Vol. 13(1): 173-189, January 2025 DOI: https://doi.org/10.23960/jsl.v13i1.1041

P-ISSN: 2339-0913
E-ISSN: 2549-5747

Jurnal Sylva Lestari

Journal homepage: https://sylvalestari.fp.unila.ac.id

Full Length Research Article

Institutional Analysis of Sustainable Management of the Sekampung Watershed, Lampung Province, Indonesia

Edison[1,*], Irwan Sukri Banuwa[2], Slamet Budi Yuwono[2], Abdullah Aman Damai[2], Kuswanta Futas Hidayat[2], Erdi Suroso[2], Qadar Hasani[2]

[1] Department of Environmental Science, Postgraduate Program, University of Lampung, Bandar Lampung, Indonesia
[2] Faculty of Agriculture, University of Lampung, Bandar Lampung, Indonesia
[*] Corresponding Author. E-mail address: edison@gmail.com

ARTICLE HISTORY:
Received: 3 August 2024
Peer review completed: 10 November 2024
Received in revised form: 24 November 2024
Accepted: 8 January 2025

KEYWORDS:
Institutional analysis
Interpretative structural modelling
Protected forest
Sekampung Watershed
Stakeholder

ABSTRACT

The Sekampung Watershed is one of the 108 critical national watersheds designated by the government as requiring restoration of its carrying capacity. In addition to restoration challenges, a lack of coordination among various institutions has led to fragmented and uncoordinated efforts in watershed conservation. Addressing these, researching the institutional aspects of sustainable management by synergistic governance across sectors in the Sekampung watershed is crucial. This study aimed to determine the key institutions directly involved in the sustainable management of the Sekampung Watershed in Lampung Province, along with their coordination mechanisms and interrelationships. This study also aimed to identify constraints in the sustainable management implementation of the Sekampung watershed. The study employed the Interpretative Structural Modelling (ISM) method using questionnaires and expert discussions. The results show that the key institutions in the integrated management of the watershed to ensure the Sekampung Watershed's functions are preserved and sustainably utilized were the provincial government institutions, governor, regent, mayor, together with the Provincial and Regency or City Regional House of Representatives (DPRD), the Bukit Barisan Selatan National Park Authority (BBTNBBS), and the Way Seputih Way Sekampung Watershed and Forest Management Agency (BPDAS HL WSS). The low awareness care of the community towards watershed management was identified as a critical constraint that must be addressed for the successful sustainable management of the Way Sekampung Watershed.

1. Introduction

The Sekampung Watershed is a priority in Lampung Province, significantly impacting nine regencies/cities. The Sekampung Watershed spans 476,390.21 ha, traversing nine regencies/cities in Lampung Province, and includes seven sub-watersheds: Way Sekampung Hulu, Way Bulok, Way Semah, Way Tugubalak, Way Kandis, Way Katibung, and Way Sekampung Hilir (Sekampung Characteristic Report, BPDAS HL WSS 2022). The Sekampung Watershed is a crucial water source for rice farming and electricity generation. It features the Batutegi Dam upstream, as well as the Sekampung and Argoguruh Dams, which supply water to downstream rice fields (Amran 2012; Asnawi et al. 2020; Libna 2022; Widodo et al. 2022). Besides agricultural irrigation, the

Sekampung Watershed is vital for electricity generation, notably with the Batu Tegi Hydroelectric Power Plant (Swastika et al. 2022), which can generate a maximum power of 2 × 14 MW, supplying electricity to approximately 2,000 households with a capacity of 1300 VA (Anggatara 2021). The Sekampung Watershed is a raw water source for the local water utility company, PDAM (Rahmadana et al. 2022; Umayasari 2021).

The Sekampung Watershed is one of the 108 critical national watersheds designated by the government as requiring restoration of its carrying capacity (BPDAS HL WSS 2022). The quality and quantity of land, water continuity, socio-economic conditions, investment in water infrastructure, and spatial utilization within the Sekampung Watershed must be fixed. Based on flood sub-criteria, the Sekampung Watershed qualifies for very high restoration (Nugroho and Rolia 2022). The damage to the Sekampung Watershed mainly occurs in the upstream area located in Tanggamus Regency. Watershed damage can be caused by human activities such as illegal logging, forest fires, forest encroachment, and forest exploitation (Fitriandhini and Putra 2022), as well as excessive land exploitation for mining, plantations, industry, settlements, roads, agriculture, and other uses (Mirnawati et al. 2022; Supriyadi et al. 2018), and land use without soil and water conservation principles (Aprianto et al. 2024; Hudi 2021; Tribiyono et al. 2018). Wasono et al. (2023) reported that the rate of erosion in the Way Sekampung Sub-Watershed is 4,288,674.84 tons/year or 8.26 mm/year, while the potential for sediment to enter the reservoir is 1,275,070.36 tons/year or 2.46 mm /year. The degradation of the upstream ecosystem of the Sekampung Watershed is in line with the increasing land use for the population's needs, such as agriculture, housing, industry, recreation, and other activities (Herison and Romdania 2023; Hudi 2021). Watershed degradation is characterized by extensive critical land, resulting in suboptimal watershed water management functions, increasing the frequency and severity of floods and droughts (Aulia 2023; Hudi 2021; Nugraheni 2021; Riswulan et al. 2021; Widodo et al. 2022).

Efforts to manage water resources are crucial for restoring the Sekampung Watershed properly. One strategy for restoring the Sekampung Watershed's function is sustainable watershed management through synergistic governance across sectors via a management institution that ensures the Sekampung Watershed's functions are maintained and sustainably utilized. Lampung Province Regional Regulation Number 22 of 2014 even regulates integrated watershed management. The Ministry of Environment and Forestry confirmed that watershed management ensures clean water, the sustainable use of terrestrial and aquatic ecosystems, the prevention of continuous land degradation, and the rehabilitation of degraded forests and lands (Narendra et al. 2021).

The performance of sustainable watershed management in a region is influenced by many aspects, one of which is institutional. The importance of institutions has received significant attention in various watershed management efforts (Noywuli et al. 2019; Sulistyaningsih et al. 2021). Existing institutions are an aspect of government policy that needs to be reviewed in watershed management to see the contributions and interrelations between sectors (Pambudi 2019). Several institutions from various hierarchies are currently managing the Sekampung Watershed. However, poor coordination and collaboration among institutions, including government agencies and non-governmental organizations, has resulted in fragmented efforts toward watershed conservation. The existing institutions are focused on their respective duties and functions without an integration program among the institutions. The roles of each institution related to the Sekampung Watershed need to be synergized within a coordination forum.

Organizing institutions to manage the Sekampung Watershed presents a challenge for the government.

Institutional analysis assessed governance structure, stakeholder relationships, and policy frameworks to enhance natural resource management, including watersheds and forests (Ostrom 2011). Few studies have examined the institutional analysis of sustainable management in the Sekampung Watershed, Lampung Province. However, it may not have been extensively covered. Notable research includes institutional analysis of the farmers' association of community forest management in the upper Sekampung watershed and the importance of institutional factors in rice farming in the downstream Sekampung watershed (Asnawi et al. 2020). Institutional research on integrated water resource management in the Sekampung Watershed still needs to be completed. In general, most research in the past five years has focused on water quality and land use (Fitri et al. 2023; Fitriani et al. 2022; Herison and Romdania 2023; Somura et al. 2019; Yustika et al. 2019a), health assessments (Rolia et al. 2021), erosion assessments (Yustika et al. 2019b), and flood inundation models (Aprizal et al. 2021). This study aimed to determine the key institutions directly involved in the sustainable management of the Sekampung Watershed in Lampung Province, along with their coordination mechanisms and interrelationships. It also aimed to identify constraints in implementing management in the Sekampung watershed. Addressing the institutional problems through comprehensive analysis can lead to the development of effective governance structures, improved policy enforcement, and enhanced institutional collaboration, all of which are essential for the sustainable management of the Sekampung watershed.

