

Collective Climate Adaptation among Wetland Smallholder Farmers: Bourdieu's Theory of Practice and Climate Justice in Pati, Indonesia

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ABSTRACT

Global climate change is not merely a biophysical anomaly, but a matter of social justice (climate justice) that disproportionately affects vulnerable communities, particularly small-scale rain-fed rice farmers in developing countries. This article analyzes how the Sido Makmur Farmers' Group in Baturejo Village, Sukolilo Subdistrict, Pati Regency, Indonesia, copes with seasonal uncertainty and the threat of extreme flooding during the peak of the rainy season. Using descriptive qualitative methods and an ethnographic approach, this study explores the interplay of social capital, economic capital, symbolic capital, and cultural capital in mobilizing collective action such as advancing the planting season through a collective water pumping system. The results indicate that farmers' adaptive capacity is significantly influenced by local institutional factors and power relations among actors, where the inaccuracy of Seasonal Forecast Information (IPM) from formal authorities drives farmers to rely on local knowledge and the strength of endogenous social capital to survive amid ecological vulnerabilities.

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1. Introduction

The current global climate crisis has transformed into a real threat to the survival of grassroots communities through increasingly extreme weather anomalies. The accumulation of greenhouse gases (GHG) due to global industrial activity has raised the earth's temperature by $0.74^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$ in the last century, which has a direct impact on changing rainfall patterns. From a development sociology perspective, this phenomenon has given rise to a discourse on climate justice due to structural inequalities. Community groups with the lowest emission contributions, such as smallholder farmers in Indonesia, are actually the most vulnerable and bear the heaviest consequences of damage. The food crop agriculture sector is particularly vulnerable due to its characteristics, which are highly dependent on the certainty of seasons and water supply.

Various studies have demonstrated that global climate change has increased the frequency and intensity of extreme weather events, altered rainfall regimes, and intensified threats to agricultural

productivity and food security (Aldrian, 2007; Ratag, 2007; Deutsch et al., 2018; Lobell et al., 2011; Zhao et al., 2017; Wheeler & von Braun, 2013; FAO, 2021). In Indonesia, this climate uncertainty is demonstrated by seasonal shifts that disrupt the traditional planting calendar. Data shows that the dry season has started 45% later and the rainy season 40% earlier in some areas, accompanied by high rainfall intensity over a short duration. This uncertainty triggers alternating floods and droughts, increasing the risk of crop failure. The knock-on effects not only harm farmers economically due to reduced incomes and increased operational costs for complementary fossil fuels, but also pose a serious threat to macro-food security. Within this context, smallholder farmers constitute one of the most climate-vulnerable social groups because of their limited access to land, financial resources, technology, and climate information, all of which constrain their adaptive capacity (UNDP Indonesia, 2007; Ribot, 2011; Smit & Wandel, 2006; Grothmann & Patt, 2003; Nykvist & von Heland, 2014; Altieri et al., 2015; Siregar et al., 2010; Kurniawati, 2012).

However, farmers' adaptation to climate change cannot be understood solely as a technical or resource-based response. Drawing on Bourdieu's theory of practice, adaptive strategies emerge through the dynamic interaction between field, habitus, and capital (Bourdieu, 1986, 1989, 1990). The field represents the social arena in which farmers interact with multiple actors—including farmer organizations, extension agencies, local government, and climate-related institutions—whose unequal power relations shape access to resources and decision-making processes. Within this field, farmers' habitus, developed through long-term experience, collective memory, and everyday agricultural practices, provides practical dispositions that guide how climate risks are perceived and negotiated. At the same time, the mobilization and conversion of different forms of capital—economic, social, cultural, and symbolic—determine farmers' capacity to maintain or transform their adaptive strategies under changing ecological and institutional conditions. Consequently, climate adaptation is understood not merely as the possession of particular forms of capital, but as a socially embedded practice produced through the continuous interaction of field, habitus, and capital. This perspective enables a more comprehensive sociological explanation of how collective adaptation is negotiated, reproduced, and transformed within vulnerable agrarian communities (Berkas et al., 2000; Pasaribu et al., 2008).

