

The Relationship between Population Dynamic and Garang River Upstream Environment in Central Java, Indonesia

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Abstract The interaction of the human population with nature can cause environmental damage such as the degradation of the watershed carrying capacity. Therefore, this study aimed to analyze the relationship between population dynamic and the upstream environment alongside Garang River using four villages including Munding, Lerep, Kalirejo, and Pakintelan. Data were collected from several stakeholders including selected heads of households supported by key informants such as community leaders and the river care communities using field observation, a household survey through questionnaires, in-depth interviews, and documentation. The households used as samples were selected through proportional random sampling and the data retrieved were analyzed through a descriptive quantitative method which involved the cross-tabulation of household data on economic activities and environmental management practices. It was discovered that 1) the population of the Garang River's upstream was very dynamic with growth rates varying from 1.05% to 3.93%, 2) the main livelihood of the population and dominant land use was the agricultural sector, 3) the community realized that the harmonic relationship with the environment was a critical condition to support farming activities and fulfil daily necessities, and 4) the society kept maintaining the river through different activities such as "bersih sungai" or river cleaning and "sedekah bumi" or thank-giving to the environment. Moreover, the harmonic relationship between the people and the river environment is in form of several activities. These included waste management, cleaning rivers, maintaining clean waterways, actions to create a clean and healthy environment, and joining the efforts to care for the environment. The harmony was observed to have been realized through the integration of diversity, interdependence, unity, and the value of providing care.

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1. Introduction

The damage to the river environment is one of the causes of water scarcity (Admiraal, 1995; Bedri et al., 2014; Olokesusi, 1994; Warner, 2007). This can be observed from the degradation of the carrying capacity of the watershed, particularly in the upstream area due to deforestation (Zuriyani, 2017). It is also important to note that the degradation of land normally declines the watershed's ability, thereby causing flooding in the rainy season and water shortage during the dry season (Mahmud, Kusumandari, Sudarmadji, & Supriyatno, 2019). This is mainly because the watershed cannot store water during the rainy season. Some problems which also associated with land degradation include erosion and higher river sedimentation. These were observed to have made the Garang watershed upstream to be in a lousy shape (Dewi Liesnoor Setyowati & Suharini, 2011) and reported to be caused by natural factors and human intervention in managing the land (Juhadi et al., 2021). Meanwhile, it is possible to achieve sustainable watershed management by balancing utilization with the maintenance and protection of river areas. It is also important to note that compliance with norms and requirements in watershed management is an indicator of successful river environmental sustainability (J. Tippet, B. Searle, C. Pahl-Wostl, & Y. Rees, 2005; Selek & Selek, 2020). The river functions which have been reduced through human intervention can be restored through certain restoration efforts in order to further enhance the relationship

of community with water (Carr, 2015). It is pertinent to state that watershed problems are very complex and require the participation of several parties.

Garang River is one of the monuments associated with the management of water resources in Semarang City (Hartatik, 2014; Ujjianti, Anggoro, Bambang, & Purwanti, 2018). However, the river has both quantity and quality problems which are related to flooding and inadequate clean water, respectively. It has been reported that approximately 60% of the residents depend on the water from the river for consumption (PDAM Municipal Waterworks). The results of water quality showed that the copper concentration exceeded the standard required by Government Regulation no. 82 of 2001. It was also discovered that the water pollution index is 1.23, indicating lightly polluted. Therefore, there is a need for sustainable management to ensure adequate quantity and quality for the river (Ujjianti et al., 2018).

The dynamic of the population on Java Island is expected to have a continuous effect on land degradation. This is also affected by the changes in the number, density, growth, and structure of the population in the globe. It has also been stated that population and the environment can be likened to two sides of a coin that need to harmonize (BKKBN, 2020). This is indicated by the current population of the world which is set at 7,373 billion, and Indonesia ranked fourth with approximately 274 million (BPS, 2021). Meanwhile, the number of rivers has not increased despite the continuous growth in the population

of villages around the Garang River due to the development of Semarang City, Central Java. There are also changes in land use over the last 10 years as indicated by the substantial conversion from agricultural to non-agricultural application. It was observed that rice fields, mixed gardens, dry fields, and forests have turned into settlements due to the increase in the number of people residing in the area with diverse activities. These were discovered to have led to a reduction in the quality and quantity of agricultural production and the environment. This shows that these activities have an indirect effect on the economic, social, and cultural orientations of the community.

The degradation of the Garang River environment is believed to be due to the human activities in managing the river, specifically the upstream. The watershed has been set at an alert status in Central Java and highly prioritized for appropriate management. However, most residents are still apathetic to any proposed changes as indicated by the relatively low attention to the need to care for the environment, specifically the river. This implies there is a need to change the local wisdom and mindsets of the community through awareness and provision of river education. This can be achieved through public involvement or participation in watershed management (Perkins, 2011). There is also the need to convey innovative environmental education to the broader community to foster awareness.