2. Materials and Methods

2.1. Research Location

The research was conducted in the Sekampung Watershed (DAS Sekampung) (**Fig. 1**) from 2022–2023. The location was selected purposively considering that the Sekampung Watershed is a vital source of livelihood for many communities. The research location administratively encompasses nine regencies and cities in Lampung Province. It covers the entire Sekampung Watershed, divided into three regions: the upstream region (Tanggamus, Lampung Barat, and Pringsewu), the central region (Pesawaran, Bandar Lampung City, Metro City, and Lampung Tengah), and the downstream region (Lampung Selatan and Lampung Timur).

2.2. Data Collection

The institutional study of the Sekampung Watershed Management used primary data (collected directly from the source via interview, Focus Group Discussion (FGD), questionnaires, and observation) and secondary data (refers to collected, processed, and published information). Primary data were obtained through interviews with respondents, expert discussions, and structured questionnaires. Data was validated through focus group discussion. The interviews aimed to identify the play role of institutions, challenges, and programs related to managing the Sekampung Watershed. Questionnaires were filled out directly. The questionnaire's questions covered the relationship pattern between institutions from the bureaucracy and vertical agencies in Lampung Province, including universities. The respondents were chosen based on purposive sampling considerations. Respondents included 15 individuals representing the bureaucracy (district secretaries, heads of provincial agencies/departments, academics from the University of

Lampung, and local Non Government Organization (NGOs) in Lampung Province with relevant experience in their respective fields. Respondents were selected based on their duties and functions, participation, and involvement in the management of the Sekampung Watershed. Secondary data on the research location's general condition, including soil type, topographic, and land use maps, as well as land characteristics, were obtained from BPDAS HL WSS (2022), BBWS MS (2022), and gubernatorial decrees from the Lampung provincial government (2024), sourced from BPDAS HL WSS and the Lampung Province Forestry Service.

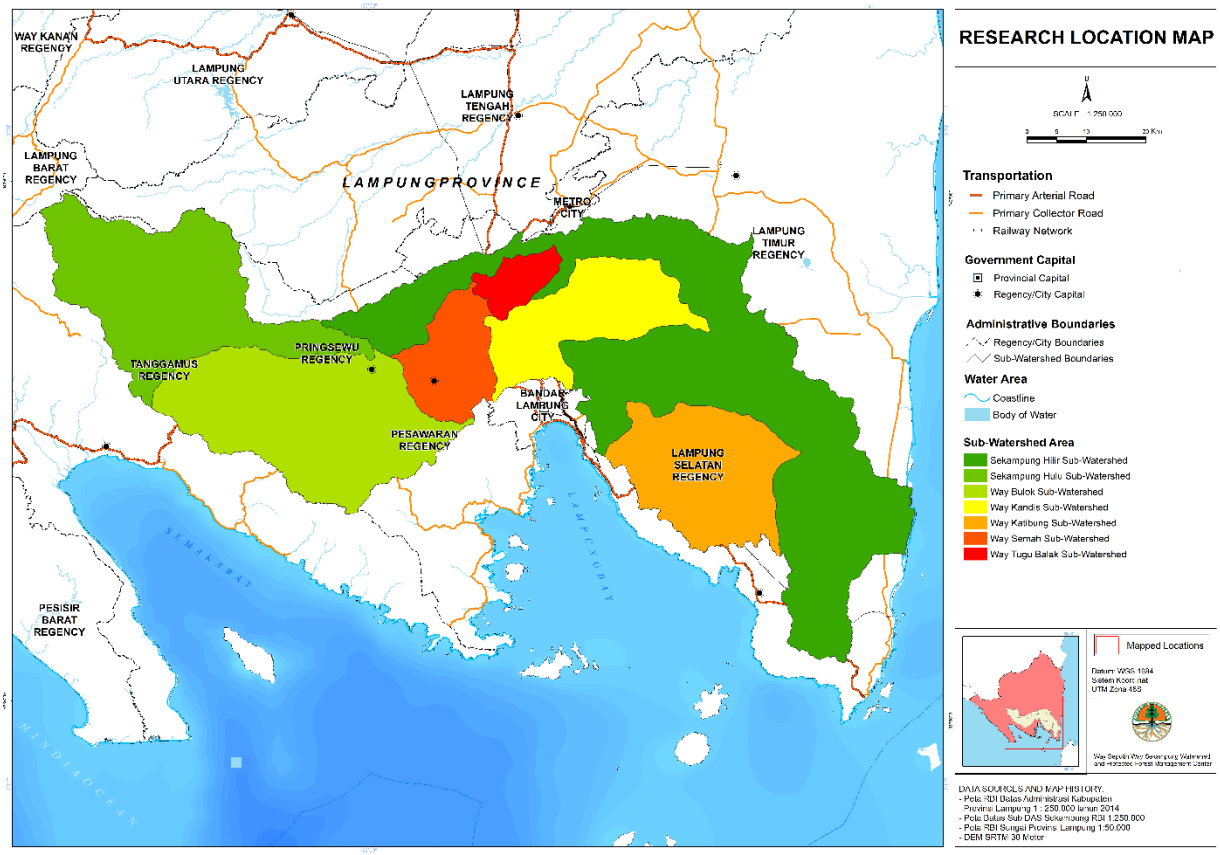


Fig. 1. Research location. Coordinates located between 104° 76' E – 105° 51' E and 05° 23' S – 05° 53' S.

2.3. Data Analysis

Data analysis in the institutional study of the Sekampung Watershed Management uses the Interpretative Structural Modelling (ISM) technique. The ISM method analyzes the structural elements based on their contextual relationships. The data analyzed consists of sub-elements of actor activities, program actors, and constraint elements related to sustainable watershed management in Lampung Province. The data was obtained from literature reviews and expert consultations. The ISM produces a matrix or diagram that groups the analyzed elements into certain quadrants. Each quadrant has a meaning based on the influence and dependency of the elements on the system being analyzed (Ahmad and Qahmash 2021). Concerning watershed management, the ISM method was used to identify institutions that play critical roles in watershed management (RazaviToosi et al. 2019; Sulandari et al. 2021) and the constraints faced in sustainable watershed management in Lampung Province based on their hierarchical structure of sub-elements. Institutions that play critical roles refer to organizations that play essential roles in

managing water resources, preventing environmental degradation, and ensuring the watershed's long-term ecological

3. Results and Discussion

3.1. General Condition of the Sekampung Watershed

Lampung Province has 15 cities and regencies, with the Sekampung Watershed spanning nine administrative areas within these cities/regencies. Geographically, the Sekampung Watershed is located between 104°76' E – 105°51' E and 05°23' S – 05°53' S, covering an area of approximately 476,390.21 ha. The Sekampung Watershed consists of 7 sub-watersheds, with each area and its proportion presented in **Fig. 1**. The Way Sekampung Hilir Sub-Watershed has the largest area, followed by the Way Bulok Sub-Watershed and the Way Sekampung Hulu Sub-Watershed, covering 37.02%, 18.34%, and 17.24% of the total Sekampung Watershed area, respectively (BPDAS HL WSS 2022).