On the other hand, a growing body of literature emphasizes that the limited adaptive capacity of individual farmers highlights the importance of collective adaptation strategies through collective action, the governance of shared resources, and the development of social capital based on trust, reciprocal norms, and collaborative networks to enhance community resilience to climate risks (Adger et al., 2005; Adger et al., 2007; Adger et al., 2009; Ostrom, 1990; Putnam, 1993; IPCC, 2022). These studies have substantially advanced our understanding of how collective institutions contribute to climate adaptation. Nevertheless, most existing research tends to examine collective action, social capital, adaptive capacity, or institutional resilience as separate analytical dimensions. Likewise, studies applying Bourdieu's theory generally focus on identifying different forms of capital without sufficiently explaining how the dynamic interaction between field, habitus, and capital shapes collective adaptation processes under conditions of climate uncertainty.

Consequently, there remains a limited understanding of how collective adaptation is socially produced through the interplay of institutional arenas, farmers' embodied dispositions, and the mobilization and conversion of multiple forms of capital. This gap is particularly evident in studies of wetland smallholder farming systems in developing countries, where adaptation is strongly influenced by ecological uncertainty, local institutions, and unequal power relations among actors. To address this research gap, this study integrates climate change vulnerability, adaptive capacity, collective action, and Bourdieu's theory of practice into a single analytical framework. Rather than treating social, economic, cultural, and symbolic capital merely as separate categories of resources, this study examines how these forms of capital interact with farmers' habitus within a particular institutional field to shape collective responses to recurrent flood risks. By doing so, the article offers a sociological perspective that explains climate adaptation as a socially embedded process emerging from the interaction of field–habitus–capital, thereby extending existing studies that

primarily emphasize resource availability or social capital as independent determinants of adaptation.

Baturejo Village, located in Sukolilo District, Pati Regency, Central Java Province, represents a compelling case of climate vulnerability among smallholder farming communities, particularly within the *tanah ngrowo* (seasonally inundated wetland) ecosystem. Farmers in this area experience recurrent flooding during the peak rainy season, especially between January and February, when prolonged inundation frequently destroys young rice seedlings and damages rice panicles at critical growth stages, leading to substantial yield losses and increasing production uncertainty. In response to these recurrent climate risks, farmers have developed collective adaptation strategies, including adjustments to the planting calendar and the collective management of irrigation through pumping systems. These locally initiated responses make Baturejo an important case for understanding how smallholder farmers organize collective adaptation under conditions of increasing climate variability.

Against this background, this study aims to analyze the collective responses of the Sido Makmur Farmers Group in Baturejo Village to seasonal uncertainty and recurrent flooding. Specifically, it addresses three research questions: (1) how do smallholder farmers perceive and respond to flood risks? (2) how do institutional actors and local leadership organize collective adaptation? and (3) how do economic, social, cultural, and symbolic capital interact within the institutional field to shape farmers' adaptive habitus and collective adaptation strategies? By integrating Bourdieu's Theory of Practice with the Climate Justice perspective, this study conceptualizes climate adaptation as a socially embedded process emerging from the interaction between field, recognition, procedural, and distributive justice, capital mobilization, and habitus formation, which together shape collective adaptation and climate justice outcomes. In doing so, the study extends previous research that has primarily emphasized adaptive capacity or social capital by proposing an integrated sociological explanation of collective climate adaptation. Beyond its theoretical contribution, the findings also provide practical insights for policymakers, agricultural extension agencies, and local institutions in designing more participatory, context-sensitive, and community-based climate adaptation strategies for flood-prone agricultural areas.

2. Research Method

This study employed a qualitative research design using an ethnographic approach to explore how smallholder farmers collectively construct and negotiate adaptation strategies in response to recurrent flooding under conditions of climate uncertainty. The empirical material analysed in this article derives from the author's master's thesis research, which was subsequently published in 2015 as the book *Petani Menyiasati Musim: Adaptasi Petani Padi Menghadapi Genangan Air di Puncak Hujan*. While the original study broadly examined farmers' adaptation to recurrent flooding in wetland agriculture, the present article reinterprets the same ethnographic dataset through a different analytical lens. Rather than focusing primarily on farmers' adaptive responses, this article examines adaptation as a collective social practice while situating it within a climate justice perspective that highlights unequal vulnerabilities, differential access to resources, and the role of local institutions in shaping adaptive capacities. Such secondary analysis of qualitative ethnographic data is widely recognised as a legitimate approach for generating new theoretical insights by revisiting rich empirical materials from perspectives not fully explored in the original study. Ethnography was selected because the study sought to understand adaptation as a socially embedded practice emerging from everyday interactions, shared experiences, local knowledge, and institutional relations within the farming community rather than merely documenting individual perceptions. Consistent with ethnographic inquiry (Roncoli, 2006; Creswell, 2013), the researcher was directly immersed in the social setting to capture the meanings that farmers attach to their adaptive practices.

