JAPSI (Journal of Agriprecision and Social Impact)
Volume 3 Issue 2 July 2026
e-ISSN: 3032-7849; p-ISSN: 3046-5397, Page 336-359
DOI: https://doi.org/10.62793/japsi.v3i2.124
Available online at: https://journal.kdp.co.id/index.php/japsi

Customary Institutions and Social Ecological Resilience in Forest and Water Governance: Kasepuhan Gelar Alam, Indonesia

Farell Firmansyah
Department of Resource and Environmental Economics, Faculty of Economics and Management, IPB University

Riska Tezara Go
Department of Resource and Environmental Economics, Faculty of Economics and Management, IPB University

Address: IPB University, Bogor, West Java, Indonesia
*Corresponding author: **farellfirmansyah@gmail.com***

Abstract. *Customary communities govern forests and water through institutions embedded in everyday practice. This study examines how such institutions organize resource use and support social ecological resilience in Kasepuhan Gelar Alam, West Java, Indonesia. An exploratory qualitative case study involved semistructured interviews with 22 purposively selected participants, with interview sessions lasting approximately 40 to 60 minutes, alongside observation and field documentation. Thematic analysis examined customary authority, role distribution, forest zoning, water allocation, collective labour, knowledge of natural boundaries, and moral sanctions. Findings reveal an integrated governance system. Forest access is differentiated among hutan garapan (cultivation forest), hutan titipan (entrusted forest), and hutan tutupan (protected forest). Water for rice fields is organized through ulu-ulu or maningtim, conveyed through susukan, and maintained through gotong royong. Hukum cowal discourages monopolization, while kebendon, pamali, and kualat reinforce compliance through internalized moral responsibility. These arrangements connect forest protection, irrigation, rice production, reciprocity, and intergenerational obligations. Rather than demonstrating measured ecological outcomes, the study identifies institutional mechanisms through which the community regulates access, coordinates maintenance, and sustains continuity amid change. Customary governance can contribute to resilience when rules are locally legitimate, responsibilities are distributed, and resource use remains tied to reciprocal obligations. Policy engagement should recognize customary knowledge and authority without romanticizing or administratively simplifying living institutions.*

Keyword: *Customary institutions, Forest governance, Indigenous water governance, Kasepuhan Gelar Alam, Social ecological resilience*

Received: May 12, 2026 ; Accepted: June 30, 2026 ; Published: July 27, 2026
*Corresponding author, e-mail address farellfirmansyah@gmail.com

INTRODUCTION

Forests and water are frequently administered as separate sectors, even though they are ecologically and socially connected. Forest condition influences runoff, sediment, and water availability. Water supports agriculture and domestic life. Both sectors are shaped by rules governing access, labour, and responsibility. These connections are especially visible in customary landscapes, where resource governance is embedded in kinship, ritual, agricultural calendars, oral histories, and collective memory. In these settings, a forest is more than a stock of timber, and water is more than a measurable input. Each is part of a lived relationship between people, territory, ancestors, and future generations.

Research on common pool resources has shown that collective management can endure when users recognize boundaries, participate in rule making, monitor use, and apply sanctions that are considered legitimate (Agrawal, 2001; Cox et al., 2010; Ostrom, 1990). Studies of traditional ecological knowledge similarly emphasize the importance of accumulated observation, social learning, and institutions that connect knowledge with practice (Berkes, 2012; Berkes et al., 2000). From a resilience perspective, the central question is not whether a community remains unchanged, but whether it can respond to disturbance without losing the relationships and functions on which its continuity depends (Berkes & Ross, 2013; Folke et al., 2010).

These approaches are useful, but they can become too functional if authority, identity, and power are treated as secondary. Resilience is never socially neutral. What is maintained, whose knowledge is recognized, and who carries the costs of adaptation are normative questions (Cote & Nightingale, 2012). The same caution applies to descriptions of customary governance. Adat should neither be portrayed as a timeless conservation mechanism nor dismissed as informal tradition. It is a living institutional order that may combine inherited authority, practical negotiation, selective innovation, and interaction with religious and state norms.

Kasepuhan Gelar Alam is located in Sirnaresmi Village, Cisolok District, Sukabumi Regency, West Java. The community is part of the broader Kasepuhan Banten Kidul cultural landscape and is historically associated with Kasepuhan Ciptagelar. In local usage, the present customary centre is referred to as Gelar Alam. The combined spelling Gelaralam also appears in field records and public descriptions. The landscape includes forest areas, rivers, irrigated rice fields, traditional rice barns, settlements, and water

infrastructure. These elements are governed through customary authority and through responsibilities assigned to customary roles. These arrangements extend beyond a single administrative resource sector.

Previous research in Kasepuhan communities has documented differentiated forest categories, locally grounded restrictions, and the role of moral sanctions in shaping behaviour related to forests (Surati et al., 2021). Broader scholarship on Indonesia has also demonstrated that recognition of customary forests depends on the interaction between community claims and state legal and administrative processes (Myers et al., 2017; Sopaheluwakan et al., 2023). However, forest and water governance are still often discussed separately. Less attention has been given to the institutional links connecting forest zones, irrigation, rice cultivation, collective labour, reciprocal exchange, and moral responsibility within the same customary system.

This study therefore asks how customary institutions organize forest and water governance and through which mechanisms these arrangements may support social ecological resilience in Kasepuhan Gelar Alam. The objectives are to (1) describe the institutional architecture through which responsibilities are distributed, (2) examine customary rules for forest access, water allocation, and collective maintenance, and (3) interpret how these arrangements contribute to continuity, adaptation, and intergenerational stewardship. The study does not attempt to measure forest condition, biodiversity, water quality, or hydrological change. Its contribution is institutional. It identifies the rules, roles, and relationships through which the community seeks to maintain an integrated system linking forests, water, and food.

