Jurnal Pemikiran Sosiologi (JPS)
DOI: 10.22146/jps.v11i2.101311
jurnal.ugm.ac.id/jps/ Volume 11, Issue 2, 2024 (101-122)

Persisting *Pranata Mangsa*: The Challenges of Traditional Knowledge Practices in the Era of Climate Crisis

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Accepted: 21 May 2025 | Published online: 22 May 2025

Abstract

For decades, smallholder farmers in the karst areas of Gunungkidul Regency, Yogyakarta, have endured precarious livelihoods shaped by environmental limitations. Scarce surface water, the absence of technical irrigation, rugged topography, and poor soil fertility present persistent challenges. Nevertheless, farmers continue to adapt using local knowledge systems—most notably Ngawu-awu, a practice rooted in the traditional Pranata mangsa agricultural calendar. Since the early 2000s, the intensifying climate crisis has further disrupted this ecological rhythm, forcing smallholders to rethink their livelihood strategies. This study examines how smallholder farmers navigate the changing climatic conditions while attempting to sustain Ngawu-awu practices. Three key aspects are explored: first, the use of Pranata mangsa to anticipate seasonal rainfall; second, the growing mismatch between this traditional calendar and the erratic patterns of the climate crisis; and third, the coping strategies employed by farmers amid this dissonance. Drawing on a case study approach, the research identifies four expressions of local knowledge: attentive reading of natural signs, collective experimentation and learning, intergenerational knowledge transmission, and communal resilience through reflective adaptation. These practices illustrate how cultural endurance and ecological sensitivity intersect in times of uncertainty.

Keywords: Smallholder Farmers, Rain Fed Farming, Local Knowledge, *Ngawu-awu, Pranata Mangsa*, Climate Crisis, Indonesia

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Introduction

Reframing Traditional Rain Fed Agricultural Practices in Karst Landscape

Across Java's dryland agrarian landscapes, traditional seasonal calendars have long guided the rhythms of agricultural life. Among these, the *Pranata mangsa* system—an indigenous phenological calendar rooted in ecological observation—offers farmers a culturally embedded means of interpreting and responding to seasonal changes. While its origins trace back to classical Javanese cosmology, *Pranata mangsa* remains relevant today as a localized framework for anticipating climatic cycles, coordinating planting schedules, and fostering collective labor practices (Daldjoeni 1984; Badrudin 2014).

One of the most ecologically demanding areas where *Pranata mangsa* persists is the karst landscape of Gunungkidul, a region characterized by porous limestone geology, rugged topography, shallow soil layers, and the absence of perennial surface water (Retnowati 2014). These biophysical constraints shape a distinct vulnerability context in which rain-fed agriculture becomes a precarious yet enduring livelihood. In such terrains, farming strategies must be synchronized not only with seasonal rainfall but also with the collective labor capacity of rural communities. As rainfall becomes increasingly erratic due to climate change, the knowledge embedded in *Pranata mangsa*—from phenological cues to socio-agronomic timing—offers a situated response rooted in empirical observation and intergenerational transmission.

Yet, the convergence of climatic volatility and policy centralization has created tensions between localized temporalities and national forecasting regimes. Since the early 2000s, smallholder farmers in Gunungkidul have faced increasing difficulty aligning *Pranata mangsa* with actual rainfall events. The Integrated Cropping Calendar (KATAM) issued by Indonesia's Meteorology, Climatology, and Geophysics Agency (BMKG) offers standardized planting guidance but often fails to reflect micro-ecological realities at the sub-district level (Kawanishi et al. 2016). As Vogel and O'Brien (2006) argue, climate information becomes useful only when it resonates with local agricultural decision-making frameworks—a resonance increasingly fractured in rural Java.

