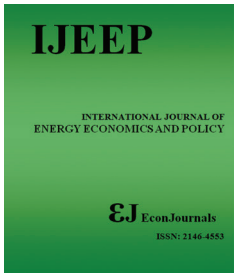

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(2), 334-340.

Effect of Ecological, Economic and Social Factors on Environmental Conservation of Dam Reservoirs for Hydroelectric Power

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Received: 05 January 2022 **Accepted:** 06 March 2023 **DOI:** https://doi.org/10.32479/ijeep.14211

ABSTRACT

The purpose of this study is to determine the mapping of water catchment areas as a basis for environmental conservation concerns, and to analyze ecological, economic and social factors that influence the stakeholder's capacity for conservation responses. The method used in this research is a mixed method and data analysis was conducted by using Global Information System (GIS) analysis and multiple regression. The results showed that all determinants have significant effects on conservation concern (coefficient = 0.635, P = 0.000). Meanwhile, the testing of moderation effect with conservation concern showed an insignificant effect (coefficient = 0.042, P = 0.545). The analysis of the variable of distance as mediating variable on conservation concern also showed the insignificant results (coefficient = −0.113, P = 0.086). Moreover, the results of data analysis in this study based on GIS analysis showed a fairly rapid and concerning increase in sedimentation between 2013 and 2017. This would imply that quick efforts were needed to conserve dam reservoirs. In the social factor, the conditions imply to improve their participation through ecotourism. The findings highlight the importance for stakeholders to encourage the implementation of conservation and ecotourism of dam environment.

Keywords: Ecology, Social Factors, Environmental Conservation, Ecotourism, Reservoirs
JEL Classifications: Q57, R11

1. INTRODUCTION

Conservation of natural resources and control of environmental damage is an effort to manage natural resources to ensure their wise use and continuity of availability while maintaining and increasing the quality of value and diversity by controlling direct and/or indirect changes to physical, chemical and/or properties. Biological environment that exceeds the standard criteria for environmental damage. As one of man-made environmental engineering, dam construction has social and economic functions, but also has detrimental effects on ecosystems and the environment. The existence of reservoirs in an area is necessary, considering that reservoirs have many functions to improve the welfare of the people. The existence of reservoirs has both positive and negative impacts on the environment. One of the negative impacts of the existence of reservoirs is the disruption of the preservation of environmental biodiversity, such as the loss of forest expanses of plant and animal germplasm sources. In the watershed area it can result in a reduction in certain types of fish, plankton, benthos, and aquatic plants that live in the waters. Biodiversity degradation in general in reservoir waters will affect the local scale, natural genetic banks was lost (Widiyati and Prihadi, 2007).

Gadjah Mungkur Reservoir in one of the largest reservoirs in Java that experienced sedimentation. In 2013, the largest concentration in the Gadjah Mungkur Reservoir was at a sedimentation concentration level of 20–50 mg/L, but this figure increased to concentrations of 20–50 mg/L and 500–100 mg/L and in 2017 the concentration was 50–100 mg/L. Siltation that occurs due to sedimentation has the potential to reduce the amount of water catchment that can be carried out so that it is feared that it will cause flooding when rainfall and overflow of water increase, especially in

the rainy season. Land conservation is needed where this is closely related to concern for the condition of the environment which is defined that caring is a basic value and attitude of paying attention and acting proactively towards conditions or circumstances in the environment. The Gadjah Mungkur Reservoir was built in 1976–1981 with the main objective of controlling floods from the Bengawan Solo stream. The water capacity which was originally 4000 m^3/s was reduced to 400 m^3/s according to the capacity of the river channel downstream. On the other hand, the flow of the reservoir is also capable of irrigating 23,600 ha of rice fields in the downstream areas, especially in Sukoharjo, Klaten, Karanganyar and Sragen districts. In the initial planning, the reservoir also functions to generate 12.4 Megawatts of electricity and become a source of drinking water supply in Wonogiri district. The water catchment area of the reservoir reaches 1,350 km^2 consisting of the Bengawan Solo river, Kaduang river, Tirtomoyo river, Parangjoho river, Temin river and Posong river. The maximum inundation area of the reservoir is 8,800 ha. The construction of the reservoir had to submerge as many as 51 villages in 6 sub-districts and relocate 67,515 residents using the village bedhol transmigration model to several provinces in Sumatra.

