Sustainable Knowledge, Understanding, and Public Participation in the Construction of Water-Retaining Structures: A Case Study of Kamphaeng Sao Subdistrict, Muang District, Nakhon Si Thammarat Province, Thailand

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Abstract

This study investigates the realms of 1) Level of the knowledge and understanding in the construction of water-retaining structures, and 2) Public participation pertaining to the construction of water-retaining structures. Employing a mixed-method approach, it combines both quantitative and qualitative research techniques. For quantitative research, a questionnaire-based survey was conducted on 363 Rural Community Members in Agriculture, underwent scrutiny through measures such as frequencies, percentages, mean, and standard deviation. Concurrently, qualitative data emanated from interviews and observations conducted with 29 key informants, comprising community members engaged in agriculture, government officials, students, and leaders. The findings of the study were as follows: 1) Level of the knowledge and understanding in the construction of water-retaining structures, in all aspects was high spanning various facets of construction, including land surveys, design, materials, site planning, and the construction process itself. 2) Public participation: the participants exhibited a profound understanding of water-retaining structure erection, underlining the significance of public participation. Community-driven construction of water-retaining structures promotes decision-making, unity, and mutual benefits. Utilizing local resources, especially bamboo, aids environmental preservation. The adoption of bamboo weirs enhances cooperation, ensuring year-round water access and strengthening community bonds. Decentralized responsibilities foster collaboration, improving community relationships. These structures yield intellectual, economic, and social gains, benefiting agriculture and reducing drought risks. Ongoing evaluation and stakeholder collaboration ensure project success, enhancing community knowledge, understanding and sustainability. This collaborative culture encourages inclusivity and long-term stability, reducing external support dependency.

Keywords: Public participation, Sustainability, Construction, Water-retaining structures

Introduction

The problem macro- overview regarding the use of water resources in Thailand, including the construction of dams to block the flow to store water for use throughout the year by government agencies. Take responsibility by pointing out issues of incorrect water use with the knowledge and understanding of general water users. The southern region of Thailand continues to grapple with torrential rainfall; however, as it transitions into the hot season, certain pockets confront drought conditions, marked by low humidity and extremely hot weather. The Thai Meteorological Department predicts a looming water scarcity trend. Consequently, local communities, in their bid to alleviate the agricultural hardship exacerbated by drought conditions and provide timely assistance to affected farmers, are resorting to a wellspring of traditional wisdom: the construction of "Fai Cha Lor Nam" or water- retaining structures. These structures play an instrumental role in assisting disaster-affected individuals and ameliorating the agricultural adversities wrought by drought (The Center for Monitoring and Addressing Agricultural Disaster Risks in Nakhon Si Thammarat Province, 2023).

Water- retaining structures, constructed manually to store water and forestall flooding, serve as the bulwark against the perilous waters originating from rivers and streams, particularly during the rainy season. Moreover, these structures offer a myriad of benefits, including shielding against soil erosion and retaining moisture for an extended duration. Water- retaining structures play a pivotal role in fortifying biodiversity, thereby benefiting insects, wildlife, and a diversity of plant species. Furthermore, they serve as reservoirs during periods of drought. These structures are crafted from indigenous materials, such as wood and stones. The construction process commences by carving wooden elements and positioning poles as markers. In areas with sandy soil, sandbags are deployed within the structure, whereas rocky terrain sees the placement of rocks. The size of the water- retaining structure correlates with the dimensions of the stream it intends to service, thereby augmenting the water supply for agriculture during arid seasons (Department of Nature Conservation and Land, 2023; Warakul, & Buddhawong, 2015).

Within the confines of Kamphaeng Sao Sub- district, Mueang District, Nakhon Si Thammarat Province, several water-retaining structures have been erected in diverse locations. In light of the escalating problem of water scarcity within the agricultural sector, the imperative to introduce comprehensive water management strategies has gained prominence. The construction of water-retaining structures has emerged as a pivotal remedy for alleviating water scarcity and enhancing the moisture content in forested areas. Various stakeholders have been at the vanguard of encouraging the proliferation of these structures, serving as a source of inspiration for community collaboration and engagement in this endeavor. Notably, this project has been achieved without the utilization of government funds, with community members contributing both resources and labor toward the realization of the project's central objectives. The initiative was inaugurated through a collective discussion, followed by consensual decision-making and hands-on implementation. Expert consultants and mentors were enlisted to augment knowledge transfer, drawing from the expertise of local villagers skilled in the art of crafting water-retaining structures from bamboo. These artisans harnessed sand from nearby streams and employed techniques involving the knotting of ropes from the water source to the structure's terminus (Ok Nation, 2015). The preservation of forests and water resources holds cardinal importance, especially for communities residing in these regions, who are reliant on the symbiosis of forests and water sources to sustain their livelihoods. This reliance becomes particularly conspicuous when communities can judiciously harness forests and water for agricultural benefits, contingent on the seasons. Consequently, the equilibrium of forests and water resources assumes paramount significance, empowering communities to become

self-sufficient and ensure their long-term survival (Nikornkul et al., 2018). Villagers in community have a way of life that is bound to nature, dependent on each other in terms of occupation and livelihood. The villagers in the community understand the conservation upstream forest. People pay great attention and realize the importance of watershed forests, and construction of water-retaining structures (Mangana & Vetchapitak, 2020). The community has adeptly harnessed traditional wisdom to construct efficient water-retaining structures, using wooden stakes for support and logs as foundations to manage water flow and sediment retention. Furthermore, steel mesh containers are deployed to secure stones; thus, reinforcing structural stability. The conservation and management of natural resources have been devised as participatory endeavors, aimed at preserving the ecosystem's delicate balance. Local knowledge and indigenous wisdom have been seamlessly integrated into the management framework, effectively facilitating knowledge dissemination (Sukkorn, 2014).

The consolidation and promotion of collaboration among urban sectors that have embraced water-retaining structures have yielded substantial economic benefits for the community. Specifically, the agricultural regions have become more fertile, benefitting from an augmented water supply, which efficiently averts flooding and regulates water flow. These measures boost the chances of encountering a richer diversity of fish species. Moreover, an exhaustive analysis of cooperation models, derived from comprehensive studies and research materials, serves as an indispensable blueprint for the success of this project (Yotarak, et al., 2019). The involvement spans decision-making, implementation, public participation in benefits, and engagement in evaluation and follow-up processes (Cohen & Uphoff, 1981; Wattanasiritham, & Phetmak, 2008; Puang-ngam, 2016). Therefore, we embark on the exploration: 1) Level of the knowledge and understanding in the construction of water-retaining structures, and 2) Public participation pertaining to the construction of water-retaining structures, using Kamphaeng Sao Subdistrict, Muang District, Nakhon Si Thammarat Province, Thailand, as our case study. The research objective emphasizes the study of knowledge and understanding about water storage correctly and correctly in order to use water resources systematically and sustainably. Water users must have knowledge about storing water to be sufficient for use. The central query revolves around the depth of knowledge, involvement, and sustainability in the creation of water-retaining structures. This holistic insight can potentially inform policy recommendations for pertinent entities, such as local government organizations and water management authorities in the area. This initiative aims to serve as a model for collaboration across all sectors. Sustainable public participation in water-retaining structure construction not only fosters economic prosperity by generating fresh income for the community and participants, particularly during activities associated with these structures but also augments earnings for local tourism and food industries in the vicinity. Furthermore, the social advantages include the consolidation of the community through activities pertaining to water-retaining structures, thereby providing opportunities for individuals to congregate, share experiences, and enrich their knowledge and understanding of cultural innovations and water-retaining structures. This, in turn, fortifies interpersonal bonds and mutual support within the community.