Fieldwork was conducted in the agricultural area managed by the Sido Makmur Farmers Group in Baturejo Village, Sukolilo District, Pati Regency, Central Java Province. The study site was

purposively selected because it represents a typical *tanah ngrowo* (seasonally inundated wetland) ecosystem covering approximately 256 hectares, where recurrent flooding has become a major challenge for agricultural livelihoods and collective adaptation.

The researcher conducted repeated field visits over the research period and adopted a moderate participant observation role by participating in daily farming activities, observing collective irrigation management, informal discussions among farmers, seasonal decision-making processes, and interactions between farmers, village leaders, and agricultural extension officers. Detailed field notes were prepared after each observation to document behavioural patterns, local expressions, institutional interactions, and contextual events relevant to collective adaptation.

Key informants were selected through purposive sampling, followed by snowball sampling to identify individuals possessing extensive knowledge of the history of collective adaptation within the community. A total of 17 informants participated in this study, including the Village Head of Baturejo, leaders of the Sedulur Sikep community, former leaders of the Sido Makmur Farmers Group (2004–2007), current farmer group administrators, smallholder farmers, and Agricultural Extension Officers (PPL) from Sukolilo District. Sampling continued until data saturation was achieved, whereby additional interviews no longer generated substantially new information.

Data were collected through three complementary ethnographic techniques. *First*, participant observation enabled the researcher to observe directly farmers' agricultural practices, collective decision-making processes, irrigation management, and everyday interactions within the farming community. *Second*, in-depth semi-structured interviews were conducted using flexible interview guides to explore farmers' experiences of climate change, perceptions of flood risks, local ecological knowledge, institutional relationships, and collective adaptation strategies. *Third*, document analysis was undertaken to examine farmer group archives, community organizing reports, disaster records, agricultural extension documents, and relevant scientific literature to contextualize and triangulate the empirical findings.

To enhance the credibility and trustworthiness of the findings, the study employed source triangulation, methodological triangulation, and continuous comparison between observational records, interview transcripts, and documentary evidence. Focus Group Discussions (FGDs) were intentionally not employed because preliminary field observations indicated that discussions within village institutions tended to be dominated by local elites, potentially limiting the expression of alternative perspectives among ordinary farmers.

Ethnographic data analysis was conducted iteratively throughout the fieldwork. Interview transcripts, observation records, and field notes were first subjected to open coding to identify recurring concepts and practices. These codes were subsequently organized into broader thematic categories through axial coding, focusing on the relationships between institutional settings, farmers' habitus, collective practices, and multiple forms of capital. Finally, the themes were interpreted using Bourdieu's Theory of Practice, particularly the interaction between field, habitus, and capital, to explain how collective adaptation strategies are socially produced and reproduced within the wetland farming community. The analysis was subsequently interpreted through a climate justice perspective to examine how unequal access to economic, social, cultural, and political resources shapes adaptive capacities and influences the distribution of climate risks and adaptation opportunities among smallholder farmers. Integrating Bourdieu's relational sociology with climate justice enabled the study to move beyond descriptive accounts of adaptation, revealing how collective adaptation emerges through the interaction between social practices, power relations, and structural inequalities within the local agrarian context.

3. Results and Discussion

3.1. Vulnerability Typology "Tanah Ngrowo" Baturejo Village

Baturejo Village has a unique wetland typology characteristic locally called "tanah ngrowo." Hydrologically, this land functions as a natural water reservoir for the surrounding area during the

rainy season. Under normal climatic conditions before 2000, the water cycle was predictable. However, with increasing climate variability, rainfall patterns have become chaotic. Farmers report that rainfall is now often concentrated in high intensity for a short duration in January and February, resulting in river overflows (such as *Tus River*) flooding their rice fields up to three times in one planting season cycle.