This article revisits *Pranata mangsa* not as a relic of agricultural tradition, but as a dynamic knowledge system that continues to evolve under conditions of uncertainty. Rather than focus narrowly on specific practices like *Ngawu-awu*, the study foregrounds the broader question of how *Pranata mangsa* persists as a sociocultural schema and form of agrarian agency. It situates this investigation within the context of rural Java, particularly in regions such as Gunungkidul, where dryland farming and karst ecologies compound the challenges of climate adaptation (Binternagel et al. 2010).

By drawing on ethnographic insights and conceptual frameworks from the sociology of knowledge, this paper explores the adaptive strategies, epistemic tensions, and institutional negotiations that shape the endurance of *Pranata mangsa*. It argues that the crisis of prediction posed by climate change is not only meteorological but epistemological—raising critical questions about whose knowledge counts, under what conditions, and to what ends (Agrawal 1995; Li 2005).

In doing so, the paper aims to contribute to broader debates on indigenous knowledge, agrarian resilience, and the political ecology of temporality in an era marked by environmental precarity and policy fragmentation.

Methods

This study employed a qualitative research design grounded in ethnographic sensibilities and informed by a critical sociology of knowledge. Fieldwork was conducted in Tepus, a dryland farming village in Gunungkidul Regency, where karst geographies shape distinct agrarian vulnerabilities. The research design integrated semi-structured interviews, focus group discussions (FGDs), and netnographic observation.

Tepus Village was selected as a focal site due to its continued reliance on *Pranata mangsa* and rain-fed agriculture amidst ecological precarity. As part of the Gunungsewu Karst landscape, Tepus presents a setting where indigenous knowledge systems are constantly being tested by hydroclimatic instability and policy-induced transformation. The village's marginal position in infrastructural terms, yet central role in knowledge

reproduction, makes it a compelling site for examining how *Pranata mangsa* endures and adapts.

Data were collected between March and September through a mix of in-person and remote strategies. A total of 18 key informants were interviewed, including village elders, smallholder farmers, customary leaders (*Mbah Kaum*), agricultural extension workers, and local youth. These interviews focused on the experiential dimensions of seasonal prediction, intergenerational knowledge transmission, and adaptation practices. Two focus group discussions were held with community stakeholders: the first explored seasonal disruptions and knowledge adjustments, and the second examined community interpretations of government agricultural policies. Each FGD included diverse participants across gender and age to capture intra-community variation and generational shifts.

In addition to interviews and FGDs, a netnographic approach was used to observe digital traces and visual materials related to *Pranata mangsa*—including traditional calendar boards, farming ritual videos, and online discourses by local farmers and cultural practitioners. This method offered insights into how *Pranata mangsa* is mediated, performed, and interpreted within hybrid (offline/online) spaces.

Data were coded thematically using grounded theory techniques, focusing on emergent categories such as "temporal dissonance," "ritual adaptation," and "policy-mediated negotiation." The interpretation of data drew on the sustainable livelihoods framework (Scoones 1998) and incorporated relational concepts from the sociology of knowledge (Haraway 1988; Agrawal 1995), particularly the entanglement between situated knowledge and institutional structures. Field narratives were triangulated with village statistical reports, meteorological archives, and regulatory texts to ensure contextual accuracy and analytical depth.

All participants provided informed consent, with special attention given to anonymizing sensitive statements, particularly regarding critiques of government extension practices. As the researcher is affiliated with an academic institution based in Yogyakarta and shares cultural proximity with the community, positionality was continuously reflected upon to mitigate interpretive bias while embracing grounded empathy. This multi-method,

community-embedded approach enabled a nuanced understanding of how *Pranata mangsa* persists not merely as heritage but as a living, evolving epistemology under pressure from both climatic uncertainty and shifting governance regimes.

Finding 1: Temporal Disruption and Local Adaptation of *Pranata mangsa*

The following **Table 1** is extracted from some of the *Pranata mangsa* calendar documents and explained by *Mbah Kaum*, a cultural leader, and based on the foundational explanation of Daldjoeni (1984) The signs for each month are written from the original poetical ancient Javanese language and translated literally by the researcher, but the explanation for each month is extracted from the cultural leader's interpretation. From the calendar, it can be seen that *Pranata mangsa* offers farmers highly detailed seasonal guidance, tying specific ecological signs to planting activities.

