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Community-Based Water Management in Cambodia

A Comparative Study of Farmer Water User Communities (FWUCs) and the Indigenous *Metuk* System

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List of acronyms and abbreviations

ADB	Asian Development Bank
CDRI	Cambodian Development Resource Institute
CAVAC	Cambodia Agriculture Value Chain
CBWM	Community-Based Water Management
CFR	Community Fish Refuge
FDG	Focus Group Discussion
FiAC	Fishery Administration Cantonment
FWUC	Farmer Water User Community
ICBWM	Indigenous Community-based Water Management
IWMI	International Water Management Institute
ISF	Irrigation Service Fee
KII	Key Informant Interview
MOWRAM	Ministry of Water Resources and Meteorology
NGO	Non-Governmental Organisation
O&M	Operation and Management
PDWRAMs	Provincial Departments of Water Resources and Meteorology
RGC	Royal Government of Cambodia
TK	The Taing Krasaing
TSL	Tonle Sap Lake

Executive summary

Cambodia's water governance is shaped by the Mekong–Tonle Sap hydrological system, which alternates between seasonal floods and droughts. Irrigation and water management are therefore central to agricultural productivity and livelihoods. Since 2000, the Royal Government of Cambodia (RGC) has promoted decentralised governance through Farmer Water User Communities (FWUCs), formalised under the Water Law, while long-standing indigenous practices such as the *Metuk* system around Tonle Sap continue to regulate local water use. This report compares FWUCs and *Metuk*, analysing governance, financing, ecological fit, equity, and resilience, and argues for a hybrid approach that combines their complementary strengths.

Community-Based Water Management (CBWM) emphasises three interlinked dimensions: state and policy frameworks, community institutions, and ecological resources, with social equity at the centre. Decentralised participation, inclusiveness, accountability, and ecological adaptation are considered essential. The study applied this framework to two case studies: the FWUC of Kakaoh Commune in Kampong Thom Province and the *Metuk* system in Santey Village, Siem Reap Province. Data collection combined secondary sources, key informant interviews with officials and community leaders, and focus group discussions with farmers across the two sites.

The Taing Krasaing (TK) Irrigation Scheme, rehabilitated multiple times with donor support, irrigates nearly 10,000 ha and supports thousands of households. Kakaoh's Sub-FWUC is structured hierarchically, with group leaders collecting irrigation service fees (ISFs) from farmers. In theory, FWUCs provide legal recognition, accountability, and links to government institutions. In practice, Kakaoh's FWUC faces low participation, inequitable water allocation between head- and tail-end farmers, elite capture of committees, and weak financial sustainability, with only about half of ISF dues paid. Although the system has enabled dry season cropping, it remains highly dependent on external rehabilitation and struggles with trust and transparency.

The *Metuk* ("head of water") is a customary, community-led system closely attuned to Tonle Sap's flood pulse. Organised around three dikes (built in 1978, 2003, and 2004), it covers 117 ha and supports 259 households. Leadership is vested in elected *me-tomnup* (dike chiefs), who coordinate seasonal rules, allocate water, and mediate disputes. Farmers contribute in-kind payments of rice and voluntary labour, while chiefs are compensated with rice shares and fishing rights. Governance is grounded in trust, cultural norms, and ecological knowledge rather than legal authority. Compliance is high, and conflict resolution is effective, though the system is vulnerable to external interventions, migration, and climate variability.

The study highlights five key dimensions of contrast:

- **Governance and legitimacy:** FWUCs enjoy statutory recognition but lack everyday legitimacy and participation. *Metuk* relies on community sanctions and trust, resulting in strong compliance but lacking formal protection.

- **Knowledge and ecological fit:** FWUCs follow engineered irrigation calendars, often mismatched with floodplain ecology. *Metuk* rules are flexible and synchronised with the flood-pulse cycle.

- **Financing and O&M:** FWUCs depend on ISF collection, which is weak and unsustainable. *Metuk* mobilises collective labour and rice contributions, sustaining low-cost infrastructure but lacking capital for upgrades.

- **Equity and inclusion:** FWUCs risk elite capture, while *Metuk*'s inclusiveness depends on community cohesion, though both can reproduce local inequalities.
- **Resilience:** FWUCs are vulnerable to drought, climate variability, and upstream hydropower, while *Metuk* adapts nimbly to seasonal rhythms but has no statutory authority to contest external disruptions.

Neither FWUCs nor *Metuk* alone can adequately address Cambodia's complex water governance challenges. FWUCs bring legal legitimacy, donor access, and state linkages, while *Metuk* provides ecological fit, social legitimacy, and local compliance. The report advocates for hybrid co-governance, integrating *Metuk* into FWUC structures, aligning statutory calendars with flood-pulse knowledge, blending financing models, and embedding equity safeguards. Such integration, supported by adaptive monitoring and basin-scale coordination, could enhance resilience against climate change, upstream hydropower, and market pressures. Importantly, hybridisation must avoid eroding customary flexibility or replicating the weaknesses of statutory institutions.

Cambodia's community-based water management requires complementarity, not substitution, between statutory and customary systems. FWUCs and *Metuk* each hold distinct advantages, and a co-governance model that legally recognises indigenous practices while strengthening formal institutions offers the most promising pathway to secure water, livelihoods, and resilience in the Tonle Sap floodplain.

1. Introduction

Cambodia's hydrosocial landscape is shaped by the Mekong–Tonle Sap system, whose seasonal flood pulse structures livelihoods, mobility, and settlement patterns. Cambodia has abundant water resources during the rainy season, which often lead to floods and natural disasters. However, during the dry season, the country experiences frequent droughts that damage agriculture. Thus, water management is essential to the development of Cambodia.

Water management is equated largely with the development and management of irrigation systems. Generally, water management is centralised and sectoral. There are 2500 irrigation schemes across Cambodia, which could irrigate 2.32 million ha, among which 65 percent are located in the Mekong floodplains and Delta, and 35 percent in the Tonle Sap floodplains. However, many schemes, particularly older ones dating back to the Khmer Rouge era, suffer from flawed designs and are significantly deteriorated (MOWRAM 2024; ADB 2019).

Climate change and hydropower development have altered the hydrological regimes of the Mekong River and Tonle Sap Lake, implicating the water management. Since the 1990s, the MRB has seen the development of 156 hydropower projects. Approximately 13 percent of the annual discharge, equivalent to 62 km3, has been withdrawn from the entire lower MRB, of which Cambodia accounts for approximately 3 percent. The expansion of irrigation and croplands will play a role in decreasing the annual streamflow by 3 percent over the period of 2036–2065 compared with the period of 1971–2000 (Lui et al. 2022). Furthermore, hydropower and other infrastructure developments could reduce the water discharge in the Mekong River by 21 percent at Kratie, 5 percent at Kampong Cham, and 8 percent at Prek Kdam and Chak Tomuk (Chua et al. 2022). In the Mekong Delta River, at Neak Luong in Cambodia, the annual wet season discharge dropped by 10 percent between 2010 and 2020 (Chua et al. 2022).

In addressing these challenges, the RGC has improved water management through decentralised water governance. Since 2000, under the 2005 Water Law and subsequent sub-decrees, the decentralised water management reform has created FWUCs to manage irrigation schemes. Some 500 FWUCs have been established across Cambodia to manage the irrigation systems and distribute water to farmers for rice farming. However, FWUC faces significant challenges, including ineffective irrigation management, poor irrigation system operation, dependence on external support, and limited internal capacity. In parallel, the indigenous *Metuk* institution continues to steward water in the Tonle Sap floodplain and lake communities. The *Metuk* system has been documented as a community-operated practice that coordinates access, timing, and conflict resolution over water in and around Tonle Sap Lake. The study compares these two cases, FWUC and *Metuk* System, identifies the challenges and opportunities that these systems faced, and explores the best ways to improve them.

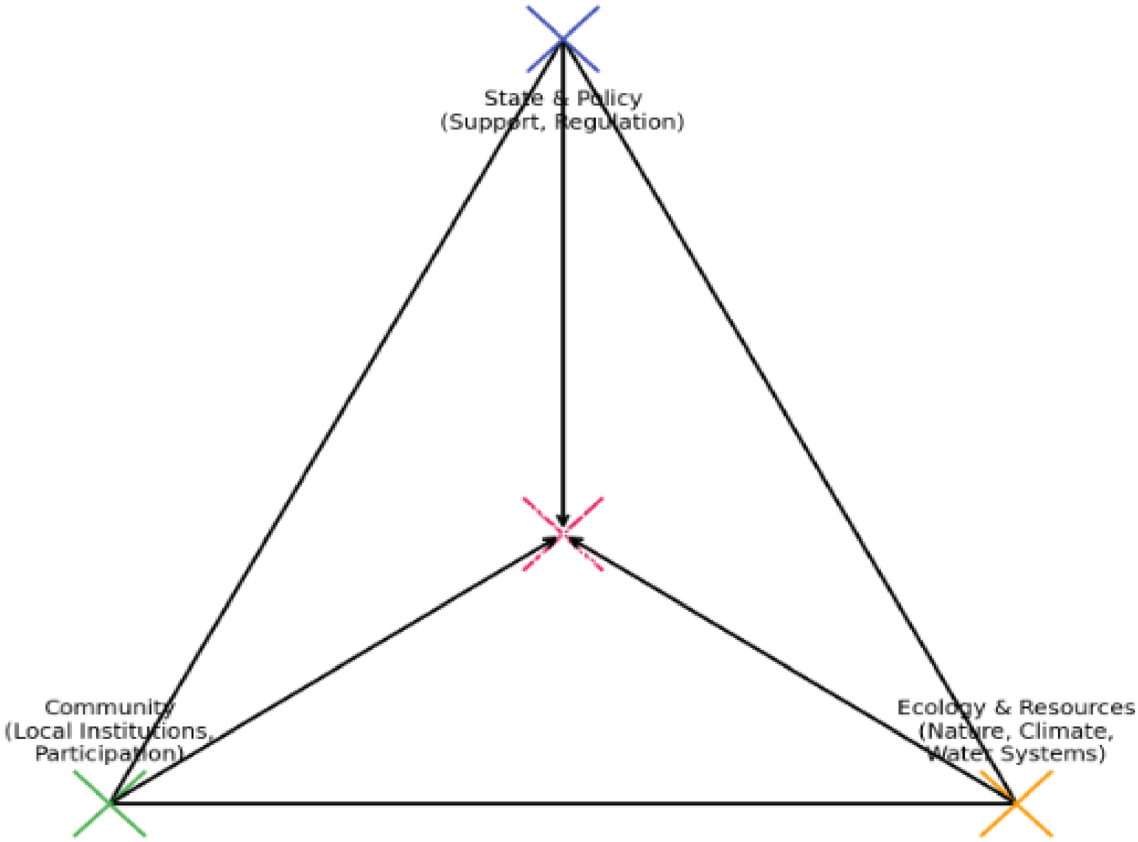
2. Conceptual approach: Community-based water management

