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Moral Infrastructure of Sustainability: Ritual Redistribution and Traditional ecological knowledge in Rural Java

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Abstract

Traditional ecological knowledge (TEK) in rural Java embodies not only environmental wisdom but also a moral ecology that organizes collective life. This study examines how TEK operates as a socio-moral system that links ritual redistribution, ecological ethics, and local equality in Nganjuk Regency, Indonesia. Drawing on an ethnographic interpretation and secondary data from Indonesia's Bureau of Statistics (2008–2025), the analysis situates these practices within a context of relatively stable interregional inequality (Williamson Index 0.12–0.15) and mild household income disparity (Gini ratio 0.30–0.32). Within this moral landscape, four interrelated pillars are identified: ritualized food sharing that redistributes symbolic and material capital; ecological calendars (*Pranata Mangsa*) which align agriculture with cosmological ethics; communal institutions which govern shared resources; and norms of reciprocity and restraint which are embedded in everyday practice. Together, these pillars show that sustainability in rural Java is an ethical practice, that integrates ecological stewardship, distributive justice, and social solidarity. This paper contributes to human ecological scholarship by reframing TEK as an ethical infrastructure of sustainability, demonstrating how moral economy and ritual practices shape lived experiences of equality beyond market logic.

1. Introduction

The pursuit of agricultural sustainability represents one of the most pressing challenges of the 21st century. Conventional, high-input farming models have successfully increased global yields but often do so at severe ecological cost, including soil degradation, biodiversity loss, and water pollution (Altieri, 2018). Furthermore, these models frequently exacerbate rural inequality by privileging large-scale, capital-intensive operations over smallholder farmers, leading to land consolidation and the displacement of rural communities (IPES-Food, 2016). This situation creates a dual crisis where the systems that feed humanity simultaneously undermine the ecological foundations of agriculture and the social fabric of the countryside. Consequently, there is an urgent need to identify and understand alternative paradigms that can reconcile productivity with ecological integrity and social equity.

In search for alternatives, indigenous knowledge systems (IKS) are increasingly recognized not as relics of the past, but as vital repositories of wisdom for sustainable living. Central to this is the concept of traditional ecological knowledge (TEK), defined by Berkes (1999, p. 8) as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission." TEK encompasses a holistic understanding of the relationships between living beings and their environment, often embedded in cultural practices and worldviews that emphasize balance and reciprocity. Rather than treating the environment as a separate entity to be dominated, IKS views humans as an integral part of a complex socio-ecological system, offering a fundamentally different framework for resource management. Recent comparative research by Nagal (2025) demonstrated that Javanese communities possess sophisticated informal institutions for transmitting indigenous agricultural knowledge, providing crucial empirical evidence for the mechanisms underlying cultural preservation in agrarian societies.

Owing to its immense cultural and biological diversity, the Indonesian provides a critical context for exploring IKS. In Java, where agriculture has shaped civilization for centuries, culturally embedded economic relationships persist, making the concept of a "moral economy" highly relevant (Scott, 1976). However, these systems are under threat from modernization and market forces, often with starkly unequal outcomes. For example, Syahri et al. (2023) reported a Gini ratio of 0.88 among rice farmers in a Javanese village with similar demographics, highlighting how market liberalization can exacerbate disparities. Against this backdrop, the Nganjuk Regency in East Java presents a compelling anomaly. While officially classified as a region with low per capita GRDP and significant poverty (Noto, 2012), the Nganjuk has maintained a remarkably low and stable Gini ratio of 0.29 (Badan Pusat Statistik BPS, 2024)—a powerful indicator of rural equality. This contrast suggests that while macroeconomic factors play a role (Falah & Rahmawati, 2024), robust local institutions are key to mediating economic forces and sustaining equity.

This paper extends moral economy theory from the realm of resistance (Scott, 1976) to the foundation of proactive rural governance oriented toward stability and sustainable equilibrium. Our primary theoretical contribution lies in reconceptualizing the integrated TEK system in Nganjuk as a collective moral-rational infrastructure. We argue that the persistence of *Pranata Mangsa*, communal resource management, and redistributive rituals is driven not solely by cultural adherence, but also by the collective rational interests of farmers (Popkin 1979, Bowen 1986, Schrauwers 1999)—a communal investment that measurably secures a subsistence safety net and mitigates risk (precarity). Furthermore, we hypothesize that this infrastructure functions as a mediating mechanism for agrarian class differentiation, where participation in ritual redistribution (Nyadran, Slametan) effectively links moral obligations to stable economic outcomes, enabling local elites to maintain social legitimacy while ensuring equitable resource distribution for smallholders, as evidenced by Nganjuk's stable Gini ratio of 0.29. Thus, we offer a framework that synthesizes long-standing dichotomies in peasant studies, showing that economic rationality is deeply embedded in communal ethics to produce structural equality.

This review posits that Nganjuk's exceptional equality is an outcome of a deeply ingrained TEK system, which functions as a cultural infrastructure for both sustainability and distribution. We argue that this system operates through four interdependent pillars: (A) a phenological agricultural calendar (*Pranata Mangsa*) that guides ecological forecasting; (B) communal institutions for managing irrigation and soil conservation; (C) the active preservation and use of local agro-biodiversity; and (D) redistributive rituals such as *Nyadran* and *Slametan*, whichact as socio-ecological governance mechanisms. These pillars collectively form a complex adaptive system that ensures the equitable circulation of resources—be they water, seeds, labor, or food—thereby converting cultural obligation into economic balance and resilience (McAnany & Wells, 2008). The low Gini ratio is, therefore, not a coincidence but a measurable manifestation of this system's distributive logic.

Moving beyond Galvin's (2021) focus on precarity and resistance, this study repositions ritual-based redistribution as a proactive model of rural development grounded in IKS. Through a qualitative-

interpretive review that integrates socioeconomic data with ethnographic insights, this paper aims to critically examine how the integrated TEK of Nganjuk sustains both agricultural sustainability and rural equality. It seeks to answer the central question: How does the traditional ecological knowledge system in Nganjuk function as a coherent socio-ecological infrastructure to produce measurable outcomes in sustainability and equity? By decoding this "moral infrastructure of sustainability," the study contributes a culturally-grounded framework for rethinking rural development, one that offers valuable lessons for designing equitable and resilient agricultural systems in Java and comparable regions worldwide.

2. Conceptual and Analytical Approach

This study adopts a qualitative–interpretive research design grounded in a constructivist/interpretivist paradigm, aiming to understand human experiences and how social reality is constructed through shared meanings, moral norms, and everyday practices (Mackenzie & Knipe, 2006). Within this framework, Traditional Ecological Knowledge (TEK) is conceptualized as a socially and morally embedded socio-ecological system through which communities organize relationships with nature, coordinate social life, and sustain collective resilience under conditions of ecological and agrarian change (Yashmita-Ulman & Singh, 2024; Companion, 2025). Guided by principles of systematic conceptual synthesis (Lindgreen, Salomone, & Reyes, 2020), the study prioritizes contextual understanding and theory-building over causal attribution, seeking not to produce a comprehensive ethnography, but to develop a theoretically grounded explanation of TEK as an integrated system supporting agricultural sustainability and relative distributive stability.

This study draws on empirical examples from Nganjuk Regency (see Fig. 1), an agrarian region in East Java Province, Indonesia, characterized by irrigated and dryland farming systems and recent agrarian transformation, including a decline of approximately 14,500 hectares of rice paddies between 2016 and 2022.

The analysis integrates three sources of material. First, a structured review of interdisciplinary literature provides the conceptual foundation for understanding TEK, the moral economy, and rural sustainability. Second, secondary statistical data from Indonesia’s Central Bureau of Statistics (BPS), particularly for Nganjuk Regency (2008–2025), are used descriptively to situate local practices within broader structural trends; indicators such as the Gini coefficient serve to characterize patterns of regional inequality rather than to test causal relationships. Third, the analysis is informed by long-term ethnographic familiarity with Nganjuk, developed between 2022 and 2024 through sustained observation of communal practices, including nyadran, slametan, and gotong royong.

Analytically, qualitative synthesis is employed to examine how four interrelated pillars of TEK operate both individually and synergistically, linking micro-level practices with macro-level patterns of resource stewardship and distributive balance. These dynamics are reflected in Nganjuk’s persistently low Gini coefficient, illustrating how culturally embedded moral arrangements can shape socio-economic outcomes without recourse to deterministic explanations.