Land conservation is not only the task of the government, especially the Department of the Environment, but requires the participation of all stakeholders. Dunlap and Jones (2002) state that conservation concern is the extent to which people are aware of problems related to conservation and support efforts to solve them and a willingness to contribute personally (Ajzen, 2020). Land conservation is closely related to concern for the condition of the environment which is defined that caring is a basic value and attitude of paying attention to and acting proactively towards conditions or circumstances in the environment. The notion of caring is also related to personality, emotions and needs. According to Swanson (1997), there are five dimensions of caring. The first is knowing, namely trying to understand events that have meaning in life. The second is playing a role, being emotionally present by conveying availability, sharing feelings, and monitoring whether other people are disturbed or not by the emotions given. The third is doing as acting something for others, as if doing it for oneself. The fourth is enabling as facilitating life's journeys and events that are not normally owned by others by providing information and explanations and support, focusing on appropriate concerns, and providing alternatives. The fifth is sustaining as beliefs support other people's beliefs about their ability to navigate events or transitions in their lives and face the future meaningfully (Swanson, 1997).

The behavior of caring for the environment is one of the determinants of consumption and production patterns in society. Various environmental problems such as reduced natural data sources, population growth that is still not fully controlled, climate change, reduced forests which have the potential to cause floods and landslides, erosion and soil contamination due to the excessive use of fertilizers and pesticides which are mostly caused by human behavior in exploiting environment (Macovei, 2015). Krajhanzl (2010) defines that environmental behavior is any behavior that has a significant impact on the environment, even if unintentional. Pro-environmental behavior is defined as individual behavior that is generally or in accordance with environmental science knowledge, assessed in the context of society which is considered a protective way of environmental behavior or respect for a healthy environment and implies carrying out a series of actions that reduce environmental damage as much as possible (Krajhanzl, 2010). Departing from the background and literature study above, the purpose of this research is to determine the mapping of water catchment areas as a basis for conservation efforts, to analyze the factors that influence the capacity of communities to respond to conservation, and to analyze the stakeholders involved in the development of conservation areas, the responses conservation and ecotourism concept in the area.

2. LITERATURE REVIEW

The environmental problems mentioned can have a very detrimental impact on the survival of humans and ecosystems. Reduced natural resources can lead to a shortage of needed resources. Population growth that is still not fully controlled can increase pressure on natural resources and the environment. Climate change can cause extreme weather changes and ecosystem damage (Heady, 1950). Forest loss can cause floods and landslides, soil erosion, and soil contamination. Excessive use of fertilizers and pesticides can cause damage to the environment and human health. Human behavior in exploiting the environment must be changed through education and development of environmentally friendly technologies, as well as adequate legal protection to prevent actions that are detrimental to the environment (Just and Rausser, 1989).

Caring for the environment is very important in the concept of ecotourism and environmental preservation. Environmental concern can encourage changes in people's consumption and production patterns in a more environmentally friendly direction, which can assist in environmental preservation and the development of ecotourism destinations (Johnson, 1971). In terms of consumption, environmental concern can encourage people to choose products that are produced by environmentally friendly production methods, such as organic or sustainable products (Heady, 1950). In terms of production, environmental concern can encourage companies to reduce greenhouse gas emissions, reduce waste, and increase energy efficiency. In addition, caring behavior for the environment can also encourage people to participate in ecotourism activities that are in harmony with environmentally friendly management principles, such as developing sustainable ecotourism destinations and prioritizing environmental preservation. The behavior of caring for the environment is very important in the concept of ecotourism and environmental preservation, because it can improve people's quality of life and ensure the availability of natural resources for the next generation (Fox, 1986; Capstick, 1983; Johnson, 1971). The exploitation of the environment is caused by several socio-economic problems. Rhead et al. (2018) found that environmental behavior was influenced by, age, education and group over status in society. Li and Chen (2018) obtained the results that there was a relationship between relative income, regional differences, geographical location and gender and environmental concern. The analysis tool used is regression, the results of the study show