Table 1. *Pranatamangsa* Calendar Season Sequence

No.	Mangsa / Month	Signs	Explanation or Indicators
1.	Kasa (22 June – 1 August)	*Sotya Murca Ing Embanan*	Leaf fall; grasshoppers laying eggs; dry summer
2.	Karo (2 August – 25 August)	*Bantala Rengka*	Cracked soil; cotton and mango trees bloom
3.	Katelu (26 Aug – 12 Sep)	*Suta manut ing bapa*	Bamboo sprouts; tubers grow
4.	Kapat (12 Sep – 13 Oct)	*Waspa Kumembreng Jroning Kalbu*	Sparrow nesting; weaverbird nests; cotton blooming
5.	Kalima (14 Oct – 9 Nov)	*Pancuran Mas Sumawur Ing Jagad*	Caterpillars emerge; tamarind trees leaf; first rain appears
6.	Kanem (10 Nov – 22 Dec)	*Rasa Mulya Kasucen*	Fruits ripen; cockroaches appear; ducks gather in wet ponds
7.	Kapitu (23 Dec – 3 Feb)	*Wisa Kentar Ing Maruta*	Season of floods, illness, and snakebite
8.	Kawolu (4 Feb – 28 Feb)	*Anjrah Jroning Kayun*	Cats mate; tall rice stands; earthworms resurface
9.	Kasanga (1 Mar – 25 Mar)	*Wedaring Wacana Mulya*	Rice blooms; crickets chirp loudly
10.	Kasepuluh (26 Mar – 18 Apr)	*Gedhong Minep Jroning Kalbu*	Rice yellows; bird eggs hatch; mammals give birth
11.	Desta (19 Apr – 11 May)	*Sotya Sinara Wedi*	Birds feed young; harvest begins
12.	Saddha (12 May – 21 June)	*Tirta Sah Saking Sasana*	Dadap trees bloom; food is stored in crop banks

Source: Adapted from Daldjoeni (1984) and field interviews, 2024

The traditional *Pranata mangsa* calendar divides the agricultural year into twelve unequal periods, each known as a *mangsa*. Unlike the Gregorian calendar, these periods are based not on astronomical uniformity but on ecological patterns observed through generations. Of particular interest are the rainy seasons, which are typically expected to begin during *Kalima* (14 October–9 November) with early signs such as caterpillars emerging and tamarind leaves sprouting, and reach their peak in *Kapitu* (23 December–3 February), characterized by heavy rainfall, widespread crop growth, and the presence of floods or water-borne diseases. Each *mangsa* reflects a nuanced relationship between environmental cues and farming decisions. For example:

- *Kalima* (14 Oct – 9 Nov): "Molten gold drops from above" – interpreted as the coming of first rains; farmers begin preparing fields.
- *Kanem* (10 Nov – 22 Dec): Water sources begin to fill; ducks return to ponds, fruits ripen.
- *Kapitu* (23 Dec – 3 Feb): Peak rainy season, but also vulnerable to pests and crop diseases.

These months are critical within the *Pranata mangsa* framework for rice cultivation, especially in systems such as *Ngawu-awu*, where dry soil must receive consistent rainfall shortly after seeds are sown. Any shift in rainfall timing across these periods poses high risk. According to several informants, inconsistencies in rainfall during *Kapitu* have led to significant losses, with seeds germinating too early or rotting before water is sufficient. These disruptions are central to farmers' growing distrust in both traditional celestial markers and formal forecasts.

