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Mapping Convergence and Divergence in Coastal Resource Governance: A MACTOR Analysis of the Salt Farming Ecosystem in Jepara, Indonesia

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ABSTRACT

Indonesia's salt sector remains import-dependent despite extensive coastal resources, reflecting not only climatic and technological constraints but also governance failures in how actors coordinate production, marketing, finance, and coastal sustainability priorities. This study examines Jepara Regency, Central Java, Indonesia, as a microcosm of these challenges and asks how actor power relations shape feasible pathways toward collaborative and sustainability-oriented salt governance. Using an exploratory sequential mixed-methods design, key actors and objectives were identified through document review, field observation, interviews, and focus group discussions, and then structured in Matrix of Alliance, Conflict, Tactics, Objectives, and Recommendations (MACTOR) matrices that distinguish direct influence, actor-objective positions, software-derived influence-dependence, convergence, divergence, and competitiveness. The results show a market-centered governance structure in which salt traders, farmers, warehouses, and industry form the core arena of high influence and interdependence. Overall convergence is high (81.9%), but official Jepara evidence on collector-based sales and strong price volatility indicates that technical alignment does not automatically secure farmer welfare. Divergence is concentrated around traders, implying that price stabilization and value-sharing reforms require incentive-compatible mechanisms rather than purely regulatory pressure. Sustainability objectives, especially coastal abrasion control and mangrove strengthening, remain peripheral; they are more likely to gain traction when embedded in production risk reduction, storage, transparent grading, tailored finance, and contract designs that reduce volatility.

1. INTRODUCTION

Indonesia, an archipelagic state with extensive coastal resources, continues to face a persistent mismatch between salt demand and domestic supply capability. National debates on salt policy show that this mismatch cannot be explained only by weather, land availability, or production technology. The Jepara industrial-salt investment profile reports that national salt demand reached approximately 4.6 million tons in 2021, while national production was below 1.5 million tons; this illustrates a structural supply gap that has encouraged continued reliance on imported industrial salt [1]. Recent studies on Indonesian small-scale salt producers similarly show that socioeconomic uncertainty and climate variability interact with institutional weakness, market access, and local adaptation capacity [2-4]. The central problem is therefore not merely how to increase output, but how to govern a coastal value chain in which production, price formation, finance, storage, ecological risk, and public regulation are tightly interdependent.

Salt policy is also a sustainability issue. Salt ponds are not only production units; they are coastal landscapes embedded in dynamic social-ecological systems. Climate variability, tidal inundation, storms, coastal erosion, salinity fluctuations, land-use change, and ecosystem degradation directly affect harvesting cycles, yield stability, and household welfare [3-5]. Coastal management choices also affect environmental sustainability through water quality, shoreline stability, mangrove condition, and the balance between production land and protective ecosystems. Salt landscapes can provide multiple ecosystem services when managed or restored with ecological objectives in mind rather than treated as purely extractive spaces [6]. This framing expands the problem from raising output to sustaining livelihoods, ecosystems, and markets under climate and institutional pressure.

Jepara Regency, one of Central Java's salt production centers, represents a useful microcosm of these national challenges. Official investment documentation records 504.5 ha of salt-processing land across six villages in Kedung Subdistrict: Tanggultlare, Bulakbaru, Panggung, Surodadi, Kalianyar, and Kedungmalang [1]. The same source reports that most harvested salt is sold to collectors, current production is largely bulk *krosok* salt, and farmer-level prices have fluctuated sharply between approximately Rp 250–Rp 2,000/kg across years, creating periods of farmer loss and limiting quality upgrading [1]. This evidence supports the governance argument of the present study: farmers face not only climatic risk, but also market dependence, price volatility, storage constraints, and weak bargaining capacity in a chain where collectors and downstream actors often control liquidity and market access [7, 8].

Sustainability challenges in Jepara are intensified by the fragmented roles of supporting actors. Local governments, financial institutions, industry, warehouses, and non-governmental organizations may share broad development intentions, but their programs often operate with different mandates, incentives, and time horizons. From a sustainability perspective, fragmentation is costly because adaptation measures (pond infrastructure, coastal protection, and mangrove rehabilitation), market measures (grading standards, storage, and value-added processing), and social measures (cooperative strengthening, inclusive finance, and household resilience) must reinforce one another. Knowledge-based coastal-governance research in Indonesia emphasizes that sustainable coastal policy requires reliable information, institutional learning, and coordination across government, market, and community actors rather than isolated sectoral programs [9]. Evidence from Indonesian coastal social–ecological systems further indicates that effective policy enforcement, institutional capacity, and community engagement are central to the long-term ecological and economic resilience of coastal areas [10].

These conditions produce a divergence of objectives among actors. Farmers tend to prioritize stable income, fair prices, accessible capital, and risk reduction; traders often prioritize margin flexibility and rapid turnover; warehouses focus on storage, grading, and transaction timing; industry emphasizes quality and reliable supply; governments emphasize regulation, local economic development, and strategic supply security; and NGOs tend to prioritize ecological restoration, participation, and accountability. Divergence is not automatically negative because sustainability transitions involve unavoidable trade-offs. However, unmanaged divergence can lock the system into short-termism: farmers underinvest in quality and resilience, environmental risks remain externalities, and policy instruments focus on output targets without addressing structural constraints.

To address this theoretical and empirical gap, this study applies the Matrix of Alliance, Conflict, Tactics, Objectives, and Recommendations (MACTOR) method [11]. MACTOR is a prospective analysis tool designed to model complex actor interactions, measure influence and dependence, and identify potential alliances or conflicts around competing objectives. In the context of salt governance, MACTOR enables an explicit diagnosis of why coordination fails, where coalition building is feasible, and which sustainability objectives remain marginal. Accordingly, this study aims to (1) map influence and dependence among actors in Jepara's salt farming system; (2) measure convergence and divergence of actor objectives, including livelihood stability, adaptive capacity, and coastal environmental management; and (3) derive a policy pathway for collaborative and sustainability-oriented salt governance.

2. LITERATURE REVIEW

2.1 Salt farming as a sustainability issue in coastal resource governance

Salt farming is often framed as a productivity and supply-security issue; however, in coastal settings, it is equally a sustainability problem because it sits at the intersection of environmental dynamics, local livelihoods, and market institutions. Sustainability here is treated as a linked set of environmental integrity, social equity, and economic viability; the salt sector can only endure if these dimensions improve together. In practice, salt systems behave like social–ecological systems: ecological processes (rainfall patterns, tidal flooding, and sediment dynamics) interact with social institutions (credit relations, marketing channels, and local rules) to shape outcomes; therefore, interventions that ignore either side tend to produce short-lived gains.

Coastal salt ponds occupy shorelines exposed to sea-level rise, subsidence, tidal inundation, storms, and salinity fluctuations, which shape the feasibility of production and household welfare. Indonesian evidence shows that salt harvesting can be embedded in locally adapted, relatively sustainable practices; however, these practices are increasingly threatened by coastal hazards and changing coastal dynamics [4]. In Jepara, where ponds, settlements, and mangrove belts are closely interwoven, sustainability also implies managing spatial competition and externalities (e.g., drainage, water quality, and access routes) so that sector upgrading does not shift costs onto vulnerable households or adjacent coastal ecosystems.

Environmentally, salt landscapes are not “empty” production spaces. They can function as wetland-like systems with multiple ecosystem services if managed or restored with ecological goals in mind [6]. Conversely, poorly governed coastal development and land conversion can erode the ecological base that supports salt production and other coastal livelihoods. Satellite-based studies of coastal wetland change demonstrate how sensitive coastal ecosystems are to policy and market drivers, with long-run implications for coastal functioning [12]. This is particularly relevant for Indonesia’s north coast, where salt ponds coexist with mangroves, tidal flats, and settlements.