that the addition of relative income will have a positive effect on increasing environmental awareness while absolute income does not have the same effect (Li and Chen, 2018).

Community concern for the environment is very important in efforts to preserve the environment, including in the development of the concept of ecotourism. Ecotourism is a tourism concept that promotes environmental sustainability and local community development. In this case, the Gadjah Mungkur reservoir can be used as an ecotourism destination that prioritizes environmental preservation. However, to realize this, it requires the support and active participation of the community in the management and development of these ecotourism destinations (Johnson, 1971). The level of public concern for the environment has begun to increase over the last decade, including in tourism which has begun to lead to ecotourism. Research conducted by Mafruhah et al. shows that the pattern of returning to nature is currently being encouraged in tourism models in many countries (Mafruhah et al., 2020). Tourist demands to get tourism that returns to nature, another research conducted by Mafruhah on the development of community empowerment-based ecotourism shows that there are three main needs in ecotourism development, namely: (1) The role of the government, namely the development of supporting infrastructure to increase accessibility, ease of business licensing which supports tourism and organizes annual events that attract tourists. (2) Business actors and Academics who play a role in facilitating and enhancing research and development collaboration networks as well as mentoring and corporate social responsibility. Meanwhile, (3) community empowerment carried out includes (a) increasing tourism awareness (b) mentoring and (c) developing superior products (Mafruhah et al., 2019).

3. RESEARCH METHODS

The method used in this research is a mixed method, namely a combination of quantitative and qualitative. Data analysis used GIS analysis and multiple regression, where the dependent variable used in this study was concern for land conservation, while the independent variables consisted of education, environmental knowledge, age, income, social status, ownership of agricultural area, and ownership of large yards. Then analyzed with stakeholder analysis, using factor analysis. The actors involved in this analysis consist of community leaders in the Jatisron sub-district and in the Wonogiri sub-district, Bappeda Wonogiri, SMEs and cooperatives, investment agency, village community empowerment, sub-district heads in Jatisrono and sub-district heads in Wonogiri and banking. The objectives used in this study are natural resource potential, community education, own capital, institutional, training, third party funds, marketing, welfare improvement, poverty reduction, economic growth rate.

Data analysis in quantitative research was carried out by collecting data in the field using participatory observation, in-depth interviews and documentation. In observation, the focus of observation is carried out on three main components, namely space/place, actors or actors and activities. In detail, the data that was collected with this technique is data on efforts to preserve tourism potential and develop ecotourism in the Gadjah Mungkur reservoir environmental preservation conservation area. Data analysis in qualitative research is carried out during data collection and after data collection is complete. The analysis consists of three activity streams, namely: data reduction, data presentation, drawing conclusions/verification.

The first objective was carried out with GIS analysis using GIS data that has been available and analyzed as needed. The second objective was analyzed using multiple regression, the dependent variable used in this study is concern for land conservation, while the independent variables consist of education, environmental knowledge, age, income, social status, ownership of agricultural area, and ownership of yard area. In detail, the multiple linear regression model is as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + u_i$$

Information:
Y = Concern for land conservation
X_1 = Education
X_2 = Environmental knowledge
X_3 = Age
X_4 = Income
X_5 = Social status
X_6 = Ownership of agricultural land area
X_7 = Ownership of yard area
u = Distraction variable
β_0 = Constant
$\beta_1, \beta_2, \beta_3 \ldots \beta_9$ = Independent variable regression coefficient
i = Observation.

