com
DOI 10.22515/sustinere.jes.v1i1.6

standards, expansion of employment opportunities, and the fulfillment of the consumption of fish protein sources.

Those economic benefits as a result of floating net-cages encourage people to continue developing floating net-cages. This statement is supported by research results from Widyastuti (2005) who said that the aquaculture activities of floating net-cages is a freshwater fishery business that can be developed intensively with a limited water area and artificial feeding, thus the aquaculture of floating net-cages is potential for development on an industrial scale. The factor that the input is easily accessible is one of the reasons why people continue expanding floating net-cages, resulting the total number of existing floating net-cages have exceeded the ecological carrying capacity of the reservoir. Whereas, the development of floating net-cages should always consider the quality and sustainability of water reservoirs for the sustainability of floating net-cages business. The development of floating net-cages business is determined by contamination from residual that feed into the waters, such as phosphor and nitrogen because it can trigger eutrophication process. If there is an upwelling process in the territorial waters of the reservoir, it will cause mass mortality in fish cultivation of floating net-cages. The activities of floating net-cages in Jatiluhur Reservoir have not considered the carrying capacity aspect, thus it causes a decrease in quality of reservoir water.

The implementation of the aquaculture should concern about the ecological principles, so that the negative impact of aquaculture activities can be avoided. Aquaculture technology which was initiated by Effendi (2004) such as construction of container production; selection of aquaculture site; determination of cropping patterns; use of improved seeds and appropriate stocking density; feeding an appropriate quantity, quality, time, and method; control for pests and diseases; water management; regular monitoring; as well as harvesting and post-harvest handling can be done as an effort to avoid the negative impact caused by the activity of aquaculture because it is based on ecological carrying capacity of the waters. Meanwhile, based on research results by Siagian (2012), the calculation of the environmental carrying capacity of the reservoir is conducted to determine the ability of these reservoirs in support of a number of fish biomass, so the number of optimum floating net-cages units which is in accordance with the carrying capacity of the reservoir can be estimated. Therefore, the calculation of the carrying capacity of Jatiluhur reservoir needs to be done as a first step in estimating the number of optimum floating net-cages, so that the negative impact of floating net-cages activities can be avoided.

The institutions in Jatiluhur Reservoir are not only limited to the management of reservoir but also the management of floating net-cages aquaculture activities. According to the research of Nasution (2005), "Management and utilization of reservoir aquatic environments that is related to the presence of floating net-cages should consider the institutional aspects". A good institution can restrict the number of floating net-cages units by giving permission to floating net-cages business based on the rule of legislation and looking at the ecological carrying capacity of the reservoir.

The management of floating net-cages in Jatiluhur Reservoir is carried out by local government, state-owned enterprises, government and non-governmental institutions, and fish farmers and each of these parties have different perceptions. These different

perceptions may influence the decision-making or achievement goals of KJA management in Jatiluhur Reservoir. Therefore, it is necessary to identify the perceptions of all parties in order to increase the productivity of floating net-cages and maintain or improve the quality of the reservoir environment.

Based on the description above, there are several issues which are interesting for the research, such as how is the carrying capacity analysis of Jatiluhur Reservoir related to floating net-cages business? How is the institutional analysis of floating net-cages management in Jatiluhur Reservoir? How is the analysis of stakeholders' perceptions who are involved in floating net-cages management in Jatiluhur Reservoir?

2. Research methods

2.1. Location and research team

The research was conducted in Jatiluhur Reservoir, Jatiluhur Sub-District, Purwakarta Regency, Province of West Java. The specific location was chosen after considering that the number of KJA units in Jatiluhur Reservoir has exceeded the ecological carrying capacity of the reservoir. Data were collected from March until June 2016.

2.2. Types and sources of data

This study used primary and secondary data. The primary data was obtained through direct interview to the managers of Jatiluhur Reservoir, fish farmers in floating net-cages, the government, and other related institutions. The secondary data was obtained through government and non-governmental institutions who have data about floating net-cages and Jatiluhur Reservoir, such as Statistics Indonesia (BPS), Department of Animal Husbandry and Fisheries of Purwakarta Regency, Regional Government of Purwakarta Regency, Perum Jasa Tirta II as state owned enterprise, and other related institutions.

