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The Climate-Wetland-Policy Nexus: Advancing Community-Based Adaptation through Participatory Co-Knowledge Design at Sui Lake, Lao PDR

Phoummixay Siharath[a,*], Vilas Nitivattananon[b], Rajendra P. Shrestha[c], Somchay Vilaychaleun[a], Chankhachone Sonemanivong[a]

[a]Faculty of Engineering, National University of Laos, Sokpaluang Campus, Vatnak Village, Sisattanak District, Lao-Thai Friendship Road, Lao PDR

[b]Faculty of Climate Change and Sustainability, Asian Institute of Technology, P.O. Box 4, 58 Moo 9, Km. 42, Paholyothin Highway, Klong Luang, Pathum Thani 12120 Thailand

[c]Faculty of Food, Agriculture and Natural Resources, Asian Institute of Technology, P.O. Box 4, 58 Moo 9, Km. 42, Paholyothin Highway, Klong Luang, Pathum Thani 12120 Thailand

***Corresponding Author:** Phoummixay Siharath (phoummixay2011@gmail.com)

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Abstract

Wetlands are vital ecosystems that support the livelihoods of local communities. Effective preservation depends on robust policy frameworks; however, for these policies to be inclusive and sustainable, local community engagement in the design phase is essential. This study aims to establish a formal policy framework that empowers local communities to manage and sustain wetland ecosystems amidst a changing climate and aligns with environmental protection with socio-economic development. The study employed a participatory approach involving consultation meetings. key informant knowledge interviews and Focus Group Discussion include sample size (n = 1,534), and Likert analysis this research explores the "Climate-Wetland-Policy Nexus" through the co- design of a management framework for Sui Lake. By engaging district authorities and local communities from eight targeted upstream and downstream villages, quantitative analysis using a Likert scale demonstrated a high level of community consensus and significant positive response toward the co-design process. The research found that participatory approach is very significant to design the policy and also management mechanisms, there are 8 articles those are reflection of local communities's insights and needs. Therefore, district authorities and local communities are able to employ and disseminate this policy to local communities as a routines to preserve and protect Sui Lake for sustainability as encountering with climate change situation.

Keywords: Communities, Climate, Co-design, Policy, Wetland

Introduction

Policy engagement is a fundamental practice in conducting dialogues and consultations among local communities, beneficiaries, and multi-sectoral

stakeholders. This process is essential for promoting knowledge transfer and enhancing institutional capacity building [1-3]. To influence systemic change and streamline these engagement processes, the Rapid Outcome Mapping Approach (ROMA) provides a robust set of tools and methodologies designed to bridge the gap between research and policy influence[4-7].

Effective policy engagement requires that local communities both understand and contribute to the conceptualization and implementation of regulations. This ensures that the highest benefits are realized by the end-users [8, 9]. Furthermore, decision-makers must design policies that are grounded in realistic local conditions and aligned with broader socio-economic strategies. Adopting a bottom-up approach is critical to mitigating risks and ensuring that policies remain usable and sustainable in the long term [10,11].

Community-Based Adaptation (CBA) serves as a vehicle for social inclusion, allowing stakeholders to plan, design, and collaborate on strategies to combat climate change [12-14]. Integrating local knowledge and cultural insights is crucial for understanding community needs and facilitating effective regulatory decisions. Consequently, co-design has emerged as a central component in developing policies relevant to climate change and Ecosystem-based Adaptation (EbA) [15,16].

Policy engagement and co-design approach, while “policy engagement” is a broad and multifaceted concept [17,18], this study narrows its scope to the specific interaction between Champhone District authorities and the eight targeted villages. This targeted definition ensures that the research remains grounded in the local administrative and social realities of the Sui Lake region.

The policy development process followed a structured, collaborative trajectory:

- Initial drafting and knowledge synthesis: The policy was initially drafted through a consultative process involving the research team, district authorities, and local community representatives. This stage prioritized the sharing of localized insights and the unique environmental characteristics of each village [19, 20]. This ensured that the resulting framework was not a generic mandate but a context-specific reflection of the community’s diverse ideas and needs.
- The co-design framework: A co-design approach was rigorously applied during the preparation of the water and wetland management protocols. The primary goal was to establish a mechanism for the long-term sustainability of Sui Lake [21]. Co-design requires the active participation of all primary beneficiaries, fostering an environment where stakeholders can exchange technical knowledge and lived experiences [22,23].
- Community-Based Adaptation (CBA) as an Alternative Solution: By centering the process on the climate change challenges encountered by the villagers, the study positions Community-Based Adaptation as a viable and practical alternative to top-down environmental management [24-26].