This flooding is fatal for the crucial early vegetative phase of rice (seedlings and young plants) and the generative phase (panicle formation). If chest-deep floodwaters inundate rice fields for several consecutive days, the rice plants will inevitably rot and die, forcing farmers to replant, resulting in increased costs for seeds and labor.

3.2. Adaptation Response Dynamics: Advancing the Planting Season vs. Pump Dependence (*fossil fuel*)

To circumvent the annual flood trap during the peak rainy season (December–March), the Sido Makmur Farmers Group developed a radical autonomous adaptation strategy: significantly advancing the planting season. Under the 2004–2007 leadership, the group advanced the first planting season (MT I) to mid- or late August. Traditionally, the planting calendar begins in October, in line with the arrival of regular rainfall.

The primary goal of this accelerated planting is to ensure that by the time the peak rainfall and flooding occurs in January and February, the rice plants have reached maturity, are sufficiently tall, can withstand waterlogging, or have even been harvested. However, because rain has not yet fallen in August, this innovation requires a massive artificial water supply for land wetting, soil cultivation, and seeding. *"If we wait for the rainy season, the fields will already be flooded. That is why we agreed to start planting in August, even though we have to pump water from the river."* (Former Head of Sido Makmur Farmers Group, interview).

This is where collective pumping technology was introduced. Farmer groups utilize water from *Tus River* using a large water pump machine managed centrally by the group administrator to irrigate 256 hectares of land.

Tabel 1. Farmers' Collective Adaptation

Adaptation Parameters	Management Period 2004–2007	Post-2007 period (until 2009)
MT I Start Time	Mid/Late August (Extreme)	October/November (Following the Rain)
Main Water Source	Collective Pumping of the Tus River	Rainfall + Supplemental Pumping
Driving Factors	Solid Leadership, Group Energy Subsidy	Change of Management, Fuel Price Surge
Ecological Risk	Free from puddles during peak rains	High Vulnerability to Recurrent Flooding

Post-2007, there was a regression in adaptation strategies. Changes in the management structure of farmer groups, combined with the surge in subsidized diesel fuel prices, caused pump operating costs to skyrocket, making them unaffordable for smallholder farmers. Consequently, farmers were forced to revert to passive, conventional planting patterns, relying heavily on daily rainfall, and were again exposed to the risk of flooding, which inundated their land three times in early 2009.

3.3. The Crisis of Formal Information and the Legitimacy of Local Knowledge

The findings of this study indicate that the adaptation challenges experienced by the Sido Makmur Farmers Group cannot be understood solely as a consequence of increasing climate variability but also as an issue of climate justice, particularly in relation to unequal access to

climate information and decision-making processes. Climate justice literature argues that climate vulnerability is socially produced through unequal distribution of resources, exclusion from governance, and the failure to recognize local knowledge systems (Schlosberg, 2007; Fraser, 2008; IPCC, 2022). Viewed from this perspective, the empirical findings reveal at least three interrelated dimensions of climate justice.

First, the findings illustrate a problem of distributive justice. Although the government has introduced Seasonal Forecast Information (*Informasi Prakiraan Musim/IPM*) through the Climate Field School (*Sekolah Lapang Iklim/SLI*), access to useful climate information remains uneven. Farmers in Baturejo Village reported that seasonal forecasts were often perceived as too general, highly technical, and insufficiently accurate for determining local planting schedules in the *tanah ngrowo* ecosystem. Consequently, the unequal distribution of climate information as an adaptive resource limits farmers' ability to reduce flood risks and increases their dependence on self-financed adaptation strategies.

Second, the findings demonstrate a lack of recognition of justice. Scientific climate information is predominantly communicated using standardized meteorological terminology that does not adequately acknowledge farmers' experiential knowledge, local ecological memory, or indigenous environmental indicators developed through generations of farming. As a result, farmers perceive official climate information as disconnected from the realities of their agricultural environment. Rather than rejecting science itself, they question its relevance to their local context and continue to rely on local ecological knowledge and traditional cosmological indicators, including those practiced within the Sedulur Sikep community, to interpret seasonal changes and organize collective farming activities.

Third, the study reveals shortcomings in procedural justice. Decisions regarding seasonal forecasting, agricultural extension, and planting calendar recommendations are largely formulated through top-down institutional mechanisms with limited participation from farmers in flood-prone wetland areas. Farmers function primarily as recipients of technical recommendations rather than as active participants whose local knowledge contributes to the design of adaptation strategies. This institutional arrangement weakens the legitimacy of formal climate information and reduces farmers' trust in government-supported adaptation programs.