This study was conducted to analyze the relationship between population dynamic and the upstream environment in Garang River. It was observed that several studies have been conducted on the river and its watershed with the main focus on the physical conditions. Furthermore, this present empirical study is expected to be used in developing a conceptual model of the harmonic relationship between population dynamic and the river upstream environment.

2. Methods

Garang River watershed was generally selected as the study site with precise attention on some selected villages in

the upstream area. It was discovered that there are 40 villages in the watershed upstream and the households were used as the population. Furthermore, the samples were selected through the following two stages, (1) the selection of the study villages and (2) the determination of the household heads to be used as respondents. In the first stage, four closest villages to the river including Munding, Lerep, Kalirejo, and Pakintelan were selected through a purposive sampling technique. This closeness indicates more significant interaction and dependency on the river environment. It is important to note that three are in the administrative area of Semarang Regency while the last one is in Semarang City as indicated in Figure 1. In the second stage, a total of 99 heads of households were selected as samples through proportional-random sampling with due consideration of the number of households in each village.

A descriptive quantitative approach was used due to some of its advantages such as 1) the appropriateness in examining ordinal, intervals, and ratio data in line with the phenomena under investigation, 2) the ability to reveal measurable aspects, and 3) the provision of new data and insights to explain positivistic phenomena. The variables used in this study include population dynamic, land use, and environmental management practices. Moreover, primary data were obtained from selected respondents which include heads of households, and community leaders, and through field observations, while secondary data were retrieved from relevant governmental agencies.

The data collection was carried out through field observations, household surveys with questionnaires, in-depth interviews, and document studies, as indicated in Table 1. The observations focused on the community activities on the river. Meanwhile, the surveys and in-depth interviews were conducted with informants to gather the main data on river utilization and caring activities. The document studies were used to collect and extract data from several research agencies such as population data from the Central Statistical

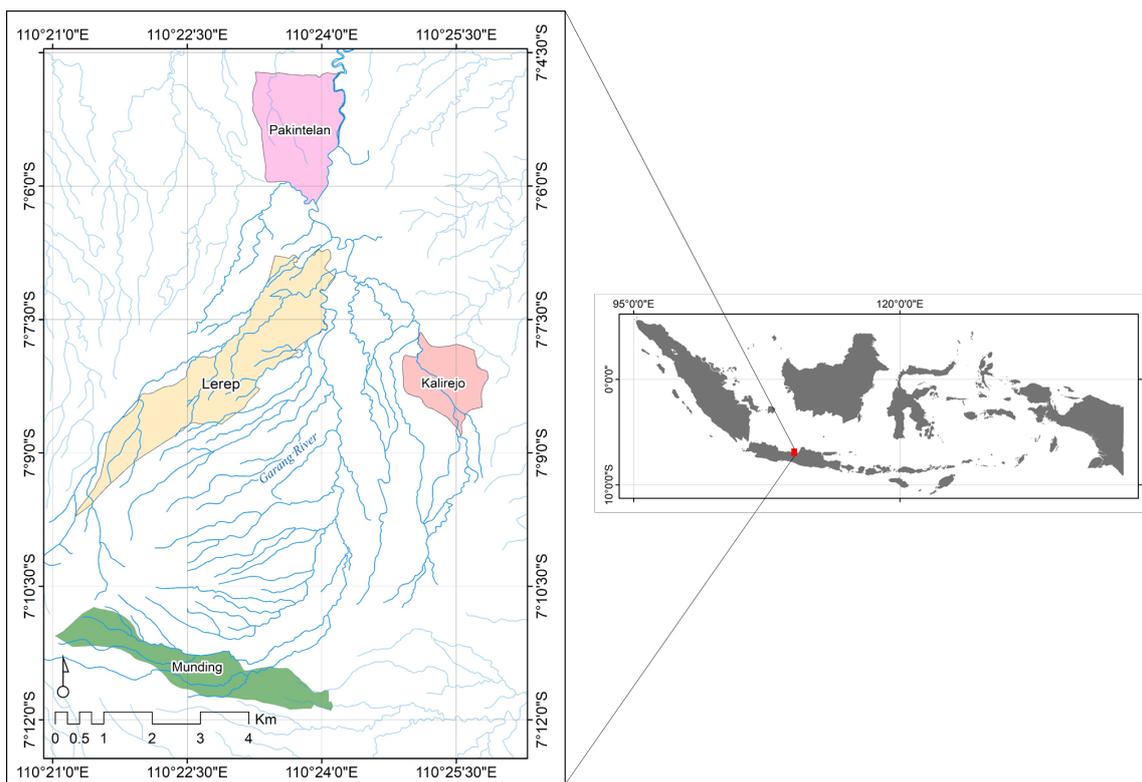


Figure 1. Location Map of Munding, Lerep, Kalirejo, and Pakintelan Villages

Table 1 Respondents' Characteristics

Type of Respondents	Characteristics	Total	Data Collection Techniques
Household Heads (total= 7,652)	The household heads in villages close to the river	99	Questionnaire
- Munding (964)		12	
- Lerep (3,022)		39	
- Kalirejo (1,277)		17	
- Pakintelan (2,389)		31	
Public figure	Village officials in each village	4	Interview
River care forum	Member	2	Interview