2.3. Sampling methods

The model of floating net-cages management in Jatiluhur reservoir by fish farmers is homogeneous, that is the maximum ownership of floating net-cages unit is 20 units, limited to the some types of fish such as carp, tilapia and catfish, as well as the same type of feed. Therefore, the sampling technique used in this research was a snowball sampling. The criteria when selecting respondents were all people who were involved in the management of KJA and Jatiluhur Reservoir, a total of 57 respondents. The total of 50 fish farmers were considered to represent the population. The other seven respondents were stakeholders which consisted of the Head of the Fisheries Department of Animal Husbandry and Fisheries of Purwakarta Regency, Head Office Technical Implementation Unit Place Fish Landing (UPTD TPI), Head of Sub Division of Dam Perum Jasa Tirta II, Fisheries Agricultural Extension Associate, and three Chairman of the Supervisory Community (POKMASWAS).

2.4. The methods of data processing and data analysis

Data analysis used in this study was both qualitative analysis with descriptive analysis and quantitative analysis (Beveridge Method and Likert scale). Data analysis in the computer used Microsoft Excel 2013. The matrix linkage of the research purposes, data, and analysis can be seen in Table 1.

Table 1. The matrix linkage of the research purposes, data, and analysis

Research purposes	Data	Analysis
Analyzing the carrying capacity of Jatiluhur Reservoir related to KJA.	Type: secondary Source: literature	Beveridge Methods
Analyzing management institutions of KJA in Jatiluhur Reservoir.	Type: primary and secondary Source: Perum Jasa Tirta II, Department of Animal Husbandry and Fisheries of Purwakarta Regency, fish farmers, and literature review.	Analysis of the content and transaction costs
Identifying the perception of stakeholders who are involved in the management of KJA in Jatiluhur Reservoir.	Type: primary Source: Perum Jasa Tirta II, Department of Animal Husbandry and Fisheries of Purwakarta Regency, and fish farmers.	Descriptive statistical analysis with Likert scale

2.5. Beveridge methods

Based on research by Widyastuti et al. (2009), the carrying capacity of the reservoir can be calculated from the content of phosphor in the water. The steps to calculate the carrying capacity of reservoirs by the methods of Beveridge (1984):

$$L_{\text{fish}} = \frac{\Delta P \times z \times \rho}{1 - R_{\text{fish}}} \quad (1)$$

$$R_{\text{fish}} = x + (1 - x)R \quad (2)$$

$$R = \frac{1}{(1 + 0.5\rho^{0.5})} \quad (3)$$

$$\text{Total load of } P \text{ allowed} = L_{\text{fish}} \times A \quad (4)$$

$$P \text{ tons of pellets to grow} = P \text{ pellets per year} \times \text{conversion of pellets} \quad (5)$$

$$\begin{aligned} \text{Load of } P \text{ of intensive floating net-cages} &= P \text{ tons of pellets to grow} + \\ &\quad - P \text{ tons of tilapia} \end{aligned} \quad (6)$$

Carrying capacity of intensive floating net-cages:

$$\begin{aligned} \text{The number of fish that may be produced per year (tons)} \\ &= \text{total load of } P \text{ allowed} / \text{load of } P \text{ of intensive floating net - cages} \end{aligned} \quad (7)$$

$$\text{Total production of fish} = \text{average production of tilapia} \times \text{number of KJA} \quad (8)$$

Description:

L_{fish} = The capacity of phosphor per unit area of the reservoir for fishing ($\text{g}/\text{m}^2/\text{yr}$)

ΔP = The capacity of the reservoir to accommodate phosphor from KJA (g/m^3)

R_{fish} = Total of phosphor produced by fish from KJA activities

x = Proportion of total P which permanently into the base (50%)

R = Total of P retained by sediment

- ρ = The rate of water flushing (year⁻¹)
 z = Mean of reservoir depth (m)
 A = The width of reservoir (ha)

2.6. Content analysis

The management and utilization of Jatiluhur Reservoir that is relating to KJA business need clear regulations, so that the implementation will not negatively impact the territorial water of the reservoir. The formal regulations are including Act (UU), Regulation of the Minister (*Permen*), Ministerial Decree (Kepmen), Local Regulations (Perda) of West Java Province, Governor Decree of West Java Province, and Local Regulations (Perda) of Purwakarta Regency. On the other hand, the informal regulations are including an agreement among the public associated with KJA in Jatiluhur Reservoir. The regulations might come from government institutions and non-governmental institutions, such as community groups.