Taken together, these findings suggest that the limited utilization of Seasonal Forecast Information in Baturejo Village should not be interpreted merely as a communication failure or resistance to scientific knowledge. Instead, it reflects broader issues of climate justice arising from unequal access to adaptive resources, insufficient recognition of local knowledge, and limited participation of vulnerable farmers in climate governance. Consequently, effective climate adaptation requires not only improvements in forecasting accuracy but also institutional arrangements that integrate scientific knowledge with local ecological experience through more inclusive and participatory climate governance.

3.4. Field, Habitus, and Capital in Collective Climate Adaptation

Drawing on Bourdieu's theory of practice, the adaptive capacity of the Sido Makmur Farmers Group is better understood through the interaction between field, habitus, and multiple forms of capital, rather than by examining each form of capital independently. In this study, the field refers to the institutional arena in which farmers interact with fellow farmers, farmer group leaders, agricultural extension officers, local government, irrigation authorities, and climate information providers. This institutional arena shapes access to resources, knowledge, authority, and opportunities for collective decision-making. Within this field, farmers continuously mobilize and convert different forms of capital that gradually shape an adaptive habitus and ultimately influence collective responses to recurrent flooding.

a. Social Capital.

Social capital represents the primary mechanism through which collective adaptation is organized. Strong bonding relationships, mutual trust, reciprocity, and shared norms developed through years of farming in the *tanah ngrowo* ecosystem enabled farmers to coordinate water distribution, organize communal pumping operations, and collectively advance the planting calendar. As one farmer explained, "*Without mutual trust, we could never agree on who receives irrigation water first because every farmer depends on the same river.*" However, changes in farmer group leadership generated internal tensions that weakened trust and reduced farmers' willingness to cooperate. This finding indicates that social capital functions effectively only when supported by stable institutional relationships within the field.

b. Economic Capital.

The institutional field also determines farmers' access to economic resources necessary for climate adaptation. Operating collective pumping systems requires substantial financial investments for machinery, maintenance, and diesel fuel. Repeated crop failures significantly reduced farmers' financial capacity, limiting their ability to sustain these adaptive practices. Moreover, limited access to affordable credit, adaptation financing, and government support further constrained farmers' adaptive capacity. These findings demonstrate that economic capital is not merely an individual asset but is strongly conditioned by institutional arrangements governing access to adaptation resources.

b. Symbolic Capital.

Symbolic capital emerged through the legitimacy, credibility, and moral authority of farmer group leaders. During the 2004–2007 management period, respected leaders successfully mobilized farmers to adopt earlier planting schedules despite the associated financial and labour risks. Their authority transformed collective adaptation from an individual choice into a shared institutional commitment. Following leadership changes, however, declining organizational legitimacy reduced farmers' compliance with collective decisions, illustrating that symbolic capital mediates the relationship between institutional leadership and collective action within the field.

c. Cultural Capital.

Cultural capital consists of farmers' accumulated ecological knowledge, practical farming skills, and collective memory developed through decades of cultivating seasonally inundated wetlands. This embodied knowledge enables farmers to interpret environmental signals, select appropriate rice varieties, and anticipate flood risks beyond formal climate forecasts. Nevertheless, increasingly unpredictable rainfall patterns associated with climate change have challenged the effectiveness of traditional ecological knowledge alone. Consequently, farmers continuously reconstruct their adaptive habitus by combining inherited local knowledge with new experiences and institutional learning acquired through interactions with farmer organizations and agricultural extension services.

Taken together, these findings demonstrate that collective adaptation is not simply the result of possessing social, economic, cultural, or symbolic capital. Rather, adaptation emerges through the dynamic interaction between the institutional field, the mobilization and conversion of multiple forms of capital, and the formation of an adaptive habitus that guides collective decision-making under conditions of climate uncertainty. This analysis extends Bourdieu's theory of practice by showing how the interaction of field–habitus–capital explains the emergence and sustainability of collective climate adaptation among wetland smallholder farmers.