Literature Review

The context of Kamphaeng Sao Subdistrict, and Water- Retaining Structures: Kamphaeng Sao Subdistrict includes nine villages, namely Village 1 Suan Phol, Village 2 Na Nod, Village 3 Yan Suea, Village 4 Chan, Village 5 Tin Na, Village 6 Klang, Village 7 Huai Prang, Village 8 Paeng Sao, and Village 9 Nong Lung. The area offers a population of 8,193 individuals, with 80 percent actively engaged in agriculture. Their agricultural endeavors include the cultivation of economically significant crops, including durian, longan, rubber, cassava, and various other plants. The subdistrict covers an approximate area of 38.43 square kilometers, characterized by flat terrain and natural water sources, featuring four streams, one canal, and three rivers. Given the predominant focus on rubber plantations, fruit orchards, and crops, water scarcity issues frequently afflict the residents. Consequently, it becomes imperative to institute comprehensive water management strategies to tackle these water scarcity challenges. Hence, the construction of water-retaining structures in Kamphaeng Sao Subdistrict, Mueang District, Nakhon Si Thammarat Province, emerges as a pivotal solution to address the escalating water shortage and augment local moisture levels. The project actively encourages the involvement of diverse stakeholders, inspiring the community to join forces in this endeavor. Furthermore, the initiative entails contributions of resources and labor without reliance on government funding, aiming to empower the community and emphasize their public participation in the transformative process. The project commences with the collective generation of ideas and collaborative decision-making. Subsequently, the project transitions to the implementation phase, with the engagement of expert advisors and mentors providing guidance, drawing from the expertise and wisdom of local residents skilled in constructing water-retaining structures from bamboo, employing local sand, and utilizing techniques for tying ropes from the water source to the endpoint (Office of the Kamphaeng Sao Subdistrict Administrative Organization, 2023; Department of Health Service Support, 2023).

General Knowledge about Water- Retaining Structures: Community Organizations Development Institute (2016) highlights water-retaining structures as a means of water management, reviving local wisdom while nurturing an ecosystem that coexists harmoniously with society, improving the local economy through self-sustained practices, and rejuvenating traditional community support systems. Rakchim (2016) underscores that water-retaining structures represent a local wisdom that has emerged in the southern region of Thailand, aiming to employ natural materials within the community to address issues related to flooding, water scarcity, and groundwater resources. During the rainy season, these structures play a pivotal role in water storage and flood prevention in agricultural areas, while they release water during dry spells, ensuring a consistent year-round water supply. The Office of Conservation and Restoration of Water Sources (2017) emphasizes that water-retaining structures, also known as check dams, serve as tools for creating moisture, conserving and restoring forests, reinstating river source fertility, and promoting biodiversity. These structures act as barriers placed in small streams, rivers, or sloped areas to control water flow. Moreover, the preparation and construction of check dams, as mentioned: Sasadee et al. (2018) mention the use of mixed check dams in constructing hybrid check dams, utilizing natural materials such as branches, trees, sand, soil, rocks, and gravel, following regional wisdom and site suitability. The Royal Irrigation Department (2016) outlines the construction steps for check dams based on the royal initiative, which includes surveying suitable topography or riverbeds, specifying the type and design, and planning the construction. It further stresses the need for adhering to specified design, size, and materials, ensuring the dam's strength to withstand water flow without disrupting the ecosystem.

The concepts and theories related to public participation: The concepts and theories related to public participation, as discussed by Thongkachock & Thongkachock (2017) and Hanghon et al. (2018), describe the promotion of community and public participation and the

necessary regulations that should exist in the form of local laws. The public participation of citizens, community organizations, local leaders, local government agencies, state agencies, and private sectors fosters collaborative thinking, decision-making, problem-solving, shared benefits, and joint evaluation. On the other hand, Songdechtar (2021) discusses the concept revolving around the requirement of public participation and the implementation of comprehensive and inclusive strategies to engage stakeholders effectively. This entails the strategic coordination of operations across all sectors, the formulation of pragmatic policies, plans, projects, or initiatives that align with community-centric policies. These endeavors are aimed at improving the quality of life within the community, including the identification of issues, planning, execution, and the assessment of these initiatives. Public participation is a dynamic process in which the community actively engages in decision-making, starting from issue identification, through project engagement, and extending to monitoring and evaluation. This process guarantees that budget allocations are warranted for community development, ultimately leading to an improved quality of life within the framework of public participation. The United Nations (1998) discusses forms of public participation that include voluntary or self-organized engagement, where individuals or groups independently address issues without external aid. This form of public participation is self-initiated and operates independently without dependence on third-party support. It can be incentivized but requires government endorsement. This model is prevalent in developing countries. Mandatory public participation takes place when involvement is aligned with government policies, enforced by government authorities or coercion. Those who transgress these mandates face immediate repercussions, although these lack any lasting impact, as they lack public support and yield no positive outcomes.

Also, Phongphook, & Bodeerut (2021) proposed plans and decisions for the local community to collaborate effectively in development meetings. Both the community and the natural environment are pivotal to the development process, requiring collaborative endeavors and local-level coordination. Operations and practices are executed under the oversight of a village development committee, and the involvement of the local community improves the progression. The community's cooperation in the process is predicated on individual benefits. Nevertheless, these advantages can precipitate conflicts within the community. Moreover, there is an absence of ongoing monitoring and evaluation conducted by the community, which has repercussions for long-term sustainability in the future. Bungmoom & Zumitzavan (2018) state that public participation involves community engagement in local development, beginning with problem identification, cause analysis, and finding solutions. The aim is to define operational procedures and techniques that align with the local setting and its potential. Promoting internal educational sources and employing technology facilitate convenient access to information and expression of viewpoints. Public participation serves as a vital foundation, ensuring that all community members can enjoy a content and sustainable existence in their area. Building upon the framework proposed by Muhammad-Ali et al. (2023), a cooperation and public participation network has been established within the community. Public relations campaigns serve to disseminate knowledge, motivate, and raise awareness. Adequate resources, equipment, personnel, and budget allocation should be made accordingly. In line with the findings of Andrew & Stiefel (1979), public participation includes involvement in decision-making, engagement in implementation processes, public participation in reaping benefits, and engagement in evaluations. As per Pricklek et al. (2022), in summary, public participation includes participating in decision-making, engaging in implementation processes, taking part in reaping benefits, and participating in evaluations.