Several limitations warrant acknowledgment. Reliance on secondary statistical data constrains causal inference, while the absence of systematically elicited interview material limits fine-grained analysis of intra-community variation, including gendered and generational dynamics. The focus on selected localities within Nganjuk also restricts broader generalization. Nevertheless, by integrating conceptual analysis, structural indicators, and interpretive insight, this study offers a coherent human ecological account of TEK as a dynamic moral infrastructure underpinning sustainable and relatively equitable rural livelihoods.

3. Results and Discussion

3.1 Cognitive Pillar: *Pranata Mangsa* as an Embedded Ecological Calendar

The Javanese people form Indonesia's largest ethnic group and are renowned for their enduring cultural traditions. The name "Java" dates back to the term *jawawut*, a type of grain noted by early colonizers in East and Southeast Asia. Another name for this island was Nusa Hara-hara or Nusa Kendang, which means a wild island or one bordered by hills. (Raffles, 1817). In folk etymology, this evolved from *jawa + wut* (meaning disorder), reflecting a transition from chaos to order. Alternatively, Endraswara (2003) suggested that "Java" derives from *ja* (birth) and *wa* (character), symbolizing the emergence of a new civilization. This cultural foundation has endowed the Javanese with a rich epistemological system using symbolic communication dating to prehistoric times (Badrudin, 2014).

Javanese peasants have long been agrarian people. In regions such as Nganjuk Regency, their cultural worldview is deeply rooted in Javanese cosmology and expressed through the use of *Pranata Mangsa*—a traditional Javanese calendar. N. Daldjoeni (1984) noted that this calendar served as a practical tool for rural farmers and was already in use before Hindu influences reached Java. Its origins are associated with the prosperity of Central Javanese agricultural kingdoms such as Old Mataram, Pajang, and Islamic Mataram. The true value of this calendar lies in its ability to link the cosmic, climatic, and social dimensions of agriculture, establishing a continuous dialog between people and their environment. *Pranata Mangsa* functions as an indigenous ecological framework that regulates planting cycles and rainfall prediction (Rahmadhani et al., 2022; Iboy et al., 2022), enhances climate adaptation through flexible seasonal management (Zaki et al., 2020; Karjanto, 2022; Irawan & Komori, 2024), integrates traditional and scientific knowledge for sustainable farming (Apriyana et al., 2021), and reinforces social cohesion through collective rituals grounded in ecological ethics (Zaki et al., 2020; Karjanto, 2022).

This system represents the first pillar of Nganjuk's traditional ecological knowledge, functioning as an intricate phenological calendar that guides agricultural life through sophisticated ecological forecasting. Grounded in generations of observed relationships between biological indicators and climatic patterns, it embodies what Scott (1976) identified as the peasant's deep understanding of environmental "moral balance." Farmers interpret natural signals - from the flowering of kapok trees to specific bird behaviors - as reliable indicators of agricultural timing, creating a proactive approach that minimizes external inputs. This democratic knowledge system, accessible to all community members regardless of economic

status, prevents information asymmetry and ensures that even resource-poor farmers can make informed decisions, thereby addressing a key driver of rural inequality in the region.

As a cognitive pillar within the traditional ecological knowledge (TEK) system in Nganjuk, *Pranata Mangsa* represents a sophisticated form of ecological intelligence developed through generations of deep observation (ngelmu titen) of natural patterns. This traditional calendar system not only divides the year into twelve periods (mangsa) with specific climatic and phenological characteristics but also contains a profound philosophy about the harmonious relationship between humans and the cosmos. Each mangsa has a unique character reflected in Javanese cultural metaphors, such as Mangsa Kasa, likened to 'a jewel dropping from its setting' (*sotya murca ing embanan*), marking the period of falling leaves, or Mangsa Kalima as 'golden rain spreading across the earth' (Pancuran mas sumawar ing jagad), signaling the start of the rainy season (Wibisono, 2025).

The astronomical basis of *Pranata Mangsa* (see Figure 2) shows a high level of complexity, beginning with the observation of the sun's movement of the sun (starting June 22 when the sun is at the northern solstice) to observe eleven traditional constellations such as Lintang Waluku (Orion) as markers for the planting season (Wibisono, 2025). According to Daldjoeni (1988), this system reflects the worldview conception of the archipelago communities, dividing the 365-day tropical year into twelve unequal months, corresponding to the bioclimatological and socio-cultural aspects of agricultural activities in Central Java. The seasonal rhythm in *Pranata Mangsa* not only serves as an agricultural guide but also marks important periods in socio-cultural life, such as the festival during Mangsa Saddha (Asudji) which coincides with the end of the rainy season and is marked by festivals (Nyadran ritual and others) (Daldjoeni & Hidayat, 1988).

Table 1. *Pranata Mangsa* System: Characteristics, Periods, and Ecological Guidelines

No	Mangsa Name	Period	Number of Days	Character/Philosophy	Agricultural Activities & Natural Phenomena
1	**Kasa**	Jun 22 - Aug 1	41	*A jewel drops from its setting*	Leaves fall, plant secondary crops, grasshoppers lay eggs
2	**Karo**	Aug 2 - 24	23	*Cracked earth*	Famine season, hot weather, mango and kapok trees bloom
3	**Katelu**	Aug 25 - Sep 17	24	*A child follows the father*	Harvest secondary crops, dusty wind, wells dry up
4	**Kapat**	Sep 18 - Oct 12	25	*Tears stored in the heart*	End of dry season, sow upland rice, kapok trees fruit
5	**Kalima**	Oct 13 - Nov 8	27	*Golden rain spreads across the earth*	Prepare rice fields, build irrigation, snakes and caterpillars become active
6	**Kanem**	Nov 9 - Dec 21	43	*A feeling of nobility from purity*	Rice fields turn green, harvest durian/mango, plow fields
7	**Kapitu**	Dec 22 - Feb 2	43	*Poison blown away by the wind*	High rainfall, floods, diseases, sow seeds
8	**Kawolu**	Feb 3 - 28	23-24	*Spread evenly in the heart*	Rice fields turn green, rice plants grow tall
9	**Kasanga**	Mar 1 - 25	25	*The spreading of joyful news*	Rice plants flower and fruit, crickets chirp
10	**Kasapuluh**	Mar 26 - Apr 18	24	*The pregnancy of animals*	Harvest upland rice, rainfall decreases
11	**Dhesta**	Apr 19 - May 11	23	*Birds feeding their young*	Harvest rice, bird eggs hatch
12	**Saddha**	May 12 - Jun 21	41	*Water disappears from its place*	Sun-dry rice, store in barns, dry season begins

Source: Adapted from Wibisono (2025) and Wisnubroto (1995)

Operationally, as shown in Table 1, this system is equipped with specific agricultural guidelines based on natural indicators, such as the emergence of tonggeret insects marking the end of the rainy season in Mangsa Kasanga, or the flowering of kapok trees initiating Mangsa Kapat. The scientific validity of this system has been further strengthened by recent studies testing its accuracy with modern climate data, which revealed an 83.3% alignment with the seasonal periods determined by BMKG (Nabila & Wirawan, 2024).

However, in a contemporary context, this system faces significant challenges due to climate change which disrupts seasonal patterns and the behavior of indicator flora and fauna. This astronomical and cultural approach confirms that *Pranata Mangsa* is not merely a traditional calendar, but rather an integrated ecological knowledge system that requires adaptation through integration with contemporary climatological data without losing its local wisdom essence. Thus, *Pranata Mangsa* function not only function as a seasonal prediction tool, but also as an integral knowledge system that codifies the interrelationships among the cosmos, climate, and agricultural practices. Its ability to provide a 'cognitive buffer against precarity' (Galvin, 2021) for the farmers of Nganjuk makes it an essential cognitive foundation in the moral economy architecture that maintains rural stability and equality.

3.2 Practical-Infrastructural Pillar: Communal Resource Management as Moral Economy in Practice

In his ecological argument, Geertz (1963) divided Indonesia into inner and outer geographical regions, placing East Java within the former region on the basis of its population density and intensive wet-rice cultivation (sawah). Within this inner zone lies what he calls Kejawen. The term Kejawen itself has both a broad and narrow meaning. In its broad sense (tlatah [wewengkon] ing wong-wong Jawa), it denotes the territory inhabited by Javanese-speaking populations; in the narrow sense, as noted by Poerwadarminta in Baoesastra Djawa (Kano, 1980), it refers to “the land still belonging to Javanese principalities,” namely the regions under the cultural influence of the Surakarta and Yogyakarta courts (tanah sing isih rada kawengku ratu Jawa). In this narrower interpretation, Kejawen is less of a natural region than a political–cultural zone defined by dialect, customs, and values rather than ecological boundaries.