Unlike previous Kasepuhan studies that primarily describe forest categories, moral sanctions, or legal recognition, this study examines forest zoning, water allocation, irrigation maintenance, reciprocity based on rice, and distributed customary roles as a single institutional configuration. Its novelty lies in showing how several mechanisms connect forest, water, and food governance. These mechanisms include bounded use, relational allocation, collective maintenance, moral restraint, and the selective adaptation of roles. Rather than treating resilience as an assumed outcome of *adat*, the analysis defines it as an institutionally supported capacity and explicitly distinguishes these mechanisms from ecological outcomes that were not measured.

LITERATURE REVIEW

Customary Institutions and Collective Resource Governance

Institutions are the rules, norms, roles, and shared expectations that structure action. In customary settings, they may be transmitted orally and reinforced through practice rather than codified in a single written instrument. Their effectiveness depends not only on the severity of sanctions but also on legitimacy because people must recognize who is entitled to decide, how responsibilities are distributed, and why a rule should be followed.

(Ostrom, 1990) showed that common pool resources are not inevitably overused. Communities can create durable governance arrangements when resource and user boundaries are sufficiently clear, rules fit local conditions, users participate in modifying them, and monitoring and sanctions are socially recognized. Comparative work has since emphasized that these design principles are diagnostic rather than universal recipes (Cox et al., 2010). (Agrawal, 2001) similarly cautioned that successful governance depends on combinations of resource characteristics, group relations, institutional arrangements, and the wider political environment.

Customary environmental governance adds a relational dimension to this institutional perspective. Knowledge is often held in place names, seasonal practices, stories, ritual obligations, and distinctions among resource zones. (Berkes et al., 2000) describe traditional ecological knowledge as a knowledge practice belief complex that can support adaptive management through feedback and learning. Its value lies not in being inherently conservationist, but in the way knowledge, practice, and authority are connected. As (Berkes, 2012) argues, these systems are dynamic and must be understood in their cultural and institutional context.

Social Ecological Resilience and Adaptive Governance

Social ecological resilience concerns the capacity of linked social and ecological systems to absorb disturbance, reorganize, and retain important identities, functions, and feedbacks (Folke et al., 2010). Adaptation can involve learning, adjusting rules, diversifying livelihoods, or creating new roles. Transformation may also be necessary when existing arrangements no longer support a viable system. The concept therefore directs attention to both continuity and change.

Adaptive governance scholarship highlights polycentric authority, knowledge sharing, networks, and institutional flexibility (Folke et al., 2005). Adaptive capacity at

community level is also influenced by social memory, leadership, institutional diversity, and access to resources (Armitage, 2005). These ideas help explain why role systems and collective labour matter because resilience is not produced by ecological knowledge alone, but through institutions capable of turning that knowledge into coordinated action.

At the same time, resilience language may obscure unequal influence or portray persistence as an unquestioned good. (Cote & Nightingale, 2012) call for closer attention to culture, agency, and power. (Berkes & Ross, 2013) likewise distinguish community resilience from a purely ecological metaphor by emphasizing people place connections, social networks, and collective action. This study follows that caution. It interprets resilience as a set of observed or reported institutional capacities, not as proof that all social interests are equally represented or that ecological conditions are objectively secure.

Forest Water Relations, Legal Plurality, and Relational Equity

Customary forest zoning can establish graduated levels of access, from livelihood use to strict protection. Such categories function as institutional boundaries because they define which activities are acceptable, under what conditions, and for whose benefit. In Indonesia, customary forest governance also operates within changing legal and administrative arrangements. Formal recognition can strengthen community claims, yet it may require customary territories to be translated into maps and categories legible to the state (Myers et al., 2017; Sopaheluwakan et al., 2023). Translation is necessary, but it can simplify boundaries that communities understand through rivers, ridges, paths, histories, and responsibilities.

Water governance adds a further challenge because water moves across plots and administrative boundaries. Institutions must coordinate upstream and downstream users, infrastructure maintenance, and access during varying flows. Research on irrigation demonstrates that locally accepted rules developed and applied by users can address asymmetries among users (Ostrom & Gardner, 1993). (Meinzen-Dick, 2007) warns against universal institutional solutions because water rights are often overlapping, negotiated, and embedded in wider social relations.

Indigenous water governance scholarship goes further by framing water as a relation rather than only a resource. (Wilson, 2014) shows how hydrosocial relations connect governance with identity, knowledge, and responsibility. (Wilson & Inkster,

2018) argue that respect, kinship, and obligation are integral to Indigenous water governance. This relational perspective provides an appropriate lens for *hukum cowal*, a local allocation principle in Kasepuhan Gelar Alam that links fair access with the natural movement of water and a prohibition against monopolization.

Analytical Framework

The analysis connects four components institutional architecture, governance practice, compliance mechanisms, and resilience capacities. Institutional architecture includes leadership and the *rorokan* division of roles. Governance practices include forest zoning, boundary recognition, water allocation, and infrastructure maintenance. Compliance mechanisms include reciprocity, moral sanctions, and the coexistence of religious, state, and customary norms. Resilience capacities refer to continuity, coordination, ecological restraint, equitable access, and selective adaptation. Table 1 summarizes how these components were used to organize the field material.