Cohen & Uphoff (1981) Wattanasiritham, & Phetmak (2008, and Puang-ngam (2016), The specified forms of public participation are as follows: Decision Making: This entails active engagement in decision-making processes through discussions, mutual consultations, and the

selection of activities or directions deemed most appropriate or optimal. Decisions are reached collaboratively to plan for development, formulate policies, define objectives, methods, strategies, and allocate resources. Implementation: This entails offering support for resources, participating in management, and coordinating collaborative endeavors. It involves actively participating in the execution of activities. According to Namburi (2019), discussing public participation in implementation entails contributing by aiding with financial resources, materials, and labor, or engaging in the management of tasks, coordinating efforts, and seeking external assistance. The aim is to collectively achieve the shared goals of the group and promote a sense of unity and shared responsibility within the community. Public participation in reaping the benefits is also crucial. Khamphilaanont (2007) highlights that community benefits from activities include material, social, and personal gains, both tangible and emotional. Public participation in evaluation involves the engagement of the community in assessing project outcomes through various processes, which drives the entire development process. This process places emphasis on planning, implementation, and the collective utilization of benefits. It is of utmost importance to participate in a comprehensive, suitable, feasible, and beneficial evaluation and monitoring process to ensure successful development according to the objectives (Supawong & Rattanachuwong, 2022; Joomsoda, & Tirasuwanvasee, 2022). From the perspectives of various scholars, including Maslow (1943) and Balraj (2017), who address human necessities with a special emphasis on water as vital for survival, public participation becomes a guiding principle in management. This fosters cooperation to enhance community benefits. Active community involvement, efficient budget utilization, resource management, conflict reduction, and responsiveness to needs all contribute to increased community cohesion and attachment, creating a more tightly knit community.

The related research studies: Mangana & Vetchapitak (2020) highlighted that the community's way of life is intricately tied to nature, relying on it for both their livelihoods and living conditions. Villagers comprehend the vital role of conserving watershed forests and actively participate in the construction of check dams aligned with their needs. Community-based research informs their decisions, and adequate funds and resources are made available through donations. Villagers possess a strong sense of responsibility for conserving natural resources, which fosters pride and unity within the community. Varitwuttikul et al. (2021) found that communities across different areas experience common water issues such as drought, flooding, erosion, and scarcity. These problems are exacerbated by insufficient water storage. Community-led efforts involve the construction of storage facilities, check dams, and erosion barriers to mitigate challenges and ensure sustainable water management. Chasuwan & Sanpugdi (2019) emphasize that holistic water management, including the construction of check dams, necessitates the mobilization of resources and the engagement of communities at various stages. Collaboration at provincial and local levels, involving people, finances, materials, and expertise, is crucial. This approach fosters public participation, enabling them to identify issues, devise solutions, implement strategies, and monitor outcomes. Successful implementation relies on the resilience of structures, ensuring effective water distribution post-monsoon. This initiative positively impacts local economies, social well-being, and the environment, fostering sustainable development. Finally, Buntao & Thaochalee (2020) found that sustainable water management arises from applying the wisdom of the royal family in water management to address water issues in daily life. This is achieved by actively engaging community members and emphasizing collaboration as a crucial mechanism. Constructing check dams collectively is a significant component of this communal effort to ensure sustainable water resources.

Khamsaen, Chamnanputthiporn, & Yotharak (2018) underscore the importance of effective policy formulation, which stems from addressing people's concerns, translating problems into policies, and selecting optimal solutions. Governments launch water resource

initiatives, such as dams, involving communities in cooperative water management. Committees devise resource plans, which are subject to annual monitoring by government agencies. Public participation begins at policy creation, fostering self- sufficiency, and allowing locals to manage resources independently. In addition, Konwong et al. (2021) found that promoting water management involves large, medium, and small- scale systems. Government agencies have established procedures for planning and constructing water management infrastructure. Water allocation in downstream regions follows a systematic approach. Information is disseminated for water management, and user groups are formed to negotiate agreements concerning water usage in irrigation zones. Communities with robust capabilities maintain ongoing management committees. However, communities without management committees for water management structures often face damages. Panyasean et al. (2023) observed that raising awareness and enhancing the learning process of target groups and networks create a sense of forest conservation among people in the community. This engagement leads them to take part in various activities, including the establishment of firebreaks and the construction of water management infrastructure. Ajui et al. (2019) also found that there are initiatives to construct water management structures and conduct community forest development activities in collaboration with both government and private organizations. The transfer of knowledge and collaboration transpire between government officials and the community, with a focus on community forest management guided by a participatory and responsible approach to natural resource management within community forests.

Furthermore, Chiamsathit et al. (2020) address water scarcity by implementing initiatives like repairing water gates and constructing additional structures at water sources and ponds to increase storage capacity and reduce the impact of drought. Community committees, formed through participatory efforts, facilitate knowledge exchange and collaborative problem- solving, minimizing flooding and enhancing the community's resilience and understanding of effective water management. Pilert & Thanunrum (2018) observed that the community has gained a better understanding of its geographical landscape and has the potential to manage water resources effectively. This includes increasing surface water usage options and enhancing groundwater levels through the construction of water gates. They have also made innovations in developing simple household water filtration systems, with support from the sub-district administrative organization in allocating budgets to establish standardized water supply systems in the area, meeting domestic and consumptive water needs for the community. Moreover, Nikornkul et al.(2020) found that activities within the community forest area involve discussions, consultations, and negotiations between the government sector and the local community. Measures have been implemented to prevent forest fires and build water gates, guided by rules and regulations aimed at mutual benefits.

Based on these related research studies, it is essential to conduct follow-up activities as a crucial step after constructing water gates. This follow- up is essential to assess the success and effectiveness of the constructed water gates. Such monitoring will facilitate the gathering of data and experiences that can be utilized for future enhancements and advancements in water gate construction and water management. Additionally, this follow- up can provide valuable input for the efficient planning and management of projects related to water gate construction. Analyzing the outcomes of past water gate construction projects will help identify the most effective approaches and methods that yield optimal results and offer valuable insights for planning sustainable and efficient future projects. However, this research utilized the public participation concepts and theories proposed by Cohen & Uphoff (1981) and Pricklek et al. (2022) as a conceptual framework, as illustrated in Figure 1.