The eastern boundary of this narrow *Kejawen* region situates Nganjuk precisely within the cultural zone of *Macanegara Wetan*, which is part of the Islamic Mataram kingdom was then divided after the Giyanti Treaty of 1755. This cultural geography is crucial for understanding the ecological logic of communal resource management in Nganjuk. The sustainability of its agrarian system is materially grounded in the collective regulation of vital resources—constituting the practical–infrastructural pillar of its traditional ecological knowledge (TEK). Water distribution follows customary rules (like awig-awig in Bali) overseen by respected elders, while irrigation maintenance is carried out through gotong royong, reflecting what Hayami (1989, 2009) terms the “community mechanism.”

For water allocation there is a person who chores ensure that all farmer receive equitable distribution. In some parts of Nganjuk it is known as “*klantung*” or *ulu-ulu* (Nugroho et al., 2023). These practices exemplify how the moral principles of Kejawen—reciprocity, balance, and communal harmony—are concretely realized in the management of agrarian infrastructure.

These institutions effectively prevent the "tragedy of the commons" through what Polanyi (1944) would recognize as an "embedded economy," where resource management is governed by social obligation rather than market logic. The distributive significance of this pillar is profound: ensuring equitable water access and shared infrastructure maintenance, prevents resource monopolization and directly contributes to Nganjuk's remarkably low Gini ratio of 0.29 (see Figure 3). This demonstrates how moral

economic principles, when institutionalized through TEK, create structural foundations for equality rather than merely functioning as a safety net during crises.

3.3 Biological Pillar: Agro-biodiversity and Seed Sovereignty as Resistance to Market Dependence

The third pillar encompasses the deliberate preservation and utilization of local agro-biodiversity, which serves as both an ecological buffer and an economic safeguard. Farmers maintain diverse local seed varieties that are resilient to local pests and drought, practicing seed sovereignty through traditional exchange systems. This biological capital represents what Chayanov (1966) would recognize as the peasant household's logic of balancing consumption needs rather than pursuing capital accumulation. By controlling their genetic resources, the community maintains what Scott (1976) calls a "subsistence insurance" against market volatilities and corporate dependency. The home garden (*pekarangan*), which is managed predominantly by women, further enriches this pillar by functioning as a micro-sanctuary for medicinal plants and nutritional crops. This decentralization ensures that the means of production remain dispersed throughout the community, making tangible contributions to the region's economic equality while enhancing ecological resilience.

Examples of highly popular superior local varieties in Nganjuk are the "Tajuk" and "Bauji". The Tajuk variety is a cross between several local shallot varieties and is resistant to both dry and rainy seasons. Tajuk excels because of its relatively high yield, long shelf life of up to 7-8 months, and resistance to disease and pests. Its bulbs are round in shape, with a color, aroma, and firmness that are favored by farmers and consumers. This variety has an ideal planting period of approximately 4 months and is highly adaptable to the Nganjuk area and other regions in Indonesia. The Bauji variety is a superior shallot variety for the rainy season. In Addition to Tajuk, which excels in the dry season, Bauji is one of the shallot varieties relied upon by farmers in Nganjuk. Bauji has been released as a superior variety that can support shallot farming in Nganjuk and the surrounding area.

Yards also function as agro-ecosystems that support diverse plants with nutritional, medicinal, and ritual benefits, and play a role in maintaining germplasm. A study in Ngumpul Village, Nganjuk Regency (Nurlaelih, 2022) recorded the percentage of plant use including as a food source (26.83%), ornamental (24.66%), shade (16.97%), medicine (15.85%), aromatic (6.8%), cultural/religious rituals (5.84%), color producers (3.2%), and wood producers (0.03%). This explains why the plants frequently found and used in yards in mostly rural Nganjuk areas, are Mango (Mangifera indica), Banana (Musa paradisiaca), Pandanus amaryllifolius, Basil (Ocimum × citriodorum), Papaya (Carica papaya), and Bamboo (Bambuseae sp) which also function as part of ritual raw materials.

3.4 Socio-Governance Pillar: Rituals as Redistributive Infrastructure

Rice farming practices in Nganjuk are characterized by a series of rituals that are tangible manifestations of traditional ecological knowledge (TEK), serving not only as spiritual practices but also as practical guidance closely tied to natural cycles and seasons. The process begins long before the main planting, beginning with the *Nyebar* (Nampek) stage, which involves scattering the rice seeds while

still in the unhusked stage. Prior to this seed scattering, the community holds a small feast (*kenduren*) featuring rice and the usual side dishes, but with the specific addition of *jenang lemu* (fat porridge), as an initial expression of hope for the seeds' thriving. After the seeds have germinated and reached an age of approximately 25-30 days, the process continues to the Daut stage, which involves removing or collecting the rice seedlings from the nursery, not scattering them. Prior to this *Daut* process, a thanksgiving or bancaan (small feast) is usually held, accompanied by jaddah (sticky rice), as a prayer with the hope that the plants will be transplanted to grow well and be free from pests.

Once the seeds are ready, the Tandur (planting) stage begins. Before planting begins, the ceremony begins with the *Miwiti Tandur* (starting planting) ceremony, which involves preparing the rice paddy. If cok bakal is philosophically interpreted as "the origin of life, the origin of all the contents of the universe," then the contents of the rice paddy used in the field are detailed in the following ingredients: eggs, betel leaves, shallots, garlic, chilies, and candlenuts. These ingredients often symbolize fertility, protection, and completeness. The *Miwiti* process involves planting the first few clumps of rice to mark the beginning of the planting season, before farmers begin planting together. In addition to the initial ritual, rituals are also performed mid-planting; in some places, when the rice plants are approximately 15-30 days old, the Ngasih *jenang sumsum* (rice porridge) is placed on the rice plants, possibly as a ward off disaster or as a form of 'feeding' the plants to strengthen them. Finally, when the rice is ready to be harvested, the cycle concludes with the Wiwit Panen ritual, which marks the beginning of the harvest season. Thus, *Miwiti Tandur* and wiwit panen are two different stages that encompass the entire process, from the beginning of planting to the start of harvest, showing that every phase of agriculture in Nganjuk is full of spiritual meaning and local wisdom.

Other places held the *Sengkolo ritual*, which was performed in the middle of the rice paddies to welcome the first rainfall, where village elders lead prayers for blessings and protection from disaster. There is also Wiwitan, a traditional Javanese offering ritual as an expression of gratitude to the earth and the crops about to be harvested. Most importantly is Cok Bakal, a tradition performed before the rice planting season begins, involves offerings of symbolic ingredients (spices, flowers, rice) that symbolize hopes for safety, prosperity, and a smooth harvest. Collectively, these rituals demonstrate the deep connection and inherited knowledge shared by farming communities about how to manage and interact with their environment. The primary function of these customary practices lies in the socio-governance pillar that binds the entire TEK system together. This concept, identified by McAnany and Wells (2008) as a sophisticated "ritual economy" system, is clearly visible in the Sengkolo ritual in Nganjuk, where dozens of foods and market snacks are brought by residents and eaten together in the middle of the rice fields.

Nyadran held during the “lean season” after major harvests which were sometimes followed by months of Ramadan communities in agrarian societies and in pre modern Java. (White,1982; Geertz (1963). This communal sharing and consumption create a system that systematically distributes resources (food and labor) and strengthens collective identity. In Florida’s account of Javanese literacy, even those who could not read became “literate” through participation in hearing and reciting texts (1993, p. 11). In this sense, Nyadran may be read as a living ritual text, as valid as a babad or the spatial axis of a palace.

Resonating Scott's notion of the "moral economy" (1976), Nyadran ensured social equilibrium even under colonial pressure and modernizing transformations.

These ritual mechanisms collectively establish a normative framework that regulates access to material resources and social legitimacy. Their distributive implications are empirically reflected in long-term inequality indicators. Drawing on Gini ratio data from the Central Statistics Agency (BPS) covering the period 2008–2025, Nganjuk Regency presents relatively moderate and stable levels of income inequality over the long term, particularly when compared with more urbanized areas in East Java. While fluctuations occur across years, the overall trajectory suggests the presence of locally embedded mechanisms that moderate inequality rather than allowing persistent escalation.