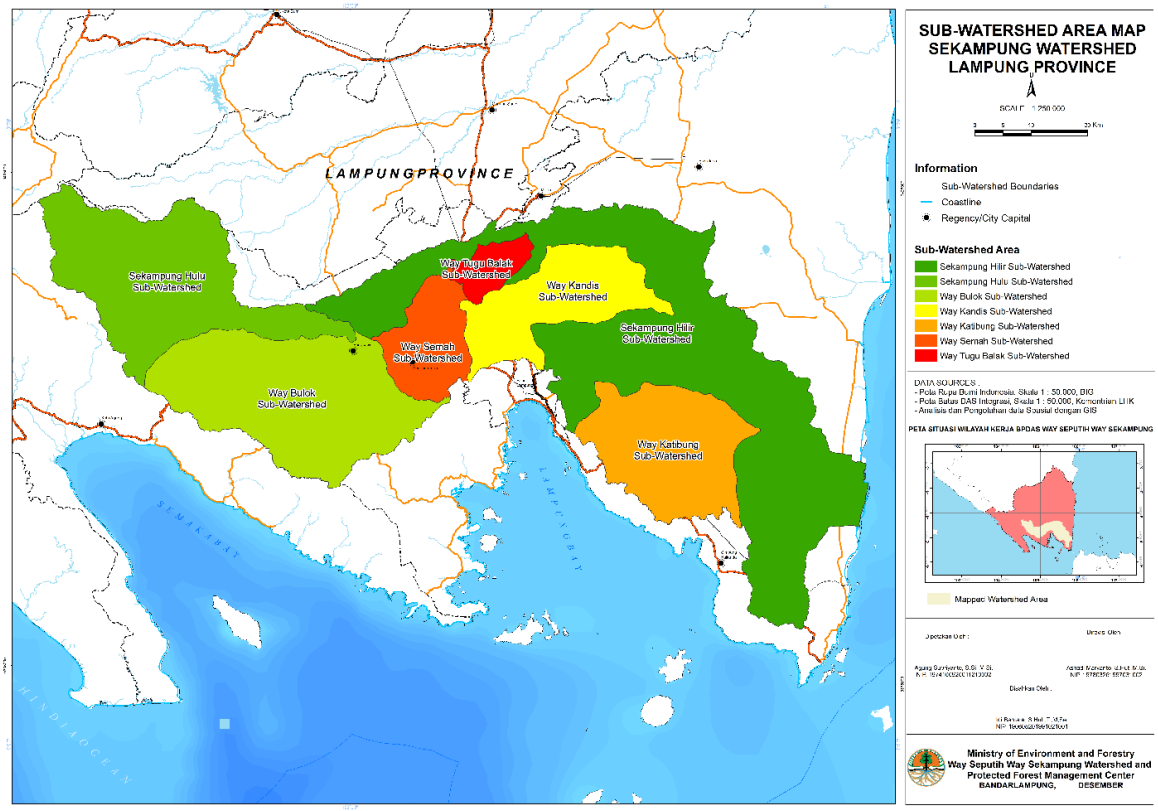


Fig. 2. Sub-watersheds in Sekampung Watershed (BPDAS HL WSS 2022). Coordinate located between 104° 76'E – 105° 51' E and 05° 23' S – 05° 53' S.

From an administrative watershed boundary perspective, the largest regency within the Sekampung Watershed is Lampung Selatan Regency 34.74%, followed by Tanggamus Regency and Lampung Timur Regency, with proportions of 22.39% and 11.96%. Cities/regencies within the Sekampung Watershed are further divided into sub-districts and villages within the watershed. The spatial layout of the Sekampung Watershed, its tributaries, and their relative position concerning administrative boundaries are shown on the Sekampung Watershed map (BPDAS HL WSS 2022).

The critical land map analysis for 2022 using GIS (BPDAS HL WSS 2022) shows that vital land is scattered across all sub-watersheds in the Sekampung Watershed, with the most significant areas located in the Way Bulok and Sekampung Ilir sub-watersheds. The details are presented in **Table 1**.

Table 1. Area of critical land in the Way Bulok Sub-Watershed and Sekampung Ilir Sub-Watershed

Sub-watershed	Dominant soil type	Area (ha)
Way Bulok	Slightly critical	24,920.23
	Critical	23,632.64
	Potentially critical	9,780.82
	Total	89,136.42
Way Sekampung Hilir	Slightly critical	13,548.99
	Critical	2,037.92
	Potentially critical	82,370.01
	Total	97,955.92

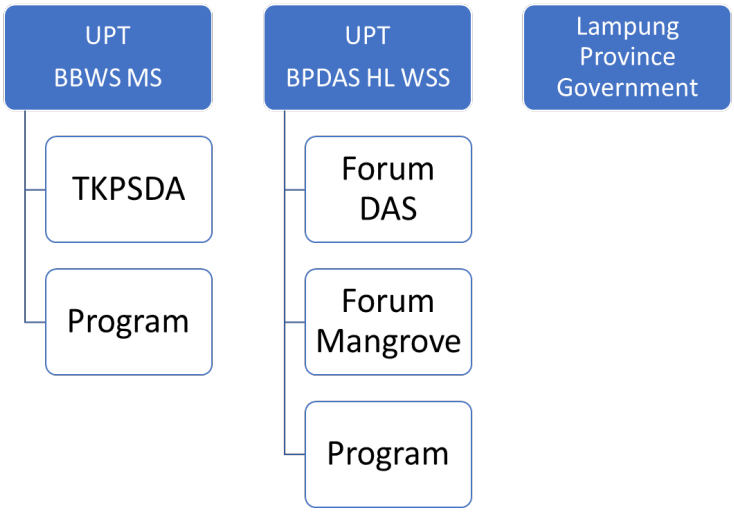
Based on interviews, document studies, and field observations, the institutions directly managing the Sekampung Watershed include provincial government institutions, ministry agencies, and community groups (**Table 2**).

Table 2. Watershed institutions in Lampung Province

Institution	Name of Institution	Legal Basis	Form of Institution
Provincial Government of Lampung	Lampung Provincial Water Resources Council	Lampung Governor Decree Number GI/492/III.10/HK/2011	Coordinating Agency
Provincial Government of Lampung	Lampung Provincial Irrigation Commission	Lampung Governor Decree Number G/ 308 /VI.01/HK/2017	Coordinating Agency
BPDAS HL WSS	Lampung Watershed Forum	Lampung Governor Decree following the mandate of Regional Regulation No 22/2014/ and No 22/2017 on Integrated Watershed Management	Coordinating Agency
BPDAS HL WSS	Lampung Mangrove Forum	Lampung Governor Decree No 409/208/ issued by 2020	Coordinating Agency
BBWS MS	Sekampung Watershed Natural Resources Management Coordination Team	Indonesian Minister of Public Works and Housing Decree on Integrated Watershed Management in Lampung Province	Coordinating Agency
Community	Water Users Farmer Association	Formed based on mutual commitment	Coordinating Agency
Community	Water Users Farmers Communication Forum (FKP3A) Lampung		Coordinating Agency

Table 2 illustrates the coordination bodies directly involved in managing the Sekampung Watershed. These coordination bodies coordinate watershed management institutions, policy formulation, institutional integration, and monitoring and evaluating management implementation. According to Narendra et al. (2021), challenges in managing watersheds in Indonesia encompass issues such as hierarchical ambiguities, legislative inconsistencies and asynchrony, as well as limited participation, synchronization, and coordination among stakeholders involved in watershed management. Based on field studies and expert discussions, the existing institutions (**Table 2**) have fulfilled some institutional functions but have yet to comprehensively. Of the five challenges Narendra mentioned, coordination among watershed management stakeholders has become relevant to be further followed up.