The *Pranata mangsa* calendar consists of twelve agricultural months (*mangsa*), each varying in duration between 23 and 43 days. Unlike the Gregorian calendar, which is based on fixed solar cycles, *Pranata mangsa* is organized according to phenological signs—such as the blooming of certain plants, the behavior of birds and insects, the direction of winds, and the appearance of constellations. Each *mangsa* encodes a set of environmental indicators and

recommended agricultural activities. For example, *Kapat* (12 September–13 October) is marked by sparrow nesting and weaverbird activity, signaling the pre-monsoon dry spell, while *Kalima* (14 October–9 November) is associated with the first rains and the emergence of caterpillars and young tamarind leaves—often prompting initial field preparations.

These symbolic and empirical indicators serve as mnemonic devices for farmers to align cropping cycles with ecological rhythms. In Tepus, some elders still refer to wooden calendar boards inscribed with *mangsa* icons to determine planting periods. Each icon corresponds to a crop, such as legumes or root vegetables, and a phase of seasonal transformation. The cultural leaders (*Mbah Kaum*) interpret the signs and announce collective readiness to plant, usually accompanied by community rituals. However, this fine-grained temporality is increasingly challenged by erratic rainfall patterns and disruptions in expected biotic cues. In interviews, multiple respondents pointed out how rains now fall during what should be dry periods, or fail entirely during months that once guaranteed planting certainty.

The findings reveal that *Pranata mangsa*, as a temporal guide, is undergoing a significant epistemological strain in the context of climatic volatility (Binternagel et al. 2010). Farmers in Tepus reported increased difficulty in synchronizing planting decisions with the calendrical cues traditionally derived from star constellations such as Orion or the Pleiades. The once-reliable correspondence between celestial indicators and rainfall has been destabilized. Many elder farmers noted a "disruption of seasonal logic," where rainfall now often arrives outside the expected windows defined by the Javanese calendar. The concept of *temporal dissonance* emerged strongly in interviews: the perceived misalignment between ecological rhythms and calendrical expectations.

In response to these disturbances, local knowledge practices have undergone significant adaptation. The role of *Pranata mangsa* is no longer exclusively astronomical but increasingly ecological. Farmers are shifting attention toward terrestrial indicators—such as the flowering of cotton trees, the nesting behaviors of sparrows and weaver birds, the dryness of the soil, or the smell and color of local vegetation—as more reliable signs of seasonal transition. While constellations still hold symbolic meaning, their functional role

has diminished in agricultural decision-making. This transition from celestial to biotic cues illustrates an important recalibration of indigenous knowledge to cope with environmental instability (Kawanishi et al. 2016).

Importantly, the adjustments are not purely practical but also ritual and affective. Field rituals, including collective prayers for rain, land offerings, or seed blessings, which previously followed a fixed calendrical sequence, are now organized based on accumulated empirical signals and collective interpretations. One village elder explained, "We no longer wait for the seventh *mangsa*; we look at the winds, the tamarind trees, and the movements of the birds." These rituals, while flexible, remain essential social events that reaffirm community bonds and collective memory. They serve both agronomic and ontological functions: to bind humans to the land, to manage uncertainty, and to affirm moral belonging (Shindunata 2011).

This adaptive persistence is further reflected in the strategic use of *Pranata mangsa* as a layered knowledge system. For older farmers, the calendar offers a mnemonic code, a structured archive through which observations are organized and communicated. For younger generations, even when the astronomical referents are less familiar, *Pranata mangsa* is still invoked symbolically—as a sign of cultural rootedness and as a critique of the perceived "coldness" of bureaucratic calendars such as KATAM. Thus, *Pranata mangsa* functions not only as a practical tool but also as a form of epistemic resistance, an insistence that knowledge must remain entangled with landscape, seasonality, and social life.

Moreover, while some farmers have begun integrating official forecasts into their practices, they often do so with skepticism. Many reported that BMKG forecasts are too generalized or arrive too late. In contrast, *Pranata mangsa* remains tied to the immediacy of embodied observation. One farmer stated, "Even if BMKG says rain tomorrow, I still wait to see if the termites rise or if the nights get heavier." Such statements reflect an epistemological pluralism where modern meteorology and local ethno-climatology coexist in tension, negotiation, and selective integration.