The Gini ratio is employed as the primary secondary indicator to assess rural equality outcomes across an extended temporal horizon (2008–2025). This longitudinal scope enables the analysis to capture structural continuity, episodic disruption, and post-crisis recovery within Nganjuk's socio-economic landscape. Over this period, Nganjuk Regency generally maintains lower or comparable inequality levels relative to those of its urban counterparts such as Malang and Surabaya, reinforcing its analytical value as a case study for examining non-market redistributive mechanisms.

The sharp increase in Nganjuk Regency's Gini Ratio in 2019 warrants careful reflection rather than being interpreted as a contradiction of the central argument advanced in this study. Instead, this anomaly may be understood as a moment of structural stress preceding broader economic disruptions that culminated in the COVID-19 crisis. Episodes of rapid inequality escalation often coincide with market volatility, shifts in agricultural commodity prices, or uneven access to non-farm income sources—dynamics that are particularly salient in semi-rural regions undergoing partial commercialization. Crucially, the post-2019 trajectory does not indicate a persistence of elevated inequality. Rather, the subsequent stabilization and gradual decline in the Gini Ratio during the 2020–2025 period suggests that ritual-based socio-governance mechanisms, while not eliminating exposure to macroeconomic shocks, function as social buffering systems that prevent short-term disparities from solidifying into long-term structural inequality. In this sense, the 2019 anomaly highlights the conditional—rather than absolute—efficacy of ritual economies, whose strength lies in restoring distributive balance over time through embedded norms of reciprocity, collective obligation, and shared subsistence ethics.

3.5 Theoretical Reorientation: From Resistance to Stability through Integrated TEK

The Nganjuk case necessitates a theoretical reorientation of moral economy from what Scott (1976) originally framed as resistance toward a framework emphasizing stability and everyday governance. While Galvin (2021) highlights precarity as a defining condition of peasant livelihoods, the Nganjuk experience demonstrates how integrated traditional ecological knowledge (TEK) systems can transform vulnerability into resilience under conditions of gradual economic change. The four pillars of TEK together constitute what this study conceptualizes as a moral infrastructure of sustainability, in which ecological knowledge, practical institutions, biological diversity, and ritual governance interact to sustain environmental balance and social cohesion. This argument is supported not only by qualitative

ethnographic evidence but also by persistent structural patterns in regional economic data. As shown in Table 1, agriculture consistently contributes between 27 and 29 percent to the regional gross domestic product, alongside the steady expansion of service-related sectors. This configuration indicates an agrarian-based yet diversified economy in which communal values continue to shape economic organization.

Table 2. Sectoral Composition of Gross Regional Domestic Product (GRDP) of Nganjuk Regency at Current Market Prices, 2019–2024 (in Percentages)

Industry Classification	2019	2020	2021	2022	2023	2024
A. Agriculture, Forestry, and Fishing	28.23	29.20	28.34	27.33	27.31	26.91
B. Mining and Quarrying	2.01	1.42	1.39	1.39	1.45	1.47
C. Manufacturing	14.11	14.92	14.93	15.89	15.86	16.31
D. Electricity and Gas	0.05	0.05	0.06	0.05	0.05	0.05
E. Water Supply, Sewerage, Waste Management, and Remediation Activities	0.11	0.11	0.12	0.12	0.11	0.11
F. Construction	10.78	10.31	10.23	10.63	10.48	10.54
G. Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	20.3	19.57	20.09	20.23	20.33	20.11
H. Transportation and Storage	1.62	1.53	1.57	1.63	1.71	2.03
I. Accommodation and Food Service Activities	1.98	1.87	1.93	1.97	1.98	2.05
J. Information and Communication	4.36	4.17	4.26	4.46	4.59	4.68
K. Financial and Insurance Activities	2.21	2.22	2.46	2.62	2.65	2.72
L. Real Estate Activities	1.67	1.73	1.69	1.66	1.64	1.62
M–N. Business Services	0.34	0.32	0.33	0.33	0.33	0.34
O. Public Administration and Defence; Compulsory Social Security	5.03	5.19	4.89	4.43	4.36	4.22
P. Education	3.8	3.93	3.96	3.99	3.94	3.93
Q. Human Health and Social Work Activities	0.61	0.68	0.69	0.70	0.72	0.73
R–S–T–U. Other Services Activities	2.81	2.47	2.51	2.56	2.61	2.63
Total GRDP	100.00	100.00	100.00	100.00	100.00	100.00

Source: Central Bureau of Statistics (Badan Pusat Statistik) of Nganjuk Regency, 2019-2024.

The quantitative evidence presented in Table 2 further reinforces this theoretical reorientation. According to Berliyan et al. (2025), the Williamson Index for Nganjuk Regency remained relatively stable at approximately 0.12- 0.15 from 2019 to 2023, indicating low levels of interregional inequality, whereas the Gini ratio fluctuated between 0.30 and 0.32, reflecting mild household income disparity. Although Nganjuk is classified as a relatively underdeveloped region within East Java's Klassen Typology, its economic structure remains notably stable. Agriculture consistently contributes between 26 and 29 percent of the GRDP, whereas manufacturing and trade sectors show moderate but sustained growth. This pattern suggests that distributive stability in Nganjuk cannot be attributed solely to market dynamics, but is embedded in a moral and ecological system that mediates economic processes through cultural practice.

This finding stands in contrast to neoclassical assumptions that emphasize fiscal policy rules and GDP growth as self-regulating mechanisms leading to long-term prosperity. In the case of Nganjuk, the relative stability of income distribution, as reflected by consistently low Williamson and Gini indices up to 2021, was not merely a byproduct of economic growth but also a manifestation of deeply rooted moral and ecological arrangements within the community's social structure. However, the increase in the Gini index after 2022 indicates that the effectiveness of this moral infrastructure has begun to encounter structural limits in the context of accelerated capital accumulation and economic restructuring. These developments suggest that while collective mechanisms grounded in moral and redistributive values were effective in producing structural equality in earlier periods, they are increasingly challenged under contemporary economic pressures. In this sense, the statistical consistency of income equality in Nganjuk empirically reflects the moral infrastructure of sustainability theorized in this study, while also revealing its historically contingent capacity to regulate inequality.

4. Implications for Rural Development and Agricultural Extension

4.1 Reframing Rural Development through the Moral Economy

The reorientation of the moral economy from resistance to stability offers a new framework for understanding rural development. Conventional agricultural policies in Indonesia have often prioritized productivity, infrastructure, and technological modernization. The Nganjuk case illustrates, that social equity and moral reciprocity are equally critical in sustaining rural well-being. Development interventions that neglect these cultural dimensions risk undermining the very cohesion that enables community resilience.

Integrating moral economy principles into rural development implies acknowledging that economic behavior is not purely market-driven but rather socially and ethically embedded. Redistribution, cooperation, and ritualized generosity are not residual customs but informal welfare mechanisms that supplement limited state capacity. Recognizing and strengthening these mechanisms can enhance the inclusiveness and sustainability of development outcomes.

4.2 Policy relevance: Institutionalizing Community Mechanisms

From a policy perspective, the findings suggest that *community mechanisms* (Hayami, 1989; Ogaki, 2025) should be institutionalized as complementary governance tools. Rather than replacing traditional systems, agricultural extension programs can work with local ritual and cooperative frameworks to deliver assistance, distribute resources, and mobilize participation.

For example, *Nyadran* or *gotong royong* gatherings can be used as platforms for participatory planning, agricultural training, and disaster-preparedness education. By aligning technical interventions with existing social structures, policymakers can reduce transaction costs, increase legitimacy, and encourage behavioral adoption among farmers. This approach transforms development from a top-down administrative effort into a culturally synchronized partnership.

Agricultural extension has traditionally focused on transferring technology and knowledge to farmers. However, its success depends heavily on trust, reciprocity, and collective participation which are all hallmarks of the moral economy. In Nganjuk, the dense networks formed through *slametan* and *gotong royong* provide the *social capital* necessary for the effective diffusion of innovation.

Extension programs that incorporate these networks can achieve broader and faster impact. For example, local farmer groups could integrate ritual-based meetings into knowledge-sharing sessions, transforming cultural gatherings into hybrid forums of moral and technical exchange. This would not only improve productivity but also reinforce the ethical bonds that sustain equality and cooperation.

4.3 Cultural indicators for sustainable development

The evidence from Nganjuk also challenges policymakers to broaden the metrics used to evaluate rural progress. Economic indicators such as income and output capture only part of the picture. As Vel and Warren (2024) observed in their research on Bali and Sumba, well-being in rural Indonesia cannot be understood only through income or consumption data. People often measure welfare by their ability to participate in rituals, share food, and maintain reciprocal relations with others. They questioning, why do even those people who have low incomes invest so much time, money and food in ceremonial activities. These cultural forms of care and solidarity operate as informal systems of social security that remain invisible in official statistics.