Water governance refers to the overall framework and processes for decision-making and implementation of policies related to the use and management of water resources. It involves a range of actors, including central and local governments as the key drivers (Hufty 2011; Dore 2014). The state centralised water resource management through building large-scale infrastructures, guided by engineering technicality and controls. Limited community participation had affected the management of water resources, resulting in low productivity of water resources in the development process (Romano, Nelson-Nuñez, and LaVanchy 2021). After the 1970s and 1980s, there were shifts from state-led, technocratic water resources management programs to an increase of 'participatory' and 'community-based' water resources management, where civic participation and ownership of development endeavours were seen to result in better outcomes of the projects (Ahluwalia 1997; Mehta 1997; Sithirith 2017). Such shifts have come in the wake of criticisms of large-scale infrastructure-focused water development projects that have had negative social and environmental impacts (McCully 1996). There have been changes in the governance of water resources from state-controlled and managed to focus on community-based institutions and less direct state responsibility. Participatory community-based water management projects have become popular as ways for states, international donors, and NGOs to attempt to pursue 'sustainable development' (Nelson and Wright 1995; Chambers 1997; Agarwal and Narain 2000; Cornwall 2000; Agrawal and Gibson 2001).

CBWM is organised based on three components: (1) state and policy, (2) community and (3) ecology and resources (Figure 1). At the centre lies social equity and outcomes, which is influenced by all three (Madrigal, Alpízar, and Schlüter 2011). First, communities establish CBWM as the primary institutions. Second, CBWMs develop local rules to regulate water access, prevent conflict, and maintain infrastructure. Community-based water laws coexist with state and customary legal systems, shaping access, use, and allocation of water. Community rules provide local legitimacy and responsiveness, while state policies contribute technical, financial, and legal support. Enforcement may be supported by customary authority or external actors. Third, CBWM is tied directly to improving community well-being, supporting agriculture, domestic needs, and income generation, with equity and sustainability as guiding principles (Tantoh and McKay 2021). Last, but not least, water management outcomes are shaped by ecological factors (e.g., groundwater arsenic in Bangladesh, variable rainfall in Africa) as well as social dynamics. Community systems are dynamic, adapting to population growth, new technologies (e.g., pumps), and environmental stressors (Sultana 2009).

The key principles of CBWM include five key elements: (1) Community participation and ownership; (2) Decentralised decision-making; (3) Capacity building and training for local communities; (4) Equity and inclusiveness; and (5) Transparency and accountability (Cox, Arnold, and Tomás 2010; Sustainability Shiksha 2025). Community participation and engagement are critical components of CBM. This involves ensuring that local stakeholders are actively involved in all stages of the decision-making process, from planning to implementation and monitoring (Sultana 2009). Decentralised decision-making is another key component of CBWM. This involves giving local communities the authority to make decisions about their own water resources, rather than relying on centralised authorities. Decentralised decision-making can help to ensure that decisions are more responsive to local needs and contexts. Capacity building and training are essential for ensuring that local communities have the skills and knowledge they need to manage their water resources effectively. It increases efficiency, transparency and equity in water projects. CBWM addresses social and economic inequalities. This can ensure that marginalised groups, such as women and minority communities, are included in decision-making processes and have equal access to water resources. Community management systems must establish robust accountability mechanisms to maintain trust and transparency that prevent corruption (Naiga 2018; Ari et al. 2013).

Figure 1: Conceptual framework for community-based water management



Source: Compiled by the author

Sultana (2009) examines how community participation in water resource management projects in 18 villages across 4 arsenic-affected districts in Bangladesh, particularly in the context of the arsenic contamination crisis in rural drinking water. The article bridges nature–society debates and development geography, showing how ecological processes interact with social power relations in shaping outcomes of community-based water management. The community participation discourse assumes that communities act as unified entities, but in reality, they are divided by gender, class, and power relations. Indeed, arsenic contamination creates uneven access: wealthy households drill deeper wells, while poor and marginalised groups remain dependent on unsafe sources. She argues that while CBWM is presented as inclusive, it often reproduces existing inequalities, with elite capture and exclusion of marginalised groups. Community institutions (e.g., water user committees) often reinforce inequalities by favouring elites. Also, water crises are not only socially produced but also shaped by geohydrology and ecological variability (e.g., arsenic in shallow aquifers). Thus, outcomes are co-produced by both social power relations and natural processes. Women carry the burden of water collection and care, yet remain underrepresented in decision-making structures of water governance. Gendered power dynamics shape who participates, whose voices are heard, and who benefits.

Similarly, Michael Schnegg and Michael Bolling (2016) examine CBWM in Namibia, particularly during the severe drought of 2012–2014. The study shows that in practice, these formalised institutions are embedded within broader social-ecological systems and shaped by cultural norms of kinship, reciprocity, and solidarity. The study highlighted that the prolonged drought put these rules under severe strain. The crisis revealed a stark divergence between official rules and local practices. Although the constitutions required outsiders to pay higher fees, during the drought, these rules were largely suspended. Kinship networks facilitated access to water and grazed across communities, as refusing relatives would cause social conflict and undermine long-term reciprocity. Wealthier herd owners, with larger and more mobile herds, exercised greater bargaining power to secure open access, while poorer households were less able to negotiate. In many cases, outsiders were treated like insiders, contributing diesel or small payments informally rather than adhering to formal fee structures.

On the other hand, Tantoh and McKay (2021) highlight similar challenges facing by the CBWM in Cameroon. While the CBWM is a form of decentralisation and participatory in water sector, in which communities are empowered to manage water resources, they suffer from limited technical capacity, poor record-keeping, and inadequate financial management skills. CBWM often reflects existing power hierarchies within communities. Wealthier or more influential members tend to dominate decision-making, while poorer households, women, and marginalised groups have less voice in governance. This imbalance sometimes results in inequitable water distribution or exclusion of vulnerable households from decision-making processes. In some cases, mismanagement or misuse of funds further undermines trust and the credibility of CBWM institutions. However, traditional chiefs and customary leaders continue to play an important role in mediating disputes and legitimising water rules. CBWM in Cameroon thus operates as a hybrid governance system, blending state-promoted institutional frameworks with local cultural practices and authority structures.

Along the above line, we saw some effective community-based water managements integrate traditional approaches with modern scientific understanding. In the indigenous community-based water management (ICBWM); first, indigenous peoples maintain holistic relationships with water that integrate spirituality, ecology, and community well-being. Second, community-based institutions—such as traditional councils or watershed guardians—are crucial for regulating use, enforcing norms, and ensuring equitable access. Third, ICBWM supports biodiversity and climate resilience, as their territories often overlap with areas of high ecological value. However, persistent challenges include lack of legal recognition, marginalisation from formal governance, and threats from industrial or extractive projects (Sioui 2022; Susie 2024). The ICBWM represents both an ethical imperative and a practical strategy for sustainable governance. Recognising and integrating indigenous governance systems into national and transboundary water policies can foster social equity, ecological stewardship, and resilience to climate change. The reviewed literature calls for shifting from tokenistic inclusion to genuine power-sharing, ensuring Indigenous peoples' sovereignty, knowledge, and practices shape the future of global water governance (Jackson and Moggridge 2019).