The processing analysis was performed by using partial least square-structural equation modeling analysis. Moreover, the empirical examination was analyzed with stakeholder analysis, using factor analysis. Freeman stated that stakeholders are groups that are important for the survival and success of a corporation and/or community in achieving goals (Fontaine et al., 2006). Planning activities that start from planning, implementation to evaluation of results have so far been carried out only on the basis of habits and main tasks of functions or job descriptions that have existed or been determined, so that they are often not in accordance with the needs in the field. Stakeholder analysis is an alternative that needs to be carried out for the participation of each stakeholder, the method used is to identify stakeholders, distinguish between and categorize stakeholders and investigate the interests between stakeholders. This linkage can be analyzed with Stakeholder Analysis (MACTOR) which describes the relationship between stakeholders, how strong the network is formed, how divergence and convergence are, how important the relationship between stakeholders is to other stakeholders and the relationship between stakeholders and the goals to be achieved (Reed et al., 2009).

This analysis will compare the roles and functions of each stakeholder through power and interest. In detail is (1) power interest grid, namely the level of power and stakeholder interest based on the impact or outcome of the activity; (2) power influence grid, namely analysis of stakeholders based on their level of power and influence/

involvement in activities; (3) influence impact grid, namely analysis based on the level of influence or involvement in the project and their ability to influence the magnitude of the impact on activities, especially in planning and implementation; (4) salience model, namely the analysis explaining the ranking of stakeholders based on the level of power, level of interest, and legitimacy.

4. RESULTS

At the beginning of construction, Gadjah Mungkur Reservoir was planned to be 100-years-old, but the sedimentation that occurred has caused the reservoir's life to be estimated not to be long. The results of research conducted by Aziz et al. in 2017 show that there has been a considerable change in the condition of the reservoir in just 4 years. In 2013 the largest concentration was at the sedimentation concentration level of 20–50 mg/L, but this figure increased to concentrations of 20–50 mg/L and 500–100 mg/L and in 2017 the concentration has become 50–100 mg/L (Santoso et al., 2017), this condition is very concerning. Siltation that occurs due to sedimentation has the potential to reduce the amount of water catchment that can be carried out so that it is feared that it will cause flooding when rainfall and overflow of water increase, especially in the rainy season.

The condition of the Gadjah Mungkur Reservoir over the past 4 years has shown significant changes, as a result of GIS processing carried out by Santoso et al. (2017) showed results that there was a fairly rapid change in sedimentation. Data shows that in 2013, the area distribution at a concentration of 0–20 mg/L was 1.64%; 20–50 mg/L of 79.70%; 50–100% concentration of 10.32%; Concentration above 100% is 8.43%. In 2015 there was a shift in sedimentation in the distribution area of the concentration of 0–20 mg/L which decreased to 0.08%; concentration of 20–50 mg/L with an area of 48.022%. At a concentration of 50–100 mg/L, there was an increase with an area of distribution almost the same as a concentration of 20–50 mg/L, namely 42.129%. Concentrations >100 mg/L have an area of 9%. 2017 showed a more concerning distribution of sediment concentration with a distribution area of sedimentation concentration with a concentration of 0–20 mg/lt of 9%; at a concentration of 20–50% it decreased drastically to 1.7%, while at a concentration of 50–100 mg/L it was 77.640%. Followed by concentrations >100 of 19.8%. The pattern of increasing TSS values is clearly visible and especially occurs in the estuaries of the sub-watershed. In the estuaries of the Kapang Sub-watershed and Wiroko Sub-watershed which are marked with red circles, it can be seen that Class TSS values >100 mg/L have continued to increase dramatically from 2013 to 2017. This pattern is also followed in areas other than the estuaries of the Sub-Watershed, where there is an increase in class 50-100 mg/L. In detail can be shown in Figure 1.