This hybridization of temporal knowledge challenges simplistic dichotomies between tradition and modernity. It reveals instead an agrarian intelligence shaped by necessity and

grounded in lived experience. As climate change accelerates, and as state systems struggle to reach granular realities, the situated flexibility of *Pranata mangsa* may offer a template for climate-adaptive knowledge grounded in both memory and improvisation.

Finding 2: Knowledge Disjuncture and Generational Gaps

One of the most salient tensions surrounding *Pranata mangsa* today is the epistemic disjuncture between localized temporal knowledge and institutionalized climate governance. Farmers in Tepus consistently reported a lack of trust in the state's climate information systems, particularly the Integrated Cropping Calendar (KATAM) and forecasts from BMKG. These systems were often described as "too generalized," "late," or "not suitable for karst land" (Vogel and O'Brien 2006). Farmers preferred immediate, localized indicators that were visible, interpretable, and narratively familiar—e.g., the behavior of birds or the scent of soil before rain. One older farmer said, "It's not just the calendar that fails. The government doesn't know what these hills are saying." Such statements highlight a broader ontological divide: where bureaucratic knowledge aims for universality, *Pranata mangsa* is resolutely place-based, relational, and historically situated.

This divide is reinforced by generational shifts. Younger farmers are increasingly disconnected from the cosmological and ritualistic dimensions of *Pranata mangsa*. Many view the calendar as outdated or esoteric, especially in comparison to digital tools or the predictability offered by tourism-related incomes. "My friends don't wait for stars—they wait for TikTok weather," joked one respondent. But underneath the humor lies a significant concern: the erosion of intergenerational transmission. Elders express anxiety that *Pranata mangsa* will become mere folklore—respected, but no longer practiced. This concern was echoed in focus group discussions, where some older participants acknowledged the need to approach knowledge sharing differently. As one elder put it, "We cannot just tell them to follow. We have to listen too—what makes sense to them, what language they speak now."

Conversely, some youth expressed admiration for the values embedded in *Pranata mangsa*, though they felt alienated by the way it was taught. They called for more dialogic engagement rather than top-down instruction. This signals that intergenerational

transmission must evolve into intergenerational negotiation—where both elders and youth recognize the legitimacy of each other's worldview. Rather than framing the problem as generational loss, it becomes a matter of mutual translation. One young participant in the FGD stated, "If we can connect this to apps or visuals, we'll be more curious to learn."

Thus, the key to sustaining *Pranata mangsa* lies not only in content preservation but in perspective openness. Transitions across generations require older knowledge holders to better understand how the younger generation interprets time, environment, and authority, while also inviting youth to see tradition not as a burden, but as a flexible resource for making meaning. This mutual recognition can create a shared space where *Pranata mangsa* continues to live—not as nostalgia, but as an evolving practice shaped by relational trust and dialogical pedagogy.

Despite these fractures, some hybrid practices are emerging. Youths who return from cities for seasonal work often bring new media sensibilities to traditional practices—recording rituals, editing *mangsa*-based planting tutorials, or designing calendars that integrate lunar, solar, and agricultural cycles. These efforts, although small, suggest that the future of *Pranata mangsa* may depend on its ability to be remediated—translated across generations, platforms, and social roles without losing its core sensibility: that time is not abstract, but embodied, seasonal, and collectively sensed (Magni 2017).

Findings 3: Policy Negotiation and The Limits of Recognition

The persistence of *Pranata mangsa* as a temporal and ecological framework encounters structural obstacles when interacting with Indonesia's formal policy regime. One of the main frictions emerges from the incompatibility between *Pranata mangsa*-based planting periods and the fiscal and bureaucratic cycles of the Indonesian state, which adheres strictly to the Gregorian calendar. This incongruity is most visible in the implementation of village funds (*Dana Desa*) and agricultural assistance programs. While local farmers typically prepare for planting around the fifth *mangsa* (mid-October to early November), fiscal disbursement procedures often delay funds until late December or early January. As a result, critical interventions—such as seed procurement or fertilizer

distribution—arrive either too late or outside the agronomic window defined by *Pranata mangsa*, rendering them ineffective.