2.7. Transaction costs

According to Abdullah et al. (1998), the transaction costs consisted of the information costs, shared decision-making costs, and the joint operational costs. The transaction costs in this study were costs that would be spent to other party for the occurred rules. These rules can be formal or informal. The equation in transaction costs is:

$$TrC = \sum z_i \quad (9)$$

Description: TrC = Total of transaction costs (Rp/year)
 $\sum z_i$ = The component of transaction costs

Transaction costs are the costs that were incurred by local government and Perum Jasa Tirta II which is related to the management of Jatiluhur Reservoir and fishing activities in KJA. The component of information costs are including the cost of creating rules, while the shared decision-making costs are including banquet costs during the coordination meeting among stakeholders. The component of the joint operational costs are including the cost of coaching and training of fish farming business for the fish farmers, the cost of monitoring and controlling floating net-cages, and the cost for infrastructure development of Jatiluhur Reservoir.

2.8. The perception analysis

The analysis of stakeholders' perception usually used four aspects, such as ecological, economic, social, and institutional (management). This study focused on the aspect of ecological, economic, and management. While the parameters used in ecological aspect were the environmental conditions of Jatiluhur Reservoir and the presence of floating net-cages, parameters for the economic aspect were the opportunity to work and income from floating net-cages. Parameters for the management aspect were the understanding and implementation of the rules in floating net-cages business. The results of the analysis of this perception were then measured using Likert scale.

3. Result and discussion

3.1 Carrying capacity analysis of Jatiluhur Reservoir for floating net cages

The calculation of the carrying capacity and the capacity of a reservoir for aquaculture is determined based on the amount of waste cultivation and trophic status in the reservoir. The calculation of the carrying capacity of water in Jatiluhur Reservoir used Beveridge Methods with an assumption that the floating net-cages activities in Jatiluhur Reservoir were conducted intensively.

Calculation:

Formula	Calculation
R (the total proportion of P retained in the sediment) = $1 / (1 + 0,5\rho^{0,5})$ (Beveridge, 1996 in Widyastuti et al., 2009)	$= 1 / (1 + 0,5 \times 1,50^{0,5})$ $= 0,6202$
R_{fish} (the fraction of L_{fish} retained in the sediment) = $x + (1 - x) R$	$= 0,5 + (1 - 0,5) 0,6202$ $= 0,8101$
$L_{fish} = \Delta P \times z \times \rho / (1 - R_{fish})$	$= 50 \times 32,85 \times 1,50 / (1 - 0,8101)$ $= 12,973 \text{ kg/m}^2/\text{year}$
Total load of P allowed = $L_{fish} \times A$	$= 12,973 \text{ kg/m}^2/\text{year} \times 77\,800\,000 \text{ m}^2$ $= 1\,009\,299\,400 \text{ kg/year}$
P tons of pellets to grow = P of pellets per year x conversion of pellets	$= 12,7 \text{ kg} \times 2$ $= 25,4 \text{ kg}$
load of P of intensive KJA = P tons of pellets to grow - P tons of tilapia to grow	$= 25,4 \text{ kg} - 9 \text{ kg}$ $= 16,4 \text{ kg/year}$
carrying capacity of the intensive KJA: the number of fish that may be produced per year (tons) = total load of P allowed / load of P of intensive KJA	$= 1\,009\,299\,400 \text{ kg/year} / 16,4 \text{ kg/year}$ $= 61\,542 \text{ tons/year}$
Total production of fish	$= 3 \text{ tons} \times 23\,000 \text{ KJA plots}$ $= 69\,000 \text{ tons/harvest or } 207\,000 \text{ tons/year}$
excess number of fish production	$= 207\,000 \text{ tons/year} - 61\,542 \text{ tons/year}$ $= 145\,458 \text{ tons/year or } 48\,486 \text{ tons/harvest fish (assumption: harvest was occurred thrice a year)}$

Based on the results of these calculations, the number of floating net-cages in accordance to the carrying capacity of Jatiluhur Reservoir was about 6,838 units. However, according to the annual report of Perum Jasa Tirta II, the number of floating net-cages in

Jatiluhur Reservoir in 2014 was 23,000 units. It showed that it is necessary to reduce or restrict the number of floating net-cages in Jatiluhur Reservoir in order to minimize the level of water pollution due to the content of phosphorous. There are few steps that can be taken by the fish farmers of floating net-cages to increase the carrying capacity of Jatiluhur Reservoir, such as giving the feed according to the needs and the level of high digestibility, avoiding the use of materials that have the potential to pollute the environment, and making arrangements for stocking density.