Climate adaptation and nature-based solutions (NbS) add another layer. Research on muddy coasts highlights that NbS for erosion and flood protection, often involving mangroves and living shorelines, are increasingly important under climate change, but their effectiveness depends on local geomorphology and governance capacity [13]. In Java, coastal vulnerability assessments have been used to guide mangrove restoration priorities, underscoring the need to align ecological interventions with risk profiles and institutions [5]. From a business-management perspective, coastal sustainability also requires community engagement, market awareness, crisis management, and environmental-impact integration in coastal economic activities [14]. For salt regions, sustainability therefore includes spatial planning, coastal protection, ecosystem stewardship, and viable market institutions, in addition to production technology.

2.2 Stakeholder theory, power asymmetries, and sustainability trade-offs in salt value chains

Stakeholder theory argues that governance performance depends on identifying actors who affect or are affected by collective decisions and then recognizing how their power, legitimacy, and urgency shape strategic priorities [15-17]. In salt value chains, stakeholders include operational actors (farmers, pond laborers, and households), market actors (collectors, traders, warehouses, processors, and industry), and enabling actors (local governments, NGOs, and financial institutions). Sustainability relevance lies in legitimacy and distribution: a chain can appear technically efficient while remaining socially and environmentally fragile when powerful actors capture value and vulnerable actors absorb risk.

Actor categorization based on power, legitimacy, and dependence helps explain persistent asymmetries. Primary actors such as farmers may have high legitimacy because they bear operational risks and maintain the landscape; however, they often have weaker bargaining power and less access to finance, storage, quality information, and reliable buyers [18, 19]. These imbalances generate sustainability trade-offs. Traders may prioritize short-term margins and liquidity, whereas farmers prioritize stable prices, fair grading, and investment support that improves quality and reduces vulnerability. Agricultural market-power research shows that buyer concentration and intermediation can depress producer bargaining capacity and generate double marginalization in food and commodity chains [7, 20].

Technology adoption is also closely linked to socioeconomic sustainability. Evidence from small-scale salt farmers (SF) in East Java shows that environmental–socioeconomic factors and technology adoption relate to technical efficiency improvements, suggesting that upgrading practices can support productivity and welfare when constraints are addressed [21]. However, adoption is mediated by actor relationships and benefit-sharing in the chain; without fair contracting and supportive institutions, gains can be captured downstream.

Institutional market design can reduce these asymmetries. Cooperatives, transparent grading, warehouse receipts, and seasonal finance can stabilize producer income and strengthen bargaining positions when the institutions are trusted, audited, and linked to real market demand. Warehouse receipt systems are particularly relevant because they allow commodities to be stored and used as collateral, reducing distress sales after harvest [22, 23]. Maeenuddin et al. [24] show that microfinance institutions must be financially sustainable if they are to reduce poverty and support financially excluded producers over time. For SF, credible storage, receipts, and finance can support sustainability by smoothing prices, improving quality incentives, and expanding liquidity.

2.3 Environmental sustainability: Risk, ecosystem services, monitoring, and carbon co-benefits

Environmental sustainability in salt farming landscapes involves (i) exposure to coastal hazards, (ii) ecosystem service dynamics, (iii) land use changes, and (iv) monitoring capacity. Hazard exposure is increasing, and salt production is sensitive because it depends on stable salinity, evaporation conditions, and pond infrastructure. Approaches to estimate economic losses from tidal inundation illustrate how physical exposure translates into livelihood risks and investment disincentives [3]. On a broader scale, vulnerability assessments along Java's north coast show how risk profiling can support targeted adaptation actions, including mangrove restoration [5].

Ecosystem services and coastal protection create a bridge between production and stewardship. Saltpans can potentially be managed or restored to provide multiple ecosystem services; however, this requires governance arrangements that reconcile production objectives with ecological objectives [6]. Insights from landscape governance in agroforestry similarly stress the importance of connecting conservation and farming actors to avoid fragmented interventions [19]. In salt regions, coordination is needed so that pond expansion, mangrove protection, and coastal infrastructure decisions do not undermine one another.

Land use change at the wetland–saltpan interface is also central. Satellite-based analyses of historical and future coastal wetland change have shown that trajectories depend on policy and land use drivers, with potential losses in buffering capacity and biodiversity if conversion accelerates [12]. This raises sustainability questions about where salt ponds should expand, where retreat or restoration is preferable, and how spatial planning can reduce risk while maintaining livelihoods. Monitoring is increasingly feasible through remote sensing. Methods for monitoring coastal salt pans using a multi-feature fusion of satellite imagery have shown how saltpan dynamics can be detected and analyzed at scale, supporting planning, compliance, and early warning for encroachment or abandonment [25]. For local governments, this can reduce information asymmetry: actors debate objectives and responsibilities using shared evidence rather than fragmented claims. Monitoring also matters for private actors (warehouses, buyers) because consistent information on pond conditions and quality potential can make pricing and grading rules more credible.

Another sustainability concern pertains to the policy mix used to reduce hazard exposure. Nature-based solutions can complement engineered defenses, but they require alignment between land rights, maintenance responsibilities, and benefit distribution. Where mangrove rehabilitation or living shorelines increase protection for pond owners, fishers, residents, and infrastructure users, governance must specify who pays, who manages, and how benefits are shared [13]. The triple bottom line perspective is useful here because sustainable performance requires the economic, social, and environmental dimensions to be assessed together rather than treated as separate policy silos [26]. This once again highlights the centrality of actor coordination in coastal sustainability strategies.

2.4 Social and economic sustainability: Resilience, equity, and livelihood security

Social sustainability in coastal agribusiness concerns equity, voice, and the capacity to maintain well-being under stress. Equity and resilience are intertwined: interventions that ignore distributional impacts may increase vulnerability, whereas inclusive approaches can strengthen adaptive capacity [27]. In salt communities, equity issues involve access to land, credit, storage, information, and fair pricing, as well as who bears the costs of climate shocks and policy changes. Seasonal-income research on agro-industrial micro-, small-, and medium-sized enterprises (MSMEs) in East Java shows that fluctuating income affects financial awareness, capability, money stress, and risky financial behavior, making tailored finance and household-level risk management important for producer resilience [28].

Economic sustainability concerns the viability of salt farming and the stability of the value chain. Broader farming-system research argues that sustainability and resilience increasingly require moving from incremental adaptation to structural transformation in organizations, finance, and market linkages [18]. Oktasari et al. [29] show that green investment behavior depends on aligning financial returns, environmental norms, policy credibility, and investor characteristics. This is directly relevant to Jepara because storage, grading, and coastal protection will attract participation only if they are structured as investable and risk-reducing governance packages rather than isolated environmental or welfare programs.

2.5 Convergence, divergence, and collaborative governance for sustainability transitions

In public strategy and policy analysis, convergence refers to the alignment of goals and preferences among actors, whereas divergence denotes mismatches or conflicts in objectives [29]. Sustainability transitions require sufficient convergence for collective action, and managed divergence so that trade-offs are negotiated rather than imposed by power. In agribusiness, divergence often emerges between producers and marketing actors around grading standards, sales timing, and price formation [30]. If divergence is high and mediation is weak, outcomes can include monopsony-like pricing, informal debt dependence, and reduced investment in quality upgrading.