3. Methods and materials

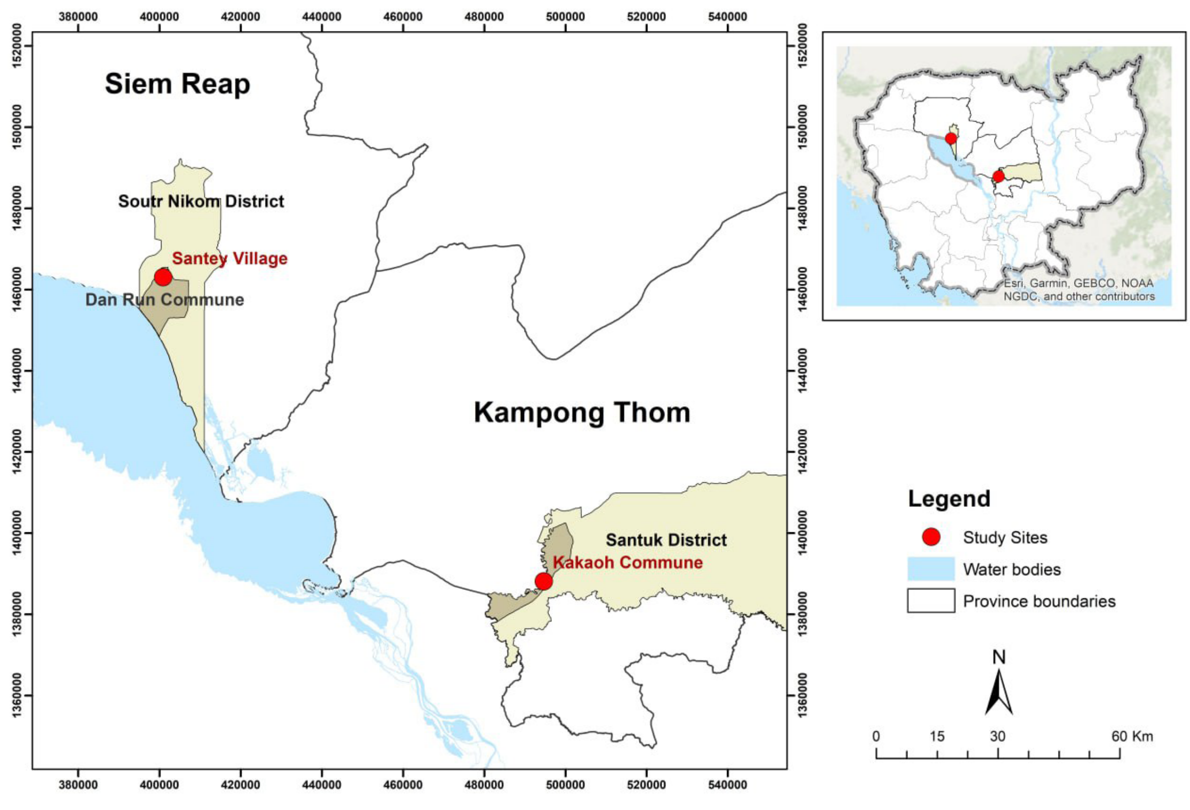
The conceptual framework above has been utilised to analyse community-based water management in Tonle Sap Lake. The study examines FWUC and *Metuk* Systems. In so doing, empirical research was carried out in two study sites in two different provinces in Tonle Sap Lake (TSL): (1) the FWUC in Kakaoh Commune, Santuk District in Kampong Thom Province; and (2) the *Metuk* System in Dan Run Commune, Sot Nikum District in Siem Reap Province (Figure 2).

Within the Tang Krasaing Irrigation Scheme, Kakaoh Commune is home to approximately 3,325 households that are spread across 10 villages and organised into Sub-FWUC. This study explores the Sub-FWUC of Kakaoh Commune as a crucial component of Tang Krasaing Irrigation Scheme. The *Metuk* system is an indigenous water management practice in Santey

Village, located in the Tonle Sap Floodplain and its management is largely influenced by the flood pulse.

Primary and secondary data were collected from the study sites. The secondary data is collected from the districts and commune sources, including the demographic data, the agricultural lands, the water uses and other relevant data. The primary data was collected using the key informant interviews (KIIs) and the focus group discussions (FGDs). In Kakaoh's FWUC, five FGDs were conducted in five different villages, namely Chey Chumneah, Kiri Von, Cheay Sbai, Samnak and Santuk Krau. In the *Metuk* System, two FGDs were conducted, one FGD was conducted with the Dike Chiefs and the second FGD was conducted with farmers whose rice fields utilise the water from the *Metuk* system to irrigate their rice fields. Each FGD was participated by 7-9 people, including men and women. In total, 55 people participated in the FGDs, and the discussions focused on the governance and legitimacy of FWUC and *Metuk*, the power relation and the decision-making over water uses, the ISFs and water fees, the financial management and the O&M, the equity and benefits, the resilience to climate change and impacts of hydropower development, and the challenges facing FWUC and *Metuk*.

Figure 2: Map of the study areas



Source: Author

The KIIs were conducted with PDWRAMs, FiACs, District Officers in charge of Agriculture, Environment and Water Resources, Commune Chiefs, and NGOs in the respective sites to obtain their knowledge on sectors, the policy and legal frameworks, the institutional arrangements, roles, responsibilities, activities, challenges and opportunities in carrying out their works. In Kakaoh's FWUC, 15 KIIs were conducted with five villages; one Commune Chief; three Officers from District Office of Agriculture, representing hydrology, fisheries and agriculture; four FWUC's members, and two Offices from the provincial government.

In the *Metuk* System, 10 KIIs were conducted with one Village Chief, three Dike Chiefs, one representative of Community Fishery, three farmers in three different zones of the *Metuk* system, and two officers from the Commune Administration. The interviews focused on the roles of FWUC and *Metuk*; the contributions of FWUC and *Metuk* to rice farming, livelihoods and incomes; the recognitions by the government; the conflict resolution mechanism and the involvements of local governments; the support of government agencies, and decision-making processes.

This study combines primary data collected at different times across the two case studies. Data for the Kakaoh FWUC were collected between 2023 and 2024, while Metuk data were gathered in 2014 and again in June–July 2025. To ensure comparability, consistent qualitative methods were used across all periods, including semi-structured interviews, focus group discussions, and key informant interviews guided by the same core themes. Analysis focused on institutional and governance dynamics—such as leadership, decision-making, accountability, and benefit-sharing—rather than short-term performance outcomes. The two Metuk datasets were treated as a longitudinal record, with the 2014 data establishing baseline practices and the 2025 data capturing adaptation and continuity over time. Contextual changes were explicitly considered, and findings were triangulated across sources to strengthen validity. The data were consolidated and analysed to support the governances of both the FWUC and the *Metuk*s.

The information gathered from the FGDs, interviews, and secondary sources underwent analysis utilising an Excel spreadsheet. The data were then transformed into percentages, figures, and tables, with qualitative data included to support the findings. This article is descriptive and based on the data and analysis, and it is structured into six parts: first, the introduction; second, the analytical frameworks; third, methods and materials; fourth, the results; fifth, discussions; and sixth, the conclusion.

4. Results

4.1. Community-based water management in Cambodia

The community-based water management has been practised in Cambodia since the Angkor period, but has not been well-documented, such as the *Metuk* water management system. Instead, after the year 2000, the RGC has delegated water governance to local communities, and the FWUC has been formalised to manage water at the community level. Nevertheless, FWUC has faced several challenges, including limited capacity, financial constraints, water conflicts, and more. This study examines two case studies: (1) FWUC in Kakaoh Commune in Santuk District in Kampong Thom Province, and (2) the indigenous *Metuk* water management in Santey Village, in Sotr Nikum District, Siem Reap Province, to compare them for improving community-based water management.

4.1.1. The FWUC in Kakaoh Commune

The Taing Krasaing (TK) Irrigation Scheme, located in Kampong Thom Province, originates from the Stung Chinit River and flows 22 km into the Boeng Ream in Kor Koh Commune, Santuk District, before draining into the Tonle Sap Lake. With an upstream watershed of about 1,100 km², the system provides abundant water resources during the wet season, supporting rice cultivation and fisheries. Constructed between 1975 and 1978, it has undergone multiple rehabilitations: partial modernisation in 2005 and 2012, and a major rehabilitation in 2015, funded by the RGC with support from the Asian Development Bank (ADB). The PDWRAMs has proposed extending the main canal beyond National Road No. 6 to expand service to adjacent paddy fields.

The TK system irrigates 9,869 ha across five sections: (1) 2,664 ha in the upper area; (2) Tipou (2,989 ha, high ground with pumping station); (3) Cambodia Agricultural Value Chain (CAVAC) (1,370 ha); (4) Chroab (855 ha, partly rainfed); and (5) Kakaoh (1,991 ha, largely rainfed but later developed). The scheme was reorganised into a district-level FWUC in 2018, structured hierarchically: the District FWUC covers three communes, each serving as a Sub-FWUC. Kakaoh's Sub-FWUC encompasses 10 villages and 3,325 households. At the village level, each community forms a Group-FWUC, headed by one leader and two deputies responsible for water fee collection. In Kakaoh, there are two Sub-FWUC leaders and 17 group leaders. Leaders report monthly to the Commune FWUC, which in turn reports to the District FWUC Committee.

Farmers pay ISFs based on land size and proximity to canals: 40,000 riel/ha/crop for fields near canals and 20,000–30,000 riel/ha/crop for fields further away. Fees are paid to group leaders, who retain 15 percent as commission. However, compliance is low: only 50–60 percent of members pay, and typically only for one crop (November–February). Farmers also use pumping generators to draw water from sub-canals and CFR areas, but fees are paid to FWUCs rather than CFR committees.

In theory, FWUC structures enable community-based management. In practice, however, the Kakaoh FWUC faces challenges. Farmer participation in decision-making is limited, with many perceiving the FWUC as externally imposed rather than community-driven. Water allocation is uneven, with upstream farmers benefiting disproportionately. Conflicts occur between head- and tail-end users, especially during dry season scarcity. Financial sustainability is fragile: low fee collection undermines O&M, leaving canals poorly maintained and the FWUC dependent on external rehabilitation projects. Governance weaknesses—elite capture, irregular meetings, and poor financial transparency—further erode farmer trust.