Processing results using PLS obtained results as shown in Table 1. Statistical results as shown in Table 2 found that there were three significant independent variables, namely yard area, education and environmental knowledge, while the independent variables were income, age or age, agricultural area and social status which were not significant. The environmental knowledge variable is divided into 5 understandings, namely knowing that land management is related to erosion; knowing the use of organic fertilizers has an effect on soil fertility; knowing that land with lots of trees can hold rainwater from entering the soil; knowing that fertile soil can hold water compared to infertile or less fertile soil; knowing the presence of trees (many or few perennials on the land) affects the ecosystem.

Figure 1: Distribution of sedimentation (2013; 2015 and 2017)

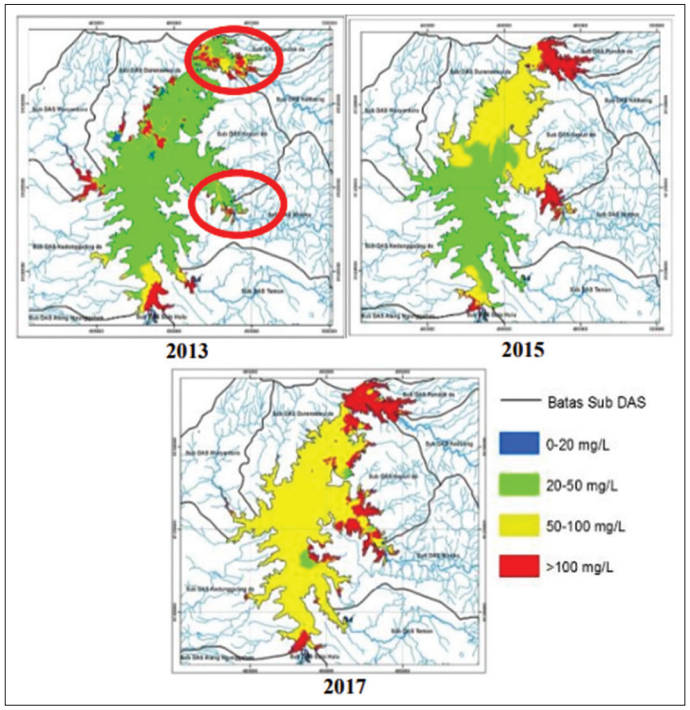


Table 1: Partial least square (PLS-SEM) analysis results

Variables	Coefficient	T statistics	P values	Confirmation
Education	0.279	2.375	0.018	Accepted
Social status	−0.131	1.014	0.311	Rejected
Income	−0.151	1.182	0.238	Rejected
Age	−0.197	1.205	0.229	Rejected
Yard area	0.308	3.357	0.001	Accepted
Agricultural land area	−0.046	0.550	0.583	Rejected
PL10a <- Determinant	0.575	7.180	0.000	Accepted
PL10b <- Determinant	0.743	16.507	0.000	Accepted
PL10c <- Determinant	0.759	14.208	0.000	Accepted
PL10d <- Determinant	0.671	8.492	0.000	Accepted
PL10e <- Determinant	0.668	6.933	0.000	Accepted

PLS-SEM: Partial least squares-structural equation modeling

Table 2: Hypothesis testing

Variables	Coefficient	T statistics	P values
Determinant -> conservation concern	0.635	15.259	0.000
Moderation Effect 1 -> conservation concern	0.042	0.605	0.545
Distance -> conservation concern	−0.113	1.721	0.086

The interpretation shows that income has no effect on land conservation concern, this is possible because farmers who are in the catchment area have an average homogeneous and low income, but the negative regression coefficient value indicates that income is negatively related which means that the lower one's income is actually concern for land conservation will increase. Age is not significant or has no effect on land conservation concern, but when viewed from the coefficient value the relationship between age and land conservation concern is negative, indicating that the older a person is, the level of concern for land conservation decreases, in other words, the older age group tends to ignore land conservation. compared to young age. Ownership of the area of the yard influences concern for land conservation and has a positive coefficient indicating that the area of the yard is positively related to land conservation concern, meaning that the wider the yard owned, the higher the concern for land conservation, one of the behaviors is by planting trees in the yard owned. Ownership of agricultural area had an insignificant effect on land conservation concerns. The negative coefficient value is interpreted that the wider it is, the less concern for land conservation. Education has an effect on land conservation concern, the education coefficient value is positive. It is interpreted that education has a positive relationship with land conservation concern, meaning that the higher the education the higher the land conservation concern.

