

Penta Helix Model Communication to Promote Appropriate and Green Technologies for Ayung River Preservation Program in Bali

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Abstract. The Ayung River Preservation Program in Bali involves the community and stakeholders to address the degradation of the river. This research focuses on implementing the Penthealix communication model to promote green technology and involve stakeholders in preserving the Ayung River, which is the longest river on the island. The degradation of the river watershed highlights the critical state of the water supply in Bali. Existing data shows that the decrease in river flow rates along the watersheds in Bali has reached 60%, which has the potential to cause a water crisis on the island of Bali. Using the case study method, this research uses in-depth interviews and FGDs with local communities and other stakeholders. Secondary data was also collected from reports in newspapers. The results of the study show that efforts to preserve the Ayung River are implemented in the Green Technologies Program, which includes: 1) Biopori Holes and Infiltration weels; and 2) Community-based waste management. In its implementation, a Penta-Helix collaboration model was built between 1) The Government; 2) Communities; 3) businesses; 4) Academicians; and 5) the media. This program runs the Penta-Helix partnership model, which prioritizes Attribute, communication, and Conflict Resolution Technique efforts to achieve Partnership Commitment between stakeholders.

1 Introduction

Use The Ayung River is the main river that flows in the Ayung watershed and is in the south of the mountains bordering North Bali and South Bali, ending at Padanggalak Beach (Denpasar City). In the upper reaches of the Ayung River, there are three sizable tributaries, namely the Tukad Bangkung, which originates in the Pelaga area, the Petang District area, Badung Regency; the Tukad Mengani, which originates in Catur Village; and the Tukad Siap, which originates in the Kintamani area, Kintamani District, Bangli. These three Tributaries

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unite in the Payangan District, Gianyar Regency. The upper Ayung River is located at an altitude of 2000 m asl, has a width of about 3.4 m-7.3 m, and a surface area of between 10.7 m-16.8 m [1].

The Ayung River Basin is very important for the lives of the people of the Bali region, especially those who live in the South Bali region. The Ayung Watershed is the largest watershed in the Bali Region. With an area of 29,717.17 ha, this watershed passes through six areas in Bali, namely the Badung area, Gianyar area, Bangli area, Tabanan area, Buleleng area, and Denpasar City. Instead of the type of land use, the Ayung Watershed is dominated by land use/plantation covering an area of 11,984.94 ha, or 40.33%, and agricultural land covering an area of 6,332.16 ha, or 21.31%. Furthermore, the utilization of irrigated paddy fields is 3,384 ha (11.39%), settlements are 2,799.93 ha (6.13%), rainfed rice fields are 1,792.95 ha (6.03%), forests are 1,579.67 ha (5.32%), and other uses are 22.31 ha (0.08%).

The Ayung River, as the largest river in the Ayung watershed, has a length of about 62.5 km across 3 areas, namely Badung, Gianyar, and Denpasar. With a flow rate of river water between 23.39 m³/second (min) and 65.31 m³/second (max), the Ayung River is one of the water providers for people's lives, especially those in the Middle and Downstream areas.

The decreasing quality of the Ayung River Basin is one of the indications that the water supply in Bali is facing problems. The data shows that currently Bali is experiencing a water crisis, such as a decrease in river flow along the watershed in Bali by up to 60%, a decrease in the flow rate of the Lake Buyan river by 3.5 meters in a three-year period, the inflow of seawater into the groundwater in southern Bali up to 600 meters, Residents' wells drying up in the last five years from a depth of 4-6 meters to more than 60 meters, and reduced subak water supplies [2].

The Ayung Watershed is divided into three parts, namely the upstream, which is the watershed area and the most critical area if it is not properly maintained. The upstream area is a water catchment area, and there should not be many changes in land use, which is converted from forests to buildings. The area is currently being utilized by the community as an area for cultivation, animal husbandry, and plantations. The downstream area is also a residential area. Each area is interdependent. If the buffer forest in the upstream area is greatly reduced, it will cause the middle and downstream areas to experience a water crisis.

In relation to community development, management of the Ayung River watershed needs to be scrutinized in a multi-dimensional way. Where one component and other components are interrelated, as well as one actor with another actor, if it is not accompanied by a good empowerment synergy, then it will become a conflict [2].

Empowerment is both a process and a goal. As a process, empowerment is a series of activities to strengthen the strength or potential of weak groups in society, including individuals who experience poverty problems. As a goal, empowerment refers to the circumstances or results to be achieved by a social change, namely, people who are empowered, have the power, or have the knowledge and ability to meet their life needs, both physical, economic, and social, such as self-confidence, being able to convey aspirations, having a livelihood, participating in social activities, and being independent in carrying out life tasks [3].