Despite these limitations, the TK irrigation scheme has transformed livelihoods in Kakaoh by enabling dry season cropping and intensification. Yet, without stronger farmer engagement, transparent financial management, and improved coordination with fisheries and CFR initiatives, the FWUC risks remaining a hollow institution—legally recognised but operationally weak. Strengthening its capacity is critical to ensuring equitable, sustainable water management in the Tonle Sap floodplain.

4.1.2. The Metuk Water Management System in Santey Village

The *Metuk* (literally "head of water") is a customary institution that regulates flows, access, and dispute resolution in the Tonle Sap floodplain. Practised widely in Siem Reap Province, it aligns community water use with the Tonle Sap's flood-pulse regime. This case focuses on Santey Village, Dan Run Commune, Sot Nikum District, where the *Metuk* continues to shape water security and livelihoods.

The *Metuk* system rests on locally generated rules, voluntary labour and contributions, and leaders elected by villagers. These leaders, known as *me-tomnup* (dike chiefs), coordinate water allocation, maintenance, and seasonal farming activities in accordance with the lake's rhythms. Unlike statutory FWUCs, *Metuk* derives legitimacy from trust and collective sanction rather than national law. While it ensures high compliance and resilience, it remains vulnerable to external interventions such as infrastructure expansion, hydropower projects, and administrative encroachment (Sithirith 2017, 2022).

In Santey Village, the *Metuk* supports 265 ha of land, of which 117 ha are farmland. Of this, 96 ha belong to Santey villagers and 21 ha to Kanthou, a sub-village of Santey, located closer to the lake. About 259 households with 964 people participate in the system, including 167 households from Santey (740 people) and 92 from Kanthou (224 people). Most families are smallholders—around 100 families own less than one hectare, while 30 are landless. Of these households, 252 depend on agriculture and 61 on fishing. The system is organised into three zones, each anchored by a dike, with reservoirs above and rice fields below:

- Zone 1: Dike 78 was built in 1978, 1,270 m long and 7 gates. Reservoirs fill during July–October floods, retaining water for dry season rice cultivation (variety 5154 OM, yielding 5–6 t/ha). Farmers typically grow one to two dry season rice annually.
- Zone 2: Dike 2003 was built in 2003 by villagers, 1,150 m long, 800 m high, and 4 gates. It irrigates 92 ha farmed by 103 households. While historically used for floating rice, it now supports dry season crops after floods recede, with occasional wet season planting. Fishing continues around its reservoirs.
- Zone 3: Dike 2004 was built in 2004 with 1,100 m long, 2.5 m high, and 4 gates. It irrigates 44 ha of lower fields (*Srekrom*) for a single crop annually. Floodwaters submerge this area from June to October, with farming resuming in December. About 66 households rely on this dike.

Governance is structured through *Metuk* committees, with one dike chief and two assistants per dike (except Dike 2004, which has only two members). Chiefs are elected annually before the dry season rice begins, based on technical skill, experience, and community trust. Chiefs gain prestige and privileges: they farm their own land without water fees, receive rice contributions (about 150 kg/ha from each farmer), and share in income from fishing in reservoirs once waters are released. Revenues are used both to compensate chiefs and to support communal infrastructure, such as road repair.

Conflict resolutions are handled through mediation and social norms. Sanctions are moral rather than legal—such as shaming or temporary exclusion—ensuring compliance in cohesive communities. Participation in maintenance is viewed as a shared obligation, strengthening solidarity while reducing reliance on external resources. Despite its resilience, *Metuk* faces growing pressures. Migration and generational change reduce voluntary labour, commercialisation of agriculture undermines collective rules, and climate variability complicates the predictability of flood cycles. Without statutory recognition, *Metuk* decisions can also be overridden by external agencies or projects.

In sum, the *Metuk* system in Santey Village illustrates how indigenous governance can align with ecological rhythms to secure water and sustain livelihoods. Its adaptability, legitimacy, and collective practices contrast with the rigidity of statutory irrigation models. However, its vulnerability to external shocks underscores the importance of hybrid approaches that combine customary authority with legal recognition and state support to ensure sustainability in the Tonle Sap floodplain. We compare FWUCs and *Metuk* across five dimensions: (1) governance design and legitimacy; (2) knowledge and ecological fit; (3) financing and O&M capacity; (4) equity and inclusion; (5) resilience to external change.

Table 1: The characteristics of the Farmer Water User Community (FWUC) and the Metuk Water Management System

Community-Based Water Management	**Farmer Water User Community (FWUC) in Kakaoh**	***Metuk* Water Management System in Santey**
Geography	The Taing Krasaing River flows from the Stung Chinit River into the Koh Koh Commune, Santuk District, with a total distance of 22km. The Taing Krasaing Irrigation system was rehabilitated in 2015, comprising of five sections, covering 9869 ha: (1) First section—2664 ha in the upper area, (2) Tipou—2989 ha—high grounds with pumping station; (3) CAVAC—1370 ha; (4) Chroab—855 ha, only partly developed as rainfed; and (5) Kakaoh—1991 ha, fully developed as rained. The Taing Krasaing (TK) irrigation was organised into one FWUC in 2018. The FWUC's Kakaoh is a Sub-FWUC of TK, located in the lower reach of the Taing Krasaing River in Santuk District, Kampong Thom Province, in the floodplain of Tonle Sap Lake.	The *Metuk* system of Santey is located in Santey Village, Dan Run Commune, Sotr Nikum District, Siem Reap Province. It is situated in the floodplain of Tonle Sap Lake. The *Metuk* system is organised on the slop of the Tonle Sap floodplain into three zones: Zone 1—there is a dike 78, with a reservoir above the dike, and the *Sreleu* above the reservoir. Below the dike 78, there is a *Srekandal*. It is about 5km from Tonle Sap Lake. Zone 2 is located below Zone 1. There is the dike 2003, built in 2003 by Santey's villagers, who have Srekandal (mid-rice fields) located below it, and then named the dike after the year of construction. Above the dike 2003, there is a reservoir, and below the dike, there is a rice field named Srekandal. Zone 3 is located below Zone 2, about 1.5km from the lake. Villagers built the dike in 2004 with local funds from villagers who own the *Srekrom* (lower rice fields) below the dike 2004.
Hydrology	In the wet season, FWUC Kakaoh is flooded by the rise of water from Tonle Sap Lake, and also by the flow of water from Taing Krasaing River. In the dry season, FWUC Kakaoh receives water from the Taing Krasaing irrigation system for rice farming.	In the wet season, the water level in Tonle Sap Lake rises up from May to October, and submerges the Zone 3, Zone 2 and Zone 1. From November to March, floodwater recedes from Zone 1, then from Zone 2, and finally from Zone 3. Farmers start cultivating recession rice accordingly in Zone 1, then Zone 2, and then Zone 3.
Irrigated area (ha)	The Kakaoh irrigation system is surrounded by 1,991 ha. Farmers as members of Kakaoh's FWUC cultivate both the wet and dry season rice.	The *Metuk* system could irrigate 117 ha of rice fields in Sreleu, Srekandal and Srekrom. Farmers cultivate both wet and dry season rice. Rice farming during the wet season is uncertain due to irregular water levels in the Tonle Sap Lake.
Establishment and recognition	The FWUC of Kakaoh was established in 2018 to manage the irrigation system by communities, and it is legally recognised by MOWRAM and PDOWRAM.	The *Metuk* system was established in 1988 by local communities and recognised by village and commune administrations.

Community-Based Water Management	**Farmer Water User Community (FWUC) in Kakaoh**	***Metuk* Water Management System in Santey**
Membership	3,325 households are members of Kakaoh FWUC.	259 households are members of the *Metuk* System.
Committee, management structure, and decision-making system	17 FUWC Committees are elected by FWUC members, supported by PDRAM and endorsed and approved by MOWRAM. The management structure is complex, with multiple layers of decision-making at higher levels.	*Metuk* committee comprises *me-tomnup* (chief of dike). Each *me-tomnup* has three members: one dike chief and two members. There is a simple organisational structure and decision-making system. Decision-making is at the community level, with the participation of *Metuk* members.
Water fees	FWUC's members pay water fees. The water fee is 40,000 riel/ha/crop for a rice field located close to the irrigation canals, and 20,000-30,000 riel/ha/crop for a rice field located far from the irrigation canals. The payments are made to the Group-FWUC leaders.	Each farmer contributes 150kg of paddy rice per hectare to *Metuk. If rice yields are low in some seasons, the Metuk charges lower fees.*

Source: Author

4.2. Governance and legitimacy

4.2.1. Farmer Water User Communities (FWUCs)

FWUCs are statutory organisations formally recognised under Cambodia's *2007 Law on Water Resources Management*. With bylaws, mandates, and governance frameworks, they reflect the government's decentralisation agenda and are expected to manage irrigation systems, collect ISFs, and enforce rules (MOWRAM 2007). In Kakaoh Commune, this recognition exists largely on paper. In practice, Kakaoh's FWUC operates with limited authority.