Social status in this study is classified into two, namely community leaders and ordinary people. The regression coefficient of social status are empirically proven to have insignificant influences on environmental awareness. The negative regression coefficient value can be interpreted that the higher the social status, the lower the concern for land conservation. The independent variable of environmental knowledge as a qualitative variable is used as an indicator variable. with five determinant variables all significant, so it can be concluded that environmental knowledge influences concern for land conservation. All regression coefficients of the independent variable determinants of environmental knowledge are positive. It can be said that the wider the environmental knowledge possessed by the respondents, the higher the level of concern for land conservation, or conversely, the lower the environmental knowledge, the lower the concern for land conservation.

The Goodness of Fit test was conducted to find out how much or the accuracy of the regression model for making predictions. The analysis showed shows that the R^2 value of the sample mean is 0.464, with a significance level of 0.000. These results are interpreted to mean that the R^2 coefficient is significant, so that the specified model structure is good and can be used to make predictions. The significant R^2 estimation results show that 46.4% of the variation in the dependent variable of land conservation concern can be explained by variations in the independent variables of education, environmental knowledge, age, income, social status, ownership of agricultural land area and yard area. The R^2 value after being corrected, namely Adjusted R^2 0.453, is also significant, which is shown by the value of P = 0.000. The next step is Regression Analysis using distance as a moderating variable. The estimation results obtained the magnitude of the moderation coefficient of 0.042 and the probability of a significance level of 0.545, so it was concluded that the distance moderating variable was not significant as shown in Table 2.

The distance variable was empirically proven to have an insignificant effect in moderating effect on land conservation concerns. This shows that the majority of people in the catchment area of the Gajah Mungkur reservoir have the same thoughts about land conservation concerns. The variable of distance as an independent variable obtained a partial regression coefficient of −0.113, with a significance level probability value of 0.086, with a significance level of $\alpha = 0.05$. Thus, the distance variable does not affect land conservation concerns.

Further analysis was performed by using the Matrix of Alliances and Conflicts: Tactics, Objectives and Recommendations (Mactor) and the results of the map of influence and dependency between actors are obtained. The first element in Mactor is actors who have high influence and high dependency are sub-district heads in Jatisrono and Wonogiri, community leaders in Jatisrono and village community empowerment services. The second is actors that have a low level of influence and high dependency are cooperatives and SMEs, Bappeda, Bapepam, and community leaders in Wonogiri. The third is actors with a low level of dependency and low influence are financial institutions/banks. The detail was shown Figure 2.

The relationship between actors and goals is indicated by divergence and convergence. The convergence to be analyzed is the third order which is a combination of first and second orders, or called weighted convergence, namely identifying the number of alliances that may be formed by considering preferences between actors in terms of goals and competitiveness between actors as shown in Figure 3.

The results of data processing using mactor analysis show that there are 3 actors who have very strong convergence, namely the District Head and the Village Community Empowerment Agency (Bapermades). These three actors are also strongly connected with Cooperatives and SMEs, meaning that after these three main actors, the cooperative and UKM services have an important role in developing the community's economy which aims to improve people's welfare. Bappeda is moderately connected to the four actors because it is a planning agency and not a technical one, so the relationship is not direct. Divergence analysis has three types of orders, namely: (1) The first order identifies the number of potential conflicts between actors. (2) Describing the actor's relationship with his goals or preferences means not measuring the amount of potential conflict but the intensity of the conflict with the hierarchy of goals (preferences) of several actors. (3) Order three has a weighted value indicating the intensity of conflict for each pair by describing their hierarchy of goals, preferences and competitiveness (Dewa et al. 2019) (Mafruhah et al., 2019). Order 3 divergence is shown in Figure 4.