3.2 The institutional analysis of floating net cages management in Jatiluhur Reservoir

Analysis of rules management of floating net cages in Jatiluhur Reservoir

The rules that regulate the management of floating net cages in Jatiluhur Reservoir are only formal rules. These formal rules are including the Purwakarta Regency Regulation No. 6 in 2010 about Licenses for Fishing Enterprises.

Stakeholders identification

Stakeholders who directly or indirectly get involved and coordinate with each other about the management of floating net-cages in Jatiluhur Reservoir are the Department of Animal Husbandry and Fisheries of Purwakarta Regency, Office Technical Implementation Unit Place Fish Landing, Perum Jasa Tirta II, Fisheries Agricultural Extension Associate, Investment Board and One Stop of Purwakarta Regency, Environmental Agency of Purwakarta Regency, the regulatory community groups, and fish farmers.

The governance structure of Jatiluhur Reservoir and Fisheries

Stakeholders that are associated with the management and utilization of Jatiluhur Reservoir for fishing activities can be classified as policy maker level (collective choice level) and operational level (operational level choice). The collective choice level are the level to supervise, coordinate, and make decisions while the operational level is the level of the basic activities. Stakeholders included in the collectice choice level are the Ministry of Maritime Affairs and Fisheries, the Fisheries Department of West Java Province, Department of Animal Husbandry and Fisheries of Purwakarta Regency, Board of Investment and Integrated Services One Stop of Purwakarta Regency, Environment Agency of Purwakarta Regency, and Perum Jasa Tirta II. On the other hand, stakeholders included in the operational level are the Technical Implementation Unit (UPTD), institutional and counseling section, POKMASWAS, a group of fish farmers, and fishermen groups.

The types of fisheries resource management in Jatiluhur Reservoir are coordination, consultative/coaching, instructive, and supervision. The type of coordination is the cooperation between the government/private sector and the fishery in making a decision as partners that have the same bargaining power (equal partner). The type of

consultative/coaching is a mechanism for dialogue between the government and the fishery, but decisions are still made by the government. The type of instructive is the lack of communication and information exchange between the government and the fishery. Besides, there are also types of supervision.

The structure model of governance in this study was conducted in two conditions, such as existing and recommendation. The modelling of good institutions was expected to establish KJA management that is environmentally sustainable, so it becomes a continuous business. In the existing governance structure of Jatiluhur Reservoir and fisheries, there were missing link between Perum Jasa Tirta II and fisheries agricultural extension associate and the relations between Perum Jasa Tirta II and fish farmers, namely the consultative relationship. This consultative relationship between three stakeholders can help increasing awareness of fish farmers to the preservation of the territorial waters of the reservoir and become the first step in the effort to secure the quality of the water in the reservoir. The governance structure of reservoir and fishery in the condition of existing and recommendation can be found in Appendix 1.

Identification and estimation the need of transaction fees

Based on the institutional analysis of the governance structure of Jatiluhur Reservoir and fishery, it is known that the main stakeholder in the management of Jatiluhur Reservoir and fishery is the Department of Animal Husbandry and Fisheries of Purwakarta Regency, which is the part of the Regional Government of Purwakarta Regency and Perum Jasa Tirta II.

a. Regional Government of Purwakarta Regency

Total of transaction costs spent by the Regional Government of Purwakarta Regency in the management of Jatiluhur Reservoir and fishery every year is Rp 689,400,000. The total of these transaction costs consist of the cost of shared decision-making such as the cost of banquets during the coordination meeting with other stakeholders amounted to Rp 17,500,000. and joint operational costs such as the cost of coaching and business training fisheries business and infrastructure fishery development costs amounted to Rp 671,900,000..

b. Perum Jasa Tirta II

Based on the analysis of transaction costs, it is known that the total transaction costs spent by Perum Jasa Tirta II in the management of Jatiluhur Reservoir every year is Rp 70,107,900. The total of these transaction costs consist of the cost of shared decision-making such as the cost of banquets during the coordination meeting with other stakeholders amounted to Rp 13,627,900 and the joint operational costs such as the cost of supervision and control floating net-cages amounted to Rp 56,480,000.