Table 1. Analytical framework for interpreting customary governance and resilience

Component	Empirical focus	Analytical question	Potential resilience capacity
Institutional architecture	Abah, Mamah Ageng, rorokan, and sepuh lembur	How are authority and responsibilities distributed?	Coordination, legitimacy, and institutional continuity
Resource governance	Forest zones, natural boundaries, water roles, and susukan	How are access, use, and maintenance organized?	Bounded use, ecological restraint, and infrastructure continuity
Compliance	Reciprocity, kebendon, pamali, kualat, and plural norms	Why are oral rules regarded as binding?	Internalized responsibility and reduced dependence on external enforcement
Adaptive continuity	New roles, livelihood diversification, electricity, and communication	What can change while core obligations are maintained?	Learning, selective adaptation, and cultural continuity

RESEARCH METHODS

Research Design and Study Setting

The study used an exploratory qualitative case study design. This design was selected because the research concerned locally defined roles, oral rules, moral meanings, and relationships among forests, water, and agriculture. These features cannot be adequately understood through resource inventories alone. The case study approach enabled the researchers to examine how institutional arrangements were described and practiced within their landscape context.

Fieldwork took place in Kasepuhan Gelar Alam, Sirnaresmi Village, Cisolok District, Sukabumi Regency, West Java. Field documentation used in this article was recorded on 12 June 2026. The observed landscape included the customary settlement, forest edges, irrigation channels, water storage structures, rice growing areas, and community facilities. The study treats Gelar Alam as a customary and relational landscape rather than assuming that its boundaries are identical to administrative lines.

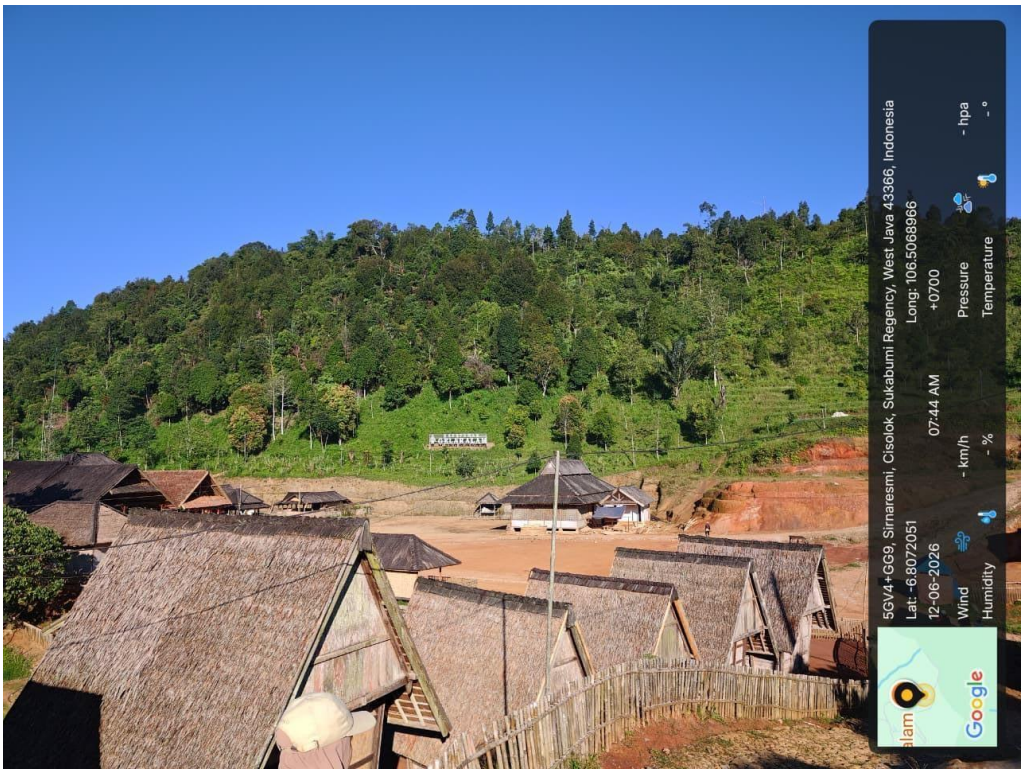

Figure 1. Customary settlement adjoining a forested landscape in Kasepuhan Gelar Alam.
Source: Field documentation, 12 June 2026

Data Generation

Data were generated through semistructured interviews with 22 participants, field observation, informal conversations, and photographic documentation. Observation focused on the physical relationships among settlements, forested areas, rivers, water conveyance structures, and agricultural spaces. The interviews lasted approximately 40 to 60 minutes and explored community history, customary authority, the *rorokan* system, forest categories, water responsibilities, sanctions, collective labour, food storage, and responses to social change. Informal conversations provided contextual information about daily farming, livelihoods, customary service, and infrastructure maintenance.

The study involved 22 adult participants selected purposively because of their direct knowledge of, or practical involvement in, customary governance and everyday resource practices. Eligibility required contributors to be adults who held or supported a customary role, possessed direct knowledge of forest or irrigation rules, or participated in farming, water use, food storage, or collective maintenance. Participants included customary role holders and residents directly involved in farming, water use, food storage, or collective maintenance. Interview sessions lasted approximately 40 to 60 minutes and were complemented by informal exchanges, direct observation, and photographic documentation. Institutional accounts were compared with observed landscape and infrastructure features and checked for consistency across the topics recorded during fieldwork.

Local terms were retained where direct English equivalents would remove important meanings. Each term is explained at first use and then italicized consistently. The spelling of local terms follows the field records. Photographs included in the article show landscapes and infrastructure rather than identifiable participants or restricted customary practices.

Data Analysis and Trustworthiness

The material was examined using a thematic procedure informed by (Braun & Clarke, 2006). The researchers first organized field notes and documentation by topic. Initial codes covered leadership, role distribution, forest zones, boundary markers, water sources, allocation rules, labour, sanctions, reciprocity, and change. Related codes were then grouped into broader themes comprising institutional architecture, differentiated resource access, relational allocation, compliance, and adaptive continuity.