Collaborative governance frameworks explain how convergence can be built under interdependence and distrust. Collaborative governance emphasizes inclusive participation, shared understanding, and facilitative leadership to create joint solutions across sectors [31]. In salt ecosystems, collaboration is also a practical necessity: farmers control production decisions, traders and warehouses shape liquidity and market access, governments provide regulation and infrastructure, financial institutions provide working capital, and NGOs often support capacity building and mediation. Sustainability-oriented leadership is therefore necessary to translate environmental intent into day-to-day organizational practice; in small and medium-sized enterprises (SMEs), Shah et al. [32] showed that green servant leadership can encourage pro-environmental behavior through environmental passion and a climate for green creativity.

The convergence–divergence lens is helpful because sustainability reforms rarely benefit all actors immediately. For example, strengthening quality standards can raise compliance costs for farmers in the short run; expanding storage can shift margins away from traders who rely on rapid turnover; and restoration or protection measures can restrict land conversion options. If these distributional effects are not surfaced and negotiated, powerful actors may block reforms or reshape them to preserve rents, while weaker actors may disengage. Conversely, well-designed packages can convert conflict into conditional support; for example, pairing stricter grading with accessible finance and storage, or pairing coastal protection with livelihood co-benefits. The literature on actor roles in sustainable agriculture suggests that different actor types champion different futures, and that influence distributions matter for which trajectory dominates [30].

2.6 Matrix of Alliance, Conflict, Tactics, Objectives, and Recommendations for mapping sustainability-relevant actor interactions

MACTOR combines qualitative expert judgments with quantitative matrix-based computations to map inter-actor influence and dependence and to position actors relative to strategic objectives. Beyond descriptive stakeholder mapping, it explicitly surfaces potential alliances and conflicts by integrating the balance of power with actor agreements and disagreements, producing outputs that distinguish where convergence is strong and where divergence can constrain collective action [11, 33]. MACTOR has been applied in resource-governance settings to examine stakeholder interactions and power structures, including water management systems [34] and agribusiness/supply-chain contexts [35].

For sustainability, MACTOR is useful because sustainability goals are multi-objective and contested. Environmental objectives (coastal protection and restoration), social objectives (fair pricing, inclusion, and labor welfare), and economic objectives (stable supply and competitiveness) rarely align automatically. MACTOR allows these objectives to be represented explicitly and linked to actor positions, helping identify where sustainability trade-offs surface and where coalition building is feasible. It can also be strengthened by pairing matrix outputs with empirical evidence such as price-series data, saltpan monitoring, vulnerability assessment, and field-validated stakeholder narratives, so that actor debates are grounded in observable risks and trade-offs [5, 25].

3. RESEARCH METHOD

3.1 Research design and study area

This study adopts an exploratory sequential mixed-methods design. The research began with qualitative work to map the system (actors, objectives, interactions, and sustainability concerns), and then translated those insights into structured matrices analyzed using the MACTOR framework. This design is appropriate for salt farming governance because the main problem is not only what happens in production and marketing, but how decisions and power relations among actors shape outcomes, including coastal protection, ecosystem management, storage, value distribution, and livelihood stability.

The study was conducted in Kedung Subdistrict, Jepara Regency, Central Java, where salt production is concentrated and actor interaction is highly visible. Fieldwork focused on six salt-producing villages: Tanggultlare, Bulakbaru, Panggung, Surodadi, Kalianyar, and Kedungmalang. These villages represent variation in pond access, market linkages, and exposure to coastal dynamics. The unit of analysis is the salt farming system at the subdistrict level, covering upstream conditions (seawater access and pond infrastructure), midstream coordination (labor, technology, and storage), downstream market arrangements (pricing, buyers, and processing), and cross-cutting sustainability concerns (coastal abrasion, mangroves, household resilience, and finance).

3.2 Identification of actors and strategic objectives

Actor and objective identification followed a two-step process: (1) document and literature review to establish a preliminary list; and (2) field verification through observation and early-stage interviews to confirm relevance, refine categories, and avoid missing informal but influential actors.

For analytical clarity, actor categories and strategic objectives are separated. Table 1 reports actor categories and governance roles, while Table 2 reports strategic objectives and their sustainability dimensions.

Table 1. Actor categories and governance roles

Code	Actor Category	Governance Role in the Salt Ecosystem	Why Included in MACTOR
SF	Salt farmers	Pond operation, harvesting, quality decisions, and direct livelihood risk bearer	Primary producer with high legitimacy and dependence
ST	Salt traders/collectors	Liquidity provision, aggregation, price formation, and market access	Key intermediary with strong influence and potential conflict
Lab	Laborers	Daily pond work, harvesting, transport, and operational continuity	Production capacity and labor welfare dimension
HW	Households/housewives	Household finance, consumption smoothing, unpaid support work, and social resilience	Captures household vulnerability behind producer decisions
VG	Village government	Local facilitation, village regulation, infrastructure support, and mediation	Institutional actor closest to communities
MS	Maritime/fisheries service	Sector planning, technical assistance, coastal management, and public programs	Public authority for production and coastal objectives
I/SF	Industry/salt factory	Quality requirements, processing, value addition, and downstream demand	Downstream buyer and upgrading actor
B&FI	Banks and financial institutions	Working capital, credit, guarantees, and receipt-linked finance	Enabling actor for storage and investment
NGO	Non-governmental organizations	Capacity building, advocacy, environmental programs, and facilitation	Potential mediator for sustainability and inclusion
SW	Salt warehouses	Storage, grading, receipt issuance, timing of sales, and inventory management	Strategic post-harvest actor affecting bargaining power

Source: Author fieldwork synthesis (2024).
Note: MACTOR = Matrix of Alliance, Conflict, Tactics, Objectives, and Recommendations.

Table 2. Strategic objectives and sustainability dimensions

Code	Strategic Objective	Operational Meaning	Sustainability Dimension
SWater	Quality seawater	Reliable access to seawater with adequate salinity for pond operations	Environmental/economic
PRoad	Pond access roads	Adequate road access to reduce transport cost, loss, and isolation	Economic/social
Salt	Seasonal salt production	Stable production throughout the salt season	Economic
Land	Salt pond land	Availability and protection of productive salt-pond land	Economic/environmental
Cap	Capital	Fast, affordable, low-collateral financing suitable for seasonal income	Economic/social
Geo	Geomembrane and equipment	Affordable geomembranes and supporting technology for quality and efficiency	Economic/technological
LabObj	Skilled labor	Availability of trained labor for pond operation, harvesting, and handling	Social/economic
Output	Output market	Reliable buyers and transparent price channels for salt at policy-relevant prices	Economic/institutional
Abr	Coastal abrasion control	Protection of ponds, roads, settlements, and shoreline assets from erosion	Environmental/social
Mgrv	Mangrove strengthening	Mangrove planting and ecosystem management to support protection and co-benefits	Environmental
HVal	High-value salt	Processing and upgrading salt into higher-value products	Economic/technological
Warehouse	Warehouse receipt system	Storage, grading, receipts, and finance to reduce distress selling	Economic/institutional

Source: Author fieldwork synthesis (2024).

3.3 Data collection procedures and fieldwork audit trail

Primary data were collected from May to September 2024 through 36 semi-structured interviews, three focus group discussions (FGDs), direct field observation, and document review. Interviews targeted informants able to explain both operational practice and institutional relationships: SF (8), traders/collectors (4), laborers (4), housewives/household representatives (4), village-government representatives (3), maritime/fisheries-service representatives (3), industry/salt-factory actors (3), bank/financial-institution representatives (3), NGO representatives (2), and salt-warehouse actors (2). The three FGDs involved 30 participant attendances drawn from these actor categories and were used to validate actor categories, strategic objectives, direct-influence relations, and actor-objective positions.