Material and Methods

Approach

The conceptual framework (Figure 1) for this study was developed to systematically integrate each research component and provide a robust operational roadmap for the fieldwork. As illustrated in Figure 1, the framework is structured to bridge the gap between global climate adaptation theories and local-level policy implementation.

The framework is built upon three primary pillars:

- Input Phase: Utilizing the Climate-Wetland-Policy Nexus to identify the environmental and regulatory challenges at Sui Lake.
- Process Phase: Applying Community-Based Adaptation (CBA) and Rapid Outcome Mapping (ROMA) through participatory tools such as KIIs, FGDs, and multi-stakeholder co-design workshops.
- Output Phase: The formulation of the 8 Articles of Policy, validated by community consensus (Likert scale) and official district approval.

This integrated approach ensures that every step of the fieldwork from the initial kickoff meeting to the distribution of policy booklets is aligned with the goal of long-term social inclusion and ecosystem sustainability.

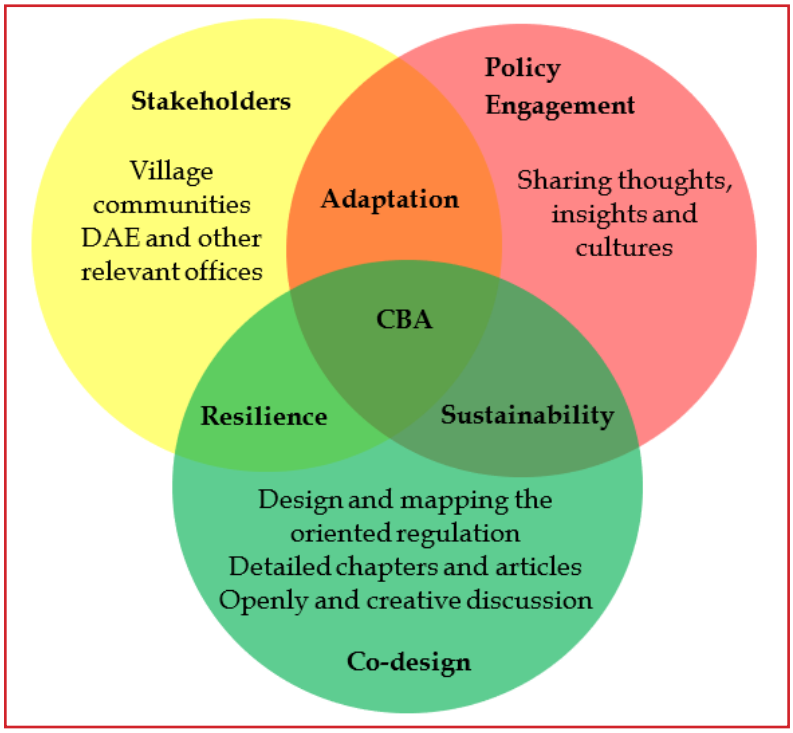

Figure 1. Conceptual framework of policy engagement and co-design diagram

Sample Size and Respondents

Due to policy engagement is very important for local community to participate and share knowledge and experiences. therefore, sample size is designed in order to select and identify the local community to be involved in

the consultation meeting, research team had interviewed on the representative of each household as shown in Table 1 which includes: rice farmers, user groups, fisheries, gardeners, family heads or who leads the families (either men or female).

In addition, KII and FGD are employed, when research team and district representatives conducted the first and second consultation meeting and used very simple local language with individual village to consult and share insights on draft of policies articles by articles and then let participants to get to know and understand the concept and real meaning of articles, research team asked them by employing Likert scale: ("1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree") and then research team carefully counts and notes down for those who are responded on and so on.

Table 1. Sample size and respondents

No	Village name	Sample size and respondents (persons)
1	Phonthong	229
2	Doneyeng	174
3	Sakeun Neua	216
4	Sakeun Tay	205
5	Dongmeung	114
6	Phonmouang	386
7	Dongmakor	105
8	Beungtaloung	105
	Total	1,534

The Study Area

Sui Lake is a primary component of the Xe Champhone Wetlands, a site of international importance designated under the Ramsar Convention (Figure 2). It is identified as a "Core Zone" within the Ramsar site due to its exceptional biodiversity and the abundance of its ecosystem services. Beyond its ecological value, the lake plays a critical role in climate change adaptation and disaster risk management, serving as a natural buffer against the extreme hydrological cycles of both flood and drought seasons [27-30]. The broader wetland area encompasses 44 villages, where more than 95% of the local population identifies as farmers. Consequently, the wetland serves as the fundamental backbone for their agricultural activities and food security [31-33]. This high level of community dependency underscores the necessity of a balanced policy that protects the ecosystem while supporting the agricultural livelihoods that sustain the region.