Drawing on von Benda-Beckmann's theory, Vel and Warren (2024) demonstrate that well-being in rural Indonesia depends on a "social security mix" built from kinship, ritual, and community reciprocity, rather than on income alone. In this sense, cultural participation and moral obligations are not residual traditions but measurable forms of social stability—key cultural indicators for sustainable development. Von Benda-Beckmann and von Benda-Beckmann (1994) emphasize that social security is never derived from a single source but from a web of overlapping relationships.

Individuals construct what they call a “social security mix,” drawing support from multiple domains—kinship, neighborhood, religious communities, and state institutions. For example, someone may rely on neighbors to repair a roof, receive care from family members when sick, obtain donations from a local mosque or church, and still depend on limited government assistance during unemployment. Investing time and resources in these relationships is therefore a key security strategy, since giving help today builds the moral credit to receive help in the future. The effectiveness of this mix depends on maintaining trust and active participation within these social and institutional networks. In this sense, social security is not merely an institutional arrangement but a cultural system of reciprocity that relies on the strength and continuity of community-based relationships.

The low Gini ratio (0.29) in Nganjuk reflects not only efficient market distribution but also the cultural circulation of value through ritual and moral norms. Therefore, new cultural indicators—such as participation in community rituals, the frequency of cooperative labor events, or levels of inter-household reciprocity—should complement quantitative economic data. This approach aligns with Vel and Warren’s (2024) concept of a social security mix, where community-based moral economies coexist with, and often compensate for, the limitations of formal welfare programs.

Incorporating such indicators would allow development agencies to measure social stability and moral cohesion as integral components of sustainable development. This aligns with the UN Sustainable Development Goals (SDG 1 and SDG 10), which emphasize the reduction of inequality through inclusive and culturally grounded governance. Ultimately, the lessons from Nganjuk advocate for a moral framework of rural equality—one that positions culture not as a barrier to modernization but as a driver of equitable transformation. The persistence of moral economy within modernization processes, as also demonstrated by Vel and Warren (2024), shows that ethical redistribution and community solidarity are productive forces, not traditional remnants.

Agricultural and rural development programs that integrate moral economy principles can thus build resilient and self-sustaining communities, where equality is maintained not by constant subsidy but by collective ethics. As Scott (1976) viewed subsistence as a moral right and Galvin (2021) reinterpreted it through precarity, the Nganjuk experience extends this trajectory—showing that stability itself is a moral achievement, produced by culture, reinforced by ritual, and measurable in social outcomes.

5. Conclusion

This study demonstrates that Traditional ecological knowledge (TEK) in rural Java operates as a moral ecology that organizes collective life by linking ecological ethics, ritual redistribution, and local equality. Through the case of Nganjuk Regency, the findings reframe moral economy not as episodic resistance but as a form of everyday governance that sustains stability and distributive balance under conditions of gradual economic transformation.

The analysis identifies four interrelated pillars through which this moral ecology operates: the ecological calendar of Pranata Mangsa, communal resource management institutions, the preservation of local

agro-biodiversity, and ritualized redistribution through practices such as Nyadran and slametan. Together, these pillars function as a collective moral–rational infrastructure that converts cultural obligation into practical mechanisms of risk mitigation, subsistence security, and equitable resource circulation. Sustainability in this context emerges not as a technical outcome, but as an ethical practice embedded in routine social and ecological coordination.

Empirical patterns support this interpretation. Longitudinal indicators of income distribution and regional inequality show that Nganjuk has maintained relatively low and stable levels of inequality over an extended period, despite exposure to market volatility and broader agrarian transformation. Temporary fluctuations, including short-term increases in inequality, do not indicate structural breakdown but rather highlight the adaptive role of ritual-based governance in restoring distributive balance over time. These patterns suggest that equality in Nganjuk is shaped less by market forces or fiscal policy alone than by culturally embedded mechanisms that regulate accumulation and reinforce reciprocity.

From a human ecological perspective, the findings underscore the co-evolution of culture, economy, and environment in sustaining rural resilience. TEK-based moral economies operate as informal social security systems that mediate external pressures while preserving local cohesion. By conceptualizing TEK as an ethical infrastructure of sustainability, this study contributes to human ecological scholarship by demonstrating how moral economy and ritual practice shape lived experiences of equality beyond market logic, offering a culturally grounded framework for understanding sustainable and equitable rural development.

Declarations

Ethics approval and consent to participate

Not applicable.

Clinical trial registration

Clinical trial number: not applicable.

Use of AI Tools

The author confirms that no Artificial Intelligence (AI) tools were used in the conception, design, execution, or interpretation of the research presented in this article. AI was not utilized for drafting the core content, analyzing the ethnographic data, or generating any figures or tables. The author takes full responsibility for the content, integrity, and originality of the final manuscript.

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Author Contribution

HM conceived the original idea of the study, designed the research, and conducted the ethnographic fieldwork, interviews, and documentation. HW and N analysed the data and drafted the manuscript. AH and KN contributed to the conceptual development, provided critical feedback on the analysis, and revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Data Availability

All data used in this study, including field notes, transcripts, and photographic documentation, are described within the manuscript. Additional ethnographic records are available from the author upon reasonable request.

References

1. Anand, S. (2024). Evaluating traditional knowledge systems through bio-cultural approach: A shift towards sustainable management of resources. In Potency of the Vernacular Settlements: Recent Scholarships in Vernacular Studies (pp. 207–221). Routledge. https://doi.org/10.4324/9781003389002-12
2. Apriyana, Y., Surmaini, E., & Estiningtyas, W. (2021). The Integrated Cropping Calendar Information System (ICCIS): Bridging Local Knowledge and Climate Science. Sustainability, 13(11), 6495. MDPI. https://doi.org/10.3390/su13116495
3. Badan Pusat Statistik Kabupaten Nganjuk. (2024). Kabupaten Nganjuk dalam angka 2024. Nganjuk: BPS.
4. Badan Pusat Statistik Kabupaten Nganjuk. (2025). Gross Regional Domestic Product Of Nganjuk Regency By Industry 2020–2024. Nganjuk: BPS
5. Badrudin, Ali. (2014). *PRANATA MANGSA* JAWA (Cermin Pengetahuan Kolektif Masyarakat Petani di Jawa). Adabiyyāt: Jurnal Bahasa Dan Sastra, 13(2), 229-252. https://doi.org/10.14421/ajbs.2014.13204

6. Berkes, F. (1999). Sacred ecology: Traditional ecological knowledge and resource management. Taylor & Francis.
7. Berliyan, B., Aldy Purnomo, R. ., Cahyono, Y. ., Santoso, S. ., & Abas, S. . (2025). Analysis of Regional and Income Disparities in Nganjuk Regency: A Study Based on the Williamson Index and Gini Index. Eduvest - Journal of Universal Studies, 5(3), 3403–3415. https://doi.org/10.59188/eduvest.v5i3.50901
8. Bernstein, H. (2010). Class Dynamics of Agrarian Change. Halifax: Fernwood.
9. Borras, S. M., Edelman, M., & Kay, C. (2008). Transnational Agrarian Movements Confronting Globalization. Oxford: Wiley-Blackwell.
10. Casali, N., Filippi, S. & Feraco, T. (2024). Does Inequality Shape Human Character? Cross-Cultural Associations between Character Strengths and the Gini Index in 68 Countries. J Happiness Stud 25, 37. https://doi.org/10.1007/s10902-024-00751-w
11. Chayanov, A.V. translated by D.Thorner, R.E.F. Smith and B. Kerblay (eds), The Theory of the Peasant Economy, Glencoe, Ill., Irwin, (1925) 1966.
12. Companion, M. (2025). Traditional ecological knowledge. In Issues of Equity: Key Concepts in Qualitative Methods (pp. 35–41). Routledge. https://doi.org/10.4324/9781003560128-9
13. Daldjoeni, N., & Hidayat, B. (1988). Astronomical Aspects of "Pranotomongso" of the 19th Century Central Java. In International Astronomical Union Colloquium (Vol. 91, pp. 249-252). Cambridge University Press. https://doi.org/10.1017/S0252921100106128
14. Edelman, M. (2005). Bringing the moral economy back in … to the study of 21st-century transnational peasant movements. American Anthropologist, 107(3), 331–345. https://doi.org/10.1525/aa.2005.107.3.331
15. Edelman, M. (2012). E. P. Thompson and moral economies. Anthropological Theory, 12(3), 221–241. https://doi.org/10.1177/1463499612454118
16. Endaswara, S. (2003). Falsafah hidup Jawa (Cetakan pertama). Cakrawala.
17. Falah, M.A., & Rahmawati, F. (2024). The GRDP per capita, human development index, open unemployment rate, regional expenditure, and poverty in East Java Province. Jurnal Ekonomi & Studi Pembangunan, 25(1), 1-16.
18. Fassin, D. (2009). Moral economies revisited. Annales. Histoire, Sciences Sociales, 64(6), 1237–1266. https://doi.org/10.1017/S0395264900033256
19. Florence, P. S., & Mishra, A. (2024). Traditional ecological knowledge repository in the Indian Himalayas: An overview. In Addressing the Climate Crisis in the Indian Himalayas: Can Traditional ecological knowledge Help? (pp. 293–311). Springer. https://doi.org/10.1007/978-3-031-50097-8_12
20. Florida, N. K. (1993). Javanese Literature in Surakarta Manuscripts: Introduction and Manuscripts of the Karaton Surakarta. Cornell University Press. http://www.jstor.org/stable/10.7591/j.ctv1ntf7x