This issue was starkly illustrated during the failed *Ngawu-awu* planting season of 2019 in Tepus. Following an early sowing based on traditional seasonal cues, many farmers lost their rice seeds due to unanticipated drought in what should have been a rainy period. When farmers reported crop failure, the bureaucratic process for compensation required multiple levels of verification—from village officers, to the district agricultural agency, and then to the Ministry of Agriculture. By the time the process was approved, compensation arrived not in cash but in the form of new seed stocks—well after the viable planting season had passed. Moreover, this compensation was tied to stringent eligibility rules under the national agricultural insurance scheme, which demanded prior enrollment and formal documentation that many subsistence farmers lacked.

Such delays and procedural rigidity highlight the limits of recognition afforded to local knowledge systems. Even when the state formally acknowledges indigenous practices or endorses village autonomy through laws like UU Desa (Village Law No. 6/2014), the operational logic of national development remains standardized, linear, and disconnected from local temporalities. As one farmer put it: "Rain doesn't follow Jakarta's calendar." The friction between agricultural policy instruments and *Pranatamangsa* is not merely administrative—it is epistemological, rooted in different conceptions of time, urgency, and ecological intelligence.

Despite these challenges, some village leaders in Tepus have begun advocating for a more flexible alignment between state programs and local calendars. They have proposed incorporating *mangsa*-based considerations into *Musrenbangdes* (village development planning meetings) and lobbying for seasonal forecasting at subdistrict levels. However, without structural reform at higher levels of government, such efforts remain contingent and partial. The bureaucratic preference for centralized accountability and budgetary uniformity continues to marginalize localized farming logics that operate on rhythms beyond the Gregorian grid.

Discussion

The discussion of *Pranata mangsa* must begin from its core function as a socio-ecological rhythm internalized in Javanese farmers' daily life. As Handayani et al. (2018) argue, *Pranata mangsa* is more than a calendar—it is a way of being with nature, of building seasonal expectations, organizing household economies, saving in times of drought, and celebrating life in planting and harvesting seasons. This is consistent with Shindunata's (2011) observation that aligning with nature through *ilmu titen* nurtures resilience by teaching communities to live with limitations and welcome uncertainty with hope.

Although indigenous communities have been increasingly integrated into the market, bureaucracy, and institutionalized services, their subsistence strategies still rely heavily on customary ways of interpreting and managing natural resources (Kronk and Verner 2010). In the case of Tepus, despite access to formal assistance, farming households continue to rely on *Pranata mangsa* to guide crop planning and water use.

However, adaptation is uneven, and institutional misalignment exacerbates vulnerability. As Agarwal, Perrin, and Chhatre (2012) point out, variations in local institutions greatly affect how communities manage climate risks. In Indonesia, bureaucratic processes—from the procurement of subsidized seeds to the conditionalities of agricultural insurance—have a tendency to obstruct rather than enable timely farmer response, particularly when state systems are not calibrated to local calendars.

The enactment of UU Desa (Village Law No. 6/2014) was hailed as a major breakthrough for rural autonomy and the formal recognition of local knowledge. Yet, as White (2017) cautions, this legal rhetoric is not always matched by implementation capacity. The law recognizes cultural leadership and customary institutions as part of village governance, but their influence is often symbolic rather than operational. Ramdhaniaty and Ratnasari (2017) show that even in areas where indigenous groups are legally acknowledged, socio-political conflict and lack of contextual understanding often hinder meaningful development outcomes.