Members of Kakaoh's FWUC are farmers. Rice farming is a primary livelihood activity, supplemented by fishing for about 19–20 percent, and non-farm activities. About 31 percent of households own farmland less than one hectare, and about 16 percent of households are landless, and thus, fishing is their primary occupation. About 18 percent of households fall into the ID Poor 1 and 2. The Santuk Khnong has the highest percentage of poverty, constituting 29 percent of the total households. Rice farming has intensified to 2–3 crops per year, leading to competition for water, especially during the dry season rice farming from January to March. The participation of FWUC members is mainly around the water to irrigate their rice fields, and their participation is constrained by poverty. Although all farmers in Kakaoh's irrigation schemes are members by law, few engage actively in meetings or decision-making. Many compete for water for their own rice fields and perceive FWUCs as externally imposed by government projects rather than community-owned. This detachment leads to reluctance to pay ISF or contribute labour, further weakened by inequitable water distribution. Head-end farmers in the Kakaoh irrigation scheme often secure better access to water than tail-end farmers, particularly near the Boeng Ream CFR, fuelling mistrust and conflicts (IWMI 2011).

Governance problems, such as participation and ownership over FWUC, compound these challenges. Committees, meant to be representative, are often dominated by elites or village chiefs politically brokered through local authorities. Among 17 Committee members, only two are women. FWUC's committee members do not meet FWUC's members frequently, only when they collect the ISF, once every three months. However, FWUC's Committee meets with the District Authorities every month to report on the activities and finances.

Oversight is fragmented: Ministry of Water Resources and Meteorology (MOWRAM)'s support is minimal, commune authorities lack capacity, and district authorities focus narrowly on rice irrigation, neglecting links with fisheries and biodiversity. Consequently, FWUCs risk becoming hollow institutions—legitimate in law but ineffective in practice—unless supported with capacity-building, transparency, equitable water allocation, and stronger state engagement. The state's role in supporting FWUCs is also ambiguous. While the MOWRAM formally oversees FWUCs, monitoring and technical backstopping are minimal. Commune authorities of Kakaoh are often expected to support FWUCs but lack capacity themselves, resulting in fragmented governance arrangements. However, the Santuk District Authorities are more powerful than the Commune, overseeing the FWUC through the District Office of Agriculture, Natural Resources and Environment. The oversights of FWUC in Kakaoh focus only on water for rice farming, not on fishery and biodiversity, often conflicting with the CFR in Boeng Ream, downstream of the Kakaoh irrigation scheme. Consequently, FWUCs are frequently caught between legal recognition and practical marginalisation.

Table 2: The number of households and the poverty rate

Names of villages	No. of HHs	ID Poor 1	%	ID Poor 2	%	No. of HHs with farmlands less than 1ha	%	# of HHs do not own farmland	%	No. of households fishing	%
Chey Chumneah	392	24	6	30	8	120	31	50	13	30	8
Kiri Von	330	14	4	39	12	60	18	80	24	30	9
Tboung Krapeu	354	28	8	40	11	275	78	31	9	30	8
Cheay Sbai	402	25	6	45	11	54	13	32	8	30	7
Svay Kal	299	23	8	35	12	48	16	53	18	30	10
Santuk Knong	309	29	9	62	20	57	18	54	17	30	10
Santuk Krau	275	14	5	37	13	71	26	23	8	30	11
Chi Meakh	421	20	5	28	7	188	45	83	20	30	7
Sala Santuk	184	10	5	28	15	25	14	75	41	30	16
Samnak	359	21	6	47	13	134	37	59	16	30	8
Total	**3325**	**208**	**6**	**391**	**12**	**1032**	**31**	**540**	**16**	**300**	**9**

Source: Fieldwork, 2025

4.2.2. Metuk system

The *Metuk* system in Santey Village represents a customary model of indigenous water governance. Unlike FWUCs, *Metuk* legitimacy rests on collective action to manage water for their rice farming and livelihoods, social trust, and ecological knowledge of the Tonle Sap's flood pulse (Sithirith 2022). Leaders (*me-tomnup* or dike chiefs) emerge from within the community, chosen by villagers for their moral authority and technical skills that are trusted by the community. The whole system of *Metuk* relies on voluntary labour, mutual help and local contributions. Villagers collectively maintain dikes, reservoirs, and canals, reducing dependence on external funding while strengthening solidarity. Enforcement comes through social norms—shaming or temporary exclusion—rather than legal sanctions, ensuring high compliance in cohesive communities.

The dike chiefs provide equal treatment to members of the *Metuk* Community, and they are compensated with 150kg/ha/season of paddy rice after harvest and with gratitude. In so doing, the dike chiefs prevent conflicts and provide effective conflict resolutions. Seasonal rules for water allocation and farming are adapted to the Tonle Sap's rhythms, and no one questions the inequalities of water sharing. Leaders mediate disputes using calendars of rising and falling water of the Tonle Sap's flood pulse, and cultural rituals of Buddhist practices of sharing and support. Empirical studies show that, compared to FWUCs, *Metuk* often secures higher everyday legitimacy and farmer engagement.

However, *Metuk* faces serious limitations. Without statutory recognition, its decisions can be overridden by state agencies or private investors. Large-scale agriculture and hydropower development have redirected flows without consultation, leaving *Metuk* vulnerable. Internally, cohesion is not guaranteed. Migration, commercialisation, and generational change reduce voluntary participation, while younger farmers prioritise wage labour over unpaid collective work. Market pressures and climate variability further destabilise seasonal calendars.

In sum, *Metuk* illustrates the adaptability and resilience of indigenous governance grounded in social norms and close ecological fit with the Tonle Sap flood-pulse system. In addition to regulating irrigation, *Metuk* institutions also govern access to seasonal fisheries associated with reservoirs, inundated rice fields, and floodplain waters retained behind *Metuk* dikes. Fish accumulate in these reservoirs and channels during the flood season and are typically harvested when water levels recede or when gates are opened at the end of the dry season. Management of these fisheries is coordinated by *Metuk* leaders, who determine the timing of water release and harvesting to balance irrigation needs, fish availability, and equity among users. The benefits from fish harvests are distributed through a combination of collective and household mechanisms. In some cases, fish catches are shared directly among participating households, contributing to food and nutrition security. In others, part of the harvest or its cash equivalent is allocated to *Metuk* leaders as compensation for their management responsibilities or pooled to support communal purposes, including minor maintenance of dikes, canals, and gates. These fisheries-related benefits thus function as an embedded incentive structure that reinforces compliance, offsets management costs, and reduces reliance on external funding.

4.3. Knowledge systems and ecological fits

FWUC emphasises engineered irrigation logic, with standardised canals, pumping systems, and calendars primarily tailored to support dry season rice production. This model reflects a technocratic orientation promoted by MOWRAM and ADB as donor, which views irrigation reliability as central to agricultural intensification. The Kakaoh irrigation scheme is a sub-scheme of the TK irrigation system. It consists of a main canal of 5.6 km long, five secondary canals, 16 tertiary canals, and five gates. The tail-end canal, known as the Svay Kantrum sub-canal, supplies water to rice fields around the CFR, and it is also connected to the CFR. This expansion has enabled farmers to shift from one to two or three rice crops annually, with about 2,000 ha cultivated in the dry season. Yet, the increased demand often leads to water shortages and crop failures during the dry months (January–April). However, the Kakaoh irrigation systems are hydrologically mismatched with local ecological conditions, particularly in floodplain areas around the Tonle Sap, where traditional livelihoods rely on seasonal flood–recession agriculture. As a result, water delivery is inconsistent and unpredictable, undermining both cropping schedules and farmer trust in FWUC governance.

The Kakaoh irrigation system is a sub-system of the TK irrigation system with a limited number of secondary or tertiary canals, causing the inequality of access to water, particularly during the dry season. Geographically, the head-end canal of the Kakaoh irrigation system is located in the lower ground, while the tail-end canal is located on the high ground, which causes the flows to reach the tail-end slowly. These geographies create inequalities in water sharing, causing conflicts between the head-end and the tail-end farmers, particularly between January and April. Often, water comes to the head-end canal first, and head-end farmers start using it exhaustively before they release it to the tail-end farmers, causing complaints and sometimes conflicts. Sometimes, water comes too much, causing flooding in the head-end farmer's fields, complaining to the FWUC Committees for poor operations of the canal's water gates and the lack of a warning system.

On the other hand, canals and water system infrastructure deteriorate due to insufficient operation and maintenance funds, sedimentation, and weak institutional capacity to enforce collective responsibilities. Farmers do not collectively maintain and repair the canals themselves but rely on the District Authorities to do the reparation. The District Authorities rely on the funds from the National Government, and it takes time. These challenges limit productivity gains and highlight tensions between standardised engineering approaches and complex local hydrological realities.

On the contrary, the *Metuk* system is explicitly attuned to the Tonle Sap's unique flood-pulse regime, where the seasonal reversal of the Tonle Sap River and the annual rise and fall of the lake shape local hydrology and livelihoods. Community rules for water use, access, and navigation are closely synchronised with these rhythms, ensuring that irrigation, fishing, and rice cultivation are aligned with ecological cycles. During the wet season, from May to October, when water levels rise and fields are submerged, collective activities focus on fisheries and mobility by boat. As floodwaters recede, from November to March, the *Metuk* leaders, the dike chiefs, coordinate the timing of dike operations—the dike 78 into Zone 1, the dike 2003 into Zone 2, and the dike 2004 into Zone 3. They also ensure that the reservoirs in each dike system retain water, and that the water gates are ready to release water to *Sreleu, Srekandal,* and *Srekrom*. In late October or early November, farmers prepare for rice planting to maximise dry season cropping potential. This explicit integration with ecological dynamics enables flexible, intra-annual rules that shift with hydrological conditions, strengthening both compliance and resilience. Unlike formal irrigation schemes, which follow rigid calendars, *Metuk*'s adaptive governance reflects deep local knowledge of the floodplain environment (Sithirith 2022).