Data Collection

A second round of consultation meetings was conducted to disseminate the finalized policy framework to the local communities. The primary goal of these sessions was to ensure that all stakeholders specifically village chiefs, district authorities, and local residents fully understood the regulatory mechanisms and how to apply them in their daily lives.

To maximize accessibility and foster a sense of local ownership, these dissemination meetings were held within the community's own social spaces, such as local temples and village administrative offices. These gatherings

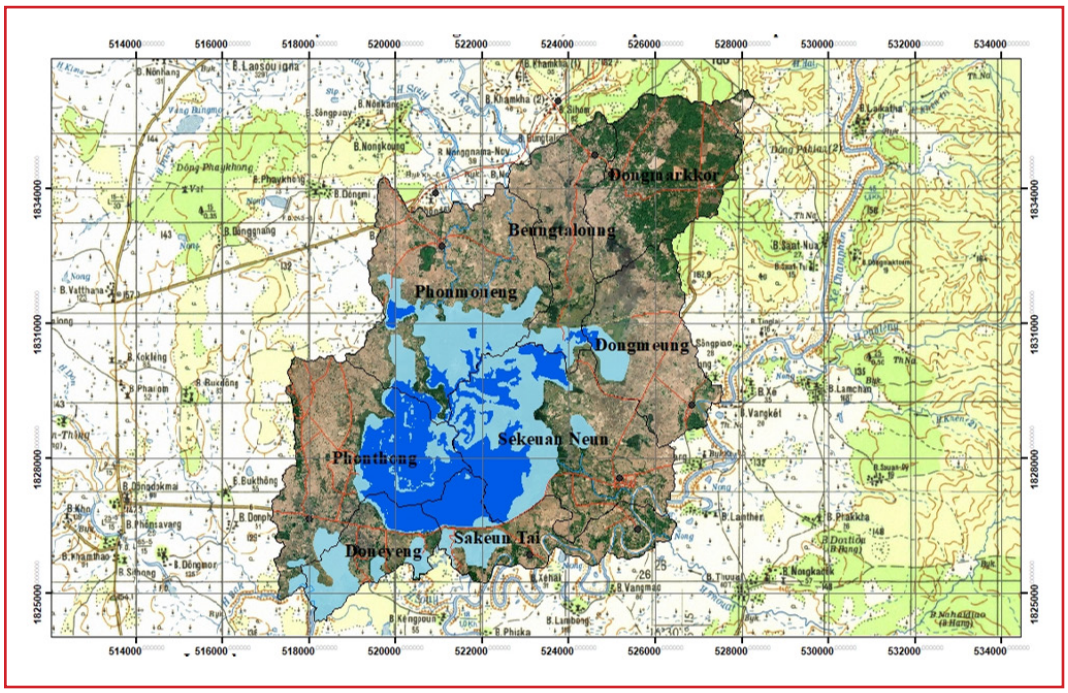

Figure 2. Study area at Sui Lake in Xechamphone wetland

provided a final opportunity for knowledge sharing and clarified the operational roles of the eight targeted villages in managing Sui Lake as shown in Figure 3. This step was essential for transforming the co-designed articles into a functional governance tool that the community feels empowered to use and enforce.

Community involvement and Social Inclusion, consultation meetings: Initial baseline data were gathered through broad based consultation meetings with the eight targeted villages. These sessions provided a platform for preliminary dialogue on wetland use and climate concerns.

Key Informant Interviews (KII): Targeted interviews were conducted, with Village Chiefs and Heads of Village Clusters. These KIIs were instrumental in capturing high-level insights into the overall socio-economic status of the villages and the historical governance of Sui Lake villages [34,35].

Focus Group Discussions (FGD) and Surveying: To capture the lived experiences of the broader population, Focus Group Discussions (FGDs) were facilitated within each village. These were complemented by the administration of structured questionnaires to local residents. This combination allowed for a nuanced understanding of community-specific needs and values regarding the wetland ecosystem and climate adaptation strategies [36-39].