Triangulation was applied across actor groups, villages, and data-collection modes. During data collection, special attention was paid to asymmetric information and power. Questions separated who formally should influence decisions from who practically does influence decisions through capital control, market gatekeeping, storage access, or social networks. Ethical procedures emphasized voluntary participation, confidentiality of individual statements, and removal of personal details from reported results.

3.4 Matrix construction and scoring

The MACTOR input consisted of four components (see Table 3): (1) the actor list; (2) the strategic-objective list; (3) the matrix of direct influences among actors (MDI); and (4) the actor-objective position matrix (2MAO). The influence matrix was scored on a 0-4 scale: 0 = no meaningful influence; 1 = limited information or symbolic influence; 2 = operational influence over routine decisions; 3 = strong influence over resources, market access, or program implementation; and 4 = decisive influence capable of blocking or redirecting an objective. The actor-objective matrix was scored from -4 to +4, where negative values indicate opposition, positive values indicate support, and the absolute value indicates intensity or salience. A score of 0 indicates neutrality, non-involvement, or insufficient evidence.

The reported MDII (matrix of direct and indirect influences), 2CAA, 2DAA, net-distance, and competitiveness scores were not assigned manually. They are MACTOR transformations of the direct influence and actor-objective matrices. The MDII output combines direct and indirect influence/dependence; the convergence matrix identifies pairs of actors supporting similar objectives; the divergence matrix identifies opposing actor-objective positions; and the competitiveness indicator summarizes the relative strategic position of each actor in the influence-dependence structure. This clarification is important because the numerical outputs should be interpreted as structured stakeholder judgments, not as survey means or causal estimates.

Table 3. Fieldwork and Matrix of Alliance, Conflict, Tactics, Objectives, and Recommendations (MACTOR) matrix validation protocol

Component	Reported Information	Procedure Applied in This Study
Fieldwork period	May-September 2024, covering pre-harvest preparation, harvest-season observation, and post-harvest validation.	Field visits covered the six salt-producing villages in Kedung Subdistrict: Tanggultlare, Bulakbaru, Panggung, Surodadi, Kalianyar, and Kedungmalang.
Interviews	36 semi-structured key-informant interviews.	Purposive key-informant interviews identified actors, objectives, influence channels, dependence relations, and contested market and sustainability issues.
FGDs	Three FGDs with 30 participant attendances; each FGD included cross-actor representation.	FGDs validated actor categories, strategic objectives, MDI scores, actor-objective positions, and interpretations of convergence/divergence.
Actor distribution	SF = 8; ST = 4; Lab = 4; HW = 4; VG = 3; MS = 3; I/SF = 3; B&FI = 3; NGO = 2; SW = 2 (36 unique interview informants).	Farmers and household actors were intentionally oversampled because they carry the largest livelihood risk, while institutional and market actors were represented by key decision informants.
Coding and synthesis	Interview summaries, field notes, FGD minutes, document extracts, and matrix-scoring sheets were organized manually.	Evidence was coded into actor roles, influence claims, dependence claims, support/opposition to objectives, sustainability concerns, and policy instruments.
Disagreement treatment	Median/modal consensus plus documented disagreement.	When informants differed, contested cells were returned to FGD discussion; the median/modal consensus score was used, while persistent disagreement was used to interpret divergence.
MACTOR software	LIPSOR-EPITA-3IE MACTOR software, version 5.1.2; matrix totals were cross-checked in Microsoft Excel.	The software transformed MDI and 2MAO matrices into MDII, 2CAA, 2DAA, net-distance, and competitiveness outputs.
Sensitivity reading	±1 check on contested non-zero cells and cluster-level robustness interpretation.	Interpretation emphasized stable actor blocks and objective clusters rather than small rank differences; the market core, trader divergence, weak institutional leverage, and environmental periphery remained stable.

Source: Primary fieldwork audit trail and MACTOR scoring protocol (2024).

3.5 Validation, reliability, and robustness

Reliability was strengthened through source triangulation, actor triangulation, and validation of matrices in the three FGDs. Matrix entries were accepted only when they could be linked to interview evidence, FGD consensus, observed actor roles, or documentary evidence. Disagreements were handled by returning contested cells to FGD discussion, using median/modal consensus for scoring and documenting persistent divergence for interpretation. A ±1 sensitivity reading was applied to contested non-zero scores; because the major structural conclusions remained stable, the results are interpreted as robust structural patterns rather than exact causal estimates. These stable patterns include the high-influence market core, trader-centered divergence, weak competitiveness of government/NGO actors, and the peripheral position of environmental objectives.

4. RESULTS

4.1 Map of influence and dependency (matrix of direct influences and matrix of direct and indirect influences)

Table 4 presents the MDII, which summarizes the overall influence structure among actors by combining direct and mediated effects. In this matrix, each cell indicates the extent to which a row actor influences a column actor. The rightmost column (Ii) represents each actor's total influence on the system, while the bottom row (Di) captures total dependence. Together, Ii and Di identify structurally powerful actors, dependent actors, and marginal actors in Jepara's salt governance system.

The influence scores (Ii) indicate that Jepara’s salt system is primarily driven by value-chain actors rather than public or civic institutions. Salt traders (ST) hold the highest overall influence (Ii = 91), closely followed by SF (Ii = 89). Salt warehouses (SW) also exert substantial influence (Ii = 80), while industry/salt factories (I/SF) constitute another influential node in the system (Ii = 75). Laborers (Lab) are likewise positioned as important actors (Ii = 73), implying that labor availability and labor relations are consequential for production continuity and the functioning of the chain. By contrast, the village government (VG) and NGOs show markedly lower influence (Ii = 32 and 11, respectively), suggesting limited capacity to steer system-wide coordination or enforce collective objectives without stronger alignment with dominant market actors.

The dependence scores (Di) further show that even the most influential actors remain highly embedded in mutual reliance. SF recorded the highest dependence (Di = 93), followed by ST (Di = 91), SW (Di = 82), and industry/salt factories (Di = 77). This configuration reflects a tightly coupled governance arena in which core actors possess leverage, yet simultaneously rely on one another for critical functions, such as access to raw materials, market outlets, storage, grading, liquidity, and distribution. The presence of both high influence and high dependence among the central actors indicates that system outcomes are shaped less by unilateral control than by negotiated coordination and bargaining among interdependent players.

The influence–dependence map (Figure 1) visualizes how actors are positioned in Jepara's salt farming governance system. The horizontal and vertical axes reflect dependence and influence, respectively; therefore, actors in the upper-right quadrant are both highly influential and highly dependent on others, indicating strong interdependence within the value chain.

Figure 1 shows ST and SF clustered in the high-influence/high-dependence quadrant, confirming them as core actors with strong leverage but also tight mutual reliance. SW sit close to this core, highlighting their strategic role in storage, transaction timing, and bargaining space. Industry/Salt Factory and Labor remain part of the same governance arena, while Village Government, Banks/Financial Institutions, and especially NGOs occupy lower-influence positions. The implication is that sustainability-oriented reforms are most feasible when negotiated with the high-influence value-chain core rather than implemented only as top-down institutional programs.

Table 4. Matrix of direct and indirect influences (MDII)

MDII	SF	ST	Lab	HW	VG	MS	I/SF	B&FI	NGO	SW	Ii
SF	22	20	12	8	5	7	14	6	2	15	89
ST	22	22	12	8	5	7	14	6	2	15	91
Lab	14	14	12	8	3	5	12	5	0	12	73
HW	9	9	6	8	3	3	8	5	1	8	52
VG	4	4	2	2	7	6	3	3	2	6	32
MS	7	7	5	2	6	10	6	4	2	6	45
I/SF	14	14	10	8	3	6	14	5	1	14	75
B&FI	6	6	5	4	3	4	5	6	1	5	39
NGO	2	2	0	0	2	2	1	1	2	1	11
SW	15	15	10	8	6	6	14	5	1	17	80
Di	93	91	62	48	36	46	77	40	12	82	587

Source: MACTOR output generated from validated matrices (2024).
Note: SF = Salt farmers; ST = Salt traders/collectors; Lab = Laborers; HW = Households/housewives; VG = Village government; MS = Maritime/fisheries service; I/SF = Industry/salt factory; B&FI = Banks and financial institutions; NGO = Non-governmental organizations; SW = Salt warehouses; Di = total dependence; Ii = total influence.