In executing their duties, the Technical Implementation Unit (UPT) of BPDAS HL WSS has established provincial-level institutions, namely the Lampung Watershed Forum (Forum DAS) and the Mangrove Forum. According to resource and cost-sharing documents (Regional Research and Development Agency of Lampung Province 2018), the forum model is a recommended institutional model for managing the Sekampung Watershed. Members of the Watershed Forum and Mangrove Forum include elements from the bureaucracy, NGOs, academics, and companies in Lampung Province. The inter-institutional coordination for managing the Sekampung Watershed, both among provincial government agencies and among UPTs and other institutions, is reflected in the following schematic (**Fig. 3**), based on field observations, document studies, interviews, and expert discussions.



Description: UPT (Technical Implementation Unit), BPDAS HL WSS (Way Seputih Way Sekampung Watershed and Forest Management Agency), BBWS MS (Major River Basin Organization for Mesuji Sekampung), Forum DAS (Watershed Forum), TKPSDA (Water Resources Management Coordination Team).

Fig. 3. General schematic of coordination of program implementation among institutions.

The above schematic shows that the coordination relationships at the field level among institutions still need to be optimal, preventing effective watershed management for the Sekampung Watershed. The existence of the Sekampung Watershed Forum is only coordinative and does not have an action program. Based on institutional data on managing the Sekampung Watershed (**Table 2**), no agency bridges and integrates across UPTs and forums to ensure cohesive functioning. Coordination issues in the watershed concept align with Pambudi (2019) review of watershed management in Indonesia.

3.2. Institutional Interpretive Structure Modeling (ISM) Analysis

The data that become input elements in the institutional ISM analysis consist of sub-elements of institutions and constraints. Both elements were obtained from field studies, interviews with 15 respondents, FGD, and expert discussions.

3.2.1. Institutions element

The expert discussion results showed that 11 sub-elements of institutions play a role in sustainable watershed management in Lampung Province (**Table 3**). Identifying these institutions is based on existing institutions in Lampung Province, both vertical and horizontal, with tasks and functions related to managing the Sekampung watershed. The ISM analysis of the institution element aimed to identify the institutions playing the most crucial role in managing the Sekampung watershed among the 11 sub-elements of institutions

Table 3. Institutions that play a role in watershed management watershed management

Code	institution
A1	Governor/Regent/Mayor Government
A2	Provincial and Regency/City DPRDs
A3	Universities/Academics
A4	Bukit Barisan Selatan National Park Center (BBTNBBS)
A5	Mesuji Sekampung River Basin Center (BB WS MS)
A6	Way Seputih Way Sekampung Watershed and Protected Forest Management Center (BPDAS HL WSS)
A7	Forestry Service of Lampung Province
A8	Sub-district Government
A9	Village/Lurah Government
A10	Private/business actors utilizing the Sekampung River
A11	Community/NGO

Based on the field study, the institutions actively involved in managing the Sekampung watershed include (1) The Lampung Provincial Government (through the Lampung Provincial Water Resources Council and the Lampung Provincial Irrigation Commission); (2) BPDAS HL WSS (with the Lampung Watershed Forum and the Lampung Mangrove Forum); (3) BBWS MS (Mesuji Sekampung River Basin Center); and (4) the community (represented by the Water User Farmers Association and the FKP3A Communication Forum for the Water User Farmers Association). Compared with the actor elements of the expert discussion, it is interesting that many actors still need to be fulfilled in managing the Sekampung watershed out of the 11 recommended actors/institutions, including the sub-district government and the village level, as well as local community/NGO. These results indicate that implementation in the field has yet to see community-based watershed management through Bottom-Up management. The involvement of local institutions for example, plays a significant role in the management of natural resources (Salampessy et al. 2024). The importance of bottom-up management has been widely evaluated in watershed management in various regions such as the Garang watershed, Bergas sub-district, Semarang district, Central Java (Sriyana et al. 2020), Batang Masumai watershed, Bukit Perentak Village and Baru Pangkalan Jambu Village, Pangkalan Jambi District (Muchlis et al. 2023).

The results of the ISM analysis of the Sekampung Watershed management institutional data show that the actors/institutions that play a significant role in integrated watershed management in Lampung Province are A1 together with A2, A4, and A6, which are in quadrant I (**Fig. 4**). This result is unique when compared to critical actors studied in watersheds in other regions of Indonesia that place BPDAS as the primary key actor in the management of the Flores Watershed (Noywuli et al. 2019), the Beka Village Watershed in Sigi District (Bakri et al. 2024), and the Biyonga Watershed in Gorontalo District.

Most respondents (80%) agreed that the management of the Sekampung Watershed needs the "political will" of the regional head, in this case, the Lampung Governor/Regent/Mayor. Meanwhile, institutions outside the bureaucracy, such as NGOs, are considered to play a role as a support system to "criticize" the programs of government institutions in managing the Sekampung Watershed. According to Adhitama et al. (2022), strengthening the institutional aspect of the government is the key to management, followed by the need for comprehensive studies in watershed/sub-watershed management.