21. Friedmann, H. (2021). “Origins of Peasant Studies.” In H. Akram-Lodhi & C. Kay (eds.), Handbook of Critical Agrarian Studies. Routledge.
22. Galvin, S. S. (2021). Peasant Studies: Subsistence, Justice, and Precarity. The Journal of Asian Studies, 80(2), 391–397. doi:10.1017/S0021911821000061
23. Geertz, C. (1960). The religion of Java. Chicago: University of Chicago Press.
24. Geertz, C. (1963). Agricultural Involution: The Processes of Ecological Change in Indonesia. University of California Press.
25. Gómez-Baggethun, E., Reyes-García, V., Olsson, P., & Montes, C. (2012). Traditional ecological knowledge and community resilience to environmental extremes: A case study in Doñana, SW Spain. Global Environmental Change, 22(3), 640–650. https://doi.org/10.1016/j.gloenvcha.2012.02.005
26. Gonzalez-Gordon, Ivan & Resosudarmo, Budy. (2019). A sectoral growth-income inequality nexus in Indonesia. Regional Science Policy & Practice. 11. 123-139. 10.1111/rsp3.12125.
27. Griffiths, M. P. (2019). Community welfare organisations in rural Myanmar: Precarity and parahita. NIAS Press.
28. Hayami, Y. (1989). Community, Market, and State: Toward a Unified Theory of Institutional Change. World Bank Economic Review, 3(1), 1–14.
29. Hayami, Y. (2009). Social Capital, Human Capital and the Community Mechanism: Toward a Conceptual Framework for Economists. Journal of Development Studies, 45(1), 96–123.
30. Hefner, R. W. (1990). Hindu Javanese: Tengger tradition and Islam. Princeton: Princeton University Press.
31. Hosen, N., Nakamura, H., & Hamzah, A. (2020). Adaptation to climate change: Does traditional ecological knowledge hold the key? Sustainability (Switzerland), 12(2), 676. https://doi.org/10.3390/su12020676
32. Iboy, R. S. B., Gata, W., & Bakri, A. (2022). Implementation of Finite State Automata on the *Pranata Mangsa* Application for Determining the Right Time for Farming. Jurnal Sistem Informasi dan Ilmu Komputer Prima (JUSIKOM PRIMA), 6(1), 29–34. Universitas Prima Indonesia. https://doi.org/10.34012/jurnalsisteminformasidanilmukomputer.v6i1.XXXX
33. IPES-Food. (2016). From uniformity to diversity: A paradigm shift from industrial agriculture to diversified agroecological systems. International Panel of Experts on Sustainable Food Systems.
34. Irawan, A., & Komori, D. (2024). Beyond Fixed Dates and Coarse Resolution: Developing a Flexible Cropping Calendar for Indonesia. Agronomy, 14(3), 564. MDPI. https://doi.org/10.3390/agronomy14030564
35. John R. Bowen; On the Political Construction of Tradition: Gotong Royong in Indonesia. Journal of Asian Studies 1 May 1986; 45 (3): 545–561. doi: https://doi.org/10.2307/2056530
36. Kanō, H. (1980), The Economic History Of Javanese Rural Society: A Reinterpretation. The Developing Economies, 18: 3-22. https://doi.org/10.1111/j.1746-1049.1980.tb00402.x

37. Karjanto, N. (2022). Revisiting Indigenous Wisdom of Javanese *Pranata Mangsa* in Modern Agriculture. Sustainability, 14(15), 9632. MDPI. https://doi.org/10.3390/su14159632
38. Laville, J.-L. (2023). Moral economy and human economy. In Encyclopedia of the Social and Solidarity Economy: A Collective Work of the United Nations Inter-Agency Task Force on SSE (UNTFSSE). Edward Elgar.
39. Li, T. M. (2014). Land's end: Capitalist relations on an indigenous frontier. Durham: Duke University Press.
40. Marckmann, B. (2019). Through the magnifying glass: Performing intergenerational relatedness on ritualised occasions. In L. Martin, N. D. Chazan, & A. Harrebye (Eds.), Families in motion: Ebbing and flowing through space and time (pp. 119–138). Routledge.
41. McAnany, P. A., & Wells, E. C. (2008). Toward a theory of ritual economy. In E. C. Wells & P. A. McAnany (Eds.), Dimensions of ritual economy (pp. 1–16). Research in Economic Anthropology, 27. Emerald. https://doi.org/10.1016/S0190-1281(08)27001-4
42. Mackenzie, N., & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. Issues in Educational Research, 16(2), 193–205. Retrieved January 12, 2025, from http://www.iier.org.au/iier16/mackenzie.htm
43. McMillen, H., Ticktin, T., & Springer, H. K. (2017). The future is behind us: Traditional ecological knowledge and resilience over time on Hawai'i Island. Regional Environmental Change, 17(2), 579–592. https://doi.org/10.1007/s10113-016-1032-1
44. Moore, B. (1966). Social Origins of Dictatorship and Democracy: Lord and Peasant in the Making of the Modern World. Boston: Beacon Press.
45. Myrdal, J. (2015). "Peasants and Rural Societies in History." In International Encyclopedia of the Social & Behavioral Sciences (2nd ed.). Elsevier.
46. N. Daldjoeni, (1984). 3. Pranatamangsa, the Javanese agricultural calendar its bioclimatological and sociocultural function in developing rural life, The Environmentalist, Volume 4, Supplement 7, 1984, Pages 15-18, https://doi.org/10.1016/S0251-1088(84)90172-4.
47. Daldjoeni, N., & Hidayat, B. (1987). Astronomical Aspects of "Pranotomongso" of The 19th Century Central Java. International Astronomical Union Colloquium, 91, 249–252. doi:10.1017/S0252921100106128
48. Nabila, K., & Wirawan, M. S. A. (2024). Sistem *Pranata Mangsa*: Tinjauan Etnosains dan Uji Keakuratan Data Iklim Tahun 2023 di Yogyakarta. Lembaran Antropologi, 3(1), 21-32.
49. Nagal, C. J. C. (2025). Harvesting Traditions: Exploring the Indigenous Agricultural Knowledge Systems in Java, Indonesia and Mindanao, Philippines. Millennial Asia, 0(0). https://doi.org/10.1177/09763996251327672
50. Notoatmodjo, S. Promosi Kesehatan dan Perilaku Kesehatan. PT Rineka Cipta, 2012.
51. Nugroho, H. Y. S. H., Sallata, M. K., Allo, M. K., Wahyuningrum, N., Supangat, A. B., Setiawan, O., Njurumana, G. N., Isnan, W., Auliyani, D., Ansari, F., Hanindityasari, L., & Najib, N. N. (2023). Incorporating Traditional Knowledge into Science-Based Sociotechnical Measures in Upper

Watershed Management: Theoretical Framework, Existing Practices and the Way Forward. Sustainability, 15(4), 3502. https://doi.org/10.3390/su15043502