Data Analysis

Comprehensive fieldwork and data collection were successfully completed across all eight targeted villages. This phase prioritized a dual-track engagement strategy: broad-based consultation meetings with local community members and semi-structured interviews with village heads to capture their specific expectations and insights. A critical success factor in this process was the active participation of district authorities, who served as the primary spearhead for

Figure 3. Consultation meeting and policy dissemination at the target villages

coordinating with diverse stakeholders. This multi-level engagement ensured that the research was supported by both top-down administrative authority and bottom-up community buy-in [40-44]. To translate the qualitative findings from the field into a structured regulatory tool, the policy analysis was simplified and integrated into a comprehensive matrix in Table 1. This systematic approach allowed the research team to categorize the diverse community inputs into a formal governance structure. Following established academic protocols for public policy analysis, the framework consists of five essential components:

- Problem definition: Identifying the core environmental and climate-related challenges at Sui Lake as voiced by the eight targeted villages.
- Policy alternatives: Exploring various management options and regulatory models based on community-based adaptation (CBA) principles.
- Evaluation criteria: Assessing the social, economic, and ecological feasibility of each proposed article to ensure local acceptance.
- Policy recommendation: Selecting and refining the final 8 Articles that constitute the new management framework.
- Implementation strategy: Outlining the roadmap for enforcement, monitoring, and the distribution of the policy booklets.

By utilizing this structured methodology, the research ensures that the resulting articles are not only technically sound but also practically implementable and aligned with the socio-economic strategy of the district [45-47].

Results

To evaluate community consensus and validate the co-designed articles, the research employed the Likert Scale (Table 2), a widely recognized and essential rating instrument for quantifying qualitative data [48, 49]. This approach was utilized to simplify and standardize the considerations and feedback provided by the respondents regarding the proposed management framework [48, 50].

The research utilized a 5-point Likert scale to measure the level of agreement with each of the policy articles: 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree.

Table 2. Likert scale and respondents' relationship.

No	Villages	Policy content (Articles) Likert scales 1-5 (1: strongly disagree, 2: disagree, 3: Neutral, 4: agree, 5: strongly agree) and respondents							
		1. Policy Objectives	**2.** Scope of Application	**3.** Community Rights	**4.** Prohibits	**5.** Penalty Standards	**6.** Incentives for Working Groups	**7.** Implementation Strategies, and	**8.** Effectiveness Measures
01	Phonthong	1:0,2:0,3:9, 4:220 and 5:0	1:0,2:0,3:9, 4:220 and 5:0	1:0,2:0,3:0, 4:229 and 5:0	1:0,2:0,3:0, 4:0 and 5:229	1:0,2:0,3:0, 4:0 and 5:229	1:0,2:0,3:0, 4:0 and 5:229	1:0,2:0,3:0, 4:0 and 5:229	1:0,2:0,3:0, 4:0 and 5:229
02	Doneyeng	1:0,2:0,3:2, 4:172 and 5:0	1:0,2:0,3:2, 4:172 and 5:0	1:0,2:0,3:0, 4:174 and 5:0	1:0,2:0,3:0, 4: 0 and 5:174	1:0,2:0,3:0, 4: 0 and 5:174	1:0,2:0,3:0, 4: 0 and 5:174	1:0,2:0,3:0, 4: 0 and 5:174	1:0,2:0,3:0, 4: 0 and 5:174
03	Sakuen neau	1:0,2:0,3:0, 4:216 and 5:0	1:0,2:0,3:0, 4:216 and 5:0	1:0,2:0,3:0, 4:216 and 5:0	1:0,2:0,3:0, 4:0 and 5:216	1:0,2:0,3:0, 4:0 and 5:216	1:0,2:0,3:0, 4:0 and 5:216	1:0,2:0,3:0, 4:0 and 5:216	1:0,2:0,3:0, 4:0 and 5:216
04	Sakeun tay and Lamphan	1:0,2:0,3:5, 4:205 and 5:0	1:0,2:0,3:5, 4:205 and 5:0	1:0,2:0,3:5, 4:205 and 5:0	1:0,2:0,3:0, 4:0 and 5:210	1:0,2:0,3:0, 4:0 and 5:210	1:0,2:0,3:0, 4:0 and 5:210	1:0,2:0,3:0, 4:0 and 5:210	1:0,2:0,3:0, 4:0 and 5:210
05	Dongmeung	1:0,2:0,3:0, 4:114 and 5:0	1:0,2:0,3:0, 4:114 and 5:0	1:0,2:0,3:0, 4:114 and 5:0	1:0,2:0,3:0, 4:0 and 5:114	1:0,2:0,3:0, 4:0 and 5:114	1:0,2:0,3:0, 4:0 and 5:114	1:0,2:0,3:0, 4:0 and 5:114	1:0,2:0,3:0, 4:0 and 5:114
06	Phonmouang	1:0,2:0,3:0, 4:386 and 5:0	1:0,2:0,3:0, 4:386 and 5:0	1:0,2:0,3:0, 4:386 and 5:0	1:0,2:0,3:0, 4: 0 and 5:386	1:0,2:0,3:0, 4: 0 and 5:386	1:0,2:0,3:0, 4: 0 and 5:386	1:0,2:0,3:0, 4: 0 and 5:386	1:0,2:0,3:0, 4: 0 and 5:386
07	Dongmakor	1:0,2:0,3:5, 4:100 and 5:0	1:0,2:0,3:5, 4:100 and 5:0	1:0,2:0,3:5, 4:100 and 5:0	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105
08	Beungtaloung	1:0,2:0,3:2, 4:103 and 5:0	1:0,2:0,3:2, 4:103 and 5:0	1:0,2:0,3:2, 4:103 and 5:0	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105	1:0,2:0,3:0, 4:0 and 5:105