Interpretation proceeded through an iterative comparison between field accounts, observations, and the analytical literature. A local term was not treated as evidence of an institution by itself. The analysis considered the role attached to the term, the practice it organized, the obligation it created, and the reported consequence of compliance or violation. Data source triangulation was used by comparing descriptions from interviews and informal conversations with observed landscape or infrastructure features when possible. The researchers also used negative case sensitivity. Uncertainty, incomplete information, and claims that could not be directly supported were retained as limitations rather than converted into definitive conclusions. This approach follows qualitative

trustworthiness principles that emphasize transparent coding, reflexive interpretation, and a documented relationship between data and themes (Nowell et al., 2017).

Scope and Ethical Safeguards

Ethical safeguards were applied throughout this qualitative fieldwork that did not involve intervention. Before the interviews, participants were informed about the study purpose, the voluntary nature of participation, and the intended academic use of the material. Verbal informed consent was obtained. Participants could decline to answer a question or discontinue their involvement. Statements are not attributed to named individuals, personal identifiers and sacred or restricted knowledge are excluded, and photographs show landscapes and infrastructure rather than identifiable participants. Illustrative statements are translated from contemporaneous Indonesian field notes and lightly edited only for clarity. Attribution is kept generic to protect contributors. Because the study did not collect biophysical measurements, the analysis does not infer changes in water quality, water quantity, forest cover, or biodiversity.

RESULTS AND DISCUSSION

1. Institutional Architecture: Leadership, Care, and Distributed Responsibility

Customary leadership in Kasepuhan Gelar Alam is commonly expressed through a family metaphor. *Abah* is understood as a father figure, *Mamah Ageng* as a mother figure, and community members as children. This language does not eliminate hierarchy, but it frames authority in terms of guidance, care, obligation, and continuity rather than administrative command alone. The legitimacy of leadership is therefore both institutional and relational.

A field informant summarized the arrangement as follows. *"Leadership in the Kasepuhan is like the relationship between parents and their children. The residents are regarded as the children"* (field informant, translated field note, 13 June 2026). This formulation presents the family metaphor as more than ceremonial language. Authority is associated with parental guidance and care, while the position of residents as children implies reciprocal duties rather than passive obedience.

Responsibilities are distributed through *rorokan*, a customary system of roles. Field accounts identified functions related to internal affairs (*jero*), birth assistance (*maparaji*), circumcision (*bengkong*), protection against agricultural pests or other threats (*paninggaran*), healing (*dukun*), religious affairs (*keamilan*), and agriculture

(*pamakayaan*). Additional roles address contemporary needs such as electricity, communication, entertainment, and relations between the customary centre and communities outside it. A *sepuh lembur* links customary authority with needs at the settlement level.

The arrangement combines continuity and adjustment. Several roles are transmitted within families, preserving institutional memory and specialized knowledge. Other responsibilities may be appointed by *Abah* when local circumstances require a suitable person. New functions can be incorporated without dissolving the underlying structure. The result is a distributed architecture. Authority is centred symbolically, but operational responsibilities are carried by multiple role holders.

The field note further distinguishes inherited from appointed responsibilities. *"The rorokan are hereditary, like Abah's position. The sepuh lembur is different because Abah appoints the person"* (field informant, translated field note, 14 June 2026). This distinction supports the interpretation that specialized knowledge can be transmitted through families while selected responsibilities remain adjustable to local circumstances.

Customary service is not described as a salaried occupation. After the harvest cycle, residents may give bundles of rice as recognition for services performed by *rorokan* members. This exchange connects governance with the agricultural economy. Rice is simultaneously food, a product of collective ecological relations, and a medium of reciprocity. The arrangement cannot be reduced to compensation at a market rate. Instead, it expresses recognition and reinforces the expectation that authority and service carry mutual obligations.

Table 2 condenses the institutional roles relevant to governance of forests, water, and food. It does not represent a complete inventory of customary offices, but identifies the functions most consistently connected to the study themes.

Table 2. Selected customary roles and their governance relevance

Role or institution	Field described responsibility	Governance relevance
Abah and Mamah Ageng	Father and mother figures in customary leadership	Moral authority, care, continuity, and guidance
Rorokan jero	Internal customary affairs	Coordination and maintenance of internal order
Rorokan pamakayaan	Agriculture and rice cultivation	Connects customary authority with food production
Ulu-ulu or maningtim	Responsibilities for irrigation water	Coordinates conveyance, allocation, and maintenance
Sepuh lembur	Customary responsibility at the settlement level	Links community needs with customary leadership
Additional rorokan	Electricity, communication, entertainment, and external relations	Incorporates contemporary functions into customary organization

2. A Plural Normative Order

Field accounts organized normative life through three domains comprising sara, *negara*, and *kamokahan*. *Sara* refers to religious norms, *negara* to state law and public administration, and *kamokahan* to customary law. These domains are not treated as mutually exclusive. Community life is shaped by their coexistence, although their authority and practical relevance may differ by issue.

This normative plurality helps explain how Kasepuhan Gelar Alam can maintain customary rules while interacting with government institutions and wider society. Adat is not positioned outside citizenship or religion. At the same time, *kamokahan* retains a distinct source of legitimacy through inherited practice and customary authority. Its rules may be oral, but they are made visible through forest categories, role obligations, sanctions, and collective work.

Plurality can also generate friction. State agencies commonly require fixed maps, written evidence, and administratively defined representatives. Customary boundaries and authority may instead be remembered through natural markers, settlement histories, and relational recognition. The field material did not document a specific legal dispute, so the analysis does not infer conflict. It does, however, show a potential point of institutional mismatch. Customary knowledge must often be translated into formal categories that do not fully capture its meaning. Comparable evidence from an Indonesian nature reserve shows that differences in priorities for resource use, regulatory ambiguity,

and weak communication can intensify conflict, whereas participatory dialogue and community building can support more durable cooperation (Azizah & Firmansyah, 2025).