An empowerment concept can be realized if there is effort from stakeholders. The role of stakeholders is one of the keys to success in developing activities. These roles have differences according to the characteristics of the organization they represent [4]. In the Ayung River conservation program, there are five stakeholders involved, which can be termed a pentahelix.

According to Lindmark, Sturesson & Roos in Juwita et al. [5], the pentahelix strategy is a strategy in world tourism that involves public elements and non-profit organizations to realize innovation that is supported by existing tourism resources and potential. Pentahelix's

strategy on tourism in Indonesia is known as the ABCGM strategy, which stands for (Academic, Business, Community, Government, and Media).

The pentahelix collaboration is a collaborative activity between academic lines/fields, business, community, government, and media, or ABCGM, which is known to accelerate the potential for development in a sizable tourism village. This pentahelix element begins in the form of a Triple Helix with elements of Academia, Business Sector, and government, then adds one element, Civil Society (or Community in this study), and then becomes a Quadruple helix, to accommodate people's perspectives.

The community opens opportunities for cross-disciplinary configurations and networks and liberates the concept of "innovation" not only for economic considerations and goals, but also by involving creativity as part of the process of knowledge production and innovation [6]. It is because art-based study and innovation allow for iterative thinking or modeling to develop the economies and markets that are currently being created. Quadruple Helix adds one more element, namely media, because in the context of developing the creative economy in Indonesia, media (both conventional media and social media) plays a significant role, although it is still an independent element or is indirectly influenced by other elements in carrying out parts or functions in one partnership [7].

Partnership requires collaboration and long-term cooperation. The partnership model from Mohr and Spekman (1994) is used to describe the pentahelix collaboration model between stakeholders [8], including:

1. Attributes suggest that certain processes and related constructions help to guide the flow of information between partners, manage the depth and breadth of interaction, and capture the complex and dynamic interchange between partners, acknowledging their mutual dependence and their willingness to work for the survival of the relationship. These attributes include commitment, coordination, interdependence, trust, and power”.
2. Communication Behavior: “indicate that partnerships must have effective communication, including communication quality, information sharing, and participation in goal and planning.”
3. Conflict Resolution Techniques “Conflict often exists in inter-organizational relationships due to the inherent interdependencies between parties. A certain amount of conflict is expected, and an understanding of how such conflict is resolved is important. The impact of conflict resolution on the relationship can be productive or destructive. Thus, the way partners resolve conflict has implications for partnership success.”

Based on the various explanations regarding the definition of collaboration above, collaboration in this study is collaboration between interdependent stakeholders to reach collective decisions in achieving common goals where each collaborating actor has closer relationships, intensive communication, and often blurs organizational boundaries. To get a better understanding of collaboration in this research, the following will explain the dimensions and components that make up collaboration. The collaborative component of a collaboration is a component that is key to the success of the collaboration itself.

2 Research Method

This study utilized a qualitative research method with a case study approach. According to Creswell [9], qualitative research is a way of analyzing the meaning behind individuals or groups in social or human problems. Qualitative research is characterized by Adrijana Biba Starman as an interpretative paradigm that emphasizes subjective experiences and the meanings they have for an individual [10]. A qualitative research method with a case study approach is used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context [11]. According to Simons [12], a case study approach is an in-depth

examination of the complexity and uniqueness of a particular project, policy, institution, program, or system in a 'real life' context from multiple perspectives. Using qualitative research methods with a case study approach, this research conducted in-depth interviews and documentation. This research method was employed in this study to gather insights from the informants. This study takes place in Bali in 2022

For this study, the Ayung River in Bali served as the study site. The Ayung River is the focus of community development programs aimed at preserving its ecosystem and promoting green technology. The researchers selected this site due to the significance of the river and the involvement of various stakeholders in its preservation efforts.

Data collection involved conducting in-depth interviews with local communities, stakeholders, and representatives from governmental and non-governmental organizations involved in the Ayung River preservation program. These interviews aimed to gather insights and perspectives on the implementation of the Penthealix communication model and the effectiveness of green technology initiatives. Additionally, documentation of relevant reports and materials pertaining to the Ayung River preservation program was collected to complement the interview data. By employing qualitative research methods, including in-depth interviews and documentation, this study aimed to gain comprehensive insights into the preservation efforts and stakeholder involvement in the Ayung River project.

3 Research and Discussion

The condition of the rivers in Bali, which are intermittent and annual rivers, causes the water flow to not fully flow throughout the year. The existence of the Ayung River as the largest river and widest flow in Bali is very strategic to provide enough water for the community, especially for the flow of agricultural land [13]. With this dependency, the problem of decreasing water quality in the Ayung River course becomes a public problem and requires all elements to collaborate in solving it.