Discussion

By applying this scale, the research team was able to consolidate the subjective opinions of the villagers into measurable data. The analysis of these responses, as detailed in Table 1, provides empirical evidence of the high level of community support for the policy framework, ensuring its social legitimacy and long-term viability. The Likert scale analysis as detailed in Table 1 reveals an overwhelming consensus among the respondents regarding the proposed management framework. A critical finding across all eight villages is the unanimous (100%) "Strongly Agree" response for Articles 4 through 8, which cover Prohibitions, Penalties, Working Group Benefits, Implementation, and Effectiveness. This indicates a high level of community readiness to adopt and enforce the new regulations

The specific responses for each village are summarized below:

- Phonthong Village : Figure 4 indicates that while 9 respondents (3.93%) "Agree" with Articles 1-3, the vast majority (96.07%) "Strongly Agreed." For Articles 4-8, 100% of the 229 respondents "Strongly Agree."
- Doneyeng Village: As shown in Figure 5, 1.14% of respondents "Agree" with Articles 1-2, while 98.85% "Strongly Agree" with Article 3. All 174 respondents (100%) "Strongly Agree" with Articles 4-8.

- Sakeun Neua Village: Figure 6 depicts a perfect consensus, with all 216 respondents (100%) “Strongly Agree” with every article 1-8.
- Sakeun Tay and Lamphan Villages: Figure 7 shows that 2.38% “Agreed” and 97.62% “Strongly Agree” with Articles 1-3, while 100% “Strongly Agree” with Articles 4-8.
- Dongmeung Village: Figure 8 presents a unique split where 100% of respondents “Agree” with Articles 1-3, shifting to 100% “Strongly Agree” with Articles 4-8.
- Phonmouang Village: Figure 9 expresses total agreement, with 386 respondents (100%) “Agree” with Articles 1-3 and “Strongly Agree” with Articles 4-8.
- Dongmakor Village: Figure 10 demonstrates that 4.76% “Agree” and 95.24% “Strongly Agree” with Articles 1-3, while 100% “Strongly Agree” with Articles 4-8.
- Beungtaloung Village: Figure 11 shows that 1.9% “Agree” and 98.09% “Strongly Agree” with Articles 1-3, with a unanimous 100% “Strongly Agree” response for Articles 4-8.

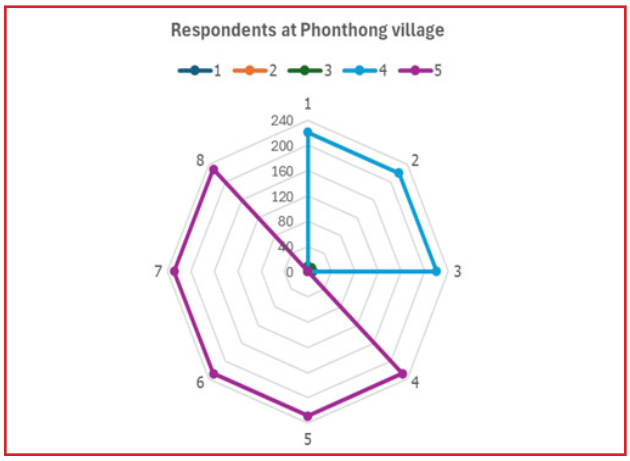

Figure 4. Respondents at Phonthong village

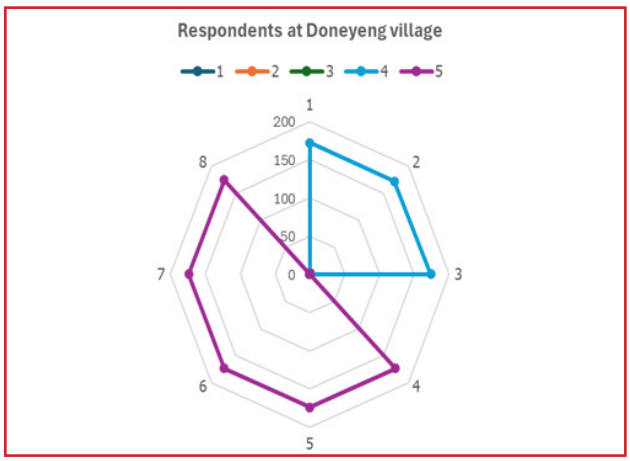

Figure 5. Respondents at Doneyeng village

Analytical Synthesis

The data confirms that the "Regulatory Articles" (4-8) received even higher intensity of support than the "Introductory Articles" (1-3). This suggests that the local communities of Sui Lake prioritize clear rules and enforcement mechanisms to protect their livelihoods against climate risks and ecosystem degradation.