Source: Field survey

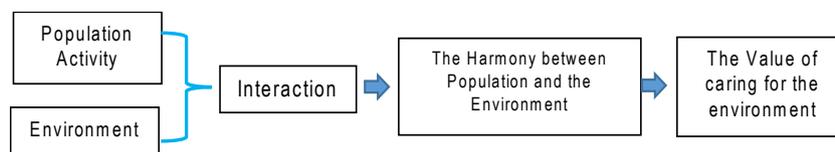


Figure 2. The Basic Concepts of the Harmonic Relationship between Population and the Environment

Agency, monograph data from villages and sub-districts, and data on the physical condition of the river environment from the Environment Agency.

The descriptive quantitative analysis of population dynamic was further conducted. It elaborated the respondents' characteristics based on the empirical data presented in cross-tabulation, which allow the comparison of population dynamic and environment management practices. It also made it possible to describe the position of the observed variable against the total as well as to link the household data to the characteristics of the respective village. Meanwhile, the secondary data analysis was in the form of a literature review and document studies. This study finally provided information on the harmonious relationship between population dynamic and environment management practices using the information obtained through in-depth interviews.

The conceptual model shows the variables used to determine the harmonious relationship between population dynamic and the environment. The harmonization concept focuses on the interaction between relatively fixed environmental conditions and an increasing population as indicated in Figure 2.

3. Results and Discussion

Population Dynamic in the Villages located in the Garang River Upstream

Munding, Lerep, Kalirejo, and Pakintelan are located on the Garang River upstream, as listed in Table 2. Munding is administratively a part of Bergas District, Lerep is in West Ungaran District, and Kalirejo is in East Ungaran District. It is important to note that these three villages belong to the Semarang Regency area. Meanwhile, Pakintelan is part of Gunungpati District, Semarang City. It was observed that Munding and Lerep occupy the top of the watershed with steep slopes, while Kalirejo and Pakintelan are relatively flat.

Munding is at an altitude of 682 meters above sea level (masl) and its topography is in the range of peak slope in the Garang River upstream. It is pertinent to note that the distance from the city to the district is approximately 11 km, and the village is accessible by passing a paved and winding highway using private two and four-wheeled vehicles because there is no public transportation. The village has a natural beauty due to the fact it is located at a high altitude as well as the natural views of the areas surrounding the springs.

Lerep is one of the villages located 409 masl on the peak's slopes. It is located 1.5 km from the district office and accessible from different routes through paved roads despite the lack of public transportation. The location at a relatively high altitude provides springs which are normally used as tourist destinations. Meanwhile, Kalirejo is at an altitude of 360 masl and considered to be the most accessible among the four villages with highways and public transportation. Its distance to the Capital Regency is approximately only 3 km with entrance and exit access to the Semarang-Solo highway and the Trans Java Ungaran expressway gate. It was further discovered that Pakintelan is located in a flat area.

There is a wide variation in population dynamic of these villages but they all have more than three thousand people. It was discovered that Lerep has the largest population, with 11,711 people while Munding has the least with 3,166. Moreover, the population has increased over the last five years, with the highest and lowest growth rate were recorded in Pakintelan and Munding at 3.39% and 1.07%, respectively. The increasing population, followed by a high growth rate, resulted in high population density due to the lack of expansion in the village area. Therefore, the highest population density was in Pakintelan while the lowest was in Kalirejo. This means Pakintelan has the highest population growth and density, and this can be associated with the fact that it has a relatively flat topography, is an administrative part of Semarang city, and is adjacent to the Universitas Negeri Semarang campus. The village provides student accommodation and allied services, thereby offering more significant opportunities to diversify the livelihoods of the people into the non-agricultural sector. This implies the existence of the campus is advantageous to the residents.