4.4. Financing, O&M, and material capacity

Water governance financing reveals a stark contrast between statutory institutions such as FWUCs and customary arrangements like the *Metuk* system. FWUCs are tasked with ensuring the financial sustainability of irrigation schemes. Their model is based on the collection of ISFs from farmers, which should cover operation and maintenance (O&M). In theory, this aligns with the best international practice: cost recovery reduces reliance on state subsidies, encourages efficient water use, and ensures long-term system viability. FWUCs are thus expected to manage budgets, hire staff, and oversee repairs in a structured and transparent manner (JICA 2013).

In practice, however, financial sustainability is another constraint. Studies show that ISF collection is irregular and often insufficient. FWUC's committee members collect ISF from FWUC members. The head-end farmers pay water fees of about 40,000 riel/ha/crop for a rice field located close to the irrigation. The tail-end farmers pay 20,000–30,000 riel/ha/crop for a rice field located far from the irrigation canals. Payments are made to the group-FWUC leaders in each village, and they then transfer them to the head of the committee. The head of FWUC transfers the ISFs to the district authorities. However, ISF collection covers only around half of the O&M costs. Farmers who rely on rainfall during the wet season resist paying full water charges for seasonal irrigation. Poor canal conditions reinforce this cycle, keeping FWUCs dependent on external rehabilitation funds.

Farmers are reluctant to pay when water delivery is unreliable or when they distrust the transparency of fund management. About 50 percent of farmers, who are members of FWUCs, pay ISFs. In tail-end areas where water is scarce, farmers feel disadvantaged and see little incentive to contribute. As a result, recovery rates are frequently too low to cover even basic canal cleaning or gate repairs. This creates a cycle of decline: underfunded O&M leads to deteriorating infrastructure, further reducing service quality and deepening farmer disillusionment. Many FWUC leaders also lack training in financial management, record-keeping, and participatory budgeting, thereby undermining accountability and reinforcing mistrust. Ultimately, FWUCs' statutory mandate is undermined by weak compliance, poor governance, and chronic financial shortfalls.

By contrast, the *Metuk* system follows a very different logic. Rooted in customary practice and community solidarity, *Metuk* financing does not rely on monetary fees but instead mobilises in-kind contributions. Households provide voluntary labour, farming tools, and local resources such as timber or bamboo for dike reinforcement. These collective work events serve as both practical maintenance and expressions of shared responsibility. Because participation is framed as a moral obligation rather than a transaction, compliance is generally high, and all farmers who are members of the *Metuk* community pay water fees in the form of paddy rice. The infrastructure itself is low-cost and ecologically adapted: earthen dikes, small reservoirs, and temporary weirs that respond flexibly to the flood-pulse rhythms of the Tonle Sap floodplain (Sithirith 2022).

This in-kind model ensures that essential functions—such as dike repair and water allocation—can be sustained without heavy reliance on external subsidies. Social norms and customary sanctions compel participation, even among resource-poor households, ensuring equitable contributions. Yet, *Metuk* faces its own constraints. Large-scale rehabilitation, such as reinforcing dikes to withstand extreme floods or installing modern sluice gates, requires financial resources beyond the reach of voluntary labour. Moreover, demographic and economic changes threaten their sustainability. Younger generations increasingly migrate for wage labour, reducing the availability of communal workforces, while market-oriented farming undermines collective norms.

The comparison highlights two divergent dilemmas. FWUCs enjoy legal mandate, statutory recognition, and potential access to donor and state funds, yet they suffer from weak local participation, financial insecurity, and poor accountability. *Metuk*, conversely, thrives on strong community legitimacy, voluntary contributions, and flexible ecological fit, but it lacks external financing and statutory protection, leaving it vulnerable to large infrastructure projects and state interventions. These experiences underscore that neither model alone can fully address Cambodia's water governance challenges. A promising pathway is hybrid co-financing models that combine statutory legitimacy and access to external finance with the grassroots legitimacy, trust, and low-cost resilience of customary systems. Such integration would not only enhance the financial sustainability of irrigation management but also strengthen community resilience in the face of climate change, upstream hydropower, and growing water demands.

4.5. Equity and inclusion

FWUCs were introduced to provide a formalised and legally recognised framework for local collective water governance. By design, they allow for structured membership, voting rights, and the election of committee leaders, offering farmers a voice in irrigation management. In theory, this institutional design should democratise decision-making and ensure accountability. However, in practice, empirical studies show that elite capture often undermines inclusiveness. Local elites, village chiefs, or politically connected individuals sometimes dominate FWUC committees, using their influence to secure preferential access to water or to control ISFs. When leadership positions are brokered through patronage rather than open competition, marginalised farmers—particularly women, landless households, or those at the tail-end of canals—often lack meaningful representation. Low participation in meetings further weakens the democratic promise of FWUCs, leaving decision-making concentrated in the hands of a few.

By contrast, the *Metuk* system draws its legitimacy from customary norms and practices. Leadership is often based on social trust, local knowledge, and the ability to mediate conflicts. In cohesive communities, this can generate a high degree of inclusiveness, as rules are understood collectively and compliance is secured through social sanction rather than legal enforcement. Farmers contribute labour and resources according to customary expectations, and decisions about water use are made with reference to shared ecological knowledge of the flood-pulse regime (Sithirith 2022). Yet, customary authority is not free from risks of exclusion. Local power hierarchies—such as dominance by wealthier households, elders, or influential kin groups—may marginalise weaker voices unless they are counterbalanced by transparent rules and collective oversight. Without such checks, *Metuk*, like FWUCs, may reproduce inequalities, highlighting the need to blend traditional legitimacy with mechanisms that safeguard fairness.

4.6. Resilience to external change

In Kakaoh Commune, given the increased rice trade to Vietnam, farmers have intensified rice farming from one to 2–3 crops per year. From May to September or October, farmers cultivated wet season rice, relying on rainfall and the rise of floodwater from TSL. From October or November, farmers cultivated the dry season rice, which was harvested in December or January. If water is available, they repeat another round of dry season rice farming from February to April. The dry season rice farming relies on water from the Kakaoh irrigation scheme. However, as rooted in localised irrigation management, Kakaoh's FWUCs depend on the wet seasonal flows of water from Stung Chinith River, located in the eastern catchment of TSL, to store in the TK reservoir in Santuk District, and its releases in the dry season for dry season farming from November to March. Kakaoh's irrigation scheme faces significant vulnerabilities with climate variability, deforestation, and planning gaps across water and agricultural sectors in Kampong Thom Province.

In the past four years (2022–2025), there have been prolonged droughts, and extreme shortages of waters, spoiling dry season rice farming in Kakaoh. Water conflicts have occurred among farmers in Kakaoh communities, upstream and downstream. The dry season rice farming from February to April was spoiled, causing income losses among farmers, reducing the reliability of ISFs and straining their limited O&M budgets. Between 2023 and 2025, farmers in Kakaoh's FWUC experienced severe and prolonged droughts. Water shortages cause the failure of rice farming for three crops per year.

Furthermore, upstream hydropower operations on the Mekong and its tributaries alter flow regimes, changing the timing and magnitude of water availability in TSL's floodplain, especially around the Kakaoh ricefields. These shifts often occur without knowledge of local FWUCs, leaving them unable to adapt canal operations or cropping calendars effectively. At the same time, coordination between FWUCs and basin-scale management institutions remains weak. National-level water policies and regional Mekong basin frameworks rarely integrate the concerns of local irrigation schemes, resulting in fragmented planning. Consequently, FWUCs remain highly exposed to exogenous pressures with limited institutional channels to influence broader water governance processes.

Table 3: Key elements of community-based water management

Key elements	FWUC	*Metuk*
Governance design and legitimacy	**FWUCs** are statutory bodies with formal mandates, bylaws, and registration. Their legitimacy is anchored in law, but day-to-day authority can be shallow when participation is thin or when committees are politically broken. Empirical assessments report weak governance and limited user engagement in several schemes.	***Metuk*** rests on customary authority and community sanction. Leaders mobilise voluntary labour and enforce seasonal rules through social norms and conflict mediation mechanisms. This often yields higher everyday compliance where communities remain cohesive. However, without legal backing, *Metuk* decisions can be overridden by external agencies.
Knowledge systems and ecological fit	**FWUCs** emphasise engineered irrigation logic and calendars designed for dry season cropping. Where schemes are poorly maintained or hydrologically mismatched, water delivery is unreliable	***Metuk*** is explicitly keyed to the Tonle Sap's flood-pulse regime—timing access, navigation, and use with the lake's rising and falling waters. This alignment supports flexible rules that adjust intra-annually
Financing, O&M, and material capacity	**FWUCs** are expected to recover costs via ISFs and to organise O&M, but fee collection and budgets are often insufficient, limiting repairs and equitable distribution.	***Metuk*** mobilises community funds-in-kind (labour, gear, local contributions) and low-cost infrastructure suited to floating/seasonal environments; yet the absence of stable external finance constrains scaling and upgrades.
Equity and inclusion	**FWUCs** can formalise membership and voting, but elite capture is reported in some cases, and marginalised farmers may lack voice where participation is low.	***Metuk*** relies on customary norms that may be inclusive in cohesive communities but can also reflect local power hierarchies unless checked by transparent rules.
Resilience to external change	**FWUCs** are vulnerable to climate variability, upstream hydropower impacts, and cross-sector planning gaps; coordination with basin-scale management remains limited.	***Metuk*** adapts nimbly to annual variability but is exposed to exogenous shocks (e.g., infrastructure that alters flows, market pressures) and lacks formal channels to contest disruptive projects.