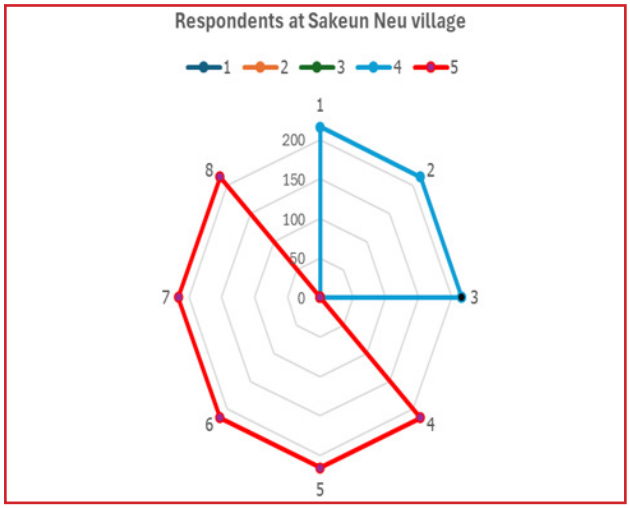

Figure 6. Respondents at Sakeun Neu village

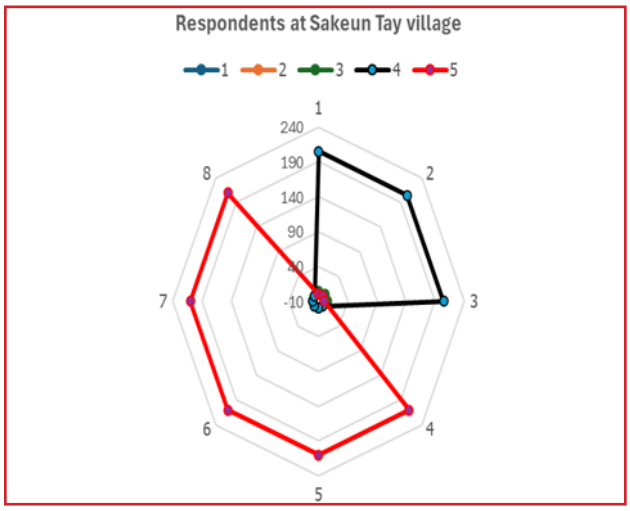

Figure 7. Respondents at SakeunTay villages

Community based adaptation is a take action by the local communities to cope with climate change issues, based on the process of policy engagement, consultation meeting and public hearing from local communities, the research team indicated that local knowledge and co-design are very important to the policy context and also details of articles that specifies on the policy, due to there are several ideas, insights and also their aspects during filed work, therefore, it is drafted by research team and district authorities officers to simplify as initial draft policy, then there were consultation and share with 8 villages in order to have inputs and finalize the draft, finally, there are 8 articles such as: 1. Policy Objectives, 2. Scope of Application, 3. Community Rights, 4. Prohibitions, 5. Penalty Standards, 6. Incentives for Working Groups, 7. Implementation

Strategies, and 8. Effectiveness Measures, therefore, outcome of the research is indicated the final policy that is summarized and debrief as indicated in Table 3.