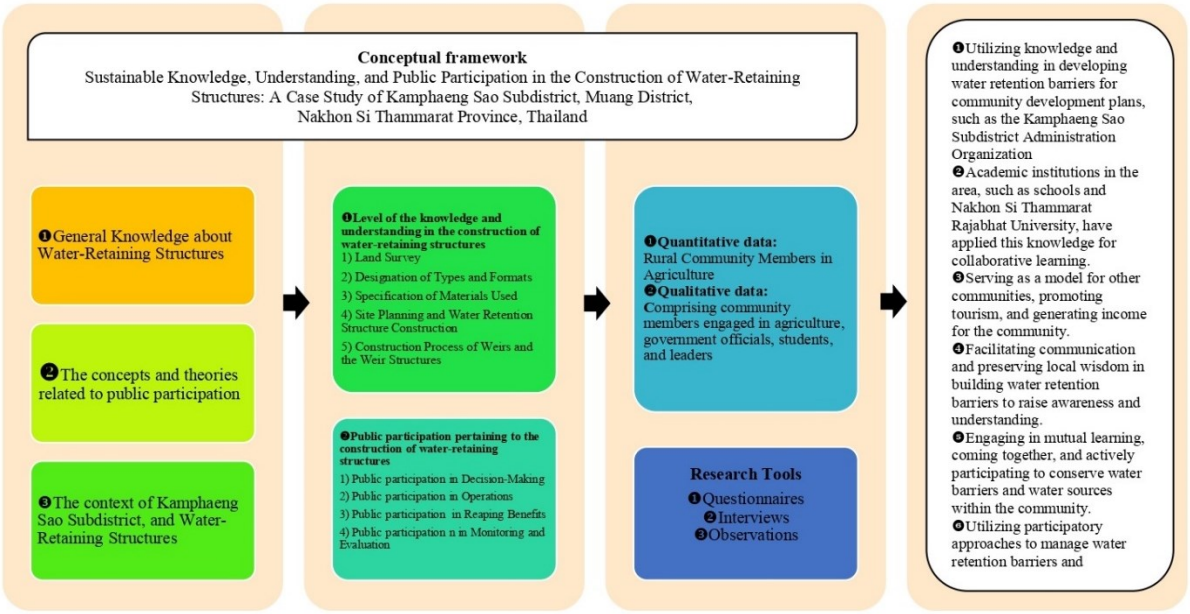

Figure 1 Framework **(**Researcher, 2024**)**

Methodology

Research model: This research employs a mixed- method approach, combining quantitative and qualitative research methods. It follows an explanatory sequential design, with an initial quantitative phase followed by a qualitative phase (Mahahing, & Thuraphun, 2022). The research process uses a combination of quantitative and qualitative research because we want to obtain study results that cover all dimensions.

Population and Sample Groups: Population: The population comprises residents in the agricultural sector of Kamphaeng Sao sub-district, including 9 villages, with a total population of 8,193 individuals. Approximately 80 percent of this population which totals 6,560 people, are engaged in agricultural occupations (Office of the Kamphaeng Saen Subdistrict Administrative Organization, 2023; Department of Health Service Support, 2023) . Sample Group: The sample group includes residents in the agricultural sector of Kamphaeng Sao sub- district, spanning 9 villages. The confidence level is set at 95 percent, with a margin of error of 5 percent. Consequently, the sample size is determined to be 363 individuals (Krejcie & Morgan, 1970). Non- probability sampling is employed in this study, which involves selecting a sample group without adhering to the principles of probability. This approach suits research focused on specific or specialized groups with characteristics aligning with predefined topics or conditions (Bunmak, 2021; Mahahing, & Thuraphun, 2022). The research sample selection uses a sample group that covers and has a stake in water storage in the province. It is a systematic selection of a representative sample that does not rely on probability in selecting the sample group.

Key Informants: Consisting of 29 individuals, the key informants group includes: 1) Rural Community Members in Agriculture: 9 individuals selected using purposive sampling in Kamphaeng Sao sub- district. Each represents one of the 9 villages, possessing knowledge, expertise, and experience in natural water management using traditional methods in Kamphaeng Sao sub-district, Mueang district, Nakhon Si Thammarat province. 2) Government Officials Group: Comprising 5 individuals chosen for their direct support and promotion of natural water management efforts. 3) Students and Participants Group: Including 6 students

and participants actively involved in natural water management activities, attending check dam construction sessions in the area more than 5 times per year. 4) Community Leaders Group: This group comprises 9 community leaders, with one representing each village in Kamphaeng Sao Subdistrict. They were selected as individuals with knowledge about check dam construction and who actively participate in building natural water management structures. Inclusion Criteria: Inclusion criteria for public participation in the study are individuals aged between 18– 70 years, residing in Kamphaeng Sao Subdistrict for at least 5 years, having experience and knowledge in check dam construction, displaying a volunteering spirit to participate in check dam construction activities, or having participated in the activity at least 5 times per year. Additionally, participants should have learned from, promoted, or benefited from check dam constructions in Kamphaeng Sao Subdistrict. Exclusion Criteria: Exclusion criteria for public participation in the study include individuals who are unable to participate during the specified time, experience discomfort or psychological stress, and wish to withdraw from the study at any point. Participants may also withdraw if they experience psychological discomfort during research interviews or activities. Additionally, individuals who pass away during the research process or are unable to provide information throughout the interviews due to urgent tasks or physical conditions are excluded.

Research Tools: 1) Research Tools Used in Quantitative Research: In the realm of quantitative research, the principal research instruments include questionnaires devised by researchers through a meticulous process. This process entails several stages, including a comprehensive literature review, analysis of pertinent documents, and the formulation of the questionnaire. To initiate, researchers explore concepts and theories pertaining to sustainable water- retaining structures from various sources, including books, documents, and related research endeavors. Subsequently, a comprehensive framework that encapsulates content and objectives is defined. The construction of the questionnaire is guided by this conceptual framework, and theories, divided into three distinct sections.

Part 1 is dedicated to gathering general demographic information about the respondents, such as their gender, age, level of education, monthly income, and marital status.

Part 2 focuses on delving into the understanding of water- retaining structure construction. This includes examining public participation in decision-making, engagement in practical activities, involvement in benefiting from the project, and public participation in monitoring and evaluation. This section is assessed using a Numerical Rating Scale with five levels, as delineated by Bunmak in 2021 (Bunmak, 2021). In this scale, five points denote the highest level of public participation, four points represent a high level, three points signify a moderate level, two points indicate a low level, and one point denotes the lowest level. Moreover, criteria have been established for interpreting the significance of the average scores pertaining to knowledge and comprehension in sustainable water- retaining structures, also according to Bunmak in 2021. These criteria entail an average score of 4.51 to 5.00, indicating the highest level; an average score of 3.51 to 4.50, indicating a high level; an average score of 2.51 to 3.50, indicating a moderate level; an average score of 1.51 to 2.50, indicating a low level; and an average score of 1.00 to 1.50, signifying the lowest level.