The clearest example from the field concerns forest boundaries and timber use. *Kamokahan defines whether a resource may be used. For example, timber from hutan titipan may be taken for a house only when a tree is planted before cutting and the timber is not sold. The state, in turn, requires the territory, authorized actor, and permitted activity to be represented in formal administrative categories. Sara* is incorporated institutionally through the *keamilan* role within *rorokan*, locating religious responsibility inside rather than outside customary organization. The field material did not document a single dispute in which all three domains issued competing decisions. Instead, the example shows how a customary resource decision is situated within wider religious and state frameworks.

3. Forest Zoning and Bounded Use

Forest governance is organized through three principal categories comprising hutan garapan, *hutan titipan*, and *hutan tutupan*. The categories establish graduated access rather than a simple division between exploitation and conservation.

Hutan garapan is an area in which residents may cultivate land or meet livelihood needs under customary norms. Access is permitted, but it is not described as unrestricted private use. *Hutan titipan*, literally an entrusted forest, can be used only for defined local needs. Field accounts gave house construction as an example. A person who needs timber is expected to plant a tree before cutting one, and the harvested timber may not be sold. The rule links present use to regeneration and restricts commercialization. *Hutan tutupan is the most strictly protected category. Extraction and disturbance are prohibited.*

These zones are institutional boundaries. Each category answers three questions about what activity is permitted, what obligation accompanies it, and what value is being protected. The requirement to plant a tree in *hutan titipan* is particularly important because it transforms regeneration into a precondition of use. The restriction on sale distinguishes subsistence or community need from commercial extraction. Similar threefold zoning and the role of *kualat* have been documented in other Kasepuhan communities, suggesting a wider cultural logic while leaving room for local variation (Surati et al., 2021).

The field data support the existence and reported function of these rules, but they do not establish their ecological effect quantitatively. It would therefore be premature to claim that the zoning has increased biodiversity or maintained a particular volume of water. The defensible conclusion is that it creates culturally legitimate limits on extraction and assigns explicit responsibility for regeneration and protection.

Table 3. Customary forest categories and institutional functions

Forest category	Permitted access	Associated obligation	Institutional function
Hutan garapan	Cultivation and livelihood use under customary norms	Use remains socially regulated	Provides livelihood space within recognized limits
Hutan titipan	Limited use for defined local needs, including house timber	Plant before cutting. Timber is not for sale	Links present use to regeneration and restricts commercialization
Hutan tutupan	No extraction or disturbance	Observe strict customary protection	Creates a protected zone and a clear limit to use

4. Natural Boundary Knowledge and Moral Restraint

Customary space is recognized through natural markers, including rivers, forest edges, routes, and landscape features. Field accounts referred to the Cibareno and Cibeureum rivers and other locally known markers in describing the customary landscape. Such boundaries are not merely coordinates. Their meaning is transmitted through memory, mobility, and recognition by customary authorities.

Natural markers have practical advantages because they are visible in the landscape and connected to resource processes. A river can simultaneously be a water source, a route, and a boundary reference. Yet natural boundaries can shift, overlap, or be interpreted differently. Their translation into cadastral maps therefore requires dialogue, not simple substitution. The importance of this issue is consistent with Indonesian research showing that recognition of customary forests depends on linking local claims with formal legal and administrative procedures (Myers et al., 2017; Sopaheluwakan et al., 2023).

Compliance is also reinforced by *kebendon*, *pamali*, and *kualat*. Although their meanings are not identical, the terms refer to prohibited conduct and the moral or spiritual consequences of violating adat. They function differently from a fine imposed by an external officer. A rule is internalized through respect for ancestors, concern for balance,

and social expectations. This can lower dependence on constant surveillance, a mechanism consistent with scholarship on norms and collective action (Agrawal, 2001; Ostrom, 2000).

Moral sanctions should not be romanticized as automatically effective or equitable. Their force depends on shared belief, legitimate authority, and ongoing social relations. Nor can the present data show whether all residents interpret the sanctions in the same way. Their analytical significance is more specific. They connect environmental conduct with moral identity and thereby extend compliance beyond formal enforcement.

The present evidence does not establish that knowledge of natural boundaries or moral sanctions are equally effective across generations. Younger residents encounter customary rules alongside formal education, digital communication, wage employment, and livelihoods oriented toward markets, which may alter how authority and sanctions are interpreted. These pressures do not necessarily imply institutional decline. The creation of *rorokan* functions for electricity and communication indicates an effort to translate customary responsibilities into contemporary settings. A field informant emphasized that *"values shift with each period, including through modernization, but the customary order can still be maintained"* (translated field note, 13 June 2026). Nevertheless, because the fieldwork was not designed for comparison across age groups, intergenerational effectiveness remains an open empirical question rather than a demonstrated finding.

5. Water Governance, Allocation, and Collective Maintenance

Water governance connects forested areas and rivers with rice fields, households, and settlement infrastructure. Field accounts distinguished water for irrigation from water used for domestic needs. Customary water responsibilities are associated with *ulu-ulu* or *maningtim*. These functionaries help coordinate the conveyance and distribution of irrigation water and the maintenance of related infrastructure.

Water is directed through *susukan,* or irrigation channels. The system depends on physical structures including diversion points, channels, and storage facilities, but these structures do not govern themselves. They require inspection, repair, and labour. *Gotong royong* provides the social organization for collective maintenance. Community members can work together to reinforce channels or address damage, while infrastructure needs may be discussed before action is taken.