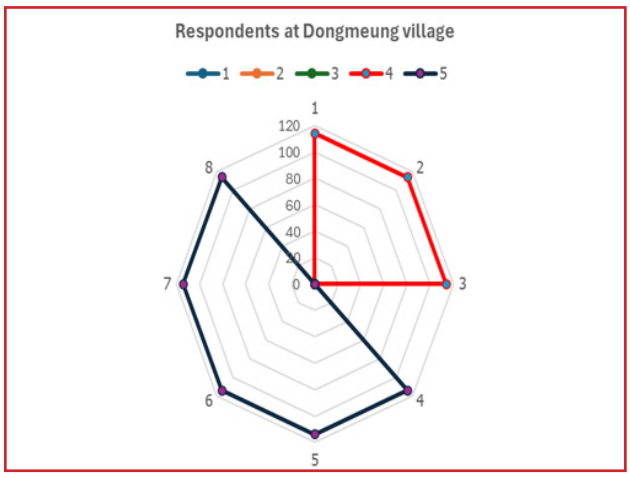

Figure 8. Respondents at Dongmeung villages

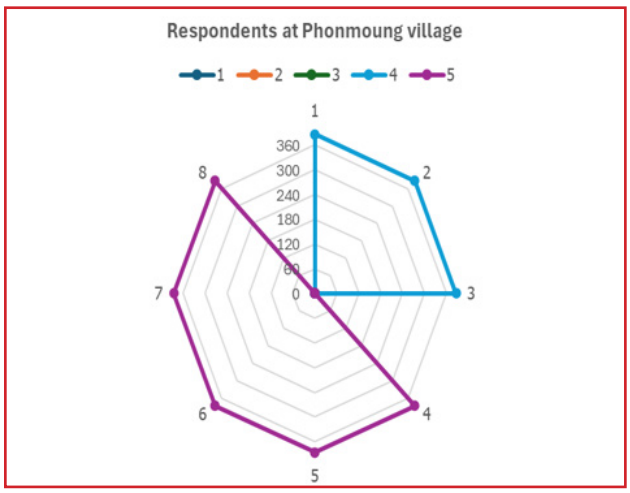

Figure 9. Respondents at PhonMoung village

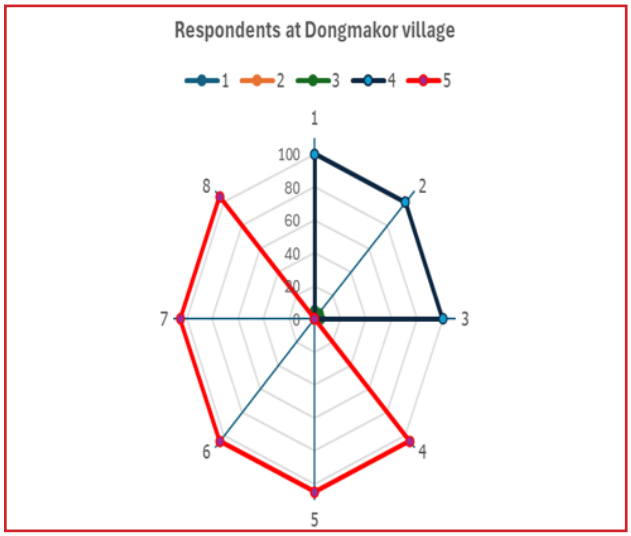

Figure 10. Respondents at Dongmakor village

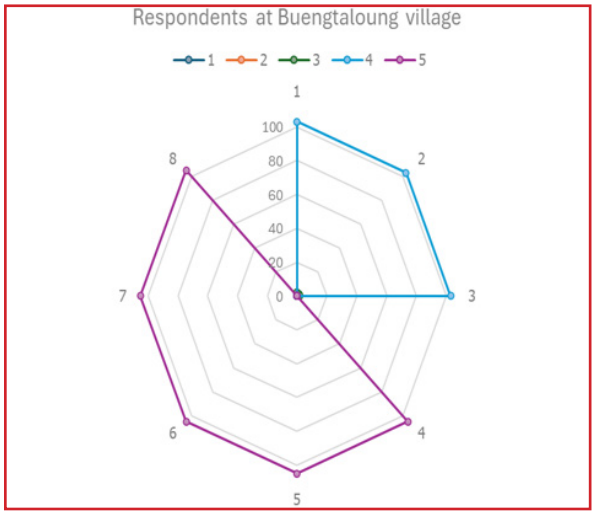

Figure 11. Respondents at Buengtaloung villages

Table 3. Summary of the articles

Articles	Context of summary/debrief
Article 1: Policy Objectives	Chapter I: General Provision To ensure that all activities of development is to follow the green direction and sustain and also contribute to leverage gradually the quality of local livelihood
	Chapter II: water, water resource and wetland management principles
Article 2: Scope of Application	There are 8 target villages namely Phonthong, Doneyeng, Sakuen neau, Sakeun tay, Dongmeung, Phonmouang, Dongmakor and Beungtaloung will be used the policy: 1. To ensure that manage, use, conserve and prevent water, water resource and wetland to follow the green direction. 2. Align with the National Social Economic Development Plan, water strategic development, integrated water recourse management. 3. To prevent significantly water, water resource and wetland 4. To ensure that all stakeholders (private sectors, entities and organization) will be involved importantly in planning, utilization and water protection, water resource and wetland. 5. To be responsible sustainably for damage on water, water resource and wetland and wetland.
	Chapter III: Prohibits
Article 3: Community Rights	Water, water resource and wetland are able to use as below: 1. To use water for livelihood of local comunities such as: fishing,Non timble forest product, irrigated paddy rice, wet paddy rice and other vegetables or crops (conservation area). 2. To use on irrigation, agriculture and forest production, livestock and fisheries 3. Waterway, study tour and researh area 4. Recreation, tourism in future and biodiversity for medical 5. To utilize on conservation,traditional, release fish,turtle birds and others,
Article 4: Prohibitions	Prohibits on private sectors, entities or organization on action as below: 1. To prohibit on allocating, buy and sell on wetland to develop the activities without authorized. 2. To prohibit on any construction, within the wetland boundary and conservation area that will be impacted on water quality and environment without authorized. 3. To prohibit on digging, landing up, destroy drainage system or block water and other activities that causes on erosion without authorized. 4. To prohibit on waste water, chemicals and other activities that impact on biodiversity and ecosystem. 5. To prohibit on hunting the aquatic-wildlife and use tools that is illegal such as batteries, poison, guns and other tools.
	Chapter IV: Policy on Good practices and measure on disobey
Article 5: Penalty Standards	**i.** Allocating, buying and selling on wetland to develop the activities without authorized will be fined as below: 1. First time 1: 10,000,000 LAK/person/time, taking over the things, panalty record, warning and destroy the barriers. 2. Second time 2: 20,000,000 LAK/person/time, taking over the things, penalty record, warning and destroy the barriers 3. Third time 3: 50,000,000 LAK/person/time, taking over the things, penalty record, warning, destroy the barriers and proceed to next step of the laws. **ii**.Any construction, within the wetland boundary and conservation area that will be impacted on water quality and environment without authorized will be fined as below: 1. First time 1: 10,000,000 LAK/person/time, taking over the things, panalty record, warning and destroy the barriers. 2. Second time 2: 20,000,000 LAK/person/time, taking over the things, penalty record, warning and destroy the barriers 3. Third time 3: 50,000,000 LAK/person/time, taking over the things, penalty record, warning, destroy the barriers and proceed to next step of the laws.
