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RESEARCH ARTICLE

ENHANCING SUSTAINABLE CIDANAU WATERSHED MANAGEMENT (CWM): THE ROLE OF FARMERS IN THE PAYMENT FOR ECOSYSTEM SERVICES (PES) MECHANISM

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ABSTRACT

Sustainable Cidanau Watershed Management (CWM) is essential for maintaining ecosystem services and ensuring long-term water security in Banten Province. This study investigates farmers' participation in the PES mechanism in the Cidanau watershed, and how their land-use decisions affect water quality and ecosystem services. Through a qualitative approach that combines field observations, interviews, and policy analysis, the challenges faced in CWM are examined. The findings reveal that the participation of farmers and farmer groups is critical in watershed governance for (CWM). Farmers and farmer groups participated in determining the price of PES compensation, enhancing and participating in the PES program, and actively monitoring and evaluating PES implementation initiatives. In the CWM mechanism, farmers and farmer groups interests are prioritized, and provided broader space for active and inclusive engagement in conserving the Cidanau watershed. Although participation models may vary across different watersheds, the inclusive participation model developed in the CWM is a potential reference for PES-based watershed governance.

KEYWORDS

Cidanau watershed management, farmer, payment for ecosystem services, CWM, participation

1. INTRODUCTION

Payments for ecosystem services (PES) have become an increasingly popular instrument for ecological management, enhancing policy instruments that were previously mostly dependent on command-and-control techniques (Engel et al., 2008; Ezzine-De-Blas et al., 2016; Bösch et al., 2019; Gain et al., 2021) . In water resources management, PES schemes are a tool for watershed conservation and management. PES employs direct or indirect roles, as well as conditional contracts, to obtain an agreed-upon watershed outcome between a supplier and customer. PES are employed to attain both watershed and human well-being goals. They incorporate a variety of governance structures, ranging from top-down national programs to localized, community-driven initiatives (Brownson et al., 2020; Le et al., 2024). In certain circumstances, local techniques might provide less expensive and more successful alternatives to the large-scale, centralized systems that have previously prevailed, with traditional knowledge coexisting with cutting-edge water management technology (Turner, 2013; UNEP, 2016). Public engagement is one of the most important aspects influencing the effectiveness of PES implementation (Le et al., 2024).

Management of river basins necessitates collaboration and coordination among multiple parties, rather than being the responsibility of a single organization (Syahputra et al., 2016; Lee et al., 2018; Shunglu et al., 2022). Effective watershed management requires participatory approaches to guarantee that coercion and subsidies improve the sustainability and success of watersheds (Johnson et al., 2011; Barrutia and Echebarria, 2019). Participation is characterized as the organized engagement of a substantial number of individuals in various activities aimed at addressing their issues, embodying the concept of unity, which enhances the benefits (Johnson et al., 2011; Mengistu and Assefa, 2021). Participatory watershed management, wherein users identify problems, establish priorities, choose technologies and policies, and assess impacts, is anticipated to enhance performance (Johnson et al., 2011). The issue of public involvement in water management is still developing (Razzaque, 2009; Widianingsih et al., 2021; Narendra et al., 2021).

Many watershed development initiatives worldwide have functioned poorly because they failed to consider local people's needs, limits, and practices; underlines the existence of obstacles that limit the poor's ability to participate in the sale of ecosystem services (Syahputra et al., 2016; Setyo Pambudi, 2019; Wunder, 2015). A lack of appreciation of community participation is one of the factors constraining the sustainability of the watershed management program (Shunglu et al., 2022; Mengistu and Assefa, 2021). Farmers' participation is critical to improving water management (Sheikh et al., 2014). Educating upstream communities about the importance of soil and water conservation represents one of the most significant challenges in establishing a PES scheme, particularly in developing countries such as Indonesia, where the majority of upstream

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populations consist of low-income farmers whose livelihoods are closely tied to the ecosystem (Setyo Pambudi, 2019; Budiarto et al., 2023).

Research on farmers and farmer groups' participation in CWM is still limited and has not been widely discussed. How does farmer participation affect the success of CWM management so that the implementation of PES in the Cidanau watershed from 2005 has survived until now? The purpose of this study is to examine and dissect the concept of farmer participation that affects the sustainability of CWM to date.