Source: Fieldwork, 2025

By contrast, the *Metuk* system demonstrates greater flexibility in responding to annual hydrological variability. Because it is explicitly keyed to the Tonle Sap's flood-pulse regime, *Metuk* rules for timing water access, reservoir use, and rice planting shift fluidly in line with rising and falling waters. This nimbleness allows farmers to adjust intra-annually, maximising benefits from flood–recession agriculture and sustaining dry season rice with modest infrastructure (Sithirith 2022). However, *Metuk*'s strength in adapting to natural variability is offset by its vulnerability to external shocks. Infrastructure projects—such as large-scale irrigation schemes, upstream dams, or road embankments—can alter local water flows in ways that undermine customary practices. Market pressures, including demands for short-duration rice varieties or aquaculture expansion, can also disrupt collective norms. Crucially, because *Metuk* lacks legal recognition, it has no formal channels to contest disruptive projects imposed by state agencies or private investors. Without statutory backing, decisions rooted in community sanction can be overridden, eroding the resilience of this indigenous system.

5. Discussion: Towards complementarity, not substitution

Evidence from Cambodia's Tonle Sap floodplain suggests that neither FWUCs nor the indigenous *Metuk* system alone can adequately address contemporary water security challenges. Both institutions represent distinct governance logics, each with strengths and weaknesses in Cambodia. FWUCs are statutory bodies anchored in national law, established under Cambodia's Law on Water Resources Management (MOWRAM 2007), and closely linked to state investment, donor finance, and inter-scheme coordination (Sithirith 2017; ADB 2012). In principle, they offer formal legitimacy, standardised irrigation calendars, and potential access to basin-level planning processes (Pham et al. 2019). Yet, their everyday legitimacy is often questioned. Many FWUCs suffer from weak farmer engagement, poor ISF collection, water conflicts between upstream and downstream irrigation schemes, and degraded irrigation infrastructures. More critically, they are designed around engineered irrigation logics that prioritise dry season rice cultivation, which makes them poorly suited to the flood-pulse dynamics of the Tonle Sap ecosystem (World Bank 2015; Ojendal et al. 2023).

By contrast, *Metuk* embodies the lived geographies of the lake and represents an indigenous, community-anchored form of governance. It is seasonally responsive, with rules that shift in accordance with the rising and falling waters of the Tonle Sap floodplain. Its authority is grounded in community sanction, voluntary labour, and deep ecological knowledge of flood–recession cycles (Sithirith 2022). This enables fine-grained rule-making and high compliance within cohesive communities, since participation is embedded in social norms rather than legal compulsion (Ostrom 1990; Berkes 2009). However, *Metuk*'s resilience is constrained by its lack of statutory recognition. In the face of exogenous shocks—such as upstream hydropower altering flow regimes, road embankments blocking drainage, or state-driven irrigation expansion, *Metuk* rules can be overridden. This exposes customary institutions to marginalisation, particularly when development projects impose new governance frameworks without consultation (Molle et al. 2009; Middleton and Dore 2015).

5.1. Debating strengths and weaknesses

The limitations of both FWUCs and *Metuk* have sparked debates in water governance scholarship. Some scholars argue that FWUCs, while weak, are essential vehicles for scaling farmer participation into state planning frameworks for water usage (Diepart and Dupuis 2014). Without statutory organisations, communities risk being excluded from investment and basin coordination. Others counter that FWUCs' reliance on technocratic, donor-driven models alienates farmers and produces low compliance, suggesting that they exist on paper, but not in practice (Sithirith 2017; Sokhem and Sunada 2006). Similarly, *Metuk* has been celebrated for its adaptive governance and cultural legitimacy. Despite its demonstrated strengths, the *Metuk* system has important limitations that constrain its broader applicability. Empirical evidence suggests that *Metuk* is most viable in areas close to the Tonle Sap Lake and within relatively small irrigation command areas, where seasonal flooding creates natural reservoirs that support both irrigation and fisheries. In upland areas farther from the lake, where flood-pulse dynamics are weaker or absent, and irrigation relies more heavily on permanent canals and pumping, the ecological and institutional foundations of *Metuk* may not hold (Sithirith 2022). Yet criticised for reproducing local hierarchies and excluding landless or migrant households unless transparent rules are enforced (Agrawal 2001). These debates point to the central tension: neither system can stand alone as a sustainable solution, but each offers complementary strengths that could be harnessed in hybrid models.

5.2. Pathways for hybrid co-governance

Legal recognition of *Metuk* within statutory frameworks—A promising approach involves the legal recognition of *Metuk* rules and leadership roles within the FWUC bylaws and sub-decrees. For example, allocating seats for *Metuk* leaders on FWUC committees serving floodplain communes would institutionalise customary representation in statutory governance. This structure could mitigate the risk of customary institutions being marginalised and would enhance the local legitimacy of FWUC decision-making (Resurrección and Rambo 2003). However, ongoing debates highlight concerns that formalising custom may reduce institutional flexibility or subject indigenous practices to state control (Benda-Beckmann 2002).

Polycentric planning that bridges engineered and ecological logics—FWUC irrigation calendars could be aligned with flood-pulse knowledge of TSL embedded in *Metuk* practices. For example, dry season pumping and fish refuge management could be scheduled with reference to customary seasonal indicators. Such integration is closely tied to polycentric governance approaches, where multiple decision-making centres interact across scales to balance ecological and social needs (Ostrom 2010). However, scholars note that polycentric systems risk coordination failures if power asymmetries are not addressed—e.g., when state agencies dominate, and customary voices are excluded from the state development process (Keskinen et al. 2007).

Blended financing mechanisms—FWUCs and *Metuk* both experience persistent underfunding. FWUCs depend on ISFs but often collect insufficient funds, while *Metuk* leverages in-kind labour and local resources but lacks capital for upgrades. A blended financing model that combines ISF revenues with targeted public or donor funding could support investment in affordable, flood pulse-responsive infrastructure, such as floating intakes and seasonal gates (World Bank 2015; CDRI 2023). Ensuring transparency is critical, as weak accountability may lead to elite capture or misallocation of funds.

Equity safeguards—Neither system is fully equitable. FWUCs are vulnerable to elite capture, while *Metuk* may favour dominant kin groups. Measures like transparent membership lists, accessible grievance mechanisms for mobile fishers and land-poor households, and gender-balanced leadership quotas can improve inclusiveness (Diepart and Dupuis 2014). However, critics note that these measures alone are insufficient to address entrenched power dynamics without broader social change (Cleaver 2012).

Adaptive monitoring—Co-produced indicators could track ecological pulse variables (water levels, reversal flow timing), distributional outcomes (who gets water, when), and O&M performance. Participatory monitoring can strengthen accountability and foster shared learning (Berkes 2009). Yet, such initiatives require capacity-building and resources—otherwise, monitoring risks becomes extractive, serving donor reporting needs rather than empowering communities (Cooke and Kothari 2001).

Basin-level coordination—Local hybrid institutions must be embedded in Mekong–Tonle Sap basin strategies and community-based water management, given the interdependence of upstream hydropower, floodplain agriculture, and fisheries (Keskinen et al. 2007; Molle et al. 2009). The risk is that basin institutions are highly politicised, with decisions shaped by state sovereignty and donor agendas, limiting spaces for local input (Middleton and Dore 2015). To address this, advocates should prioritise supporting and developing strong hybrid models and proactively work to ensure their formal integration into regional policy processes and decision-making forums.

6. Conclusion

Cambodia's community-based water management combines statutory decentralisation with indigenous practices. While FWUCs formalise community roles within national law, they often face challenges with participation, funding, equity, ownership, and technical capacity. The *Metuk* system offers a socially legitimate and ecologically responsive approach tailored to Tonle Sap's flood pulse cycle. Policy should support Indigenous governance through legal recognition and resources, while also strengthening FWUCs. This layered approach will help ensure water security amid climate and development challenges.

The path forward is not to choose between FWUCs or *Metuk* but to craft complementary co-governance arrangements**.** FWUCs bring statutory legitimacy, state linkages, and investment potential; *Metuk* brings ecological fit, social legitimacy, and compliance. A hybrid model—if designed with equity safeguards, adaptive monitoring, and basin coordination—could strengthen resilience against climate change, upstream interventions, and socio-economic pressures. Yet, caution is warranted: hybridisation must avoid eroding the flexibility of customary systems or reproducing the rigidities of statutory bodies. The debate is not merely technical but political, raising questions about who holds authority over water, whose knowledge counts, and how power is shared across scales.

Complementarity, not substitution, offers the most promising way forward. FWUCs connect communities to legal and financial structures of the state, while *Metuk* provides legitimacy and ecological fit. Hybrid co-governance, underpinned by legal recognition, polycentric planning, blended financing, equity safeguards, adaptive monitoring, and basin-scale nesting, can reconcile formal and customary strengths. This approach acknowledges that Cambodia's water governance challenges are too complex for any single model, requiring integration of state-led and community-driven institutions to build resilience against climate change, upstream interventions, and growing water demands.

References

ADB. 2012. *Cambodia: Water Sector Assessment, Strategy, and Road Map*. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/institutional-document/33593/cam-water-supply-sanitation-sector-assessment_0.pdf.

ADB. 2019. *Sector Assessment (Summary): Agriculture, Natural Resources, and Rural Development (Irrigation)*. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/linked-documents/53353-002-ssa.pdf.