Article 6: Incentives for Working Groups	1. Secretariats and coordinator will be received 5 % of the penalties value. 2. For those who gives hints will be received 20 % of the penalties value. 3. For the survey team will be received 25 % of the penalties value. 4. For the management team will be received 50 % of the penalties value.
	Chapter V: Final provision
Article 7: Implementation Strategies	District office of Agriculture and Environment will coordinate and work with relevant district offices, local communities and water user group to support, monitor and implement strictly based on their roles and responsibilities.
Article 8: Effectiveness Measures	The policy is effective, when signing onward

Conclusions

In summary, policy engagement and co-design on wetland management based on communities-based adaptation, it is a social inclusion and process to brainstorming and co-design effectively, hence, it is very useful and crucial when designing and established the regulations or policies. therefore, according to the research findings, likert scale indicated significant findings, essentially, there is no significance of respondents on disagree or strongly disagree on the articles whereas the respondents are agreed and strongly agreed on the policy. The policy is established which includes: 5 charters and 8 articles, it is agreed by 8 villages and approved by district governor, then it could be tool and significant impact to wetland management, through several multi-stakeholders' consultation meeting among of district authorities and local communities. Therefore, it is produced as booklets, hand overed to local community for their use implement through 8 villages.

This study is provided and brought the significant policy for local community to manage and prevent the wetland for long term sustainability and based on centered-local community, due to the wetland is recognized as" Ramsar site", therefore, the policy can be as a good tool to support local community to use and implement in order to prevent the wetland and ecosystem within Ramsar, additionally, the policy can revise and update, if there is consistence with the facts.

In addition, the findings of this research demonstrate that the Sui Lake Management Policy represents a significant milestone in local governance. Because the framework was established through direct community involvement and a sense of collective ownership, it transcends being a mere administrative document to become a practical tool for environmental conservation.

Article 4 (Prohibitions): This article establishes the "red lines" for resource use. Strict awareness and transparent communication are essential during implementation to ensure that all users understand what is restricted, thereby preventing accidental violations. Article 5 (Penalty Standards): As noted in the field consultations, this is a highly sensitive component. While standardized penalties provide a significant deterrent against ecosystem degradation, their application must be handled with transparency and fairness. Since these penalties were co-designed by the community, they carry greater social legitimacy, but the district must ensure they are enforced consistently to maintain public trust.

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Conflicts of Interest

The author has no conflicts of interest to declare.

Author Contributions

Phoummixay Siharath: writing-original draft preparation. **Vilas Nitivattananon:** writing-review & editing. **Rajendra P. Shrestha:** writing-review & editing. **Somchay Vilaychaleun:** data analysis, conceptualization, writing-review & editing. **Chankhachone Sonemanivong:** conceptualization, methodology, supervision.

Data Availability Statement

All the data is available in this article.

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