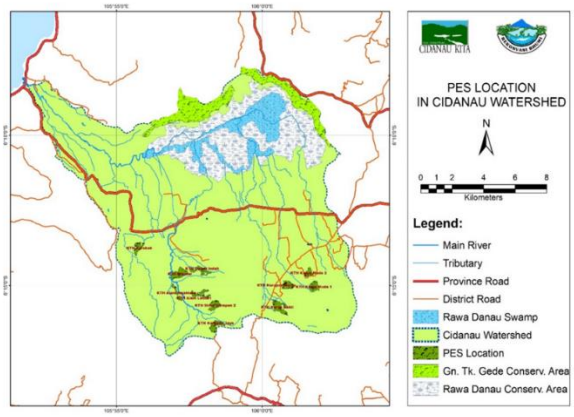
2. Methodology

This article presents descriptive qualitative research, a method used to explore and describe a phenomenon in-depth through non-numerical data. It focuses on understanding participants' experiences, behaviours, and social contexts without manipulating variables, and the results are presented in a detailed narrative form (Creswell, 2009). According to the study, the descriptive method describes or examines a research outcome without drawing broader judgments (Gabrielian, 2017). The process of data collection and analysis in qualitative research involves two interconnected stages: data collection techniques and data processing techniques. In the data collection stage, researchers apply several methods to obtain both primary and secondary information relevant to the research locus and focus. The initial steps are conducting a literature study to explore existing knowledge, theories, and previous research findings. Second, followed by in-depth interviews with key informants (FKDC, farmer, industries) and other relevant actors using the snowball sampling technique, where participants help identify additional informants. During interviews, probing strategies such as elaboration, clarification, repetition of questions, and silent probing are applied to extract deeper information. Researchers may also engage in participant observation, involving themselves in community activities to understand the dynamics among actors. Another important method is the Focus Group Discussion (FGD), where researchers facilitate focused discussions involving multiple stakeholders in a multi-stakeholder forum to gather diverse perspectives. The Focus Group Discussion (FGD) research method, a systematic discussion exercise aimed at a specific subject or problem, was employed in this study's data collection process. Once the data is collected, the process continues with systematic data processing techniques. This begins with organizing the collected data, which may include audio recordings, photographs, maps, documents, and other materials. The next step is data reduction, where researchers select and focus on the most relevant, significant, and thematic data by identifying core patterns and ideas. The reduced data is then presented through data display in the form of matrices, charts, and other visual tools to assist in interpretation and analysis. Finally, based on the results of the analysis, researchers conclude, synthesizing the findings to provide meaningful insights aligned with the research objectives

3. Result And Discussion

3.1 PES in Cidanau Watershed

The study was conducted in the Cidanau River basin located in Banten Province, Indonesia. Cidanau watershed is a small watershed with an area of 23,000 Ha that serves as a supply of raw water for more than 113 companies and more than 500,000 residents in the Cilegon City area (See Figure 1). Figure 1. PES Location in CWM



Source: (FKDC archives, 2018)

The history of Cidanau watershed management began when Rawadanau (a natural water reservoir in the central part of the watershed) was designated as a Nature Reserve monument by the Dutch East Indies government. As time went by and the population of the upper Cidanau watershed increased, the local community became increasingly concerned about the Cidanau watershed, due to social problems and poverty. Low-income smallholder farmers who mostly depend on resource exploitation make up the population of the upstream Cidanau area (Sacha et al., 2019). In the upstream area, farming communities associate to form KTH (Forest farmer groups), and LMDH (Forest Village Community Organizations), and manage community gardens/forests. Cidanau watershed is the only source of raw water for 113 industries and households in Cilegon City.

Water is expected to be in high demand in Banten Province, particularly in cities like Cilegon Municipality and Serang, as the number of industries grows from year to year (Bayuadji et al., 2020; Sunaedi et al., 2019). Water supply tends to grow in the opposite direction of demand, thus conservation in important locations is critical to meeting rising water demand. The Cidanau River has up to now been the only source of raw water that can support the city's population, business community, industry, and the bay tourism (Budhi and Iqbal, 2016; Bayuadji et al., 2020). Implementation of PWS in the Cidanau watershed is the initial PES initiative in Indonesia, beginning in 2005 and continuing until the present (Fauzi and Anna, 2013; Budiarto et al., 2023). Several causes encouraged the implementation of PES in the Cidanau Watershed, particularly those connected to challenges faced in the downstream community's demand for a sustainable water supply and the upper watershed conservation (Budhi and Iqbal, 2016; Bayuadji et al., 2020). The PES implementation of Cidanau watershed management is based on its principles of equality, participation, and cooperation (Budiarto et al., 2023). Parties interested in advancing Cidanau watershed management have equal chances to participate and collaborate. Farmers, who are generally marginalized in watershed management, are put forward to manage the Cidanau watershed and become the most central aspect of CWM.