Agrawal, Arun, and Clark C. Gibson (Eds.). 2001. *Communities and the Environment: Ethnicity, Gender, and the State in Community-Based Conservation*. New Brunswick, New Jersey, and London: Rutgers University Press.

Agrawal, Arun. 2001. "Common Property Institutions and Sustainable Governance of Resources." *World Development* 29 (10): 1649–1672. https://doi.org/10.1016/S0305-750X(01)00063-8.

Agarwal, Arun, and Narain, Sunita. 2000. "Water Harvesting: Community-led Natural Resource Management." *LEISA-LEUSDEN* 16: 11–13.

Ahluwalia, Meenakshi. 1997. "Representing Communities: The Case of a Community-Based Watershed Management Project in Rajas than, India." *IDS Bulletin*, 28 (4): 23–35. https://doi.org/10.1111/j.1759-5436.1997.mp28004004.x.

Ari, Ismu Rini Dwi, Kenshiro Ogi, Kakuya Matsushima, and Kiyoshi Kobayashi. 2013. "Community Participation on Water Management; Case Singosari District, Malang Regency, Indonesia." *Procedia Environmental Sciences* 17: 805–813. https://doi.org/10.1016/j.proenv.2013.02.098.

von Benda-Beckmann, Franz. 2002. "Who's Afraid of Legal Pluralism?" *Journal of Legal Pluralism and Unofficial Law* 34 (47): 37–82. https://doi.org/10.1080/07329113.2002.10756563.

Berkes, Fikret. 2009. "Evolution of Co-Management: Role of Knowledge Generation, Bridging Organizations and Social Learning." *Journal of Environmental Management* 90 (5): 1692–1702. https://doi.org/10.1016/j.jenvman.2008.12.001.

Cornwall, Andrea. 2000. "Missing men? Reflections on Men, Masculinities and Gender in GAD." *IDS bulletin* 31 (2): 18–27. https://doi.org/10.1111/j.1759-5436.2000.mp31002003.x.

Cox, Michael, Gwen Arnold, and Sergio Villamayor Tomás. 2010. "A Review of Design Principles for Community-Based Natural Resource Management." *Ecology and Society* 15 (4): 38. http://www. ecologyandsociety.org/vol15/iss4/art38/.

Chambers, Robert. 1997. "Shortcut and Participatory Methods for Gaining Social Information for Projects." In *Sustainable Development: Social Organization, Institutional Arrangements and Rural Development*, edited by S. Sepuldeva and R. Edwards, 177–208. San Jose, Costa Rica: IICA.

Cleaver, Frances. 2012. *Development through Bricolage: Rethinking Institutions for Natural Resource Management*. London: Routledge.

Cooke, Bill, and Uma Kothari. 2001. *Participation: The New Tyranny?* London: Zed Books.

Diepart, Jean-Christophe, and David Dupuis. 2014. "The Peasants in Turmoil: Khmer Rouge, State Formation and the Control of Land in Northwest Cambodia." *Journal of Peasant Studies* 41 (4): 445–468. https://doi.org/10.1080/03066150.2014.919265.

Dore, John. 2014. "An Agenda for Deliberative Water Governance Arenas in the Mekong." *Water Policy* 16 (S2): 194–214. https://doi.org/10.2166/wp.2014.204.

Hufty, Marc. 2011. "Investigating Policy Processes: The Governance Analytical Framework (GAF)." In *Research for Sustainable Development: Foundations, Experiences, and Perspectives*, edited by Urs Wiesmann and Hans Hurni, 403–424. Bern, Switzerland: Geographica Bernensia.

IWMI. 2011. *Improving the Governance of Irrigation Water Users Associations in Cambodia.* Colombo: International Water Management Institute.

Jackson, Sue, and Bradley Moggridge. 2019. "Indigenous Water Management." *Australasian Journal of Environmental Management* 26 (3): 193–196. https://doi.org/10.1080/14486563.2019.1661645.

JICA (Japan International Cooperation Agency). 2013. *Final Report: Data Collection Survey on Water Resource Management in Cambodia.* Phnom Penh: JICA.

Keskinen, Marko, Mira-Neea Elviira Käkönen, Prom Tola, and Olli Varis. 2007. "Water Balance Analysis of Tonle Sap Lake." *Water Resources Development* 23 (3): 463–480.

Madrigal, Róger, Francisco Alpízar, and Achim Schlüter. 2011. "Determinants of Performance of Community-Based Drinking Water Organizations." *World Development* 39 (9): 1663–1675. https://doi.org/10.1016/j.worlddev.2011.02.011.

McCully, Patrick. 1996. *Silenced Rivers: The Ecology and Politics of Large Dams*. London: Zed Books.

Mehta, Lyla. 1997. "Social Difference and Water Resource Management: Insights from Kutch, India." *IDS Bulletin* 28 (4): 79–89. https://doi.org/10.1111/j.1759-5436.1997.mp28004009.x.

Middleton, Carl, and John Dore. 2015. "Transboundary Water and Electricity Governance in Mainland Southeast Asia Linkages, Disjunctures and Implications." *International Journal of Water Governance* 3 (1): 93–120.

Molle, Francois, Tira Foran, and Mira Kakonen. 2009. *Contested Waterscapes in the Mekong Region.* London: Earthscan.

MOWRAM (Ministry of Water Resources and Meteorology). 2007. *Law on Water Resources Management of the Kingdom of Cambodia.* Phnom Penh: MOWRAM.

Naiga, Resty. 2018. "Conditions for Successful Community-Based Water Management: Perspectives from Rural Uganda." *International Journal of Rural Management* 14 (2): 110–135. https://doi.org/10.1177/0973005218793245.

Nelson, Nici, and Susan Wright (eds). 1995. *Power and participatory development: theory and practice*. Rugby, Warwickshire, UK: Intermediate Technology Publications.

Romano, Sarah T., Jami Nelson-Nuñez, and G. Thomas LaVanchy. 2021. "Rural Water Provision at the State-Society Interface in Latin America." *Water International* 46 (6): 802–820. https://doi.org/10.1080/02508060.2021.1928973.

Sokhem, Pech, and Kengo Sunada. 2006. "The Governance of the Tonle Sap Lake, Cambodia: Integration of Local, National and International Levels." *International Journal of Water Resources Development* 22 (3): 399–416. https://doi.org/10.1080/07900620500482642.

Öjendal, Joakim, Nong Monin, Sean Chanmony, Bunnath Zoe Sidana, and Ngin Chanrith. 2023. *The Political Economy of Land-Water Resource Governance in the Context of Food Security in Cambodia*. Working Paper Series No. 142. Phnom Penh: CDRI. https://doi.org/10.64202/wp.142.202311.

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge: Cambridge University Press.

Ostrom, Elinor. 2010. "Polycentric Systems for Coping with Collective Action and Global Environmental Change." *Global Environmental Change* 20 (4): 550–557. https://doi.org/10.1016/j.gloenvcha.2010.07.004.

Schnegg, Michael, and Michael Bollig. 2016. "Institutions Put to the Test: Community-Based Water Management in Namibia during a Drought." *Journal of Arid Environments* 124: 62–71. https://doi.org/10.1016/j.jaridenv.2015.07.009.

Sioui, Miguel. 2022. "Introduction: The Need for Indigenous Knowledge-Based Water and Drought Policy in a Changing World." In *Indigenous Water and Drought Management in a Changing World* (vol. 4), edited by Miguel Sioui, 1–11. Amsterdam, Netherlands: Elsevier.

Sithirith, Mak, Sok Sao, Sanjiv De Silva, Heng Kong, Chay Kongkroy, Tim Thavrin, and Hy Sarun. 2024. "Water Governance in the Cambodian Mekong Delta: The Nexus of Farmer Water User Communities (FWUCs), Community Fisheries (CFis), and Community Fish Refuges (CFRs) in the Context of Climate Change." *Water* 16 (2): 242. https://doi.org/10.3390/w16020242.

Sithirith, Mak. 2022. "Water Security and Indigenous Water Management Practice: A Case Study of the *Metuk* Water Management in Cambodia." *Journal of Ecology and Natural Resources* 6 (3): 1–15. https://doi.org/10.23880/jenr-16000300.

Sithirith, Mak. 2017. "Water Governance in Cambodia: From Centralized Water Governance to Farmer Water User Community." *Resources* 6 (3): 44. https://doi.org/10.3390/resources6030044.

Sultana, Farhana. 2009. "Community and Participation in Water Resources Management: Gendering and Naturing Development Debates from Bangladesh." *Transactions of the Institute of British Geographers* 34 (3): 346–363.

Sustainability Shiksha. 2025. *Community-Based Water Management Systems for Rural Sustainability.* Sustainability Shiksha, January 3, 2025. https://sustainability.shiksha/strategies-models-for-sustainability/community-based-water-management-rural-sustainability/.

Susie, McGovern. 2024. *Indigenous People Pave the Way for Sustainable Water Resource Management.* Hoosier Environmental Council, November 22, 2024. https://www.hecweb.org/2024/11/22/indigenous-people-pave-the-way-for-sustainable-water-resource-management/.

Tantoh, Henry Bikwibili, and T. J. M. McKay. 2021. "Assessing Community-Based Water Management and Governance Systems in North-West Cameroon Using a Cultural Theory and Systems Approach." *Journal of Cleaner Production* 290: 125804. https://doi.org/10.1016/j.jclepro.2021.125804.

World Bank. 2015. *Project Performance Assessment Report: Cambodia Water Resources Management and Irrigation Project.* Washington, DC: World Bank.

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