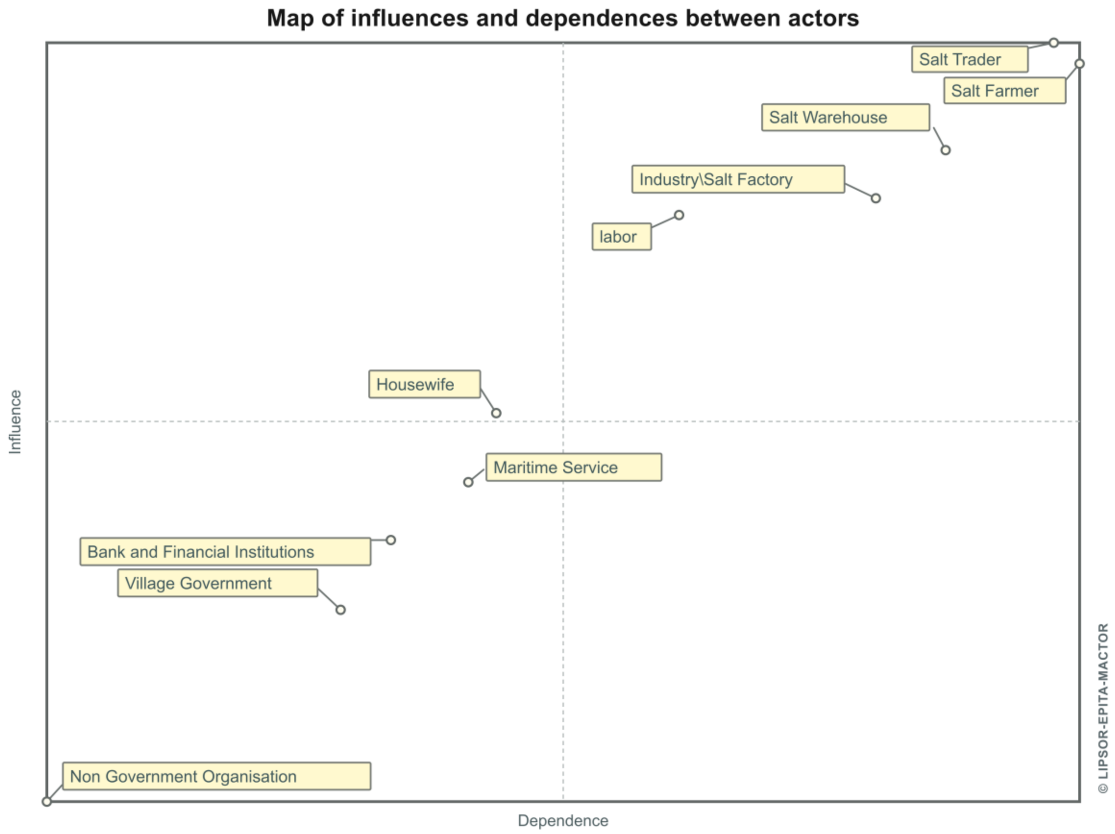

Figure 1. Inter-actor dependency influence map
Source: Data processed using original MACTOR software output (2024).

4.2 Convergence analysis

Table 5 presents the 2CAA convergence matrix, which measures how closely pairs of actors align in their support for the same objectives. Higher values indicate stronger alignment and a greater likelihood of cooperation, whereas values near zero reflect weak overlap in priorities. The overall degree of convergence is high (81.9%), indicating substantial shared objectives despite differences in roles and bargaining power.

Convergence is strongest among core value-chain and facilitation actors. SF show high alignment with maritime services (MS = 32.0), SW (SW = 29.5), labor (Lab = 28.5), and village governments (VG = 26.5). Maritime services also converge strongly with multiple actors, including farmers, village governments (25.0), warehouses (25.5), and labor (24.5), suggesting that it can function as a bridging actor for coordinated interventions. Warehouses similarly exhibit strong convergence with farmers and labor and maintain solid alignment with industry/salt factories, reinforcing the idea that post-harvest handling and storage-related objectives are widely shared across the system. In contrast, ST display consistently lower convergence with most actors, indicating a more distinct preference structure that may not automatically align with collective agendas, such as stabilization mechanisms or institutional arrangements. NGOs are the least integrated actor, with near-zero convergence with most groups and only modest alignment with village governments and maritime services. Overall, the matrix suggests that collaborative governance is feasible because many actors already share key objectives; however, effective coalition-building will likely need to be anchored in the highly convergent block around farmers, maritime services, warehouses, labor, and industry, while creating targeted incentives to engage traders and more tightly integrate NGOs into the dominant coalition.

Table 5. Convergence matrix (2CAA)

2CAA	SF	ST	Lab	HW	VG	MS	I/SF	B&FI	NGO	SW
SF	0	14	28.5	24.5	26.5	32	24.5	23	4	29.5
ST	14	0	12	9	10.5	12	14	6.5	0	11
Lab	28.5	12	0	22	19.5	25	22	21.5	0	26
HW	24.5	9	22	0	16	21	18.5	20.5	0	23
VG	26.5	10.5	19.5	16	0	25	17	16	7	20.5
MS	31.5	11.5	24.5	21	25	0	21	20	7	25.5
I/SF	24.5	14	22	18.5	17	21	0	18.5	0	22.5
B&FI	23	6.5	21.5	20.5	16	20	18.5	0	0	22.5
NGO	4	0	0	0	7	7	0	0	0	0
SW	29.5	11	26	23	20.5	26	22.5	22.5	0	0
Number of convergences	206	88.5	176	154.5	158	187	158	148.5	18	181
Degree of convergence (%)	81.9									

Source: MACTOR output generated from validated matrices (2024).

Note: SF = Salt farmers; ST = Salt traders/collectors; Lab = Laborers; HW = Households/housewives; VG = Village government; MS = Maritime/fisheries service; I/SF = Industry/salt factory; B&FI = Banks and financial institutions; NGO = Non-governmental organizations; SW = Salt warehouses.