Munding has the lowest population and growth compared to the others and this is due to the fact that it has the smallest area and location on the slopes with wavy morphology and winding road access. Meanwhile, Lerep has the largest population because it has high accessibility and is also close to the factory area, government offices, trade, and education center. It has also been stated that the high population growth recorded in Pakintelan is due to its closeness to the Universitas Negeri Semarang and this subsequently lead to a high demand for land and natural resources consumption coupled with the ecological footprint to maintain ecological services (Onyango,

Table 2 The Dynamic of Villagers Close to the Garang River Upstream

Population	Villages around the river			
	Munding	Lerep	Kalirejo	Pakintelan
Total population 2016	2,845	9,012	3,523	4,065
Total Population 2020	3,166	11,711	4,273	5,676
Population growth 2016-2021 (%)	1.07	2.65	1.94	3.39
• Population density (people/km ²)	1.768	1.717	1.405	2.132
• Land area (km ²)	1.79	6.82	3.04	2.66
Livelihoods (%)				
• Agriculture	45.02	17.24	11.12	0.89
• Non-agriculture	54.98	82.78	88.88	91.11
• Diversification index	3.43	4.70	4.13	1.83
Land use (%)				
• Agriculture	80.73	70.66	21.11	81.96
• Non-agriculture	19.27	29.34	78.89	18.04

Source: Central Bureau of Statistics of Semarang Regency, 2020-b, Central Bureau of Statistics of Semarang Regency, 2020-c, Central Bureau of Statistics of Semarang Regency, 2020-d, and Central Bureau of Statistics of Semarang City, 2020.

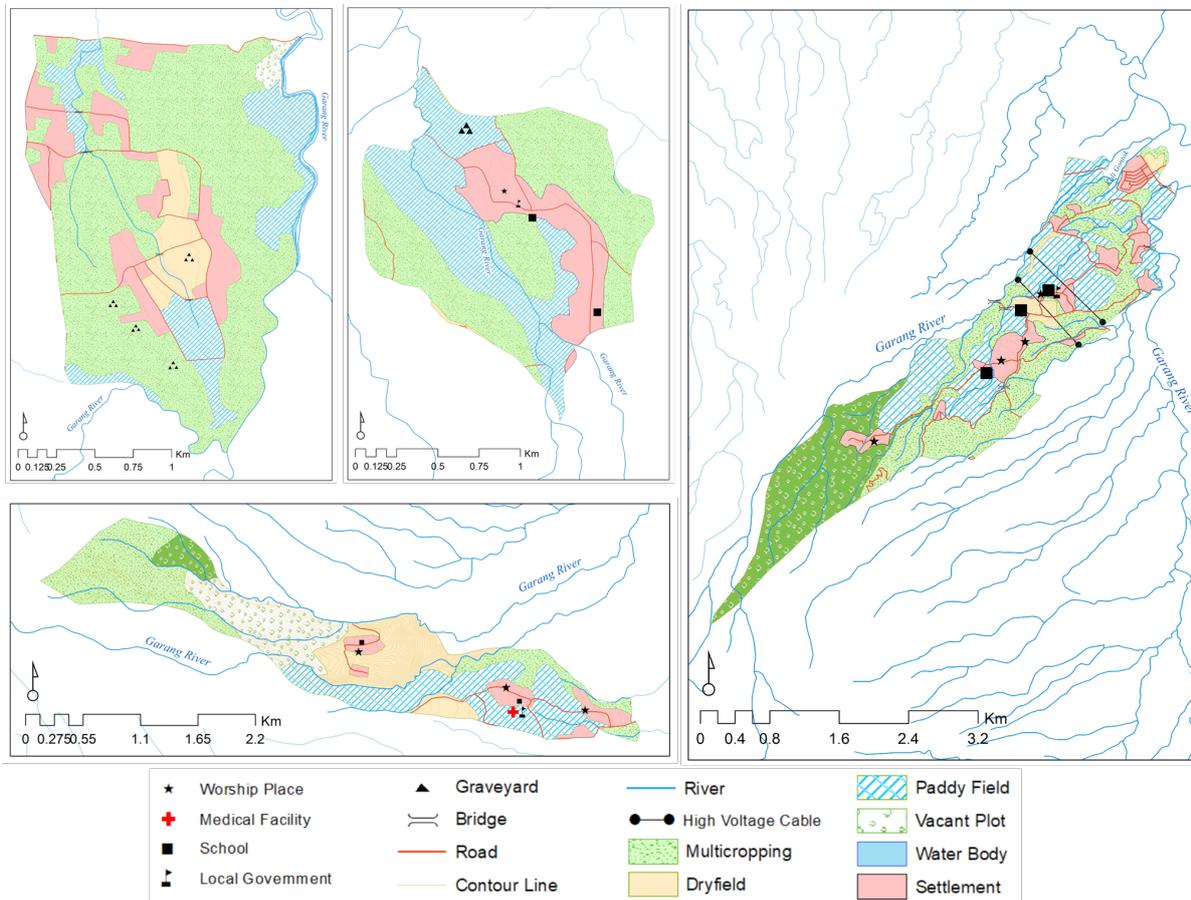


Figure 3. Land use map of the study locations (Source: Modified from BIG (BIG, 2020))

Ikporukpo, Taiwo, & Opiyo, 2021)(Obiefuna, Okolie, Atagbaza, Nwilo, & Akindeju, 2021).