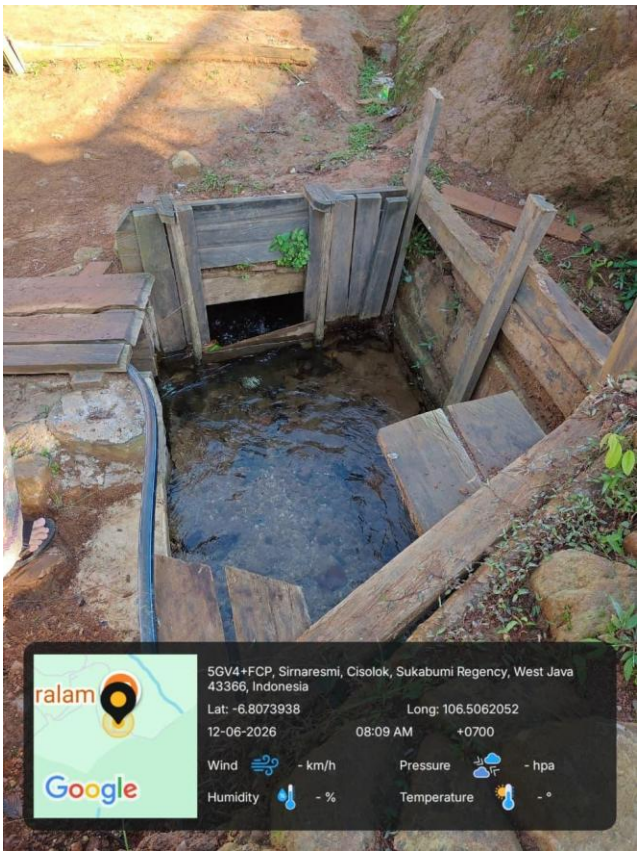

Figure 2. A small wooden water control structure observed in the customary landscape. *Source: Field documentation, 12 June 2026*

The local principle described as *hukum cowal* provides a normative basis for allocation. Field accounts explained it through the movement of water and the expectation of fair sharing. Water should not be captured in a way that deprives other users. Fairness is thus relational. A user's access is legitimate only when it acknowledges the dependence of others on the same flow.

A field informant explained the allocation principle in practical terms. *"Water follows its natural course. It is not divided in a way that lets one person control it, so everyone receives a fair share"* (translated field note, 14 June 2026). If an upstream diversion reduces flow to downstream rice fields, the issue is therefore not framed solely as an individual plot claim. The *ulu-ulu* or *maningtim* is expected to assess the shared flow and coordinate an adjustment at the diversion or channel, while *gotong royong* addresses a physical blockage or damaged structure. This sequence illustrates the decision logic of hukum cowal. However, it should not be read as a documented adjudicated dispute or as evidence of quantified distributional outcomes.

This arrangement addresses two common features of irrigation. First, users are asymmetrically located along a channel. An upstream action can affect those downstream. Second, the infrastructure requires collective labour even when benefits are received at household or plot level. *Hukum cowal*, the role of *ulu-ulu* or *maningtim*, and *gotong royong* operate at different but complementary levels, namely the allocation principle, the coordination role, and the maintenance practice. Scholarship on irrigation managed by users similarly emphasizes that workable systems combine accepted rules, role clarity, and mechanisms for cooperation (Meinzen-Dick, 2007; Ostrom & Gardner, 1993).

Figure 3. Water storage infrastructure situated near forested land and a customary building.
Source: Field documentation, 12 June 2026

The study did not measure discharge, seasonal scarcity, allocation by plot, or the incidence of disputes. It therefore cannot determine distributional outcomes across all users. What the evidence demonstrates is a locally articulated rule against monopolization and an institutional arrangement for coordinating the shared infrastructure on which rice cultivation depends.

6. Connections Among Forests, Water, and Food in the Context of Selective Adaptation

The findings reveal a connected system formed by forests, water, and food. Protected and entrusted forest categories place limits on land and timber use. Rivers and channels convey water to agricultural areas. Rice production supports household consumption and customary reciprocity, including recognition of service. Traditional rice barns (*leuit*) contribute to the continuity of the food system. The institutional link is therefore not a single rule but a sequence of dependencies. Forest stewardship is associated with water source protection. Shared water supports rice. Rice sustains households and reciprocal obligations. Those obligations help reproduce customary authority and collective labour.

The food storage system provides a further institutional link. Field notes describe one principal rice cycle each year, the intergenerational retention of local seed, household *leuit*, and a communal reserve known as *leuit Sijimat*. Informants reported that no household had borrowed from the communal reserve since the 1990s, which they interpreted as evidence that household food stocks were sufficient. This is a locally reported indicator of food security rather than an independently measured welfare outcome, but it shows how storage and the customary obligation not to sell rice can provide a buffer against scarcity.

The community also engages selectively with social and technological change. Field accounts referred to electricity, communications, small trade, livestock, vegetable farming, transport services, and work outside customary roles. Additional *rorokan* functions address some contemporary needs. These developments do not indicate the disappearance of adat. Instead, they show that new livelihoods and technologies can be incorporated while core responsibilities surrounding rice, forests, water, and customary authority are maintained.

Selective adaptation is not the same as the absence of tension. Livelihood diversification may change labour availability, aspirations, and relationships with markets. Electricity and communication can strengthen coordination while also exposing communities to new pressures. The exploratory data do not allow these effects to be evaluated in detail. They do show, however, that continuity is achieved through adjustment rather than isolation.

Institutional change is most visible in the reported expansion from an older core of approximately eight *rorokan* roles to a current structure of 33 functions, including responsibilities for electricity, communication, entertainment, and external relations. This expansion constitutes evidence of organizational response to technological and socioeconomic change. At the livelihood level, small trade, livestock, vegetable production, transport services, and work outside customary roles diversify income but may also reduce time available for collective labour and increase market exposure. The evidence captures the community's current response rather than a dated longitudinal sequence, and recent environmental change was not measured. The study can therefore identify directions of adaptation, but not their rate, effects over the long term, or ecological consequences.