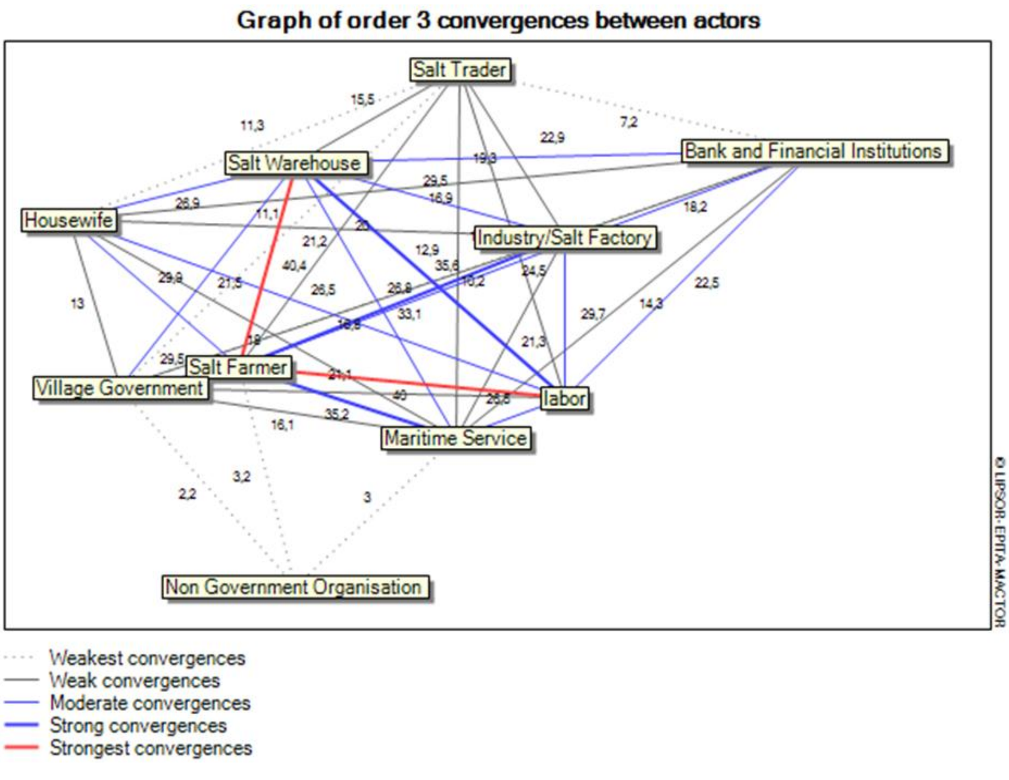

Figure 2. Order 3 convergences between actors

Source: Data processed using original MACTOR software output (2024).

Figure 2 presents the order-3 convergence network (3CAA) generated by the MACTOR software. Convergence ties are weighted by actor influence, so the visualization emphasizes alignments that are most consequential for governance. The strongest and moderate ties cluster around SF, SW, labor, maritime services, and industry/salt factories, indicating a core coalition around production, storage, quality improvement, market stabilization, and supporting services. ST remain present in the network but are less embedded in this convergence core, suggesting that trader participation requires incentive-compatible roles in transparent grading and structured marketing.

The network is structured around a dense convergence core dominated by SF, SW, labor, maritime services, and industry/salt factories. These actors are connected by strong or moderate ties, indicating substantial overlap in weighted objectives and a relatively high potential for coalition building around production continuity, post-harvest handling, market stabilization, and supporting services. Banks and financial institutions connect to the core through storage and finance objectives, but their convergence is not yet the primary organizing force of the network. NGOs remain peripheral with weak ties, indicating that environmental and inclusion objectives need to be deliberately linked to the priorities of core actors.

4.3 Divergence analysis

Table 6 presents the 2DAA divergence matrix, which captures the extent to which pairs of actors hold opposing positions across the strategic objectives. Higher values indicate stronger incompatibility and, therefore, a greater likelihood of conflict, bargaining tension, or resistance when policy changes are proposed. The diagonal values are zero because an actor is not compared with itself, while off-diagonal values show preference distance between two actors.

Table 6. Divergence matrix analysis (2DAA)

2DAA	SF	ST	Lab	HW	VG	MS	I/SF	B&FI	NGO	SW
SF	0	14.5	0	0	2.5	2.5	4	0	6.5	0
ST	14.5	0	13	13	9	13	11	14.5	3	15
Lab	0	13	0	0	0	0	3	0	3.5	0
HW	0	13	0	0	0	0	4	0	2.5	0
VG	2.5	9	0	0	0	0	2.5	0	3	0
MS	2.5	13	0	0	0	0	3.5	0	3	0
I/SF	4	11	3	4	2.5	3.5	0	3.5	3	3.5
B&FI	0	14.5	0	0	0	0	3.5	0	3	0
NGO	6.5	3	3.5	2.5	3	3	3	3	0	3
SW	0	15	0	0	0	0	3.5	0	3	0
Number of divergences	30	106	19.5	19.5	17	22	38	21	30.5	21.5

Source: MACTOR output generated from validated matrices (2024).

Note: SF = Salt farmers; ST = Salt traders/collectors; Lab = Laborers; HW = Households/housewives; VG = Village government; MS = Maritime/fisheries service; I/SF = Industry/salt factory; B&FI = Banks and financial institutions; NGO = Non-governmental organizations; SW = Salt warehouses.

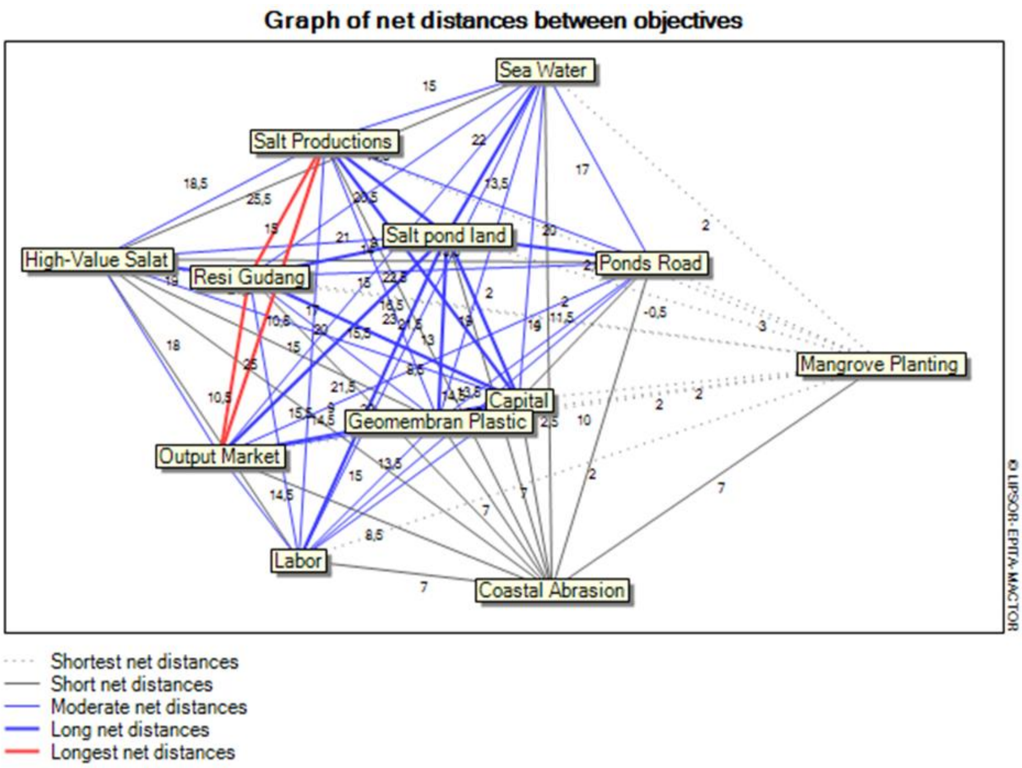

Figure 3. Net distances between objectives

Source: Data processed using original MACTOR software output (2024).

ST emerged as the primary source of disagreement. ST recorded high divergence with nearly every actor, including SF (14.5), labor (13), housewives (13), maritime services (13), banks/financial institutions (14.5), industry/salt factories (11), and especially SW (15). This was reinforced by the total divergence score for ST (106), which is far higher than that for any other actor, indicating that traders' preferences are structurally misaligned with the broader objective set pursued by other stakeholders and are therefore the most likely to contest reforms that reduce their intermediation advantage. Outside this trader-centered conflict, divergence was relatively limited. Industry/salt factory showed the next highest overall divergence (38), suggesting partial misalignment with several actors, while NGOs displayed moderate divergence (21.5), including a notable divergence with farmers (6.5). In contrast, farmers, warehouses, village governments, and maritime services exhibited low divergence with most actors, implying that there was substantial compatibility across much of the system. Overall, the matrix suggests that collaborative governance is feasible; however, progress will depend on managing high-conflict relationships involving traders, as these are the main structural constraints on consensus-building.