Most of the people living close to the river depend on the non-agricultural sector for their livelihood as indicated in Figure 3 with the highest, 91.11%, found in Pakintelan while the least, 54.98%, is in Munding. This is significantly higher compared to those operating in the agricultural sector where the highest, 45.02%, is in Munding and only 17.24% in Lerep. This generally means the people living in villages close to the river work in both the agricultural and non-agricultural sectors. This is in line with the findings of a study conducted in rural Vietnam (Phan, Tran, Phan, & Hoang, 2019) where the people were found to

depend more on professions related to farming, non-farming work, wage-earning, and non-labour work (Phan et al., 2019).

Most people residing in the Garang River upstream make a living in the agricultural sector but the conduct of all the activities varies widely in both sectors. Some of the strategies associated with the agricultural aspect include intensification, extensification, diversification, and mobility. The intensification and extensification are usually through land management in the form of nurseries, fertilization, and pest control. Meanwhile, diversification at the household level is only possible through an increment in the amount of arable land through share-cropping considering the constraints of limited capital as well

as the increasing demand and price for land usually faced by the farmers. Finally, the mobility strategy occurs when rural agricultural households combine their agricultural activities with some casual work elsewhere.

The diversification related to the combination of activities in both sectors was observed in the four villages. It was discovered that diversification within agriculture is very dominant in Munding, Lerep, and Kalirejo, while there is a tendency for more non-agricultural activities such as processing, manufacturing, and service in Pakintelan [15]. This type of combination has been reported to be a common strategy adopted by rural residents in other places (Burgers, 2008; Hardati, 2018; Ian Scoones, 1998; Riyanto Rijanta, 2006).

There is a significant variation in the diversification of livelihoods by the population as indicated by the index values ranging from 1.83 to 4.7, as presented in Table 2. It was discovered that Pakintelan had the lowest value and this was associated with the fact that most people, 91.11%, engage in the non-agricultural sector while only a few earn the livelihood in the agricultural. It was also observed that Lerep had the highest value and this can be linked to the fact that only 17.24% are in the agriculture sector while the others working in the industrial, trade, services, and other sectors range from 12.02 to 26.17%. This means the activities of both sectors are essential in shaping rural diversification. Moreover, previous studies reported that diversifying livelihoods with non-agricultural activities is very important in improving the ecological functions of the upper part of a watershed (Riyanto Rijanta, 2006, 2012).

The residents also adopt intensification, extensification, and plant diversification strategies. It was further observed that they use the home garden as the field for crop diversification strategies, indicating its function of serving as a source of local food as well as a social, environmental, and biophysical platform (Raden Rijanta, 2020). Meanwhile, in the non-agricultural sector, the diversification strategies involve non-permanent mobility to nearby cities through daily commuting and circular mobility. The commuting aspect is the optimum choice for those working within a relatively short distance from their home villages while circular migration is the option for those at a relatively long distance to their destination.

The Harmony of Land Use in the Four Villages

Riverbanks, which are normally used to accommodate floods, naturally provide several benefits for the community (Mahmud et al., 2019), [27]. These include flood regulation, clean water supply, tourist attraction, water purification, carbon storage, and improvement of human health. Moreover, river conservation efforts include effective use, maintenance, and preservation activities conducted based on good governance and strict adaptive management (Chun, Azmin Sulaiman, & Abu Samah, 2012; Kingsford, 2011). These activities are important because they can reintroduce natural processes that configure rivers to provide the diversity of habitats required for healthy ecosystems as well as to ensure long-term recovery in order to address the initial problem associated with river degradation (Speed et al., 2016).

The community efforts to preserve the river environment are observable through the condition, utilization, and management. These conditions cover the abiotic, biotic, and socio-cultural aspects while the management consists of the conservation activities related to the water bodies based on the activity of the community organizations and the government. It was discovered that the Munding community normally used water for waterfall tourism activities, watering plants, and daily needs through the long pipes installed to distribute water from springs to settlement areas. Moreover, the accessibility to the waterfall is considerably good while some perennials were observed to be functioning as catchment areas close to the river. There are also swales planted with secondary crops such as cassava, bananas, coffee, beans, and others as indicated in Table 3 and Figure 2. The type of land use carried out by the community around the river is part of the harmonization effort. The community carries out harmonization by utilizing the land around the river. Rivers are used as a source of water to meet agricultural needs. The Munding people use the dominant river as a water source. This condition shows that the water needs are highly dependent on the river. Harmony is a universal law that guarantees the continuity of the system. There are four keywords of harmony, namely diversity, interdependence, unity, and having the highest value (Wiranegara, Wirutomo, Sarwanto Moersidik, & Suganda, 2013).