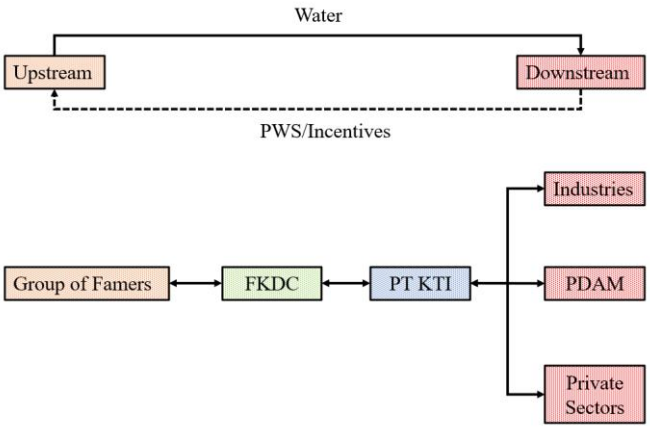


Figure 2: Implementation of PES Scheme in the Cidanau Watershed

Forum Komunikasi DAS Cidanau = FKDC (in Indonesian) or the Cidanau Watershed Communication Forum; PDAM = Regional State Water Company (Ind: Perusahaan Air Minum Daerah); PT KTI =Water Company Owned by the State (Ind: PT Krakatau Tirta Industri)

.PT KTI appointed FKDC as an intermediary to assist farmers and PT KTI collaborated effectively. In addition, FKDC organized an ad hoc panel of FKDC stakeholders, which included government representatives, buyers, and sellers. FKDC acts as a bridging organization between buyers and sellers of watershed services via indirect payment mechanisms. Many parties, such as the House of Representatives, the Governor, and some companies that use raw water, can accept this concept. Payment for watershed services is acceptable to all the parties involved in managing the Cidanau watershed. However, the PES mechanism should be decided by farmers and farmer groups interest priority (sellers) and downstream communities (buyers). Next, the form of inclusive participation of farmers and farmer groups in the implementation of PES in the Cidanau watershed will be discussed.

3.2 Farmers' Participation in the Pricing Mechanism of PES Compensation

PES programs provide financial support to those who supply ecosystem services, who in return may agree to participate by reserving farmland, implementing farming methods that protect habitats, or using new technologies to safeguard watershed functions. Since a substantial share of the global impoverished population lives in rural regions and depends on agriculture within often marginal environments, these individuals frequently possess the capacity to deliver key ecosystem services (White et al., 2022). By compensating low-income farmers to modify their agricultural practices to enhance ecosystem service provision, policymakers can achieve dual benefits: advancing ecosystem sustainability while simultaneously alleviating poverty (Gauvin et al., 2010). However, the pricing mechanism of water service compensation for farmers/poor people in the upper watershed has not been widely implemented. This study was conducted on how farmers participate in determining the pricing of ecosystem service compensation in the Cidanau watershed. What is the fair cost of water in the Cidanau watershed in terms of ecosystem services is the subject that comes up later. In what ways does the estimation of water pricing need policy recommendations? The state's financial structure, constitutional obligations, availability of sufficient information, and a robust civil society all influence the degree of the public (Syahputra et al., 2016)