Figure 3 presents the net distances among strategic objectives generated by the MACTOR software.

Shorter net distances indicate objectives that tend to be jointly supported and can be bundled in policy design, whereas longer distances indicate objectives that are less aligned and more likely to face implementation trade-offs. The network is densest around the production-market core: quality seawater, salt production, salt pond land, output markets, capital, geomembrane technology, labor, high-value salt, and warehouse receipts. By contrast, coastal abrasion control and mangrove strengthening are positioned at the periphery, showing that environmental objectives are present but not yet central to the dominant coalition.

The peripheral position of Mangrove Planting and Coastal Abrasion is an important finding rather than a weakness of the model. It suggests that environmental objectives are marginal because they produce benefits over longer time horizons, require collective maintenance, and do not immediately increase short-term transaction margins. These objectives also lack a single dominant owner: governments may have formal authority, farmers bear pond-level risk, NGOs support ecological programs, and traders/industry benefit indirectly from production stability. The practical implication is that coastal and ecosystem measures should be linked to objectives already valued by core actors, such as protecting salt pond land, maintaining seawater access, reducing road damage, improving production continuity, and supporting bankable risk-reduction packages.

4.4 Competitiveness of actors

Figure 4 summarizes MDII competitiveness using the original MACTOR histogram, showing which actors hold the strongest structural positions in the influence-dependence system. The most competitive actors are ST, SF, Labor, SW, and Industry/Salt Factory, confirming that market coordination and production capacity dominate governance outcomes. Institutional actors sit in a weaker second tier, while NGOs have the smallest competitiveness score. This distribution means that sustainability reforms require institutional facilitation, but implementation must be anchored in the incentives and commitments of the dominant value-chain actors.

The competitiveness results also explain why purely technical assistance is insufficient. If traders, warehouses, factories, and farmers remain the dominant strategic actors, interventions such as geomembrane support, mangrove planting, or warehouse receipts will succeed only when they change the risk-return structure for these actors. Village government and NGOs can still matter, but mainly as conveners, rule-setters, monitors, and facilitators of incentives rather than as unilateral drivers of change.

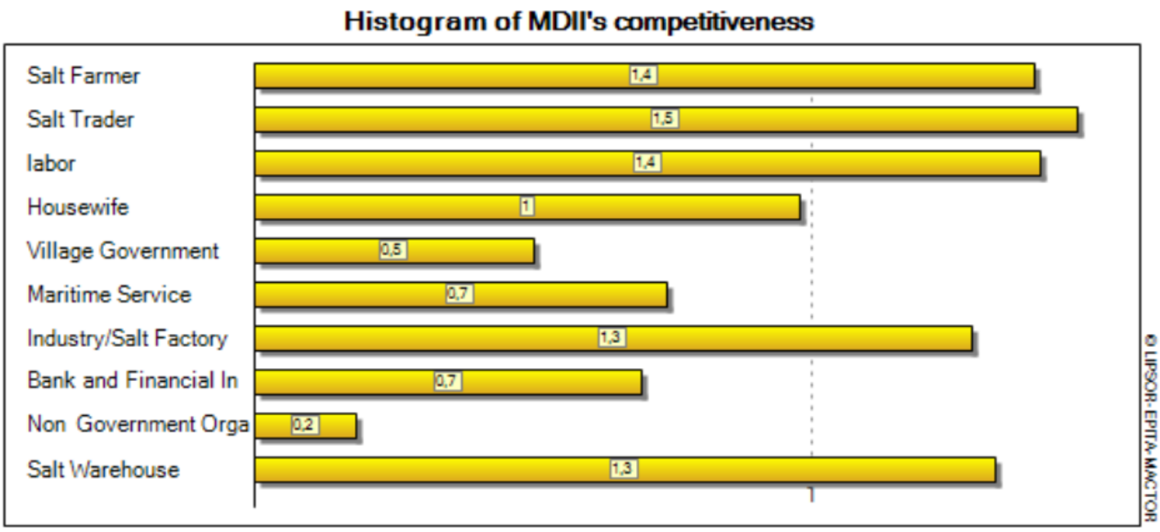

Figure 4. Histogram of MDII's competitiveness
Source: Data processed using original MACTOR software output (2024).

4.5 Discussion

The convergence level of 81.9% suggests that the governance system is relatively stable in terms of shared technical priorities. Most actors align around the prerequisites for production, including seawater availability, access roads, technology support, labor, storage, and output markets. However, this stability should not be interpreted as welfare security. Contextual evidence from Jepara indicates that most harvested salt is sold to collectors, that salt remains largely krosok, and that farm-level prices fluctuated sharply from approximately Rp250 to Rp2,000/kg across years, creating periods of farmer loss [1]. Thus, convergence keeps production running but does not automatically resolve distribution, price volatility, or investment capacity.

This welfare fragility undermines long-term environmental and economic sustainability. When farmers face low and volatile margins, they are less able to finance adaptation, quality upgrading, or pond infrastructure maintenance. This increases vulnerability to climate variability and coastal hazards. Evidence from Indonesian salt farming shows that efficiency and technology adoption are shaped by environmental and socioeconomic conditions, meaning that technical improvements will not diffuse or persist without stronger livelihood foundations and supportive institutional arrangements [21]. Seasonal-income evidence from agro-industrial MSMEs also indicates that fluctuating cash flow can shape financial stress and risky borrowing behavior, reinforcing the need for finance matched to harvest cycles and storage capacity [28].

Within this context, households, represented here by Housewives (HW), become relevant to the sustainability discussion because they mediate how shocks are absorbed at the micro level. Even when formal bargaining power is concentrated elsewhere, domestic financial management and social capital often determine whether households can smooth consumption, maintain labor allocation, or avoid distress sales during price downturns. This makes HW an important social-resilience actor, particularly in coastal livelihoods, where shocks are recurrent and recovery depends on adaptive capacity rather than one-off coping. Research on transformative resilience in Indonesian coastal communities underscores that sustained well-being under stress depends on household and community capacities to reorganize and pursue improved pathways rather than repeatedly returning to precarious equilibria [36]. The persistence of low farmer welfare therefore signals not only a distributional issue but also a constraint on the system's ability to become more resilient and sustainable.

The divergence results position ST as both highly influential and the most conflict-prone actor, confirming the role of asymmetric power in commodity chains. Traders function as liquidity and market-access gatekeepers, and resistance to price-stabilizing mechanisms is understandable when business models benefit from volatility and information advantages. The problem is not simply distributive; it is sustainability-relevant because price volatility and weak bargaining positions discourage upstream investments in quality, storage, and climate adaptation. When farmers cannot predict returns, they underinvest in pond improvements and risk-reduction measures, amplifying production instability under climate stress.

Coastal salt production is increasingly shaped by environmental risks, including inundation, erosion, and changing coastal dynamics. Vulnerability assessments on Java's north coast show that coastal risk profiling is essential for targeted restoration and protection strategies, and such risks directly affect livelihood viability [5]. If the dominant market actor benefits from short-term volatility, the system tends to drift away from long-horizon measures, such as coastal protection, nature-based solutions, and ecosystem stewardship, that stabilize production conditions. In this sense, trader-centered divergence can produce a lock-in: the chain keeps operating, but remains structurally biased toward short-term transactions rather than resilience and sustainability.