The river water sources utilized in Lerep reached 74.36% with a focus on the fulfilment of daily necessities, waterfall tourism,

Table 3. Land Use Types in the Four Villages

Land Use Type	Munding	Lerep	Kalirejo	Pakintelan
River Water Source	100.00	74.36	17.65	22.58
River Terrace	16.67	12.28	12.28	12.90
River Environment Utilization	58.33	43.59	43.59	17.74

Source: Primary Data, 2018



Figure 4. Riparian in the upstream areas in Munding and Lerep (Source: Field Survey)

and irrigation. Moreover, the pipe networks are channelled directly to the houses. Meanwhile, the river terraces contribute approximately 12.28% and they are applied to rice farming and the plantation of some crops and perennials. The general utilization of the river environment in this area is estimated at 43.59%, as indicated in Table 3 and Figure 4.

The color and flow of the water in the river basin or watershed show that the quality is decreasing. The color was also observed to be changing during the rainy and dry seasons (D. L. Setyowati, Aرسال, Hardati, Suroso, & Prabowo, 2019). This is indicated by the increase in the quantity during the rainy season which normally leads to changes in river water discharge and the dominant color is brown due to erosion and sedimentation. In the dry season, there is usually no water and the river discharge tends to be calm, thereby leading to a very transparent color. However, the water tends to be cloudy, even black, at some points of observation due to human activities such as the disposal of garbage and household waste into Garang River.

It was discovered that approximately 17.65% of water used to irrigate rice fields in Kalirejo is obtained from river sources, as indicated in Figure 5. This unremarkable usage is due to the fact that the water is not clean. The findings further showed that the Pakintelan people used 22.58% of river water for watering plants and fishing, while 12.90% of river terraces are used to plant secondary crops and perennials. It was generally observed that the river environment utilized in this area is estimated at 17.74%. This indicated low utilization, which is probably because the river is far from the settlement. Meanwhile, the community sited closer to the river utilize the water, terraces, and environment for agricultural activities. It was also discovered that the riverbanks are used to protect the river body from scouring while the embankments serve as roads. The community is making a continuous attempt to achieve a harmonious balance between the needs and environmental conservation (Anwar & Shafira, 2020; BKKBN, 2020; F, 2017; Suwartiningsih, Samiyono, & Purnomo, 2018).

The cultural and environmental behaviors of the community in utilizing the river environment were observed

to be mainly associated with water utilization and riparian management. For example, the river water is currently being used for waterfall tourism activities, watering plants, and daily needs at the uppermost area of Munding Village. The community also install long pipe networks to distribute water for daily needs directly from the springs to the houses. The riparian management effort can also be observed in the area surrounding the waterfall being used for tourism activities. Meanwhile, the local people plant perennial crops around the river flow as the water catchment areas, while swales are planted with secondary crops such as cassava, banana trees, coffee, and numerous vegetable.

The Lerep residents use the water from the river to irrigate the plants and some others also use it for daily necessities. The community also apply the water for waterfall tourism and fishing activities, as presented in Table 4. Moreover, the riparian management effort is through the plantation of secondary crops and plants such as *sengon*, bamboo, and other perennials. The observation made also showed that the riverbanks paved using concrete complemented the tourism activities in addition to the signposts installed to indicate the prohibition of litter.

The households in Kalirejo were observed to be using river water for agricultural activities such as the irrigation of plants and to feed livestock. The riparian management effort involved the planation of rice on the land and secondary crops around the river. Meanwhile, the utilization of river water in the central watershed, Pakintelan, is mainly for agricultural activities such as irrigation and fishing while the riparian management effort is based on the production of swales in several places for agricultural activities and plantation of perennials to control erosion and water discharge.

The Harmony of Population Activities in the Garang River Upstream Environment

The cultural practices and environmental conditions related to the life of the people living in the upstream part of Garang River include *'sedekah bumi'* and *'bersih sungai'*, as

Table 4. Utilization and Management of the Garang River Upstream

Utilization and Management	Munding	Lerep	Kalirejo	Pakintelan
Land use	Tourism, water management, waste management	Tourism, agriculture, and garden plants	Watering crops and livestock	Garden plants and fishing
Management	River riparian land management	River riparian land management	River riparian land management	River riparian land management

Source: Primary Data, 2018



Figure 5. Riverside land cover and land use in Kalirejo and Pakintelan (Source: Field Survey)

presented in Table 5. These activities are usually conducted to harmonize human behavior and environmental conservation. 'Sedekah bumi' is a cultural activity held once a year with the intention to show gratitude to God Almighty for the gift of the river. Meanwhile, 'bersih sungai' is a community effort to protect the river to ensure its optimal flow and adequate quantity and quality of water. These activities ensure balance, harmony, and adequacy of the natural environment, thereby harmonizing the population with the environment around the upstream.