The analysis of stakeholders' perception in the management of floating net cages in Jatiluhur Reservoir

The perception analysis identify stakeholders who have a direct relationship associated with the management and utilization of Jatiluhur Reservoir as the location of the fish farming such as head of Fisheries Department of Livestock and Fisheries of Purwakarta Regenc, head Office Technical Implementation Unit Place Fish Landing (UPTD TPI), head of sub Division of Perum Jasa Tirta II, Fisheries Extension Associate, chairman of the Supervisory Society (Pokmaswas) Matahari, chairman of Pokmaswas Mandiri Jaya, chairman of Pokmaswas Hinpujat and the fish farmers.

a. Perception of environmental condition of Jatiluhur Reservoir and the presence of floating net-cages

Stakeholder perception is presented in Table 2. Stakeholders agreed that the presence of floating net-cages affected environmental condition of Jatiluhur Reservoir. It can be seen from the high growth in the amount of floating net-cages in Jatiluhur Reservoir which has exceeded the capacity of the reservoir. The increase in the number of floating net-cages would also increase the discharge of organic wastes derived from feed residue or waste from fish. These wastes then precipitated in the bottom of the reservoir which caused sedimentation and degraded the quality of reservoir water. Generally, Jatiluhur Reservoir was still able to support the activity of floating net-cages if it was supported by the good management, such as consider the amount of feed given, the cropping pattern and stocking density of fish seeds, and maintain the cleanliness of the reservoir by not littering of used construction of floating net-cages or plastic waste in the reservoir water.

Table 2. Analysis of stakeholders' perception for ecological aspects

Indicators	Stakeholder's perception		
	Min	Max	Mean
Quality of the reservoir environment	2	4	3.375
Level of pollution of reservoir	3	5	3.750
Carrying capacity of the reservoir for floating net-cages	2	4	3.500
The management of floating net-cages	2	5	3.625
The number of floating net-cages	4	5	4.625
Restrictions on the number of floating net-cages	3	5	4.500
		Average	3.895

Description: *) 1 = strongly disagree; 2 = disagree; 3 = quite agree; 4 = agree; 5 = strongly agree

b. Perception of job opportunities and income from floating net-cages

Stakeholders quite agreed that the presence of floating net-cages business in Jatiluhur Reservoir increased job opportunities and income to the local community, Perum Jasa Tirta II, and Purwakarta Regency (see Table 3). The presence of floating net-cages activities could empower both local and migrant labours, thereby reduced unemployment rate in the District of Purwakarta Regency. The number of households fisheries of Purwakarta Regency in 2014 were 3,405 people and the workers were 246 people.

Table 3. Analysis of stakeholders' perception for economic aspects

Indicators	Stakeholder's perception		
	Min	Max	Mean
Opportunity to work and try because of floating net-cages	4	5	4.750
Income from floating net-cages	1	3	2.500
		Average	3.625

Description: *) mean: 1 = Strongly disagree; 2 = Disagree; 3 = Quite agree; 4 = Agree; 5 = Strongly agree

C. Perceptions of understanding and implementing business rules of KJA

Stakeholders were quite understand about the rules related to fish farming with floating net-cages system in Jatiluhur Reservoir, as presented in Table 4. The rules had been arranged in details in Purwakarta Regency Regulation No. 6 of 2010 about Licenses for Fishing Enterprises. However, Pokmaswas said that the socialization about licenses for floating net-cages business from the Department of Livestock and Fisheries of Purwakarta Regency and Perum Jasa Tirta II was still unequal. The full terms for licenses of floating net-cages business in Jatiluhur Reservoir per 2016 was added with a Statement of Capability Management and Environmental Monitoring (SPPL) issued by the Environment Agency of Purwakarta Regency. SPPL will be issued by BLH of Purwakarta Regency if fish farmers have active SIUP, even though starting from 2015 that license could not be extended or renewed. Based on the interview with respondents, the fish farmers in Jatiluhur Reservoir wanted to extend their licenses in order to make the SPPL, but they were unable to do so. Fish farmers who did not have SPPL worried that their fishtraps would be dismantled.