One implication is that sustainability reforms must not be designed as moral add-ons. They need to change the incentive structure that rewards volatility. Storage and structured marketing instruments are one route because they reduce distress selling and weaken the urgency leverage that often underpins trader dominance. Evidence from warehouse receipt systems indicates that such mechanisms can improve liquidity without forcing immediate sales, reducing exposure to unfavorable price cycles [22, 23]. In Jepara's context, strengthening storage- and receipt-based finance can reduce the economic divergence that sustains trader hegemony and create space for upstream investment in both productivity and resilience.

The influence map and competitiveness outputs consistently place village governments and NGOs in weak positions, despite their theoretical relevance as mediators in collaborative governance. This is a critical sustainability bottleneck. Environmental objectives such as coastal abrasion protection and mangrove strengthening require coordination, rule-setting, maintenance, and credible monitoring. However, when government and civic actors lack competitiveness, environmental objectives remain peripheral, underfunded, or detached from the market logic that drives day-to-day decisions.

A sustainability-oriented mediation strategy therefore requires two upgrades: stronger instruments and stronger evidence. First, village governments need usable local tools, such as village regulations, budget allocations, and enforceable agreements that connect livelihood protection with environmental management. Second, NGOs and local governments can increase their relevance by grounding interventions in shared evidence, including price data, land-use monitoring, saltpan condition, coastal vulnerability, and storage performance. Knowledge-based coastal-governance research in Indonesia similarly emphasizes that coastal policy needs reliable information, stakeholder coordination, and institutional learning rather than fragmented sectoral programs [9]. Satellite-based monitoring of coastal salt pans can support more transparent tracking of land-use dynamics, production conditions, and potential abandonment [25], while coastal vulnerability assessment can guide where mangrove restoration and shoreline protection are most urgent [5].

NGOs can also reposition themselves by linking environmental measures to tangible economic incentives. Saltpan and coastal landscape restoration can provide multiple ecosystem services when governance aligns production goals with ecological functions [6]. In practical terms, NGO programs become more adoptable when they help core actors secure financing, reduce risk, access credible monitoring, or qualify for market premiums. This also means that environmental objectives should be framed in the language of production continuity, asset protection, and bankable risk reduction, not only biodiversity or conservation.

Given that divergence is concentrated in economic distribution and market control, purely technical assistance, such as geomembrane support, will not resolve governance constraints. Institutional designs are needed to bind powerful market actors into arrangements that reduce volatility, improve fairness, and enable sustainable investment. In this context, hybrid contracting remains promising because it can create incentive-compatible convergence: traders or processors obtain supply certainty, farmers obtain predictable prices and earlier liquidity, warehouses obtain throughput, and banks obtain collateralizable receipts. However, contracts must include transparent grading, dispute resolution, and safeguards against side-selling or one-sided risk transfer.

A sustainability-linked contract design can incorporate conditions and co-financing for adaptation measures that stabilize production, such as pond maintenance, improved drainage, quality grading, and coastal protection. Sustainable finance literature indicates that environmental norms and financial returns must be aligned for green investment behavior to persist [29]. Therefore, a Jepara salt-governance package should connect finance to measurable outcomes: stored volume, grade improvement, price transparency, reduced distress sales, and coastal risk-reduction milestones.

Hybrid contracts can be strengthened further when integrated with storage and receipt systems because storage reduces immediate selling pressure, receipts create collateral, and grading makes quality premiums verifiable. The key institutional risk is that dominant actors may capture the system by controlling storage access, grading rules, or contract terms. This risk can be mitigated through third-party grading, transparent price formulas, farmer cooperative representation, digital receipt records, and periodic public reporting. These safeguards transform convergence from a technical alignment into a fairer and more sustainable governance arrangement.

4.6 Policy pathway for sustainability-oriented salt governance

Table 7 translates the MACTOR findings into an implementation pathway. The sequencing reflects the actor map: reforms should begin with high-convergence and high-influence market objectives (grading, storage, warehouse receipts, finance), then use those mechanisms to connect environmental objectives to production risk reduction and long-term value creation.

Table 7. Policy pathway for sustainability-oriented salt governance in Jepara

Horizon	Priority Package	Lead/Responsible Actors	Funding/Support Sources	Key Institutional Risks and Safeguards
Short term (0-12 months)	Create a salt-governance forum; publish transparent grading and indicative price information; validate actor-objective matrix annually	Maritime Service, Village Government, farmer groups, warehouses, traders, industry	District/village budget, sector program funds, cooperative contribution	Risk: symbolic forum without enforcement. Safeguard: written rules, meeting minutes, public dashboard, and trader inclusion.
Short term (0-12 months)	Pilot standardized grading at warehouse/farmer-group level and link quality grades to price bands	Warehouses, industry/factory, Maritime Service, farmer groups	Warehouse fees, industry CSR, technical-assistance funds	Risk: grading manipulation. Safeguard: third-party checks, transparent sampling, complaint mechanism.
Medium term (1-3 years)	Develop warehouse receipt-based finance to reduce distress selling and seasonal debt pressure	Salt warehouses, banks/financial institutions, farmer cooperatives, Maritime Service	KUR/SME credit, bank working capital, receipt guarantees, regional budget facilitation	Risk: exclusion of small farmers. Safeguard: cooperative aggregation, low minimum volume, digital receipts.
Medium term (1-3 years)	Introduce incentive-compatible supply contracts with transparent price formula and quality premiums	Farmers/cooperatives, traders, industry/factory, warehouses, banks	Forward purchase commitments, working-capital credit, private investment	Risk: side-selling or one-sided risk transfer. Safeguard: balanced penalties, dispute resolution, farmer representation.
Long term (3-5 years)	Integrate coastal abrasion control and mangrove strengthening into pond-land protection and production continuity plans	Village Government, Maritime Service, NGOs, coastal planners, farmer groups	Regional budget, CSR, green finance, blue-carbon or restoration grants where feasible	Risk: unclear maintenance responsibility. Safeguard: village agreements, benefit-sharing, monitoring indicators.
Long term (3-5 years)	Scale high-value salt processing and farmer participation in value-added products	Industry/factory, farmer cooperatives, warehouses, local government, universities	Public-private investment, cooperative equity, development-bank finance	Risk: downstream capture of value. Safeguard: farmer equity/share contracts, transparent margins, quality training.

Source: Author synthesis from MACTOR findings (2024).

5. CONCLUSION

This study analyzed governance in Jepara's salt farming system using MACTOR to map actor influence, dependence, convergence, divergence, and competitiveness across ten actor groups and twelve strategic objectives. The findings show a market-centered governance structure in which traders, farmers, warehouses, labor, and industry/factories form the strategic core, while local government, financial institutions, and NGOs occupy weaker facilitative positions. Overall convergence is high (81.9%), but this convergence is concentrated around production and market continuity rather than equitable value distribution or environmental resilience. Divergence is concentrated around traders, indicating that price stabilization, warehouse receipts, transparent grading, and value-sharing contracts will face resistance unless they are incentive-compatible. Environmental objectives, especially coastal abrasion control and mangrove strengthening, remain peripheral and should be embedded in risk-reduction packages that protect salt pond land, roads, seawater access, and production stability. The study contributes to sustainable coastal-resource governance by showing that the feasibility of sustainability transitions depends not only on identifying desirable objectives, but on locating them within actor power relations and designing institutional packages that convert conflict into conditional cooperation. Because MACTOR relies on structured stakeholder judgment rather than probabilistic estimation, the findings should be interpreted as a governance diagnosis of Jepara's salt ecosystem, not as a causal estimate for all Indonesian salt regions. Future studies can combine MACTOR with longitudinal price, margin, household-income, and remote-sensing data to test whether the proposed governance pathway improves farmer welfare and coastal resilience over time.

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