52. Nurlaelih, Euis & Zenobia, Zobby & Damaiyanti, Dewi. (2022). Kajian Etnobotani Tanaman Pekarangan Desa Ngumpul Kabupaten Nganjuk. PLANTROPICA: Journal of Agricultural Science. 7. 1-7. 10.21776/ub.jpt.2022.007.1.1.
53. Ogaki, M. (2022). Economics of the community mechanism. JER 73, 433–457. https://doi.org/10.1007/s42973-022-00113-2
54. Ogaki, M. (2025). The economics and theology of the community mechanism. Journal of Economics, Theology and Religion, 5(1), 97–108.
55. Polanyi, Karl. 1944. The Great Transformation. New York: Rinehart.
56. Popkin, S. L. (1979). The Rational Peasant: The Political Economy of Rural Society in Vietnam. Berkeley: University of California Press.
57. Raffles, T.S. (1817). The history of java (Volume 1). John Murray. http://www.gutenberg.org/files/49843/49843-h/49843-h.htm
58. Rahmadhani, F., Murniarti, E., & Yoyon, S. G. (2022). A Sequential Auto Irrigation for Smart Chili Farming. IOP Conference Series: Earth and Environmental Science, 1083(1), 012060. IOP Publishing. https://doi.org/10.1088/1755-1315/1083/1/012060
59. Räihä, A. (2014). Crown subject rather than landed estate peasant: Interaction and aspects of justice in the early modern Russian borderlands. Historisk Tidskrift, 134(2), 197–222.
60. Rigg, J. (2024). “Peasants and the Peasantry.” In The Oxford Handbook of Agricultural History. Oxford: Oxford University Press.
61. Ruiz-Mallén, I., & Corbera, E. (2013). Community-based conservation and traditional ecological knowledge: Implications for social-ecological resilience. Ecology and Society, 18(4), 12. https://doi.org/10.5751/ES-05867-180412
62. Sandoval-Rivera, J. C. A. (2019). The legend of Achaneh: Socio-ecological knowledge in the oral tradition of fisherwomen in Veracruz, Mexico. Southern African Journal of Environmental Education, 35. https://doi.org/10.4314/sajee.v35i1.5
63. Sayer, A. (2007). Moral economy as critique. New Political Economy, 12(2), 261–270. https://doi.org/10.1080/13563460701303008
64. Schneider, S., & Niederle, P. A. (2010). “Resistance Strategies and Diversification of Rural Livelihoods: The Construction of Autonomy among Brazilian Family Farmers.” Journal of Peasant Studies, 37(2), 379–405.
65. Schrauwers, Albert. (1999). “Negotiating Parentage: The Political Economy of ‘Kinship’ in Central Sulawesi, Indonesia.” American Ethnologist 26 (2):310–323
66. Scott, J. C. (1976). The moral economy of the peasant: Rebellion and subsistence in Southeast Asia. New Haven: Yale University Press.
67. Shanin, T. (1971). Peasants and Peasant Societies. London: Penguin.

68. Shephard, S., Muhindo, J., Nyumu, J., Mbangale, E., Nziavake, S., Cerutti, P., & van Vliet, N. (2023). Uneven transmission of traditional knowledge and skills in a changing wildmeat system: Yangambi, Democratic Republic of Congo. Frontiers in Conservation Science, 4, 1278699. https://doi.org/10.3389/fcosc.2023.1278699
69. Syahri, R. M., Hidayat, S. I. & Amir, I. T. (2023). Income Inequality of Rice Farmers in Cokrokembang Village, Ngadirojo District, Pacitan Regency. Himalayan Journal of Agriculture, 4(1), 1-8.
70. Taylor, J. P. (2015). Sorcery and the moral economy of agency: An ethnographic account. Oceania, 85(1), 38–55. https://doi.org/10.1002/ocea.5069
71. Thiele, G. (1974). Einiges über das Kalenderwesens Indonesians. Sterne und Weltraum, (8/9), 266.
72. Thompson, E. P. (1971). The moral economy of the English crowd in the eighteenth century. Past & Present, 50(1), 76–136. https://doi.org/10.1093/past/50.1.76
73. Tualle, M. D., Mujetahid, A., Dassir, M., & Prasetyo, A. D. (2023). Living through crises due to successive commodity booms and busts: Investigating the changing peasants' farming style in rural Indonesia. Forest and Society, 7(1), 1–22.
74. Tynsong, H., Dkhar, M., & Tiwari, B. K. (2020). Review: Traditional ecological knowledge of tribal communities of north east India. Biodiversitas, 21(7), 3209–3224. https://doi.org/10.13057/biodiv/d210743
75. Vel, J. A. C., & Warren, C. (2024). The changing social security mix in rural Indonesia: between state welfare and moral economy. Legal Pluralism and Critical Social Analysis, 56(3), 534–556. https://doi.org/10.1080/27706869.2024.2381939
76. von Benda-Beckmann, F., and K. von Benda-Beckmann. 1994. Coping with Insecurity. Specialissue: Coping with insecurity. An "underall" perspective on social security in the ThirdWorld, edited by F. v. Benda-Beckmann, K. v. Benda-Beckmann, and H. Marks. Focaal22/23:7–31
77. White, B. (2012). Agriculture and the generation problem: Rural youth, employment and the future of farming. IDS Bulletin, 43(6), 9–19. https://doi.org/10.1111/j.1759-5436.2012.00375.x
78. White, B. N. F. (1982). Production and reproduction in a Javanese village. University Microfilms International. https://ehrafworldcultures.yale.edu/document?id=oe05-026
79. Wibisono, A. M. (2025). Kalender Lokal *Pranata Mangsa*: Tinjauan Era Modern, Astronomis, dan Klimatologis. Azimuth: Journal of Islamic Astronomy, 6(1), 132-157.
80. Wisnubroto, S. (1995). Pengenalan Waktu Tradisional *Pranata Mangsa* Menurut Jabaran Meteorologi Dan Pemanfaatannya. Jurnal Agromet, 11(1), 15-20.
81. Withanage, W. K. N. C., & Gunathilaka, M. D. K. L. (2023). Theoretical framework and approaches of traditional ecological knowledge. In Traditional ecological knowledge of Resource Management in Asia (pp. 27–44). Springer. https://doi.org/10.1007/978-3-031-16840-6_3
82. Wolf, E. R. (1969). Peasant Wars of the Twentieth Century. New York: Harper & Row.
83. Yashmita-Ulman, & Singh, M. (2024). A review on traditional ecological knowledge of indigenous communities of Northeast India. In Advances in Asian Human-Environmental Research (pp. 259–

292). Springer. https://doi.org/10.1007/978-3-031-51696-2_10

84. Zaki, M. K., Noda, K., Ito, K., & Komori, D. (2020). Adaptation to Extreme Hydrological Events by Javanese Farmers Based on Local Knowledge of *Pranata Mangsa*. Sustainability, 12(24), 10373. MDPI. https://doi.org/10.3390/su122410373
85. Zhang, Q. F., & Donaldson, J. A. (2010). “From Peasants to Farmers: Peasant Differentiation, Labor Regimes, and Land-rights Institutions in China’s Agrarian Transition.” Politics & Society, 38(4), 458–489.
86. Ziyana Cholidah, N. N., & Irawan, L. Y. (2024). Pemanfaatan Penginderaan Jauh Untuk Pemetaan Alih Fungsi Lahan Sawah di Kabupaten Nganjuk. Jurnal Geosains Dan Remote Sensing, 5(1), 43-54. https://doi.org/10.23960/jgrs.ft.unila.203