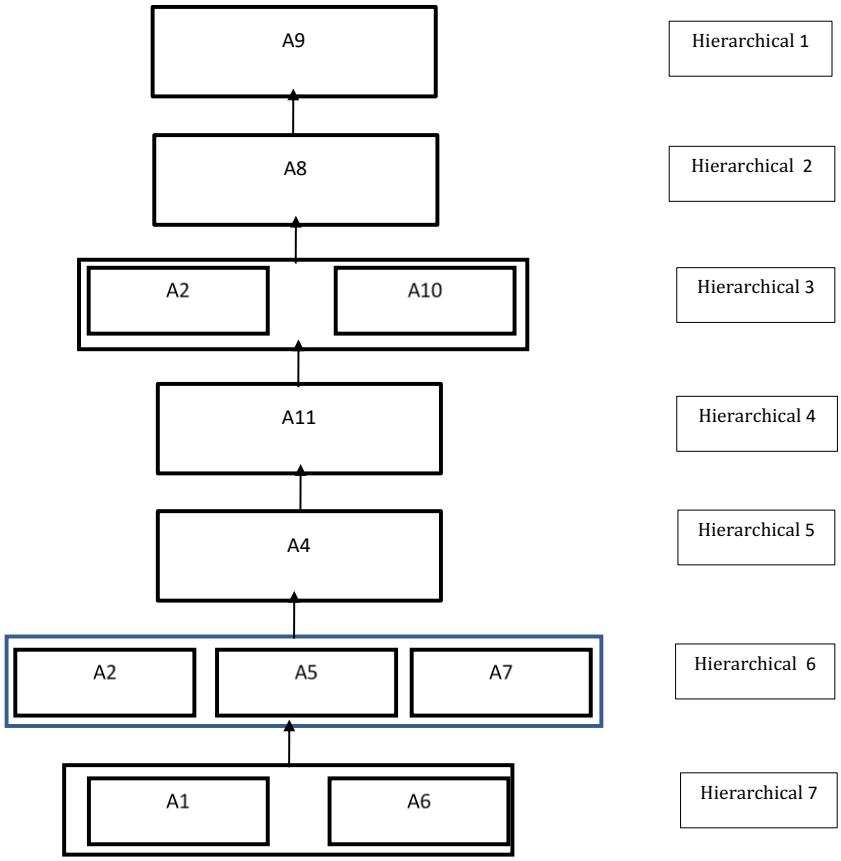
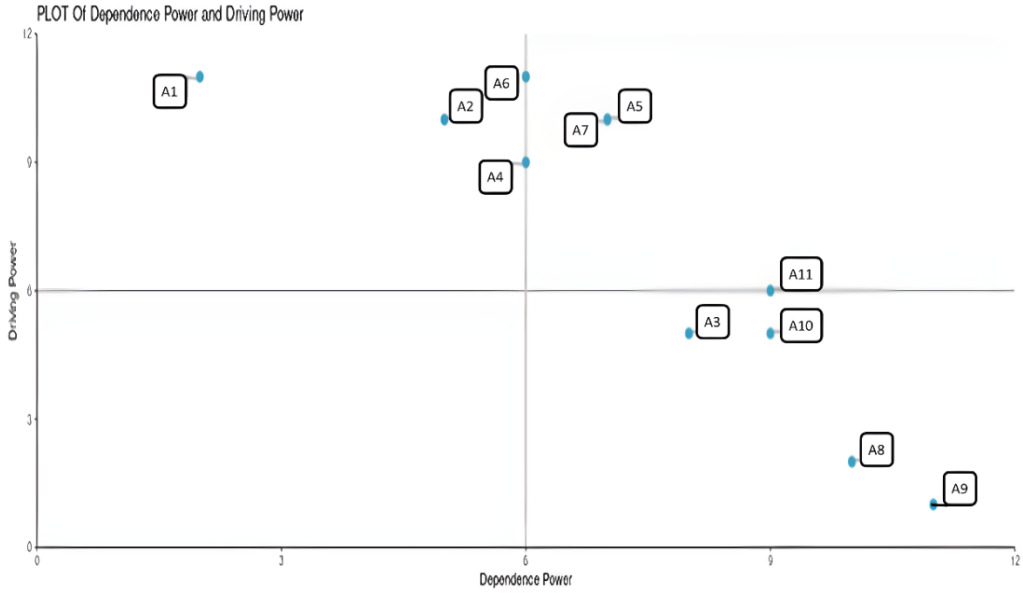


Fig. 4. Hierarchical structure of actor sub-elements in Sekampung Watershed management.

The results of the system structuring (**Fig. 5**) show that the A1 and A6, are the critical actors in the successful management of the Sekampung Watershed. The A1 and A6 sub-elements will further drive the other sub-elements, which in turn strengthen the A9 sub-element. This relationship is shown in the results of the driver power and dependent relationship (**Fig. 4**), which places the A1 in the independent sector, which shows a decisive role in the management of the Sekampung watershed. This role can be understood considering the duties and authority of the governor according to the Indonesian Law Number 23 of 2014 in Article 38 Paragraph 1,

explaining that the position of the governor as the representative of the government in the region has the function of guidance, supervision, and coordination of government affairs in the region as well as assistance tasks. Similarly, the duties and authority of the regent/mayor are adjusted to the region. Indonesian Government Regulation Number 19 of 2010 states that the governor is given a mandate as a representative of the central government in the form of full authority over the continuity of city/regency governance and, at the same time, has the right to provide rewards and sanctions to cities/regencies. This allows local governments to use existing legal authority to implement projects or change policies, such as the study results shown by Yoder et al. (2021), where local governments organize themselves to establish watershed management authorities and conduct collaborative planning and management.



Description:
A1: Governor/Regent/Mayor, A2: Provincial and Regency/City Councils, A3: Universities/Academics, A4: Bukit Barisan Selatan National Park (BBTNBBS), A5: Mesuji Sekampung River Basin Management Center (BBWS MS), A6: Way Seputih Way Sekampung Watershed and Protected Forest Management Center (BPDAS HL WSS), A7: Lampung Provincial Forestry Service, A8: District Government, A9: Village administration, A10: Private sector/business actors utilizing the Sekampung River, A11: Community/NGOs.

Fig. 5. Driver power and dependent relationships in the actor sub-element in Sekampung Watershed management.

The existing institutions of the provincial government, in this case, the governor as head of government and head of the region, are powerful in encouraging the management of the Sekampung watershed based on current regulations. The governor has Regional Apparatus Organizations (OPD) such as the Forestry Service, Environment Service, Highways/Water Department, and Development Planning Agency (Bappeda), which assist the governor in carrying out development tasks. The critical role of local governments in watershed management in Indonesia has been described by several researchers, for example in the Garang Watershed of Central Java Province (Ujianti et al. 2018), Siak Watershed, Riau (Lestari and Ridwan 2016), Cisdane Watershed, Banten (Nuralifah et al. 2023). At the same level as A1, the ISM analysis results indicate that A6 is also a crucial institution. It plays a vital role in the integrated management of the Sekampung watershed through its primary tasks and functions. BPDAS HL WSS is a vertical institution in Lampung Province under the Ministry of Environment and

Forestry. BPDAS HL WSS is a technical implementation unit in the field of watershed management and protected forests under the Director General of Watershed Control and Protected Forests (DitJen PDAS HL) based on the Minister of Environment and Forestry Regulation Number P.10 of 2016 concerning BPDAS HL Organization and Work Procedures). BPDAS HL assists DitJen PDAS HL in optimizing development service tasks in watershed management and protected forests in the regions. An analysis of the role of stakeholders has shown the importance of BPDAS/BPDAS HL WSS as a critical institution in watershed management. The synergy between BPDAS Palu Poso and Forest Management Unit (KPH) Kulawi provides a solid foundation for optimizing the management potential of the Beka Village Watershed Forest Rehabilitation (Bakri et al. 2024). BPDAS as a management tool is one of the strengths of Biyonga Watershed management in Gorontalo Regency and in Aesesa Flores watershed management in Noelmina.

3.2.2. Constraint element

As Table 4 shows, the constraint element in managing the Sekampung Watershed identified six sub-elements. Fig. 6 and Fig. 7 present the results of the structuring and the relationship between driver power and dependent sub-system elements of constraints in managing the Sekampung Watershed.