Part 3, which deals with problems and suggestions, consists of open- ended questions. Following the completion of the questionnaire, the subsequent step involves an assessment of the tool' s quality. The questionnaire, once developed, is subjected to scrutiny by five experts to make necessary adjustments and improvements for suitability. These experts meticulously review the content and structure of the questions. Subsequently, questions that attain an IOC (Item-Objective Congruence) index within the range of 0.80 to 1.00 are selected for a trial run, employing a sample group comprising 30 individuals. This sample group shares similar characteristics with the research sample but is not part of the actual study, as articulated by Worabumrungkul and Wongsasilchai in 2017. Following this, the reliability of the tool is

determined using Cronbach's Alpha coefficient method, as proposed by Cronbach in 1990. The research yielded a coefficient of 0.850, as documented by Worakam in 2019. After revising and confirming the accuracy of the questionnaire, it will be finalized and printed in its entirety. This final version will be distributed to the sample group for the upcoming research study.

Regarding the qualitative research tools, the following methodologies were employed: 1) Interviews: Researchers conducted in-depth interviews related to sustainable water-retaining structures. The process of constructing these interviews involved an examination of concepts and theories from sources such as books, documents, and pertinent research works. These were structured within a framework that outlines the content and objectives. Questionnaires were developed based on this specified framework and theories, following established protocols. The interview itself is structured into three sections: Part 1 covers general information about the interviewees. Part 2 centers on sustained public participation in sustainable water-retaining structures, including involvement in decision-making, practical activities, benefit reception, and follow-up evaluation. Part 3 addresses issues and suggestions. A quality-checking process entails seeking recommendations from advisors and experts to assess the tools created. Subsequently, modifications are made to adapt the tools appropriately for interviewing key informants. 2) Observation Record Form: Researchers employed both participatory and non-participatory observation methods. Participatory observation involves active engagement in activities alongside the studied group, while non-participatory observation entails observation from an external perspective without direct public participation in certain activities.

Data Collection: Step 1: The quantitative research was conducted as follows: 1) Initially, the researcher privately contacted the participants to explain the research objectives and benefits, as well as the various research procedures, seeking their cooperation. In addition to this, the following procedures were followed: Participants were provided with a questionnaire in advance to allow for preparation before responding. 2) Appointments were scheduled, specifying the date, time, and location. 3) The researcher acquired official approval documents to collect research data and distributed authorized letters to request information from the agricultural communities. 4) Data collection took place on the designated date and time, which was from 1:00 PM to 6:00 PM. The researcher utilized the participants' residence as the survey location, personally administering the questionnaire while ensuring consent and willingness to participate before proceeding. The agricultural community members themselves directly answered the questionnaire. 5) The researcher rigorously verified the accuracy of the collected data. Any information not provided by the participants was duly recorded, following strict adherence to guidelines. If any unusual circumstances arose during the participants' engagement in the research project, the researcher was promptly notified. 6) The data collection process included distributing questionnaires to a total of 323 participants and subsequently collecting them, resulting in a total of 323 responses. This resulted in a 100 percent response rate. The collected data were then cross-checked for accuracy.

Step 2: Qualitative Research. In this step, the following data was collected: 1) The researchers personally contacted individuals to explain the objectives and benefits of the research, along with the various research procedures, seeking their cooperation. Relevant documents and questionnaires were provided to prepare participants ahead of the interviews. Appointments for the interviews were scheduled, specifying the dates, times, and locations. 2) The researchers obtained official permission letters from Nakhon Si Thammarat Rajabhat University to collect research data, which were then presented to the key informants. The researchers studied and prepared the interview questions as per the provided guidelines. Necessary recording equipment and notebooks were prepared before conducting the interviews. 3) Data was collected on scheduled dates and times. Interviews were conducted using questionnaires with key informants. The interviews lasted between 1 to 4 h and were typically held during weekends or on Saturdays and Sundays, approximately between 1:00 PM

and 6: 00 PM, at the participants' residences. Deep interviews were conducted using the attached questionnaire, ensuring the success of this research project. The researchers sought cooperation and consent from the participants, ensured their comprehension, and requested permission to record audio and video during the discussions. It was explicitly stated that any recorded data, images, or sounds would be kept confidential. If participants opted not to record particular information, the researchers honored their preferences. Participants were encouraged to promptly notify the researchers of any issues or concerns that emerged during their involvement in the research project.

Data analysis: Quantitative Research, Analysis of General Information: Data acquired from the questionnaire in Part 1, including gender, age, education, monthly income, occupation, and marital status, underwent analysis and interpretation using computer software for statistical analysis. The analysis involved generating counts and percentages. Analysis of Knowledge and Understanding: Data pertaining to knowledge and understanding of sustainable water- retaining structures in Part 2 was analyzed and interpreted using computer software for statistical analysis. This analysis included the calculation of the mean and standard deviation. Qualitative Research Section: Qualitative research aimed to assess information regarding sustained public participation in sustainable water- retaining structures. This was achieved through in-depth interviews with key informants. Vital insights gleaned from these interviews were summarized, synthesized, and presented through a content analysis process.

Results

Preliminary Respondent Information: The predominant demographic in the sample group comprises males, totaling 240 individuals, constituting 66.12 percent of the participants. A total of 137 respondents (31.41 percent) have educational qualifications below a bachelor's degree. Furthermore, 114 respondents (37.74 percent) fall within the age range of 35–50 years. In terms of monthly income, 82 individuals (22.59 percent) earn between 8,001–10,000 baht. The primary occupation for 193 respondents (53. 17 percent) is engaged in agriculture. Additionally, 165 respondents (45. 45 percent) are in married status. The survey responses indicate a predominance of male participants, potentially influenced by their perceived leadership roles and physical strength. The age distribution suggests individuals within this range exhibit physical robustness, a volunteer spirit, and a deep commitment to their community. The marital status, predominantly married, implies a stable family life. Despite lower educational levels, the respondents demonstrate a commitment to community knowledge. Their income sources are primarily linked to agricultural occupations, emphasizing the vital role of water for their agricultural activities.

Level of the knowledge and understanding in the construction of water-retaining structures:

1) Land Survey: The overall knowledge level was notably high ($\bar{x}$ = 4.05, S.D. = 0.57). The highest average score pertained to the Availability of Fertile Land, rated as high ($\bar{x}$ = 4.07, S.D. = 0.56). Suitability of Location closely followed, also rated as high ($\bar{x}$ = 4.06, S.D. = 0.55). The Environmental Suitability for Water Retention Structures was likewise considered high ($\bar{x}$ = 4.05, S.D. = 0.55). The item with the lowest average score was Selection of Construction Sites for Water Retention Structures, rated as high ($\bar{x}$ = 4.03, S.D. = 0.63).