The arrival of the Green Revolution in Indonesia caused massive erosion of local seed diversity—thousands of varieties of indigenous rice were lost (Iskandar and B.S. 2018; MAS/RYO 2008). Standardized inputs and calendar-based planting schedules displaced regionally adapted practices like *Ngawu-awu*. Today, even though 90% of farmers in Tepus still practice *Ngawu-awu*, their autonomy is increasingly constrained by national policy instruments that fail to engage with their historical and ecological contexts (Interviewee 2020; Mahanani and Ghofur 2020).

At the same time, Yogyakarta's *Keistimewaan* Law (No. 13/2012) provides a unique political opening. In his 2020 address, Sri Sultan Hamengkubuwono X explicitly invoked the need to protect local ecological wisdom such as *ilmu titen* as part of the region's cultural heritage (Hamengkubuwono X 2020). This signals an opportunity to bridge the epistemic gap between state timing and community seasonality. However, such recognition must be backed by operational reforms—especially in budgeting logic, agricultural assistance scheduling, and planning documents like *Musrenbangdes*—so that they align with *Pranata mangsa* and the lived realities of dryland farmers.

Thus, to meaningfully integrate *Pranata mangsa*, institutions must move beyond rhetorical inclusion toward real temporal justice: respecting multiple ways of knowing and timing the world. Only then can *Pranata mangsa* endure not as an aesthetic legacy, but as a living, generative system of agrarian intelligence.

The empirical findings in this study show that *Pranata mangsa*, as a temporally-structured indigenous knowledge system, continues to serve as a vital framework for interpreting and organizing agricultural practices amidst deepening environmental uncertainties. At the same time, its persistence is increasingly shaped by tensions, adaptations, and negotiations across ecological, epistemological, and institutional registers. This discussion draws from these findings to engage with broader theoretical implications concerning the localization of temporal knowledge, intergenerational transfer, and state–community interface.

First, the tension between *Pranata mangsa* and formal agro-climatic forecasting models such as KATAM reveals a conflict not only in methodology but also in epistemic

authority. While the state promotes standardized forecasting as a vehicle for efficiency and productivity, smallholder farmers continue to privilege situated and embodied knowledge that responds to micro-ecological specificities. In this sense, *Pranata mangsa* can be understood as a form of "subaltern temporality"—a counter-hegemonic orientation to time that challenges the linear and technocratic rationality embedded in modern governance. Rather than passively resisting change, *Pranata mangsa* adapts through selective recalibration, drawing on both cosmological and ecological cues to retain relevance in unpredictable environments.

Second, this study affirms that intergenerational knowledge transmission is not a linear process of inheritance, but one that involves contestation, reinterpretation, and creative remediation. The generational disconnects in Tepus reflect both a structural disjuncture—due to youth migration and digital immersion—and a pedagogical gap. However, this should not be seen as a simple rupture. The emergence of hybrid practices—where youth remix rituals into visual media or reinterpret planting advice through mobile apps—signals the evolving nature of indigenous knowledge. Here, dialogical pedagogy becomes key: ensuring that *Pranata mangsa* is not only transmitted, but translated across cultural, technological, and generational lines.

Third, the friction between *Pranata mangsa* and national policy frameworks illustrates the structural limits of recognition in Indonesia's development regime. While laws such as *UU Desa* and the *Keistimewaan* Yogyakarta legislation provide formal space for the acknowledgment of local traditions, the operational logic of state assistance—including the timing of *Dana Desa*, the rigidity of fiscal calendars, and the conditionalities of agricultural insurance—undermine the very lifeworlds they claim to support. The case of Tepus during the failed 2019 *Ngawu-awu* season exemplifies this gap: state assistance arrived in non-liquid forms and outside the viable seasonal window, reproducing dependence rather than enabling resilience.

These findings align with critical agrarian scholarship that challenges the notion of "integration" as merely technical alignment. Rather, what is required is a rethinking of institutional synchrony: not merely recognizing *Pranata mangsa* rhetorically, but

reconfiguring administrative practices to accommodate plural temporalities. For example, the decentralization of seasonal forecasting, the temporal flexibility in fund disbursement, or the participatory inclusion of *mangsa*-based planning in *Musrenbangdes* are all practical entry points to build a more temporally just governance framework.