Table 4. Sub-elements of constraints

Code	Constraint Element
K1	Low public awareness of watershed management
K2	Weak enforcement of regulations on watershed protection
K3	Local government policies have not been fully implemented for watershed management
K4	Activities along the river that cause water pollution
K5	Behavior and habits of people who live in river borders and dispose of domestic waste in the river
K6	Regulatory support for watershed management is still not optimal

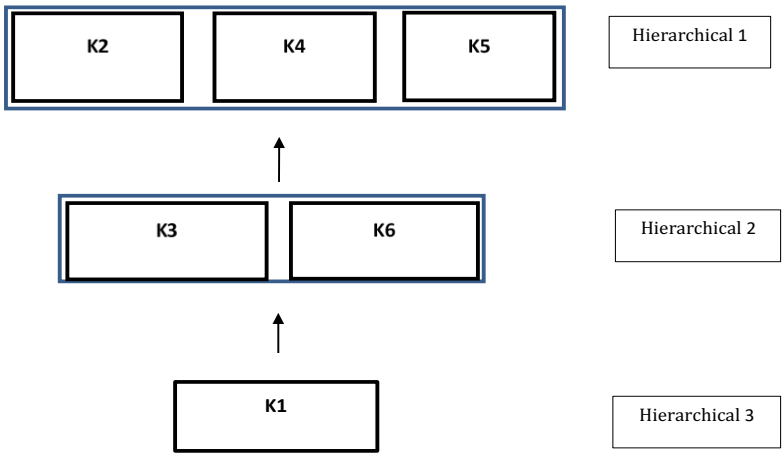
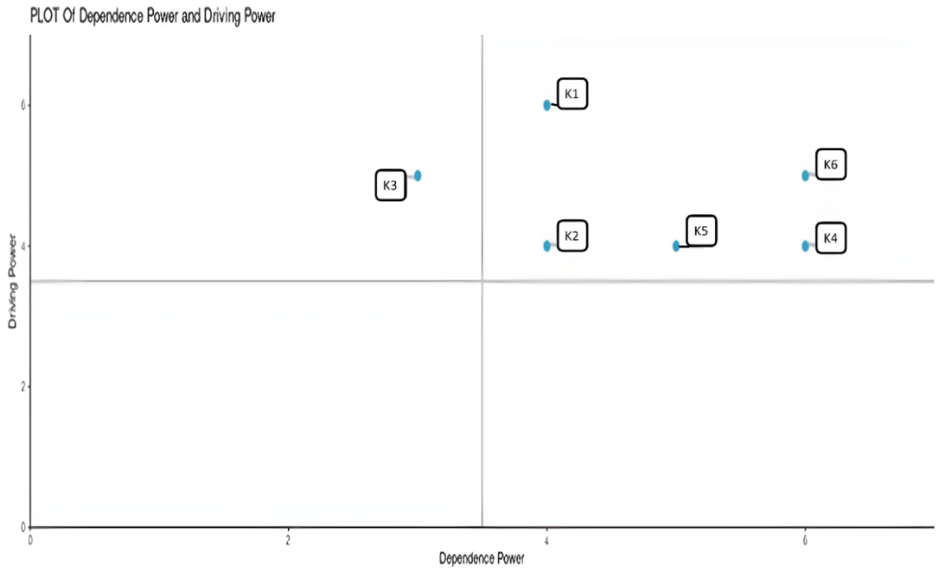


Fig. 6. Hierarchical structure of constraint sub-elements in Sekampung Watershed management.

The results of the system structuring (**Fig. 7**) show that low public awareness of watershed management (K1) is a crucial constraint sub-element that must be overcome for successful management of the Sekampung watershed. The results of the driver power and dependent

relationships place sub-element K1 in the high driver power sector, which shows a decisive role in the successful management of the Sekampung watershed. The low awareness of the community towards watershed management can be influenced by the level of education and the values that live in the community in the form of local wisdom. Generally, The average population of Lampung Province has received education up to Grade 8 junior high school, including those in the Sekampung watershed (BPS Provinsi Lampung 2024). These results align with the research of Narendra et al. (2021), which concluded that the lack of community participation in integrated watershed management is also one of the obstacles revealed by Wang et al. (2016), in addition to the constraints of lack of organizational integration, communication between institutions, and lack of cooperation for development in the implementation of watershed management.



Low public awareness/concern for watershed management (K1), weak enforcement of regulations on watershed protection (K2), local government policies have not been fully implemented for watershed management (K3), activities/activities along the river that cause water pollution (K4), the behavior and habits of people who live in river borders and dispose of domestic waste into the river (K5), and regulatory support for watershed management is still not optimal (K6).

Fig. 7. Relationship between power and dependent drivers in the sub-elements of the constraints on Sekampung Watershed management.

Furthermore, Syafri et al. (2020) and Pambudi (2019) detected a need for more public awareness and behavior toward the importance of environmental management along the river, which could threaten ecological sustainability. Suppose the constraint sub-element K1 (low public awareness of watershed management) is resolved. In that case, it will overcome the constraint sub-elements at level 2, namely sub-elements K3 and K6, which can overcome the other constraint elements (K2, K4, and K5) at level 3. These five sub-elements are included in the sector (Linkage) and must be studied carefully because their interactions affect the success of Sekampung Watershed management.

Sub-element K3 is that government policies have not been fully implemented for watershed management, while K5 is that regulatory support for watershed management is still not optimal. This is indicated by the fact that there is no government institution in the form of an authoritative body that thoroughly focuses on managing the Sekampung Watershed. In addition, local regulation number 22 in 2017 related to watershed management has yet to be fully implemented. Several researchers have also expressed the importance of full government policy in managing a

watershed. Lestari (2022) found problems of effectiveness, efficiency, and program adequacy as the causes of government policies that still need to be fully implemented to manage the Citarum Watershed. The findings of Sulistyaningsih et al. (2021) showed that the government's development of watershed management needs to present institutional arrangements, such as legal regulations that regulate watershed management, have a clear division of watershed management authority, and prioritize an integrated, participatory, and collaborative watershed management mechanism. According to Pambudi (2019), government policies in watershed management must be reviewed from scientific aspects, including existing regulations and institutions, so that contributions and interrelationships between sectors can be seen. Another factor causing watershed management to be unsuccessful is the lack of integration in planning, implementing, and monitoring watershed management (Wang et al. 2016; Waskitho 2021).

3. Conclusions

Among the key institutions directly involved in the sustainable management of the Sekampung Watershed in Lampung Province, the very instrumental in integrated watershed management in Lampung province are provincial government institutions, governor, regent, mayor together with Provincial and Regency and City DPRDs, Bukit Barisan Selatan National Park Center (BBTNBBS), and Way Seputih Way Sekampung Watershed and Protected Forest Management Center (BPDAS HWSS). Low public awareness/concern for watershed management is the most important constraint because it can act as a driver to overcome other obstacles in the hierarchical structure of constraint sub-elements in watershed management Sekampung. These findings suggest that Provincial government institutions, especially the governor, that have instrumental roles in policy formulation, implementation, and regulation should establish a central coordinating body (forum) to ensure good coordination actions among multiple stakeholders related to managing the Sekampung Watershed to overcome the constraints and implement sustainable management of Sekampung watershed with efficient resource utilization and effective watershed conservation efforts.