3.5. Implications for Climate Justice

The case of the Sido Makmur Farmers Group illustrates how climate adaptation is shaped not only by biophysical exposure to recurrent flooding but also by unequal institutional arrangements

that influence farmers' access to resources, knowledge, and decision-making processes. Interpreted through the framework of climate justice, the findings reveal several interconnected dimensions of justice that help explain why adaptation remains challenging for vulnerable farming communities.

From the perspective of distributive justice, farmers bear a disproportionate share of adaptation costs despite contributing minimally to global greenhouse gas emissions. In the Baturejo case, adaptation depends heavily on collective pumping systems that require substantial financial resources for fuel, machine maintenance, and labour. The increasing operational costs associated with diesel-powered irrigation place a significant economic burden on smallholder farmers, while institutional support for locally appropriate adaptation technologies remains limited. Consequently, the unequal distribution of adaptation resources increases farmers' vulnerability to recurrent flooding.

The findings also demonstrate limitations in recognition justice. Although farmers possess rich ecological knowledge accumulated through generations of farming in the *tanah ngrowo* ecosystem, this knowledge receives limited recognition within formal climate adaptation programmes. Seasonal Forecast Information – *Informasi Perkiraan Musim* (IPM) and extension services are predominantly based on standardized scientific approaches that insufficiently incorporate local ecological indicators and farmers' experiential knowledge. As a consequence, many farmers continue to rely on locally embedded knowledge systems and collective experience when making decisions regarding planting schedules and flood preparedness.

Furthermore, the study identifies challenges related to procedural justice. Adaptation planning, seasonal forecasting, and agricultural extension remain largely organized through top-down institutional arrangements in which farmers participate primarily as recipients of technical recommendations rather than as active partners in decision-making. Limited opportunities for meaningful participation reduce the legitimacy of formal adaptation programmes and weaken farmers' trust in externally generated climate information.

Taken together, these findings suggest that effective climate adaptation requires not only technological innovation but also more inclusive governance arrangements that strengthen the distribution of adaptive resources, recognize local ecological knowledge, and expand farmers' participation in climate-related decision-making. However, these conclusions should be interpreted within the empirical context of the Sido Makmur Farmers Group in Baturejo Village. As an ethnographic case study, the findings are intended to provide analytical insights into the interaction between climate justice, local institutions, and collective adaptation rather than to represent all wetland farming communities in Indonesia. The transferability of these findings, therefore, depends on the extent to which similar ecological, institutional, and socio-cultural conditions exist in other contexts. Future comparative studies across different wetland regions are needed to examine whether similar mechanisms of collective adaptation and climate justice emerge under varying institutional and environmental settings.

The findings of this study suggest that collective climate adaptation is a socially embedded process that evolves through the dynamic interaction between institutional structures, climate justice, and farmers' agency. The process begins within the institutional field, where farmer organizations, local governments, BMKG, agricultural extension services, irrigation authorities, and community leaders interact in shaping access to climate information, adaptation resources, and decision-making processes. The characteristics of this institutional arena subsequently influence the realization of recognition justice, procedural justice, and distributive justice, particularly in terms of acknowledging farmers' local ecological knowledge, ensuring meaningful participation in adaptation planning, and providing equitable access to adaptation resources and public support. These dimensions of climate justice, in turn, determine how different forms of capital—economic, social, cultural, and symbolic capital—are mobilized and converted to support collective responses to climate risks. Through repeated experiences of flooding, collective learning, and institutional interactions, the mobilization of these multiple forms of capital gradually shapes farmers' adaptive habitus, which guides everyday agricultural decisions and strengthens collective norms of

cooperation. This adaptive habitus is subsequently translated into collective adaptation through coordinated actions such as adjusting planting calendars, managing communal pumping systems, sharing climate knowledge, and strengthening institutional cooperation to reduce flood risks.

Ultimately, the effectiveness of these collective adaptation strategies contributes to broader climate justice outcomes, reflected in enhanced community resilience, more equitable access to adaptation resources, stronger recognition of local knowledge, greater participation in climate governance, and reduced vulnerability to climate change. Accordingly, this study argues that climate adaptation should not be understood merely as a technical response to environmental change or the outcome of resource availability, but as a relational and institutional process in which the interaction between field, climate justice, capital, and habitus shapes the capacity of farming communities to respond collectively to increasing climate uncertainty.

Collective climate adaptation is a socially embedded process in which institutional arrangements shape climate justice, climate justice influences the mobilization of multiple forms of capital, capital forms farmers' adaptive habitus, habitus generates collective adaptation, and collective adaptation ultimately determines climate justice outcomes.