2) Designation of Types and Formats: The collective understanding was high ($\bar{x}$ = 3.95, S.D. = 0.58). The highest average score related to Improving the Efficiency of Water Retention Structures, rated as high ($\bar{x}$ = 4.03, S.D. = 0.60). Designing Formats According to Project Objectives closely followed, rated as high ($\bar{x}$ = 3.99, S.D. = 0.57). Appropriateness of

Project Duration was also rated high ($\bar{x}$ = 3.92, S.D. = 0.57). The item with the lowest average score was Organizing Management Meetings and Establishing Learning Foundations, rated as high ($\bar{x}$ = 3.88, S.D. = 0.57).

3) Specification of Materials Used: The study revealed an overall high level of understanding regarding materials used ($\bar{x}$ = 3.99, S.D. = 0.55). The highest average score was achieved in the context of Durable Materials for Water Retention Structure Construction, rated as high ($\bar{x}$ = 4.06, S.D. = 0.55). Closely following was Every Equipment Material Being Useful for Water Retention Structure Construction, rated as high ($\bar{x}$ = 4.04, S.D. = 0.52). The Readiness of the Equipment Used was also rated high ($\bar{x}$ = 3.98, S.D. = 0.55). The item with the lowest average score was Appropriate Quantity of Sandbags, rated as high ($\bar{x}$ = 3.89, S.D. = 0.57).

4) Site Planning and Water Retention Structure Construction: The study found that the overall understanding of site planning and water retention structure construction was at a high level ($\bar{x}$ = 3.88, S.D. = 0.64). The item with the highest average score was Planning and Pre-construction Layout for Water Retention Structure, rated as high ($\bar{x}$ = 3.95, S.D. = 0.60). Following closely was Assignment of Roles Suitable for Individual Capabilities, rated as high ($\bar{x}$ = 3.93, S.D. = 0.54). The Budget for the Operation was also rated high ($\bar{X}$ = 3.83, S.D. = 0.64). The item with the lowest average score was Communication and Coordination with Authorities, rated as high ($\bar{x}$ = 3.80, S.D. = 0.75).

5) Construction Process of Weirs and the Weir Structures: The study found that the overall understanding of the construction process of weirs and the weir structures was at a high level ($\bar{x}$ = 4.00, S.D. = 0.55). The item with the highest average score was Post-construction Site Conditions, rated as high ($\bar{x}$ = 4.08, S.D. = 0.53). Following closely was the Management of Weir Construction Areas, rated as high ($\bar{x}$ = 4.01, S.D. = 0.54). The Construction Techniques and Methods for Weirs were also rated high ($\bar{x}$ = 4.00, S.D..= 0.55). The item with the lowest average score was the Transmission System for Water Distribution, rated as high ($\bar{x}$ = 3.91, S.D. = 0.58).

6) Overall, in every aspect, the findings indicated a high level ($\bar{x}$ = 3.97, S.D. = 0.58). Land Survey had the highest average score, rated as high ($\bar{x}$ = 4.05, S.D. = 0.57). The Construction Process of Weirs and the Weir Structures also attained a high level of understanding ($\bar{x}$ = 4.00, S.D. = 0.55). Specification of Materials Used was at a high level ($\bar{x}$ = 3.99, S.D. = 0.55). Designation of Types and Formats was also rated highly ($\bar{x}$ = 3.95, S.D. = 0.58). The aspect with the lowest average score was Site Planning and Water Retention Structure Construction, rated as high ($\bar{x}$ = 3.88, S.D. = 0.64). These findings indicate a significant level of sustainable knowledge and understanding in the construction of water retention structures, likely rooted in the community's traditional wisdom and their recognition of the agricultural benefits of water use. Consequently, the community places great importance on the construction of these check dams and values their continued involvement in this sustainable endeavor, as presented in the subsequent steps.

Table 1 Level of the knowledge and understanding in the construction of water-retaining structures

The knowledge and understanding in the construction of water-retaining structures	Level		
	$\overline{X}$	S.D.	Interpreting the average
Land survey			
- The availability of fertile land	4.07	0.56	High
- Suitability of location closely followed	4.06	0.55	High
- The environmental suitability for water retention structures	4.05	0.55	High
- Selection of construction sites for water retention structures	4.03	0.63	High
Overall	**4.05**	**0.57**	**High**
Designation of types and formats			
- Improving the efficiency of water retention structures	4.03	0.60	High
- Designing formats according to project objectives closely followed	3.99	0.57	High
- Appropriateness of project duration	3.92	0.57	High
- Organizing management meetings and establishing learning foundations	3.88	0.57	High
Overall	**3.95**	**0.58**	**High**
Specification of materials used			
- Achieved in the context of durable materials for water retention structure construction	4.06	0.55	High
- Every equipment material being useful for water retention structure construction	4.04	0.52	High
- The readiness of the equipment used	3.98	0.55	High
- Appropriate quantity of sandbags	3.89	0.57	High
Overall	**3.99**	**0.55**	**High**
Site planning and water retention structure construction			
- Planning and pre-construction layout for water retention structure	3.95	0.60	High
- Assignment of roles suitable for individual capabilities	3.93	0.54	High
- The budget for the operation	3.83	0.64	High
- Communication and coordination with authorities	3.80	0.75	High
Overall	**3.88**	**0.64**	**High**
Construction process of weirs and the weir structures			
- Post-construction site conditions	4.08	0.53	High
- The management of weir construction areas	4.01	0.54	High
- The construction techniques and methods for weirs	4.00	0.55	High
- The transmission system for water distribution	3.91	0.58	High
Overall	**4.00**	**0.55**	**High**
Overall, in every aspect	**3.97**	**0.58**	**High**

Public participation pertaining to the construction of water-retaining structures is Presented as Follows:

1) Public participation in Decision-Making: During interviews, it was observed that meetings and joint discussions played a crucial role in decision-making, activity selection, and goal setting. Decisions were made collectively on various matters, including development planning, policy formulation, objectives, methods, operational strategies, and resource allocation. These interviews revealed that holding meetings or preparing for them was a vital step, ensuring that everyone involved understood the objectives and had the necessary information for decision-making. Individuals possessing essential information or significant updates concerning the sustainable construction of check dams shared their findings during these meetings. This practice allowed everyone to stay informed and collectively evaluate the

presented information. Participants in the meetings had the opportunity to deliberate and discuss to find suitable approaches or activities. Decision-makers, including leaders and meeting participants, based their decisions on the received information and feedback. These decisions were then used to plan and execute activities in line with the defined objectives, ensuring desired outcomes were achieved: (1) Natural Resource Cost: The cost of natural resources involves constructing check dams using materials sourced from the community's natural resources, such as bamboo and timber, readily available within the community. These materials serve as the primary structure during the initial stages of check dam construction. In some cases, they are later replaced by other materials like vetiver grass and bamboo. This approach ensures the preservation of the ecosystem on both sides of the canal, maintaining stability and preventing erosion throughout the dry season. These trees play a crucial role in preventing erosion on both sides of the canal. (2) Human Resources: Human resources refer to community leaders and individuals who collaborate in the construction of check dams. This collaborative effort ensures that the community has year-round access to water without the need for external contractors. The community's ability to engage in this cooperative endeavor is rooted in the concept of "working together" and the collective spirit within the community. This mutual effort in constructing check dams has proven successful and is beneficial to the entire community. (3) Sustainable Living: In this community, people live harmoniously, working as a team, demonstrating unity, and assisting one another in times of difficulty. Alongside these cooperative efforts, another aspect contributing to the community's potential is the absence of conflicts or disputes. Community members coexist as equals, always ready to lend a helping hand to one another. There is a sense of joy and willingness to collaborate in constructing check dams, contributing to a sustainable way of life where people coexist harmoniously with nature.

2) Public participation in Operations: Public participation in these activities entails supporting the internal resources of the community to efficiently carry out the construction of check dams. This involves engagement in the management processes as part of the community's leadership or management team. Public participation in decision-making and activity planning for check dam construction facilitates coordination among those with vested interests in these activities. This collaborative effort ensures that the work proceeds in the right direction and establishes links between different aspects. In some cases, external assistance may be necessary, such as requesting equipment support to facilitate ongoing construction activities. Active involvement in operations is a fundamental principle in check dam construction, with the goal of creating sustainability and achieving long-term success. (1) Inspiring Initiative: Due to the adverse impacts of drought, the villagers convened to deliberate on ways to restore their previous conditions. Inspiration was drawn from the "bamboo weir" concept, which they had encountered and learned about. They resolved to implement this concept by arranging sandbags into a step-like structure, resulting in the construction of a weir. The community had been grappling with severe water shortages for domestic use, leading to significant hardships. They had observed similar practices elsewhere and desired to implement them within their own community. Furthermore, they recognized the imperative during the 9th Royal Development Plan to establish check dams for water usage during droughts. The community felt it was essential to construct check dams to secure their water supply during dry periods. Consequently, the community collaborated to build these dams, ensuring a year-round water supply. Moreover, the villagers were motivated to conserve water sources and the environment, inspiring them to create these structures. Through collective public participation and cooperative work, the community found the inspiration to establish sustainability, resulting in a stable water supply and fostering a sense of unity and cooperation among its members. This shared inspiration ultimately led to the successful construction of check dams, providing a sustainable water source for daily life. Additionally,

this endeavor set a positive example for the younger generation, strengthening the bond within the community and promoting love and harmony among the villagers. (2) Volunteerism and Unity: The spirit of volunteerism arose from a sense of unity and love within the community. Individuals volunteered their time, effort, and resources selflessly to contribute to the construction of weirs collectively. This act demonstrated the power of love and unity within the community, nurturing a spirit of sharing and mutual assistance. Assistance was rendered without expectations of personal rewards, as everyone collectively benefited, especially in ensuring an abundant water supply for the community. This exemplifies the volunteerism of community members, showing their collaborative and cooperative nature. Furthermore, their joint efforts and sacrifices were driven by mutual benefits, with volunteers willingly setting aside personal interests for the common good. As a result, a robust spirit of volunteerism emerged within the community, reflecting its potential and inner strength. (3) Community Bonds and Networks: The construction of weirs, aimed at conserving soil and water resources and slowing down the flow of water during rainfall, has nurtured strong community bonds. When villagers collaborate in building these weirs, a sense of cooperation and support emerges without hidden agendas. The entire community shares a common bond, exemplifying unity and solidarity. This unity is undivided and signifies a shared heart and camaraderie within the community. Additionally, various governmental and non-governmental organizations have actively participated, creating synergy to ensure that the construction of water weirs aligns harmoniously with the community's way of life. (4) Decentralization of Responsibilities: To allocate tasks and responsibilities, the community establishes teams in which each individual is assigned specific roles and procedures. Collaborative planning is used, promoting unity, cooperation, and mutual support. Village elders or community leaders organize and delegate responsibilities based on individual abilities and skills. There are no designated leaders or followers; instead, everyone assists each other. At times, the community organizes teams, distinguishing between female and male teams. The female team is responsible for filling sand into sacks, while the male team is tasked with tying and pounding stakes for constructing the water weirs.

3) Public participation in Reaping Benefits: The construction of water weirs has brought numerous benefits to the villagers, including intellectual gains, tourism advantages, financial income, social benefits, and agricultural revitalization. Moreover, it helps in addressing challenges associated with drought and decreasing the impact of forest fires. These weirs supply both drinking water and household water for the community. (1) Preservation of Local Wisdom: The construction of water weirs embodies an art and local cultural knowledge that has been transmitted through generations, reflecting the rich heritage within the region. (2) Tourism and Economic Opportunities: The construction of water weirs shows the local wisdom drawn from the community's capabilities, attracting the attention of tourists who visit to observe the process. Furthermore, the production of water weirs serves as a source of income and enables the community to promote their products. (3) Strengthening Social Networks: The construction of water weirs promotes collaboration and solidarity among the community, instilling confidence and pride in the local expertise related to water weir construction. (4) Agricultural Revitalization: One of the advantages of building weirs lies in their role in preserving life within the community. By erecting barriers in streams to retain and slow down the water flow, they conserve soil and water resources. This, in turn, enriches the soil, fostering the healthy growth of trees and creating a more humid environment that supports forest development and regeneration. (5) Mitigating Drought and Forest Fire Risks: Another agricultural benefit of weirs is their role in reducing problems associated with drought and the severity of forest fires. They help address drought-related challenges and lessen the impact of forest fires, ensuring a reliable water supply that enhances the overall well-being of community members. Additionally, during years with excessive water, some houses may be damaged due

to fluctuating forest water flow. Weirs serve as barriers that regulate water flow, necessitating careful planning and timely measures to address such challenges. (6) Access to Drinking and Household Water: Access to potable and household water is essential for any community. The construction of weirs guarantees a consistent supply of drinking and household water. This, for example, reduces the reliance on purchasing water during dry seasons, ensuring the community has dependable access to water for consumption and domestic use. Weir construction brings substantial benefits to the community in terms of water availability.