Figure 4 shows that there is a strong divergence between the Bank and the Camat and the Village Community Empowerment Agency. This is in line with convergence, in which the three elements converge together and each has divergence from Bank Financial

Figure 2: Map of dependency and influence between actors

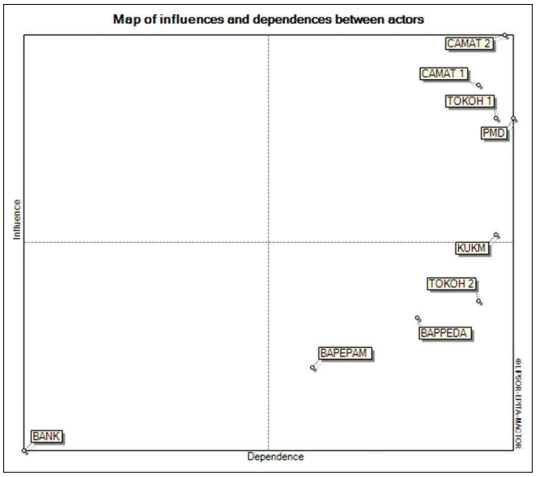


Figure 3: Convergence of order 3

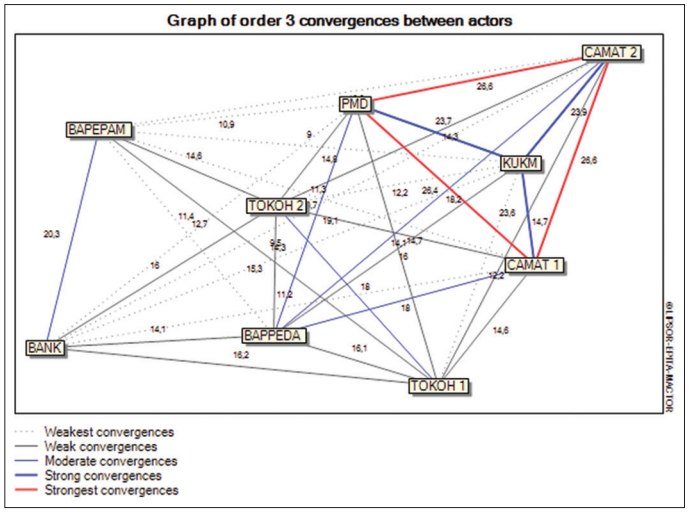


Figure 4: Order 3 divergence

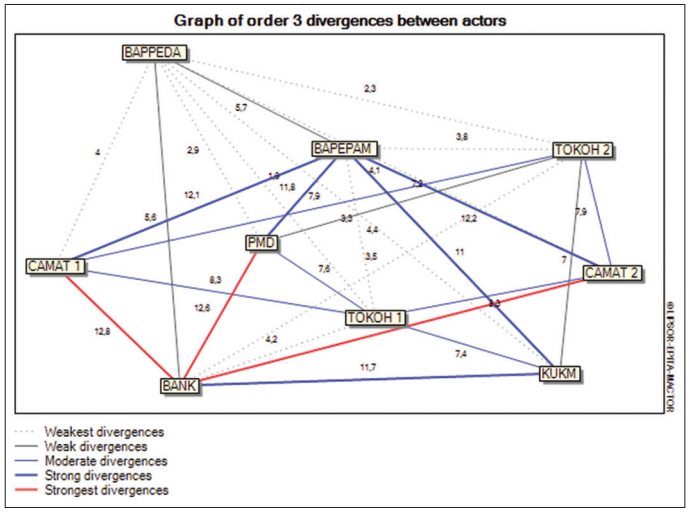
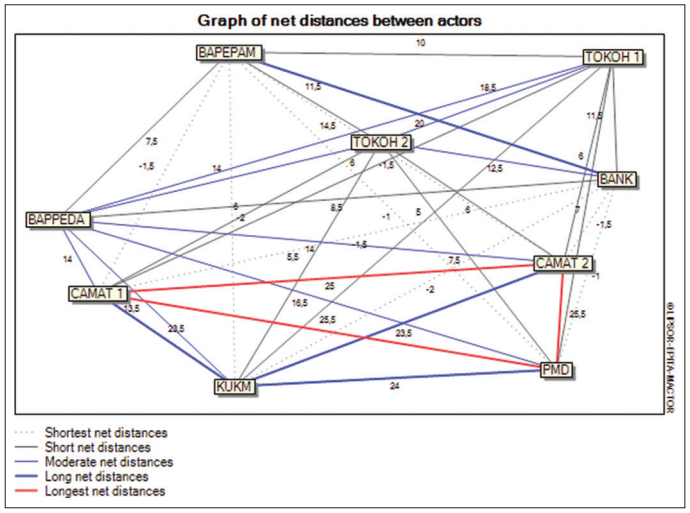