Conclusion

This study has examined the persistence and transformation of *Pranata mangsa* in Tepus Village, a karst-ecological zone marked by rainfed farming and climatic uncertainty. The findings demonstrate that while *Pranata mangsa* is under epistemological strain, it continues to adapt and assert relevance through embodied practice, cultural ritual, and community negotiation. It survives not as static heritage, but as a flexible system of ecological sense-making capable of absorbing both planetary instability and policy imposition.

Yet, the continuity of *Pranata mangsa*—especially in its most vibrant form as practiced by smallholder farmers in *Ngawu-awu* systems—requires not only cultural persistence but also political recognition. This research concludes that the challenge facing *Pranata mangsa* is not simply one of documentation or integration, but of activating political citizenship and transdisciplinary alliances to create space for its future reproduction. Local knowledge holders must be positioned not as passive beneficiaries of state development, but as epistemic agents capable of co-designing agricultural and ecological futures.

The experiences in Tepus highlight that climate resilience depends on more than infrastructure or insurance—it emerges from the embeddedness of knowledge in everyday life, the strength of communal memory, and the capacity to engage in dialogical reflection across generations. Practices like *Ngawu-awu* are not isolated techniques but are part of a wider commons of knowledge, economy, and meaning. Strengthening these commons requires a politics of commoning, where rights to time, to plan, and to fail collectively are recognized and institutionalized.

This implies a more robust role for universities and civil society to act as facilitators, not dominators. The future of *Pranata mangsa* depends on transdisciplinary efforts to bridge

scientific, ecological, cultural, and policy knowledge. Academic institutions should enable a platform for hybridization, co-production, and mutual learning—supporting rather than replacing local epistemologies. The generation of climate-adaptive strategies must come from within communities, supported by enabling systems that respect their autonomy and embed their temporalities.

Importantly, political citizenship is essential for smallholder farmers to move beyond symbolic inclusion. Currently, farmers who practice *Ngawu-awu* remain on the periphery of decision-making systems. Efforts must be directed toward enhancing their participation in planning processes, influencing budget cycles, and negotiating regulatory reforms. Without such agency, even the best knowledge systems will struggle to assert their relevance in an increasingly bureaucratized environment.

Ultimately, Tepus represents more than a site of cultural preservation; it is a living laboratory for testing how traditional ecological knowledge can persist, transform, and reassert itself in the face of global ecological crisis. Future work on *Pranata mangsa* must take seriously its potential to inform sustainable development pathways—not only through integration into policy, but through re-imagining governance, citizenship, and the rhythms of agrarian life itself. In this way, *Pranata mangsa* becomes not just a calendar, but a horizon for reorienting time, knowledge, and power toward a more just and climate-sensitive rural future.

Going forward, cross-sectoral collaboration between local actors and academic institutions is crucial for rethinking how *Pranata mangsa* can be recalibrated in ways that reflect both its ecological embeddedness and practical advantages. A transdisciplinary approach—drawing from environmental science, anthropology, agronomy, and policy studies—can help develop hybrid tools and frameworks that are more closely attuned to natural rhythms, locally specific, and easier to use for farmers. This recalibration must honor the proximity of *Pranata mangsa* to nature, its cultural rootedness, and its flexibility in supporting farmer decision-making. It must also acknowledge the wealth of knowledge already present within farming communities—*ilmu titen*, ritual calendars, intuitive meteorology, and embodied agronomic practices—that have evolved through sustained

interaction with local ecologies. These are not informal anecdotes but structured, empirical systems deeply rooted in observation, transmission, and cultural logic. Recognizing this knowledge not only strengthens the legitimacy of *Pranata mangsa*, but also offers epistemic plurality as a pathway to resilience in the climate crisis era.

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