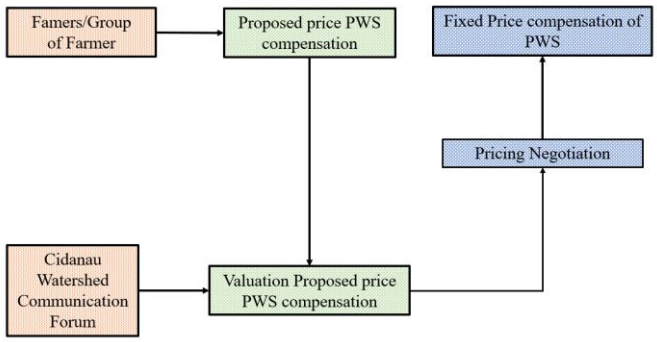


Figure 3: Pricing Mechanism of PES Compensation

Determining compensation prices PES scheme in CWM is an agreement between the farmer groups and the Cidanau Watershed Communication Forum (FKDC)(Figure 3). Farmers can propose the compensation price they are entitled to receive from the Cidanau Watershed Services program. The price proposed by farmers is then discussed by FKDC with various considerations and the ability of the buyer as a raw water user. To establish a "feasibility value" that downstream towns can supply to upstream communities, scientifically established water pricing that incorporates both qualitative and quantitative studies must be taken into consideration (Pambudi, 2019). Pricing valuation results are then discussed with farmers/farmer groups to get an agreed price between farmers and parties. In determining the PES compensation price, farmers and farmer groups are prioritized in determining the compensation price for ecosystem services, and this is a form of active participation from farmers. Farmers are no longer a marginalized part of the Cidanau watershed management scheme, but are given space to play an active role in PES Cidanau watershed. Water is a key component of PES method that is implemented in light of the interrelated functions within watershed management. Quantifying water prices within PES valuation is a key justification for the significance of PES studies.

3.3 Farmers' Inclusive Participation in the PES Mechanism.

The PES mechanism developed in Cidanau watershed management is an indirect mechanism because PT KTI does not want to pay directly to farmer groups but through the intermediary of the FKDC. The mechanism for selecting farmer groups involved in the PES is carried out by the FKDC by assessing the proposals proposed by farmer groups. The subsequent involvement of farmers is in the PES scheme within the Cidanau watershed. Participation in the PES scheme requires farmers to be affiliated with a farmer group.

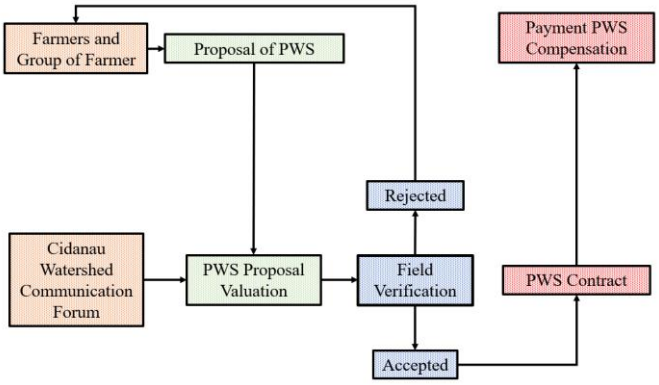


Figure 4: Farmers and Farmers'groups Involvement in PES

Figure 4 shows the involvement of farmers and farmer groups in PES implementation in CWM. Farmer groups must prepare a PES Proposal for each area of 50 hectares, with a target of 500 trees per hectare. Additionally, each member must demonstrate a willingness to participate in the PES scheme by adhering to the established rules and regulations. Subsequently, FKDC assesses the PES proposals put forth by the farmer groups to ascertain their eligibility for participation in the PES scheme. Once a farmer groups has been deemed eligible to participate in the PES scheme, it may then sign the PES contract. Those who have been unsuccessful may improve their proposal to join the PES project in the next period.

The assessment of farmer groups proposals is followed by field fact-finding to determine the truth and accuracy of the data (validation). If the group's proposal and the results of field validation match, the farmer group is entitled to participate in the Cidanau watershed PES scheme. The commencement of PES implementation is evidenced by the signing of the Memorandum of Understanding (MOU) between the farmer groups and FKDC. The implementation of PES takes five-year contracts, with the possibility of extension. The engagement of farmers in the PES program within the Cidanau watershed signifies an active contribution to watershed management, aimed at ensuring the sustainable production of raw water resources.

3.4 Farmers' Participation in Monitoring and Evaluation of PES Implementation

Upon signing the PES contract, farmers receive PES compensation with mutually agreed terms. Compensation payments are made according to the terms of the PES contract. During the ecosystem service payment contract, monitoring and evaluation of the stands must be maintained until the contract period is completed. If the evaluation results show a violation of the collective agreement, the contract can be terminated, and PES payments cannot be continued. Evaluation of the PES program is intended to ensure that the participation of farmers and farmer groups can be implemented according to the contract, and is accountable for the collective agreement