Figures

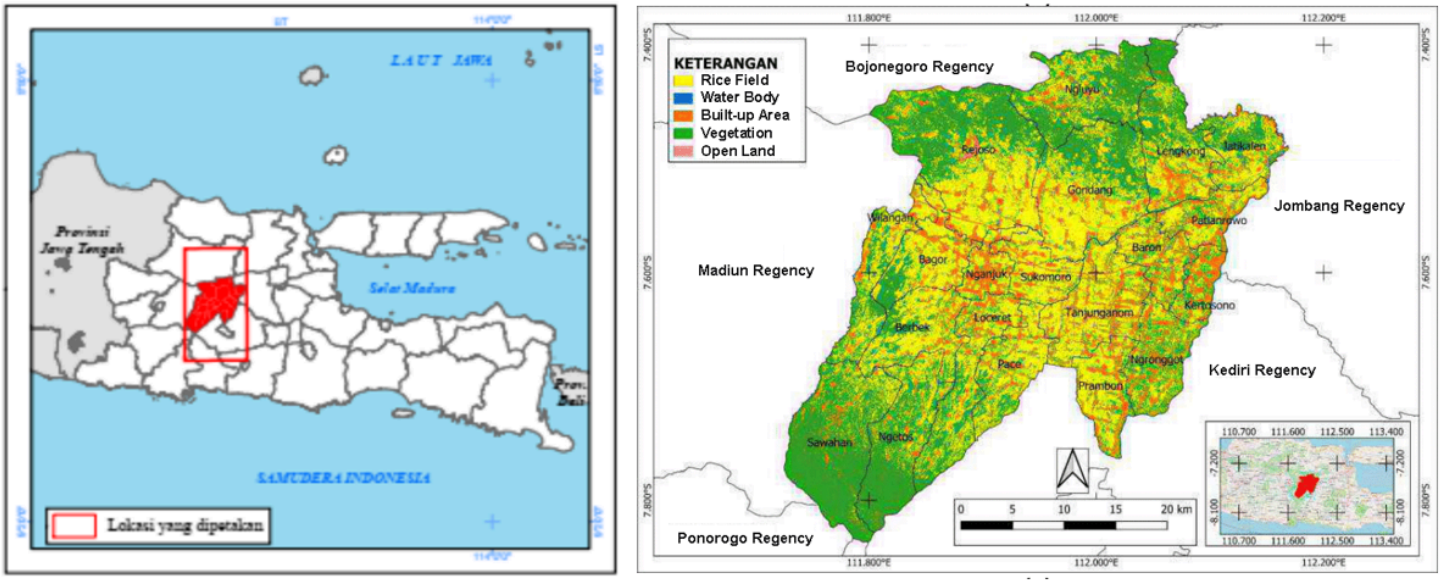


Figure 1

Nganjuk Regency, East Java, Indonesia source: (Ziyana, 2024).

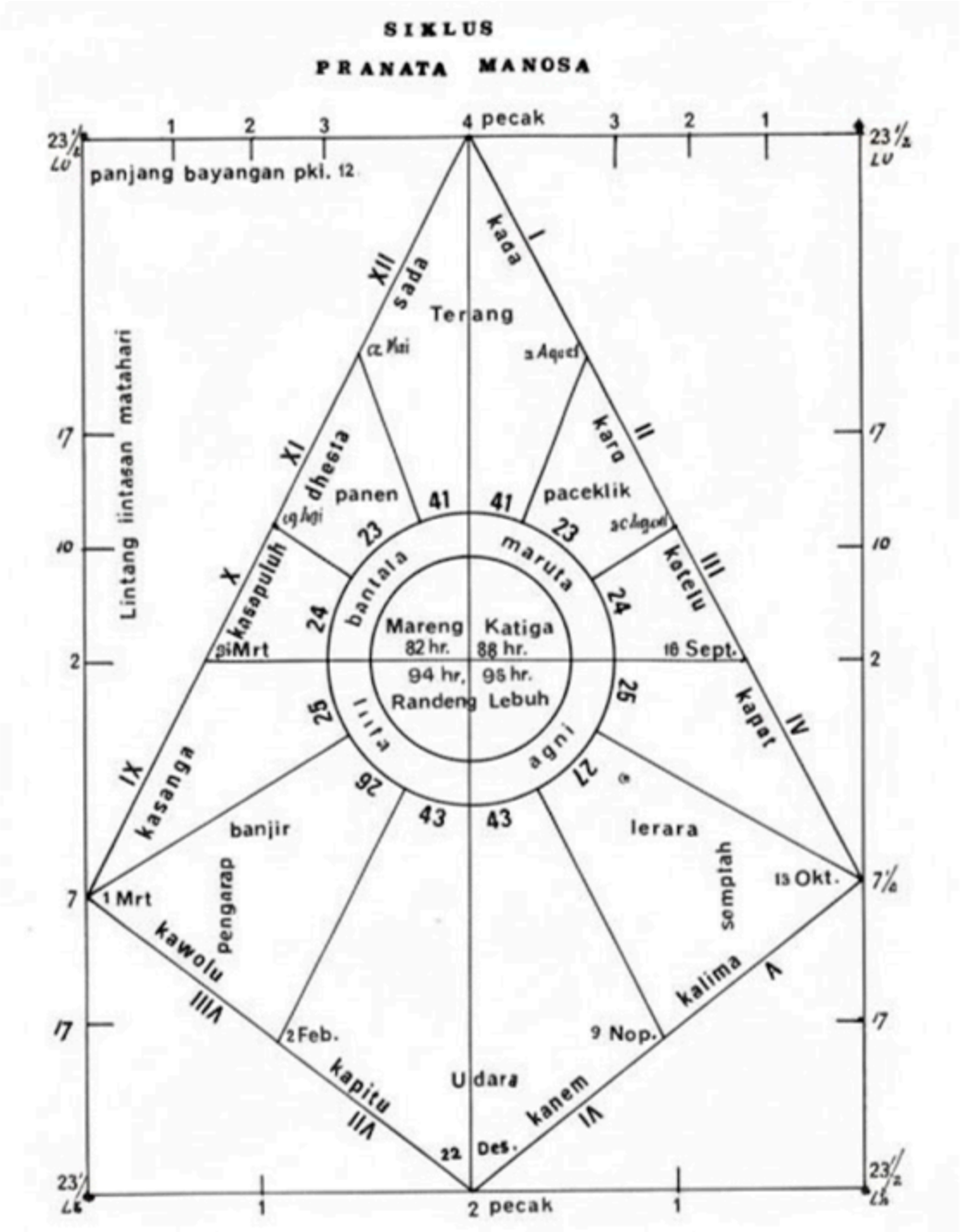


Figure 2

Diagram of the *Pranata Mangsa* Cycle Based on Astronomical Observations

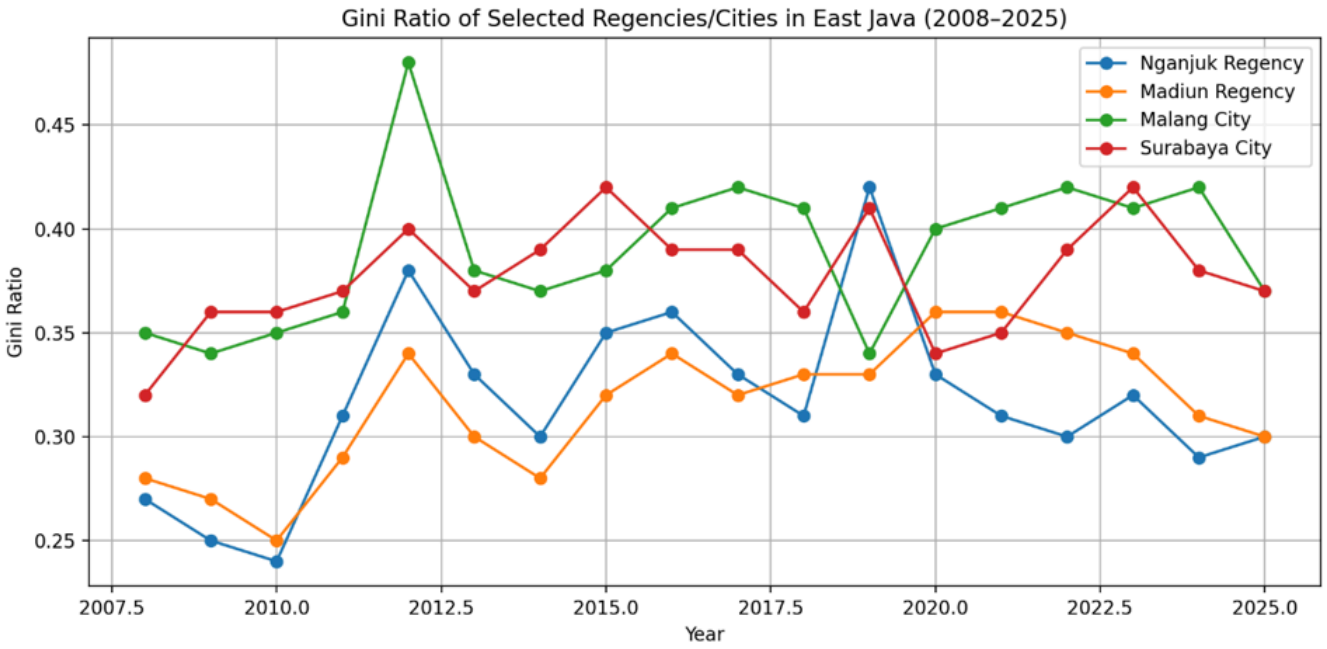


Figure 3

Gini Ratio Trends in Nganjuk Regency and Selected Areas in East Java, 2008–2025