Moreover, the matter of preserving various cultures and the natural environment is also important for the Balinese people, in line with the Balinese philosophy of life, namely *Tri Hita Karana* (THK), which means the three causes of well-being [14].

To preserve the Ayung River, there is a Green Technologies program that has been developed collaboratively by various parties in Bali recently.

3.1 Biopori Holes and Infiltration Weels

This program is carried out in Pelaga Village and Belok Sidans Village by directly involving the community. Biopore Holes and Infiltration Weels are maintenance methods to increase the absorption of rainwater into the soil. Besides functioning to increase the storage of water in the soil, biopore can also be used to treat waste that is not measurable. By making biopores, organic waste can be put into biopore holes and can eventually be used as food for organisms in the soil. According to R6, in an interview conducted by investigators:

"These benefits can be obtained by making biopores that maximize water seepage into the soil so that it can increase groundwater capacity, make natural compost as a substitute for organic waste, and reduce the water table so that skin diseases can be avoided".

With R6 added, other benefits include reducing rainwater discharged into the sea, reducing the risk of flooding and soil collapse during the rainy and dry seasons, maximizing the role and activities of fauna, preventing soil erosion and soil collapse, reducing air and water pollution, and reducing the release of greenhouse gases.

Through the biopore technique, organic waste does not need to be disposed of in the TPA. The waste will naturally be processed by soil microorganisms and converted into compost (organic fertilizer). The benefits that can be taken from making biopores are increasing water

supply and maintaining groundwater levels, which means that we also save water for human needs. According to R6, apart from biopore inlet holes, another technology is inlet wells. As said in the interview:

"Infiltration well technology functions to maximize water infiltration into the ground, especially in residential areas. An infiltration cistern is an engineering fiction that is made to resemble the shape of a cistern dug to a certain depth that functions as a place to collect rainwater or water flow."

Infiltration wells are groundwater maintenance techniques that have the function of introducing rainwater into the ground. There are several benefits that can be obtained by building infiltration wells, including increasing the amount of water that enters the ground to maintain the hydrological balance of groundwater to prevent seawater from entering, filling voids, which will prevent subsidence, and reducing the dimensions of the drainage network. In addition, it can also reduce groundwater pollution and reduce water runoff from the groundwater surface to prevent flooding.

The introduction of biopore production was carried out in collaboration with the Environmental Agency of Badung Regency (BLH) and the Environmental Impact Assessment Escort Division when socialization of infiltration wells was carried out with the Human Settlement Service Office. In addition, the introduction and development of biopores were also carried out at SMK (Vocational High School) 1 Petang Agriculture by involving teachers and students at Banjar Tinggan and Bongkasa Pertiwi.

The background of this activity is due to the dependence of farmers on chemicals (steel or corrosive poisons), chemical corrosive poisons, and toxic substances. R1 stated in the interview:

"The excessive use of chemicals can have a negative impact on the farmers themselves, as well as the environment and the products they produce. As agricultural products become tougher, their structure and texture are damaged because very few soil organisms and most of the microorganisms in the soil are killed."

He explained that the community development program in the central region is different from the upstream region, which is an agricultural area, and the character of the people living in the Central region is different from both the upstream and downstream areas, as stated in the chat with R1:

"The type of people in the central region is different from those in the upstream region. The people in the central region are people who have experienced a change from village to city. The majority are in agriculture. We are also studying aspects of factory risk and water quality."

In the central region, the company prioritizes the practice of environmentally friendly agricultural programs at Undagi Banjar, including organic laboratories, biological agents, organic fertilizers, organic waste management, verticulture, and farming on residential land. The Mambal Lestari program was continued until 2016 to achieve independence. Subak Mambal Organic Farming Makmal was built in 2013 to serve as a place of learning for farmers and other parties involved in developing environmentally friendly farming systems. To optimize laboratory functions, activities are carried out, which include Training of Facilitators (TOT) for the Organic Agriculture Laboratory.

The goal to be achieved is the ability of farmers to act as facilitators in managing organic laboratories in Subak Mambal. As many as 20 farmer cadres from five munduk (subak) in the Subak Mambal area understand the importance of controlling natural Plant Destruction Organisms and the benefits of biological agents. Participants understand various types of biological agents and how to reproduce the design of action of biological agents to meet their individual needs. A total of 24 participants came from farmer cadres from five munduk in Subak Mambal, who were selected by the respective Kelihan Munduk (Pangliman).