4. Conclusion

4.1. Conclusion

Drawing on ethnographic observations, in-depth interviews, and documentary evidence, this study demonstrates that the Sido Makmur Farmers Group has developed a dynamic form of collective adaptation to recurrent flooding by advancing the planting calendar and organizing a collective pumping system to reduce exposure to peak inundation periods. The empirical findings indicate that this adaptive strategy emerged not merely as a technical response to environmental change but as a socially embedded process shaped by the interaction between farmers' habitus, institutional arrangements, and the mobilization of multiple forms of capital.

The findings further show that the sustainability of collective adaptation depends on the interaction of both internal and external institutional factors. Internally, trust, reciprocity, solidarity, and the symbolic authority of local leaders strengthened collective action and enabled farmers to coordinate the operation of the communal pumping system. Conversely, limited economic capital constrained the long-term sustainability of adaptation by increasing farmers' dependence on costly diesel-powered irrigation. Externally, the effectiveness of collective adaptation was also influenced by broader institutional and policy environments, including fluctuations in fuel prices, the accessibility and relevance of Seasonal Forecast Information (IPM), agricultural extension services, and public policies related to irrigation management and water governance. These external factors shaped the opportunities and constraints within which local collective action could be sustained.

Accordingly, the study argues that successful climate adaptation in wetland farming systems cannot be explained solely by local leadership or social capital. Rather, adaptation emerges through the interaction between community-based institutions and wider governance systems operating at multiple scales. Strengthening farmers' adaptive capacity, therefore, requires not only reinforcing local institutions and collective leadership but also improving collaboration among farmer organizations, local governments, agricultural extension services, BMKG, irrigation authorities, and other relevant stakeholders to ensure that scientific climate information, water governance, and adaptation policies respond more effectively to local ecological conditions.

As an ethnographic case study conducted within a single farmer organization, these conclusions should be understood as context-specific analytical findings rather than statistical generalizations applicable to all wetland farming communities in Indonesia. Nevertheless, the study provides broader theoretical insights into how the interaction between field, habitus, and capital, together with institutional dimensions of climate justice, shapes collective adaptation under conditions of increasing climate uncertainty. Future comparative research across different

ecological and institutional settings is required to examine the transferability of these mechanisms in other wetland farming regions.

4.2. Recommendations

Based on the findings of this study, several practical implications can be drawn to strengthen the adaptive capacity of smallholder farmers facing increasing flood risks under climate change. First, smallholder farmers should strengthen collective action by maintaining mutual trust, reinforcing local leadership, and preserving local ecological knowledge as complementary sources of climate information alongside scientific forecasts. Establishing transparent collective financing mechanisms, such as a community climate resilience fund, would also enable farmers to share adaptation costs and reduce dependence on individual financial resources during periods of climate stress.

At the farmer group level, strengthening institutional governance is essential to ensure that collective adaptation does not depend solely on charismatic leadership. Transparent decision-making, regular organizational regeneration, and equitable management of communal irrigation infrastructure can improve the long-term sustainability of collective adaptation strategies.

For local governments, greater investment is needed in climate-resilient agricultural infrastructure, including renewable energy-based pumping systems such as solar-powered irrigation, to reduce farmers' dependence on fossil fuels and lower long-term operational costs. In addition, adaptation support should include accessible financing mechanisms, technical assistance, and targeted support for flood-prone agricultural areas.

Furthermore, BMKG, agricultural extension services, and the Department of Agriculture should improve the communication of Seasonal Forecast Information (IPM) by integrating scientific climate information with farmers' local ecological knowledge and presenting forecasts in forms that are understandable and directly applicable to local farming decisions. Strengthening collaboration among farmers, extension officers, climate institutions, and local governments will contribute to more participatory, locally relevant, and socially inclusive climate adaptation strategies.

Although these recommendations are derived from the experience of the Sido Makmur Farmers Group in Baturejo Village, they may provide useful insights for other wetland farming communities facing similar ecological and institutional challenges. Their application, however, should be adapted to local environmental conditions, institutional capacities, and socio-cultural contexts. These efforts are expected to strengthen the social, economic, and institutional resilience of farmers in facing increasing hydrometeorological risks due to climate change

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