Figure 5: Net distances



Institutions. Divergence is very strong between bank financial institutions and others because so far banks have not been able to participate in empowerment-based conservation processes and ecotourism. One interesting finding is that the Investment Agency has a strong divergence with village community empowerment agencies, sub-district heads and SMEs. This shows that conservation and ecotourism in Wonogiri have not attracted investment either by investment agencies or by banking financial institutions. In addition to convergence and divergence, Mactor also produces an analysis in the form of net distance which implies the presence or absence of potential alliances by considering the divergence and convergence between actors. The processing results show the net distance as shown in Figure 5.

Processing results that show the potential for alliances between the sub-district head and village community empowerment agencies, as well as between SMEs and the three main actors who deal directly with the community as executors of land conservation and ecotourism, show that there is potential for good cooperation in environmental management efforts and ecotourism development. Divergences and convergences that occur can be overcome by conducting effective communication and creating a constructive cooperation mechanism. This alliance can be used to improve coordination and synergy in environmental management and ecotourism development, so as to increase effectiveness and efficiency in environmental preservation and ecotourism destination development. In addition, this alliance can also assist in increasing community participation and increasing environmental awareness and awareness of the importance of ecotourism in environmental preservation.

5. CONCLUSION

The results of data analysis in this study showed that in 2013, the area distribution at a concentration of 0–20 mg/L was 1.64%; 20–50 mg/L of 79.70%; 50–100% concentration of 10.32%; Concentration above 100% is 8.43%. In 2015 there was a shift in sedimentation in the distribution area of the concentration of 0–20 mg/L which decreased to 0.08%; concentration of 20–50 mg/L with an area of 48.022%. At a concentration of 50–100 mg/L, there was an increase with an area of distribution almost the same as a concentration of 20–50 mg/L, namely 42.129%. Concentrations >100 mg/L have an area of 9%. Then, 2017 showed a more concerning distribution of sediment concentration

with a distribution area of sedimentation concentration with a concentration of 0–20 mg/L of 9%; at a concentration of 20–50% it decreased drastically to 1.7%, while at a concentration of 50–100 mg/L it was 77.640%. Followed by concentrations >100 of 19.8%. Based on this discussion, it can be concluded that based on GIS analysis data, there has been a fairly rapid and concerning increase in sedimentation between 2013 and 2017, so that quick efforts are needed to conserve land and make additional income and increase welfare through ecotourism. Important actors in the implementation of conservation and ecotourism are subdistrict heads and village community empowerment agencies, because they are directly related to the community, these three actors have the highest potential for alliances in the development of community empowerment-based conservation and ecotourism. Therefore, it is important for the sub-district head and community empowerment agencies in the surrounding villages to encourage the implementation of conservation and ecotourism of the Gadjah Mungkur Reservoir environment well with the community.

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