References

Adhitama, S. Y., Musthofa, A., Rohmah, A. A., Nurwidiani, T., Sejati, M. A., Wati, E. T., Saputro, R., Rachmawati, R., Nurjani, E., and Sudrajat. 2022. The Strategies of Sustainable Watershed Management at Bedog Sub-Watershed, Special Region of Yogyakarta. In: *IOP Conference Series: Earth and Environmental Science* 1039(1): 012066. DOI: 10.1088/1755-1315/1039/1/012066

Ahmad N, Qahmash A. 2021. SmartISM: Implementation and Assessment of Interpretive Structural Modeling. *Sustainability* 13(16): 8801. DOI: 10.3390/su13168801

Amran, Y. 2012. Pemberdayaan Masyarakat dalam Rangka Pengelolaan Waduk dan Daerah Tangkapan Air Waduk Batu Tegi. *TAPAK (Teknologi Aplikasi Konstruksi): Jurnal Program Studi Teknik Sipil* 2(1): 50–55. DOI: 10.24127/tapak.v2i1.213

Anggatara, E 2021. Kajian Efektifitas Investasi Pembangunan Pembangkit Listrik Tenaga Minihidro Way Sekampung dari Segi Operasional Kelistrikan dan Finansial. *Jurnal Informatika dan Teknik Elektro Terapan* 9(3): 77–81. DOI: 10.23960/jitet

Aprianto, D., and Ristiara, L. 2024. The Analysis of the Land Cover Changes to Surface Flows of Bulok Watershed, Lampung Province. *Jurnal Agricultural Science* 19(1): 1–8.

Aprizal, Alisjahbana, S. W., and Nurhasanah, A. 2021. The Development of the Flood Inundation Area Model in the Way Sekampung Sub-Watershed in Lampung. *Review of International Geographical Education Online* 11(3).

Asnawi, R., Arifin, B., Zakaria, W. A., Banuwa, I. S., and Abidin, Z. 2020. Analysis of Key Variables for Rice Farming Sustainability in the Downstream of Sekampung Watershed: An Application of Micmac Method. *Plant Archives (International Journal of Plant Research)* 20(2): 7895–7904.

Aulia, F. 2023. *Analisis Banjir dengan Menggunakan Rainfall-Runoff-Inundation (RRI) Model di DAS Sekampung, Provinsi Lampung*. Universitas Lampung. Bandar Lampung, Indonesia.

Bakri, W., Golar, G., Maiwa, A., and Maiwa, A. 2024. Analysis of the Role of Stakeholders in Management of Watershed Forest Rehabilitation (DAS) in Beka Village Marawola District Sigi Regency. *Savana Cendana* 9(1): 14–21. DOI: 10.32938/sc.v9i1.2426'

BPDAS HL WSS. 2022. *Laporan Karakteristik DAS Sekampung. Balai Pengelolaan Daerah Aliran Sungai dan Hutan Lindung Way Seputih Way Sekampung*. Bandar Lampung, Lampung.

BPS Provinsi Lampung. 2024. *Sensus Penduduk, Provinsi lampung*. Badan Pusat Statistik, Indonesia.

Fitri, A., Ariyanto, L., Pratiwi, D., Maulud, K. N. A., and Sari, R. O. 2023. Assessment of Water Availability in the Sekampung Argoguruh Sub-Watershed for Sustainable Water Management. In: *IOP Conference Series: Earth and Environmental Science* 1167(1): 012027. DOI: 10.1088/1755-1315/1167/1/012027

Fitriani, K., Nufutomo, T. K., and Putra, R. 2022. Water Quality Analysis Based on Land Use in Sekampung River, Lampung, Indonesia. In: *IOP Conference Series: Earth and Environmental Science* 1041(1): 012052. DOI: 10.1088/1755-1315/1041/1/012052

Herison, A., and Romdania, Y. 2023. MAP Analysis of Land Use in Khilau Sub-Sub Watershed, Way Bulok Sub-Watershed, Way Sekampung Watershed, Lampung Province. *Malaysian Journal of Civil Engineering* 35(2): 21–26. DOI: 10.11113/mjce.v35.19779

Hudi, S. M. 2021. *Pendugaan Erosi DAS Sekampung Hulu Menggunakan Metode Usle (Universal Soil Loss Equation) Berbasis GIS untuk Perencanaan Kegiatan Rehabilitasi Hutan dan Lahan*. Universitas Lampung. Bandar Lampung, Indonesia

Lestari, R., and Ridwan, M. 2016. Peran Pemerintah Daerah Provinsi Riau dalam Pengelolaan Daerah Aliran Sungai Siak: Studi Kasus Daerah Hilir Daerah Aliran Sungai Siak Tahun 2010–2013. *Nakhoda: Jurnal Ilmu Pemerintahan* 13(1): 11. DOI: 10.35967/jipn.v13i1.3217

Lestari, T., Nurasa, H., and Halimah, M. 2022. Evaluasi Kebijakan Pemerintah dalam Melaksanakan Program Citarum Harum di Kabupaten Bandung. *Kybernan: Jurnal Studi Kepemerintahan* 5(2): 108–115. DOI: 10.35326/kybernan.v5i2.1728

Libna, I. M. 2022. *Penerapan Metode Vector Autoregressive Exogenous (Varx) untuk Meramalkan Debit Inflow dan Debit Outflow Harian Bendungan Batu Tegi Tahun 2021–2022*. Universitas Lampung. Bandar Lampung, Indonesia.

Mirnawati, Ghazali, M. F., Syuhada, M. F., and Iwasaki, K. P. 2022. Analisa Relasi Kecenderungan Perubahan Luas Permukiman terhadap Kemiringan Lereng Berdasarkan Pengamatan Data Citra Satelit (Studi Kasus: Das Way Sekampung, Kota Bandar Lampung). *Seminar Nasional Geomatika* 6(1): 583–594.

Muchlis, F., Elwamendri, S., Fuadi, N. A., Zuhdi, M., and Achmad, E. 2023. Community-Based Management of Sub-Watershed Batang Masumai Sustainable. In: *Proceedings of the 4th Green Development International Conference (GDIC 2022)*. DOI: 10.2991/978-2-38476-110-4_84

Narendra, B. H., Siregar, C. A., Dharmawan, I. W. S., Sukmana, A., Pratiwi, Pramono, I. B., Basuki, T. M., Nugroho, H. Y. S. H., Supangat, A. B., and Purwanto. 2021. A Review on Sustainability of Watershed Management in Indonesia. *Sustainability* 13(19): 11125. DOI: 10.3390/su131911125

Nugroho, D., and Rolia, E. Klasifikasi Daerah Aliran Sungai di Provinsi Lampung Berdasarkan Permenhut No 60/2014. *Tapak (Teknologi Aplikasi Konstruksi) Jurnal Program Studi Teknik Sipil* 11(2): 109–117. DOI: 10.24127/tp.v11i2.2023

Nuralifah, C. P., Maula, S. I., Pangestu, I. A., and Samudra, M. M. 2023. Local Government Policy in the Watershed Management of Cisadane River on Banten Province. *Jurnal Geuthèë: Penelitian Multidisiplin* 6(1): 71–82. DOI: 10.52626/jg.v6i1.225

Noywuli, N., Sapei, A., and Pandjaitan, N. H. 2019. Assessment of Watershed Carrying Capacity for the Aesesa Flores Watershed Management, East Nusa Tenggara Province of Indonesia. *Environment and Natural Resources Journal* 17(3): 29–39. DOI: 10.32526/ennrj.17.3.2019.20

Nugraheni, I. L., Suyatna, A., and Setiawan, A. 2021. The Classification of the Level of Land Degradation as the Flood Caused in Some Sub-Watersheds at Pesawaran Regency, Lampung. *Journal of Physics: Conference Series* 1796(1): 012065. DOI: 10.1088/1742-6596/1796/1/012065n

Ostrom, E. 2011. Background on the Institutional Analysis and Development Framework. *Policy Studies Journal* 39(1): 7–27. DOI: 10.1111/j.1541-0072.2010.00394.x

Pambudi, A. S. 2019. Watershed Management in Indonesia: A Regulation, Institution, and Policy Review. *Jurnal Perencanaan Pembangunan: The Indonesian Journal of Development Planning* 3(2): 185–202. DOI: 10.36574/jpp.v3i2.74

Riswulan, Y. F. R., Banuwa, I. S., Damai, A. A., and Suroso, E. 2021. Kajian Dampak Kerusakan Sub Daerah Aliran Sungai Bulok terhadap Karakteristik Hidrologi. *Journal of Sustainable Development Research* 1(1): 46–57. DOI: 10.14710/jpl.2024.60356

Rahmadana, A., Widyawati, R., and Nama, G. F. 2022. The Operational Pattern of the Dam and Weir Cascade on the Way Sekampung River. *Lampung International Journal of Engineering* 1(1).