Table 4. Institutional mechanisms and cautiously interpreted resilience contributions

Mechanism	Evidence from the field	Interpretation	Evidence boundary
Role distribution	Rorokan and water functionaries	Supports coordination and continuity of responsibility	Effectiveness was not compared across roles
Bounded forest use	Three forest categories and regeneration obligation	Creates locally legitimate limits on extraction	No forest cover or biodiversity measurement
Relational water allocation	Hukum cowal, susukan, and shared maintenance	Discourages monopolization and organizes interdependence	No discharge, allocation by plot, or conflict data
Reciprocity and moral restraint	Rice recognition, kebendon, pamali, and kualat	Reinforces service and internalized compliance	Interpretations may vary among residents
Selective adaptation	New roles, technologies, and diversified livelihoods	Allows adjustment without abandoning core obligations	Social effects over the long term require further study

7. Customary Institutions as Adaptive Governance

The Kasepuhan Gelar Alam case demonstrates that customary governance is neither a single authority nor a fixed collection of prohibitions. It is an institutional system in which symbolic leadership, specialized roles, reciprocal exchange, and practical coordination reinforce one another. The *rorokan* structure distributes work across social, agricultural, religious, health, and technological domains. Inherited roles preserve knowledge, while selective appointment and the creation of contemporary functions provide room for adjustment.

This combination resembles adaptive governance in three respects. First, authority is distributed across multiple roles rather than concentrated in a single administrative office. Second, knowledge is embedded in practice and can be revised through experience. Third, the system connects the making of decisions with collective labour and social obligation. These features correspond with the importance of learning, institutional diversity, and networks identified by (Folke et al., 2005) and (Armitage, 2005).

The case also qualifies a straightforward application of common pool resource theory. Clearly differentiated zones, locally recognized authority, moral sanctions, and shared maintenance are compatible with conditions discussed by (Ostrom, 1990) and (Cox et al., 2010). Yet Kasepuhan governance cannot be reduced to a checklist of design principles. Family metaphors, ancestral responsibility, rice reciprocity, and kamokahan are not decorative cultural features. Instead, they are part of the mechanism that makes roles and rules legitimate.

8. Institutional Fit Across Forests, Water, and Food

Sectoral administration often separates forestry, irrigation, agriculture, and village affairs. The field evidence instead shows institutional fit across these domains. Forest zones regulate differentiated access. Water roles coordinate irrigation. Collective labour maintains physical connections. Rice provides food and a medium of reciprocity. Moral sanctions apply across resource categories. This integration may reduce gaps that arise when one institution protects forests while another ignores the agricultural or social relations that depend on them.

The strongest contribution of the case is therefore not a claim that customary institutions guarantee ecological sustainability. It is the demonstration of a governance architecture capable of connecting use, maintenance, and restraint. *Hutan titipan* illustrates this connection clearly. Limited timber use is permitted, but commercialization is prohibited and planting precedes cutting. The rule does not eliminate use. Instead, it makes access conditional on regeneration and purpose.

Similarly, *hukum cowal* frames water equity as an obligation among interdependent users. Water distribution is not only a technical calculation. Upstream and downstream positions create a social relationship, and shared infrastructure requires cooperation over time. (Wilson, 2014) and (Wilson & Inkster, 2018) help interpret this as relational

governance. The right to use water is inseparable from responsibilities to water and to other users.

9. Resilience Without Romanticization

The observed institutional mechanisms can support resilience in several ways. Differentiated zones create ecological restraint, role distribution enables coordination, reciprocity supports service, moral sanctions reinforce compliance, and selective adaptation allows new functions without abandoning the institutional core. These mechanisms may help the community maintain identity and resource governance amid spatial and socioeconomic change.

However, three cautions are necessary. First, institutional continuity does not itself prove ecological effectiveness. Longitudinal forest cover analysis, vegetation assessment, water monitoring, and seasonal observation would be needed to assess environmental outcomes. Second, shared norms do not establish that benefits, burdens, or influence are evenly distributed. Gender, generation, residence, livelihood, and position upstream or downstream may shape participation differently. Third, customary institutions operate within wider political and economic pressures, including state regulation, market demand, infrastructure development, and procedures for legal recognition.

These cautions follow the argument that resilience analysis must address agency and power rather than treating persistence as inherently desirable (Cote & Nightingale, 2012). They also guard against instrumentalizing adat as an inexpensive substitute for public responsibility. Customary communities should not be expected to conserve landscapes while bearing restrictions or external pressures without secure rights, respectful participation, and access to appropriate support.

10. Implications for Policy and Collaborative Research

The findings suggest four implications. First, engagement should begin with institutional mapping, not only land cover mapping. Identifying *Abah*, *rorokan*, *sepuh lembur*, water functionaries, and the relationships among them is essential for understanding who holds knowledge and responsibility. Second, formal spatial planning should treat rivers and other natural markers as evidence to be interpreted with the community, while using participatory mapping to document areas that require confidentiality or graduated access.

Third, water and forest programmes should be coordinated. Assistance for channels or storage structures may fail if it bypasses customary allocation rules and maintenance arrangements. Conversely, forest recognition processes should consider the downstream agricultural and domestic functions associated with water. Fourth, collaboration must protect community authority over knowledge. Documentation should distinguish information that can be published, information that can be shared for planning, and information that should remain restricted.

Future research should combine institutional analysis with repeated seasonal fieldwork. A stronger design would document participant profiles, include women, young people, role holders, upstream and downstream users, and households with different livelihoods, and compare accounts across groups. Participatory mapping could be paired with hydrological observation, water quality measurements, and analysis of remotely sensed imagery. Such a design would allow researchers to test whether the governance mechanisms identified here correspond with measurable ecological and distributive outcomes.