Table 4. Analysis of stakeholders' perception for management aspects

Indicators	Perception		
	Min	Max	Mean
Understanding and implementing of business rules related to floating net cages	2	5	3,750
Understanding and implementing of business licensing process of floating net cages	2	5	3,500
		Average	3,625

Description: *) 1 = Strongly do not understand; 2 = Do not understand; 3 = Quite understand; 4 = Understand; 5 = Strongly understand

4. Conclusions

Based on the findings, it can be concluded that total of floating net-cages in its existing condition has exceeded the carrying capacity of Jatiluhur Reservoir. Based on the calculation using Beveridge methods, the number of floating net-cages which is in accordance with the carrying capacity of Jatiluhur Reservoir is 6,838 units. However, the number of floating net-cages in Jatiluhur Reservoir in 2014 was 23,000 units. It showed that reduction or limitation of the number of floating net-cages in Jatiluhur Reservoir is necessary to minimize the level of water pollution due to content of phosphor.

Additionally, the formal rules that regulated floating net-cages business in Jatiluhur Reservoir have fitted the needs of the people in fishery business. These rules were also included economic, environmental, and social issues related to fishery resources in Jatiluhur Reservoir. The transaction costs spent by the government were greater than Perum Jasa Tirta II, particularly the costs of monitoring and controlling of floating net-cages. In the ecological aspect, stakeholders quite agreed that the existence of floating net-cages in Jatiluhur Reservoir affected the environmental conditions. In the economic aspect, stakeholders quite agreed that the floating net-cages at Jatiluhur Reservoir could increase the job opportunities and income for fish farmers and local economy. In the management aspect, stakeholders were well-informed about the rules related to fish farming with floating net-cages system.

Several suggestions that can be recommended based on the findings. First, it is necessary to do regular monitoring of floating net-cages activities by all stakeholders in order to prevent any additional KJA units in Jatiluhur Reservoir. The coordination among stakeholders is aimed to supervise the KJA activities efficiently. Second, the formal rules in the management of floating net-cages in Jatiluhur Reservoir need to be socialized equally to all fish farmers so the fish farming activities work effectively. Third, it is also necessary to do further research about the source of pollution that mostly affect the water quality of Jatiluhur Reservoir in order to improve environmental quality of reservoirs thoroughly. It can be done through coordination between central and local government, private sector, relevant institutions, Non Governmental Organizations, as well as other parties that utilize Jatiluhur Reservoir.

References

- Beveridge, M. C. M. (1984). *Cage and pen fish farming: carrying capacity models and environmental impact* (FAO Fisher). Rome: Food and Agriculture Organization of the United Nations.
- Bramana, A. (2015). *Analisis Keberlanjutan Usaha Keramba Jaring Apung Dengan Pendekatan Daya Dukung Lingkungan Dan Sosial Ekonomi (Studi Kasus: Kelompok Sea Farming Perairan Pulau Semak Daun Kepulauan Seribu, Dki Jakarta)*. Institut Pertanian Bogor.
- Effendi, I. (2004). *Pengantar Akuakultur*. Jakarta: Penebar Swadaya.
- Nasution, Z. (2005). Analisis Kelembagaan dalam Pengelolaan Lingkungan Perairan Waduk (Studi Kasus di Perairan Waduk Jatiluhur, Jawa Barat). *Jurnal Buletin Ekonomi Perikanan*, 6(1), 1-12.
- Siagian, M. (2012). Daya Dukung Waduk PLTA Koto Panjang Kampar Provinsi Riau. *Jurnal Perikanan Dan Kelautan*, 15(1).
- Widyastuti, E. (2005). *Model Pengelolaan Berkelanjutan Budidaya Ikan dalam Keramba Jaring Apung di Waduk (Studi Kasus di Perairan Waduk PB Soedirman)*. Institut Pertanian Bogor.
- Widyastuti, E., Piranti, A. S., & Rahayu, D. R. U. S. (2009). Monitoring status daya dukung perairan waduk Wadaslintang bagi budidaya keramba jaring apung. *Jurnal Manusia Dan Lingkungan*, 16(3), 133-140.