To maintain the sustainability of the program, the Sustainable Ayung Troop (Pokja Ayung Lestari) was formed. In the future, the Ayung Lestari Working Group can be expected to become a forum that supports coordination and integration with stakeholders who use water from the Ayung River in managing the Ayung River Basin. The Ayung River Basin is integrated and beneficial for life, both upstream, middlestream, and downstream. Indirectly, it becomes a joint action plan in the integrated management of the Ayung Watershed (DAS Ayung) and becomes a model for the management of the Ayung Watershed.

3.2 Community Based Waste Management

The global issue of waste has reduced Bali's image as a tourist destination. To overcome this, it is necessary to deal with the waste problem so that tourists who come to Bali can feel comfortable. For this reason, the Community-Based Waste Management program at Tanah Lot needs to be developed so that the waste management mechanism at Tanah Lot is managed properly to create a clean and comfortable environment. This program has been running since 2015 in collaboration with the Korpri Bali Foundation and the Warmadewa University Service Team. According to one informant said:

"This group functions to educate people who use Tanah Lot as a source of life and visitors to Tanah Lot Beach to maintain cleanliness. Tanah Lot Serasi is a community-based management system that also has the function of managing the waste it produces in order to provide economic benefits to the community."

In view of these problems, the Provincial Government of Bali issued Governor Regulation No. 97 of 2018 concerning the limitation of Single-Use Plastic Waste Generation. This regulation supports community-based waste management with collaboration between stakeholders, especially the habit of not throwing garbage into the river. In socializing these rules, the Governor of Bali at that time also used the mass media as a medium for social contact to encourage the enforcement of the regulation [15].

3.3 Penta-Helix Model in The Development of Green Technology Programs in The Ayung River

The community development program for the preservation of the Ayung River is supported by stakeholders including the local community, social organizations, the government and local government, schools and universities, and the media.

The development of partnerships to preserve Ayung River preservation involves five parties, or stakeholders. They are: 1. The government; 2. communities; 3. businesses; and 4. Academicians 5. Media

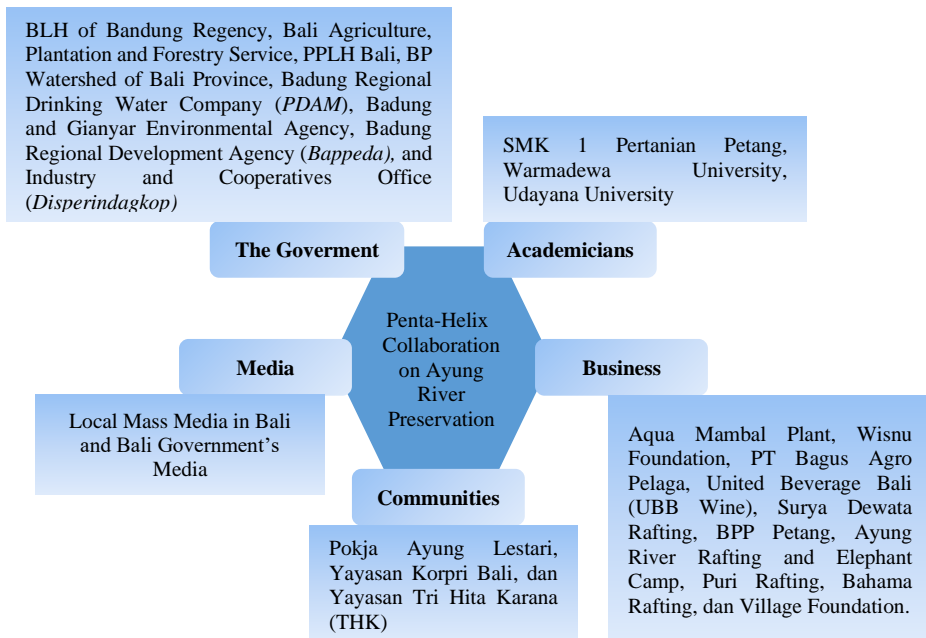


Figure 1. Penta-Helix Collaboration on Ayung River Preservation

Business stakeholders involved in efforts to preserve the Ayung River include Wisnu Foundation, PT Bagus Agro Pelaga, United Beverage Bali (UBB Wine), Surya Dewata Rafting, BPP Petang, and stakeholder groups in the central region, namely Ayung River Rafting and Elephant Camp, Puri Rafting, Bahama Rafting, and Village Foundation.

Meanwhile, local governments and NGOs also joined hands in this effort. Government elements include Agriculture, Plantation, and Forestry Service, Badung DAS Forum, Korpri Foundation, Tri Hita Karana Foundation (THK), PPLH Bali, and BP DAS Bali Province. Meanwhile, NGO elements include the Tri Hita Karana Foundation and the Bali Organic Association Foundation.