CONCLUSION

Kasepuhan Gelar Alam governs forests and water through an interconnected set of roles, rules, and relationships. Abah, Mamah Ageng, rorokan, and sepuh lembur provide a distributed institutional architecture. Hutan garapan, hutan titipan, and hutan tutupan differentiate livelihood use, entrusted use, and strict protection. Ulu-ulu or maningtim, susukan, hukum cowal, and gotong royong connect water allocation with collective maintenance. Kebendon, pamali, and kualat reinforce these arrangements through moral responsibility, while sara, negara, and kamokahan situate customary governance within a plural normative order.

The study's scientific contribution lies in an institutional account of social ecological resilience that connects several resource sectors. It shows that forest zoning, relational water allocation, collective maintenance, reciprocity based on rice, moral restraint, and selective role adaptation operate as linked mechanisms rather than isolated customary practices. This framework offers testable propositions about how locally legitimate authority may connect ecological restraint with social continuity, while clearly distinguishing institutional capacity from measured ecological performance.

Policy recognition should therefore avoid two extremes, namely treating customary governance as informal and irrelevant, or romanticizing it as a complete solution. A more productive approach is to recognize customary authority, protect community control over knowledge, and build collaborative forest and water governance around the institutions through which responsibilities are already understood. For Kasepuhan Gelar Alam, resilience is not simply persistence. It is the continuing ability to relate forest, water, rice, labour, and moral obligation while adapting to change.

Future research should test these propositions through comparative studies across Kasepuhan communities and across gender and age groups, including younger residents and customary role holders. Longitudinal designs should combine repeated seasonal interviews with analysis of changes in forest cover using remotely sensed imagery, biodiversity or vegetation assessment, stream discharge and water quality monitoring, and irrigation records for individual plots. Evidence produced through these mixed methods could determine whether the institutional mechanisms identified here correspond with measurable ecological and distributive outcomes over time.

REFERENCES

Agrawal, A. (2001). Common property institutions and sustainable governance of resources. *World Development*, *29*(10), 1649–1672. https://doi.org/10.1016/S0305-750X(01)00063-8

Armitage, D. (2005). Adaptive capacity and community-based natural resource management. *Environmental Management*, *35*(6), 703–715. https://doi.org/10.1007/s00267-004-0076-z

Azizah, S., & Firmansyah, F. (2025). Community building for conflict management in Besowo Nature Reserve. *Agrociencia*, *59*(2), 206–229. https://doi.org/10.47163/agrociencia.v59i2.3260

Berkes, F. (2012). *Sacred ecology* (3rd ed.). Routledge. https://doi.org/10.4324/9780203123843

Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, *10*(5), 1251–1262. https://doi.org/10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2

Berkes, F., & Ross, H. (2013). Community resilience: Toward an integrated approach. *Society & Natural Resources*, *26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Cote, M., & Nightingale, A. J. (2012). Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, *36*(4), 475–489. https://doi.org/10.1177/0309132511425708

Cox, M., Arnold, G., & Villamayor Tomás, S. (2010). A review of design principles for community-based natural resource management. *Ecology and Society*, *15*(4), 38. https://doi.org/10.5751/ES-03704-150438

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin III, F. S., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, *15*(4), 20. https://doi.org/10.5751/ES-03610-150420

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*, 441–473. https://doi.org/10.1146/annurev.energy.30.050504.144511

Meinzen-Dick, R. (2007). Beyond panaceas in water institutions. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(39), 15200–15205. https://doi.org/10.1073/pnas.0702296104

Myers, R., Intarini, D., Sirait, M. T., & Maryudi, A. (2017). Claiming the forest: Inclusions and exclusions under Indonesia's "new" forest policies on customary forests. *Land Use Policy*, *66*, 205–213. https://doi.org/10.1016/j.landusepol.2017.04.039

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*, 1–13. https://doi.org/10.1177/1609406917733847

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press. https://doi.org/10.1017/CBO9780511807763

Ostrom, E. (2000). Collective action and the evolution of social norms. *Journal of Economic Perspectives*, *14*(3), 137–158. https://doi.org/10.1257/jep.14.3.137

Ostrom, E., & Gardner, R. (1993). Coping with asymmetries in the commons: Self-governing irrigation systems can work. *Journal of Economic Perspectives*, *7*(4), 93–112. https://doi.org/10.1257/jep.7.4.93

Sopaheluwakan, W. R. I., Fatem, S. M., Kutanegara, P. M., & Maryudi, A. (2023). Two-decade decentralization and recognition of customary forest rights: Cases from special autonomy policy in West Papua, Indonesia. *Forest Policy and Economics*, *151*, 102951. https://doi.org/10.1016/j.forpol.2023.102951

Surati, Sylviani, Sakuntaladewi, N., Hidayat, D. C., & Ariawan, K. (2021). Persepsi masyarakat hukum adat terhadap keberadaan hutan di Kasepuhan Karang dan

Cisungsang, Kabupaten Lebak, Banten. *Jurnal Penelitian Sosial Dan Ekonomi Kehutanan*, *18*(2), 99–115. https://doi.org/10.20886/jpsek.2021.18.2.99-115

Wilson, N. J. (2014). Indigenous water governance: Insights from the hydrosocial relations of the Koyukon Athabascan Village of Ruby, Alaska. *Geoforum*, *57*, 1–11. https://doi.org/10.1016/j.geoforum.2014.08.005

Wilson, N. J., & Inkster, J. (2018). Respecting water: Indigenous water governance, ontologies, and the politics of kinship on the ground. *Environment and Planning E: Nature and Space*, *1*(4), 516–538. https://doi.org/10.1177/2514848618789378