RazaviToosi, S. L., and Samani, J. M. V. 2019. A Fuzzy Group Decision Making Framework Based on ISM-FANP-FTOPSIS for Evaluating Watershed Management Strategies. *Water Resour Manage* 33(15): 5169–5190. DOI: 10.1007/s11269-019-02423-4

Regional Research and Development Agency of Lampung Province. 2018. *Study of Resource Sharing and Cost Sharing in the Sekampung Watershed*. Collaboration with Faculty of Agriculture, University of Lampung.

Rolia, E., Sutjiningsih, D., Yasman, Y., and Siswantining, T. 2021. Modeling Watershed Health Assessment for Five Watersheds in Lampung Province, Indonesia. *Advances in Sciences Technology, and Engineering Systems Journal* 6(1): 99–111. DOI: 10.25046/aj060111

Salampessy, M. L., Nugroho, B., Kartodiharjo, H., and Kusmana, C. 2024. Local Institutions Performance in Mangrove Forest Management on Small Islands: Case Study in Buano

Island, Maluku Province, Indonesia. *Jurnal Sylva Lestari* 12(2): 296–323. DOI: 10.23960/jsl.v12i2.840

Syafri, S., Surya, B., Ridwan, R., Bahri, S., Rasyidi, E. S., and Sudarman, S. 2020. Water Quality Pollution Control and Watershed Management Based on Community Participation in Maros City, South Sulawesi, Indonesia. *Sustainability* 12(24): 10260. DOI: 10.3390/su122410260

Sulistyaningsih, T., Nurmandi, A., Salahudin, S., Roziqin, A., Kamil, M., Sihidi, I. T., Romadhan, A. A., and Loilatu, M. J. 2021. Public Policy Analysis on Watershed Governance in Indonesia. *Sustainability* 13(12): 6615. DOI: 10.3390/su1312661

Somura, H., Yuwono, S. B., Ismono, H., Arifin, B., Fitriani, F., and Kada, R. 2019. Relationship between Water Quality Variations and Land Use in the Batutegi Dam Watershed, Sekampung, Indonesia. *Lakes and Reservoirs: Research and Management* 24(1): 93–101. DOI: 10.1111/lre.12221

Sriyana, I., Gijt, J. G. D., Parahyangsari, S. K., and Niyomukiza, J. B. 2020. Watershed Management Index Based on the Village Watershed Model (VWM) Approach towards Sustainability. *International Soil and Water Conservation Research* 8(1): 35–46. DOI: 10.1016/j.iswcr.2020.01.003

Sulandari, U., Sapei, A., Faqih, A., and Karlinasari, L. 2021. Sustainable Water Availability Model with Reservoir Technique by using ISM (Interpretative Structural Modeling) Method in Bangka Island Indonesia. *Plant Archives* 21(2): 379–385. DOI: 10.51470/plantarchives.2021.v21.no2.059

Supriyadi, E., Banuwa, I. S., dan Yuwono, S. B. 2018. The Effect of Land Use Change on the Inflow Characteristics of Batutegi Dam. *Jurnal Hutan Tropis* 6(1):73–81.

Swastika, D., Wulandari, D. A., and Sriyana, I. 2022. Simulasi Pola Operasi Waduk Batutegi, Provinsi Lampung. *Cantilever: Jurnal Penelitian dan Kajian Bidang Teknik Sipil* 11(2): 81–92. DOI: 10.35139/cantilever.v11i2.149

Tribiyono, B., Yuwono, S. B., dan Banuwa, I. S. 2018. Estimate of Erosion and Potency of Sediment DAM Batutegi in Sekampung Hulu Watershed Using SDR (Sediment Delivery Ratio) Method. *Jurnal Hutan Tropis* 6(2): 161–169.

Ujianti, R. M. D., Anggoro, S., Bambang, AN., and Purwanti, F. 2018. Water Quality of the Garang River, Semarang, Central Java, Indonesia Based on the Government Regulation Standard. *Journal of Physics: Conference Series* 1025(15): 012037 DOI: 10.1088/1742-6596/1025/1/012037

Umayasari, U. 2021. *Aksesibilitas Masyarakat terhadap Ketersediaan Air Bersih PDAM Way Sekampung di Kabupaten Pringsewu*. Universitas Lampung. Bandar Lampung, Indonesia.

Wasono,A., Sari, Y. K., Sangkawati, S., and Nugroho, H. 2023. Analisis Erosi Sub-DAS Bendungan Way Sekampung Berbasis Sistem Informasi Geografis (SIG). *Jurnal Aplikasi Teknik Sipil* 21(2): 191–196. DOI: 10.12962/j2579-891x.v21i2.15602

Widodo, L. M., Safe'i, R., Winarno, G. D., and Yuwono, S. B. 2022. Community Participation Program in Forest and Land Rehabilitation in the Batutegi Forest Management Unit. *Journal of Sylva Indonesiana* 5(2): 93–102. DOI: 10.32734/jsi.v5i02.7323

Wang, G., Mang, S., Cai, H., Liu, S., Zhang, Z., Wang, L., and Innes, J. L. 2016. Integrated Watershed Management: Evolution, Development, and Emerging Trends. *Journal of Forestry Research* 27(5): 967–994. DOI: 10.1007/s11676-016-0293-3

Waskitho, A., A., Pratama, T., and Muttaqin. 2021. Sectoral Integration in Watershed Management in Indonesia: Challenges and Recommendation. *IOP Conference Series: Earth and Environmental Science*. DOI: 10.1088/1755-1315/752/1/012035

Yustika, R. D., Somura, H., Yuwono, S. B., and Masunaga, T. 2019a. Impact of Human Activities and Natural Processes on the Seasonal Variability of River Water Quality in Two Watersheds in Lampung, Indonesia. *Water* 11(11): 2363. DOI: 10.3390/w11112363

Yustika, R. D., Somura, H., Yuwono, S. B., Arifin, B., Ismono, H., and Masunaga, T. 2019b. Assessment of Soil Erosion in Social Forest-Dominated Watersheds in Lampung, Indonesia. *Environmental Monitoring and Assessment* 191(12): 1–15. DOI: 10.1007/s10661-019-7890-5

Yoder, L., Ward, A. S., Spak, S., and Dalrymple, K. E. 2021. Local Government Perspectives on Collaborative Governance: A Comparative Analysis of Iowa's Watershed Management Authorities. *Policy Studies Journal* 49(4): 1087–1109. DOI: 10.1111/psj.12389