Academics through campus institutions are also involved in collaborating, namely Udayana University and Warmadewa University. The use of media also plays a big role. A real example is the socialization carried out by the Regional Government regarding Governor Regulation 97 of 2018, which collaborates with local mass media.

In addition, the form of cooperation is being carried out by the Aqua Mambal Plant together with the government, namely the Department of Agriculture, Plantation, and Forestry (Distanbutuh), the Badung Regional Drinking Water Company (PDAM), the Badung and Gianyar Environment Agency (BLH), the Regional Development Agency (Bappeda) Badung, and Industry and Cooperatives (Desperindagkop). This collaboration aims to form a Sustainable Airborne Troop (Pokja Ayung Lestari).

Based on the collaboration between stakeholders that occurred, it shows that the collaboration process is running, some of which are through the Biopori Holes and Infiltration Weels program, an environmentally friendly agricultural program, and a community-run waste management program that are oriented towards and strengthen the capacity of the local community so that they have an awareness of nature and have a better quality of life and environment.

This is also in line with the partnership model from Mohr and Spekman (1994) used to describe the pentahelix collaboration model between stakeholders:

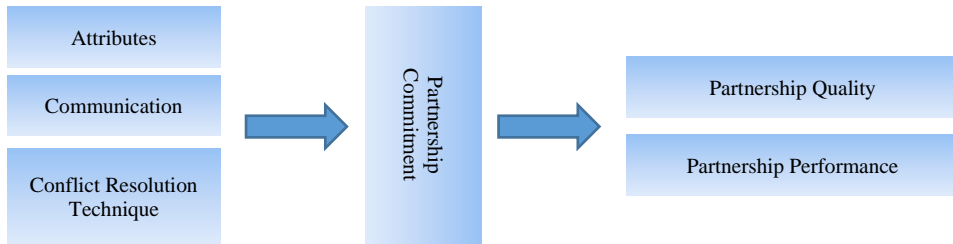


Figure 2. The Penta-Helix Partnership Model

The partnership model above illustrates that the five stakeholders in the preservation of the Ayung River have their respective strategic roles. From an attributive perspective, academics, through schools and universities, have relevant development concepts and theories. Then, the presence of the community includes people who have the same interest in this conservation effort, as well as the local community, who are not only used as program objects, but are involved as actors in this collaboration. Then, the presence of the Government is also important because it has a regulatory hammer and is responsible for solving problems in the Ayung River. Then, the business sector, as an entity that has activities to process goods and services, becomes more valuable. Meanwhile, the media is a stakeholder who has more information and plays a stronger role in promoting the program [16].

Then, the interests of these stakeholders will not be able to unite if there is no good communication. Partnerships must have effective communication, including quality communication, information sharing, and participation in goals and planning. Including the existence of conflicts between stakeholders who demand to be able to be resolved as well as possible.

The partnership commitment between stakeholders in preserving the Ayung River through the efforts of the Green Technologies program can be seen from the ongoing programs that have been implemented, where each stakeholder has their own role and leads to program outputs that are jointly produced.

At the beginning of the conservation effort, the main problem in developing the management of the Ayung River Basin was the lack of stable institutions and the weakness of a comprehensive planning system. Through the collaboration that has been carried out, the results of the program have been seen in the form of quality and sustainable partnerships, so as to be able to provide answers to the problems faced before [2].

4 Conclusion

The existence of the Ayung River, which is strategic for the people of Bali, makes the problems that occur in the Ayung River a public problem because they are related to people's welfare. To preserve the Ayung River, there is a Green Technologies program that has been developed by various parties, including the Biopori Holes and Infiltration Weels program which aims to absorb more water into the soil and so on. In addition, there is also a community-based waste management program. This program has been running since 2015 in collaboration between the Korpri Bali Foundation and Warmadewa University. Then, in 2018 the government contributed by issuing Governor Regulation Number 97 of 2018 concerning Limitation of Single-Use Plastic Waste Generation.

During these programs, it is supported by the Penta-Helix partnership process between The Government, Academicians, Business, Communities, and Media. This collaboration between stakeholders is oriented and strengthens the capacity of the local community so that

they have awareness of the natural surroundings and have a better quality of life and environment. In addition, the stakeholders also run the Penta-Helix partnership model by prioritizing Attribute, Communication and Conflict Resolution Technique efforts. This effort has been able to answer the main problems in the management of the Ayung River watershed which have not been institutionally stable and the lack of comprehensive planning.

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