It was discovered that 'sedekah bumi' is usually practised in Munding with 100% of the event based on 'bersih sungai' activities. Meanwhile, the activities are 100% 'sedekah bumi' and 71.79% 'bersih sungai' in Lerep, as well as 76.47% and 17.65% in Kalirejo, respectively. It is important to note that the cultural tradition of 'sedekah bumi' developed in Kalirejo is based on the provision of rituals to ancestors through the preparation of offerings and having a feast ('Tumpengan') followed by a traditional puppet show ('wayang'). The findings also showed that the percentage in Pakintelan Village was 54.84% 'sedekah bumi' and 38.71% 'bersih sungai'. The community was observed to be implementing environmental conservation efforts through the cultural practices inherited from their ancestors (Anwar & Shafira, 2020; BKKBN, 2020; F, 2017; Suwartiningsih et al., 2018). This further indicated the harmonic relationship with the environment through a culture of providing care.

Table 5. Environment Cultural Practices in the Villages Close to the Garang River Upstream

Environment Cultural	Munding	Lerep	Kalirejo	Pakintelan
'Sedekah bumi'	100	100	76.47	54.84
'Bersih sungai'	100	71.79	17.65	38.71

Source: Primary Data, 2018

The 'sedekah bumi' tradition is well preserved because it has been passed on for several generations to uphold the kinship system. The tradition was observed to represent the preservation of culture (Mavris, 2014; Novianti, 2012). Moreover, the development of tourism in Lerep fosters social attitudes in the form of cooperation and togetherness, caring for the community's culture, and positively impacting environmental preservation.

The river management through different activities such as conservation efforts by community organizations and government, as indicated in Table 6, is believed to be a means of creating a harmonious relationship between the people and the environment. For example, 100% of the respondents in Munding stated that they usually conduct water and soil conservation to manage the river environment in the upper watershed. The water conservation activities include rainwater retention and the construction of infiltration wells which are usually conducted by the NGO Mercy Corp handling the Garang watershed upstream. Meanwhile, soil conservation includes intercropping plantations, fertilization using organic fertilizers, and making swales on sloping land to restrain the rate of erosion and maintain soil fertility. Some other activities in the area include fully conserved water bodies including 'bersih sungai', no litter around river, tree plantation, and maintenance of riparian function.

Some of the river environment management activities include water and soil conservation as well as the involvement of social institutions as a form of effort towards harmonization

Table 6. River Environment Management Activities in the Garang River Upstream

Type of Activities	Munding	Lerep	Kalirejo	Pakintelan
Water and soil conservation (%)	100.00	76.92	29.41	64.52
Conservation of water (%)	100.00	87.18	76.47	51.61
Community organization (%)	66.67	56.41	0.00	0.00
Government Role (%)	100.00	74.36	70.59	41.94

Source: Primary Data, 2018

as previously explained in the study conducted by [37]. However, the realization of this harmonization for the community requires the input of the government through the implementation of river restoration systems aligned with the broader social, economic, and ecological aspects of the watershed (J.Tippett et al., 2005; Speed et al., 2016).

Community organizations are growing and each village has a group according to its potential. An example of those observed to be focused on the environment is the River Care Community (KPS) which is making efforts towards harmonizing the participation of the community in protecting the river environment. The chairman of this group wants to ensure more coordinated and synergistic actions involving multiple stakeholders but the members of KPS are limited because not all the community around the river can communicate directly with outsiders. The focus of KPS is mainly on areas experiencing severe environmental degradation that require immediate actions.

The harmonization efforts implemented in the Garang River upstream are reflected in several aspects including the types of land use, utilization and management of water resources, cultural and environmental conditions of the area, and river environmental management activities (Luo & Zuo, 2019; Wiranegara et al., 2013). These efforts are considered very important to meet the needs of the people while creating harmony, balance, and sufficiency as well as to ensure conformity with the surrounding environment [32], [34]. Moreover, the focus is on the utilization of the land around the river with due attention to the protection of the environment.

This means that the creation of harmonic relationship requires the community to constantly pay attention to the dynamic conditions as well as to balance, harmonize, and adjust strategies to utilize and care for the river. It is important to note that the population is constantly changing, either increasing or decreasing, and there is a need for the community to fulfil their endless needs despite the existence of limited natural resources. Therefore, they need harmonization to achieve a sustainable life through adequate interaction with the environment in the form of appropriate utilization of resources, including the river. This is necessary to ensure the occurrence of a balanced socially harmonic relationship as indicated in Figure 6.