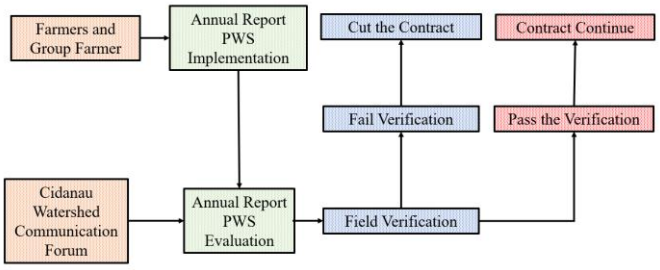


Figure 5: PES Monitoring and Evaluation Mechanism

Figure 5 shows that monitoring PES activities in the Cidanau watershed is designed to ensure that the program aligns with the objectives of watershed management. The monitoring PES implementation is conducted by the Cidanau Watershed Communication Forum (FKDC) six months after the contract is initiated, and again one year after the PES contract. Monitoring and evaluation are carried out based on mutual agreement between farmers, farmer groups, and the FKDC, focusing on crop maintenance activities included in the PES scheme. If one of the group

members is unable to participate, adjustments are made accordingly. Maintaining vegetation in the upper watershed is essential for ensuring a consistent supply of water to meet the industrial and domestic water requirements of Cilegon City. Satisfying these water needs is vital for sustaining and potentially enhancing the region's economic growth at both local and national levels. Consequently, the involvement of farmers and farmer groups in the upper Cidanau watershed indirectly contributes significantly to fostering regional and national economic development. Concerns about participatory water governance are addressed by the PES Cidanau watershed implementation, especially in view of issues noted in a number of case studies, including a lack of social trust, elite control over participatory processes, micro-level power imbalances, and a lack of inclusive participation in decision-making. The implementation of the PES Cidanau Watershed addresses concerns regarding participatory water governance, particularly in light of challenges identified in various case studies, including a lack of social trust, elite control over participatory procedures, micro-level power imbalances, and a lack of inclusive participation in decision-making.

Implementing PES offers numerous advantages to farmers and the ecosystem in the upper Cidanau watershed. The reduction of illegal logging practices, improved tree growth, enhanced implementation of conservation agriculture, and increased income are four indicators that demonstrate the positive ecosystem outcomes resulting from the application of ecosystem services. In addition, farmers benefited from the program due to the internalization of farmers' environmentally friendly attitudes and their economic conditions related to the application of ecosystem services so both conditions are important in the application of sustainable ecosystem services. There was an increase in farmers' knowledge and concern for maintaining the stands, and the number of plants per hectare even exceeded the number of plants in the PES contract. This shows that farmers have a high sense of belonging to the stand, and a growing sense to maintain the plants.

4. Conclusion

The continued implementation of PES in the Cidanau Watershed can be attributed in part to the active involvement of farmers and farmer groups. As upstream river basins serve as buffer zones, water catchments, and natural water filters, their degradation poses significant risks. Farmers and farmer groups play a crucial role in conserving the Upper Cidanau Watershed, as the success of these efforts largely depends on their ability to maintain land cover. Their participation takes several forms, including involvement in determining PES compensation, engagement in the PES program, and participation in the monitoring and evaluation processes. Farmers or farmer groups propose the compensation price they expect, which is then discussed by FKDC, considering scientific assessments and the financial capacity of downstream raw water users. This mechanism ensures that farmers are prioritized and actively involved in the decision-making process, marking a significant shift from their previous marginal role in watershed management. The PES scheme in the Cidanau watershed is implemented indirectly through FKDC, requiring farmers to join groups and submit proposals targeting 500 trees per hectare. FKDC evaluates proposals and conducts field validation; eligible groups sign five-year contracts, promoting farmers' active engagement role in sustainable watershed management. Farmers participating in the PES scheme in the Cidanau watershed receive compensation based on mutually agreed contracts, with monitoring and evaluation conducted by FKDC to ensure compliance. Regular assessments occur six months and one year after contract signing, focusing on maintaining vegetation in the upper watershed, which is crucial for water supply to Cilegon City and supports regional economic growth. The PES program promotes participatory water governance, addressing issues like social trust, power imbalances, and inclusive decision-making. The program has successfully reduced illegal logging, improved tree growth, enhanced conservation practices, increased farmers' incomes, and fostered stronger environmental awareness and responsibility among farmers. Although traditionally marginalized, farmers and farmer groups have emerged as some of the most influential stakeholders in CWM. They are now given space to voice their interests and contribute to decision-making, a key factor in establishing the CWM mechanism as a pioneer of PES implementation that continues to thrive. Future research is necessary to assess the socio-economic outcomes of PES implementation, particularly to explore whether the PES program can serve as a driver for poverty alleviation in the Cidanau Watershed.

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Conflict Of Interest

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this study

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