Harmonization is defined as the efforts implemented by the population to create a balance between harmony and life. The environment in the Garang River upstream is a habitat for living things as indicated by the activities of the residents working as farmers and non-farmers. Moreover, the population is very dynamic with the number observed to be increasing while the land is limited and this means every

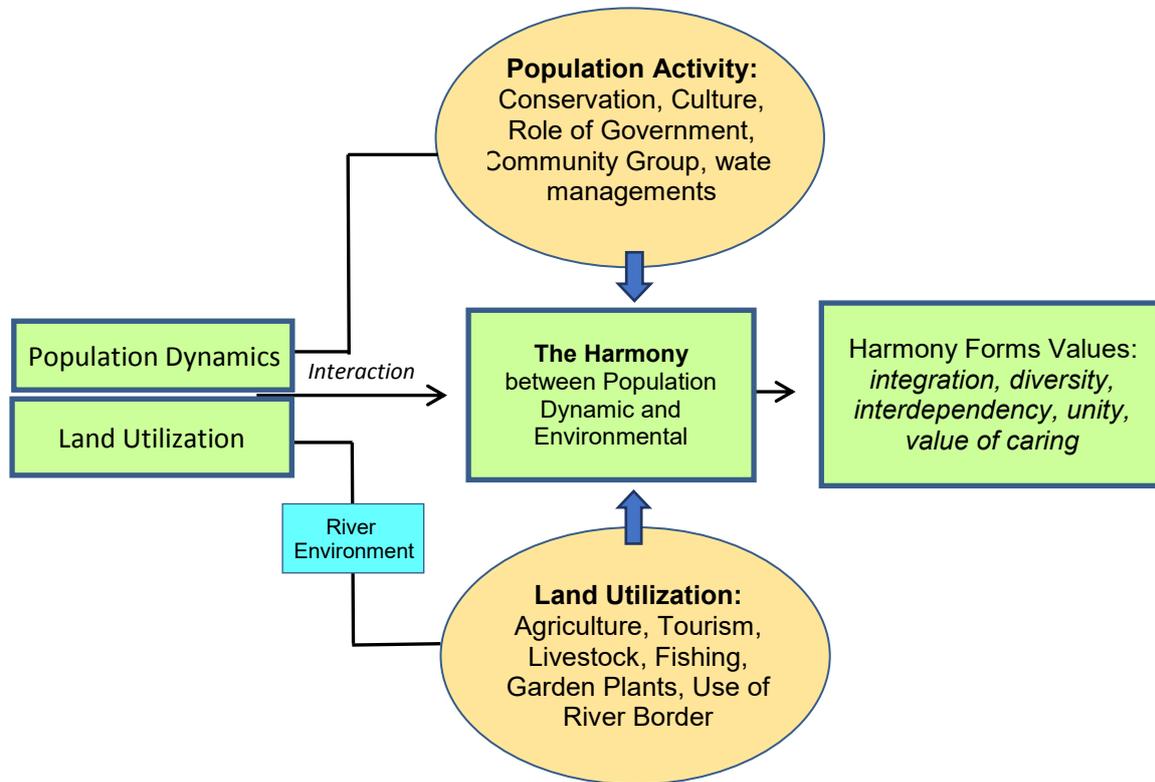


Figure 6. The Concept of the Harmony between Population Dynamic and Environment in the Garang River Upstream

inch of land is a foundation for the life expectancy of every resident. This simply shows that land is increasingly limited, while the population is not (Barenfeld, Carpenter, Ricci, Hardati, & Setyowati, 2019). Therefore, there is a need for continuous and consistent harmonization with the environment to achieve a sustainable livelihood. It is pertinent to restate that the Garang River upstream is one of the water sources usually used by the people living both upstream and downstream to meet the daily needs [7], [22]. Harmony is a universal law that guarantees the continuity of this system. Meanwhile, only a few studies examined the coordinated development of the social, water, and ecological economies (Luo & Zuo, 2019). It was observed from this study that the relationship between human activities and the river water system indicates a harmonic development between the socio-economic and river systems, thereby confirming the theory of harmony (Dasmani, Darfor, & Karakara, 2020; Zuo et al., 2020; Zuo, Luo, & Ding, 2016). It has been noted in previous studies that there are four keywords associated with the concept of harmony and they include diversity, interdependence, unity, and having the highest value (Jain & Subbaiah, 2007; Wiranegara et al., 2013).

4. Conclusion

The residents of the Garang River upstream are very dynamic as indicated by the different economic and conservation activities being conducted. It is also important to note that the economic activities associated with the non-agricultural sector vary increasingly among the villages studied. Meanwhile, those related to the agricultural sector always pay attention to environmental conditions in order to create a harmonic interaction between the population dynamic and the environment. This indicates that there is a need for further examination of this relationship through different studies related to watersheds in other more expansive areas. It is also recommended that a more rigorous study design involving spatial and ecological analyses need to be adopted to have a

deeper understanding of the harmonious relationship between population dynamic and environment management practices.

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