4) Public participation in Monitoring and Evaluation: Community involvement in weir construction, which includes planning, decision- making, implementation, and mutual benefits, is a multifaceted process that necessitates communication and cooperation among all stakeholders. Public participation in monitoring and evaluation is a crucial step that facilitates feedback for the project and enables necessary improvements. It offers the project valuable suggestions and insights, thereby enhancing its chances of success and allowing adjustments based on the community's needs**:** (1) Drawing Lessons: Drawing lessons from this experience, it becomes evident that the community has embraced the construction of weirs and successfully integrated them into their daily lives. For instance, the community has fostered love and harmony, promoting unity among its members. There is a spirit of mutual assistance, resource sharing, punctuality, and fulfillment of duties to contribute to the future development of the community. Additionally, a harmonious balance between environmental factors and natural resources is observed due to the storage of water in river streams for essential use. The knowledge gained from weir construction has significantly benefitted agricultural practices, resulting in improved livelihoods and increased income for farmers. Another critical aspect is the collective effort of the community in collecting debris and materials carried downstream by the water. This practice prolongs the lifespan of lower water sources, mitigates sedimentation, and enhances water quality by reducing turbidity. It also promotes biodiversity in the area, serving as a habitat for aquatic and forest animals. Additionally, it furnishes a clean water source for drinking, household needs, livestock, and wildlife within the community. (2) Community Knowledge: The community has acquired valuable knowledge concerning weir construction and related environmental systems. This knowledge has been imparted through the process of constructing weirs and by various relevant organizations. Topics covered include weir construction and water management. The community members have embraced principles of cooperation, unity, and sustainable economics. Furthermore, they have learned how to design weirs to ensure year-round water availability. They have gained fresh insights into weir construction, witnessing collective efforts and mutual support. Additionally, community members have expanded their knowledge by exploring projects beyond their area and adapting external experiences to construct weirs within their own community. Moreover, the community has received knowledge about weir construction, maintenance, and conservation practices, ensuring the longevity of the weirs and reducing reliance on government resources during water scarcity seasons. All of these accomplishments are the result of collaborative discussions and knowledge- sharing initiatives among community members regarding weir construction, fostering a sense of inclusivity across all sectors.

Discussions

Level of the knowledge and understanding in the construction of water-retaining structures: Land surveys, the designation of types and formats, the specification of materials used, site planning, water retention, structure construction, and the construction process of weirs and weir structures are integral components of this endeavor. On the whole, this undertaking attains a commendable level in all aspects ($\overline{X} = 3.97$, S.D. $= 0.58$). This performance aligns with the findings from the Royal Irrigation Department (2016), which investigated the procedures for erecting sustainable check dams, as per the Royal Initiative. The construction process includes several key stages. At first, the preliminary task involves conducting a survey of the suitable topography or riverbed for construction, which is pivotal. Subsequently, it is imperative to determine the type and design of the check dams. This entails meticulous planning of their dimensions, proportions, and the materials employed in their assembly. Furthermore, the positioning and construction of the check dams must strictly adhere to the specified patterns, sizes, and materials. This meticulous approach is essential to ensure the structural stability and strength necessary for the check dams to withstand water flow without detriment to the environmental ecosystem. It is noteworthy that the villagers demonstrate a profound comprehension of check dam construction, likely stemming from their awareness of traditional wisdom concerning the sustainable utilization of natural resources. For example, their judicious selection of appropriate trees for check dam construction and their inventive methods for enhancing water systems during drought seasons have proven advantageous for agricultural water utilization. Given the critical importance of water resources, the community places significant emphasis on effective water management. Consequently, the villagers enthusiastically partake in the construction of check dams, contributing to the overarching concept of "sound water management" as articulated by Buntao and Thaochalee in 2020. The discernible outcomes of these endeavors, including the mitigation of flooding, the enhancement of agricultural productivity, and increased income from tourism, engender a sense of confidence and comprehension within the community regarding the construction of water-retaining structures.

Public participation pertaining to the construction of water-retaining structures: Public participation in decision-making provides access to information concerning the costs of natural resources. This is facilitated by the presence of a thriving ecosystem rich in trees and abundant water resources. Additionally, the community possesses human resources in the form of leaders who foster unity and friendship, demonstrating their commitment to resource restoration along the canal's perimeters; thus, ensuring the preservation of forests and water sources, as highlighted by Mangana and Vetchapitak in 2020. This collective sustainable cohabitation is realized through the collaborative construction of check dams, aiming to establish a harmonious relationship between humans and nature. Operating as a unified team, the community emphasizes unity, mutual assistance during challenging times, and the avoidance of conflicts. This approach aligns with the principles expounded upon by Andrew & Stiefel (1998), and the Office of The Public Sector Development Commission (2021). Public participation commences with being well-informed about operations and expressing opinions regarding the community's requirements. It is indispensable for the intricacies of change planning and needs to be perceived as a long-term process rather than a one-time consultation, as discussed by Simon et al., in 2020.

Active public participation, which underscores the significance of inspiration, draws from the collective wisdom of peers, where ideas are gathered and collaboratively shared as a form of social capital and community engagement, in line with the research of Chiamsathit, et al. in 2020, and Miller & Buys in 2008. This realization motivates the community to effectively

construct these barriers, grounded in their understanding that water is indispensable for daily consumption. In previous years, the community experienced a severe scarcity of clean and usable water, which greatly distressed the residents (Maslow, 1943; Balraj, 2017). In response, the power of volunteerism was harnessed among the people who possessed a spirit of volunteering to construct these water barriers. This collaborative effort enabled the community to conserve water, ensuring an adequate supply for agricultural purposes. The emphasis on volunteerism united the community, people joined forces and hearts, successfully building the water barriers. Through this collaboration, the community developed strong relationships and networks. Villagers collaborated effectively in building the barriers, indicating improved community relations. The community exhibited mutual assistance and support in constructing the water barriers, reflecting a sense of self-reliance in their management and the principle of "self-sufficiency" (Khamsaen et al., 2018). Without expecting any rewards, the community fostered unity, shared a common spirit, and actively participated with various agencies. Duties and responsibilities were distributed among teams, each with specific roles and tasks. One team focused on tree cutting for the framework, another on filling sandbags for water barricades, and a third on barrier construction. Subsequently, all teams collaborated to build the water barriers. This division of labor and teamwork paralleled their collaborative implementation approach, which involved resource support, public participation in management, coordination, cooperation, and active involvement in operations, as described by Namburi (2019). Public participation in implementation includes contributing to the project by providing financial resources, materials, labor, as well as involvement in project management, coordination, and operations, while seeking external assistance, in accordance with the research of Chasuwan & Sanpugdi (2019). The study revealed that achieving sustainable water management through the construction of bamboo weir dams necessitates the mobilization of various resources, including human capital, financial assets, raw materials, effective management, and the coordination of collaborative networks.

Furthermore, participating in the benefits helps to acknowledge the diverse local wisdom inherited from ancestors, transforming the community into a tourist destination, generating income, and promoting the sale of local products. This fosters social networks that encourage cooperation and unity within the community, particularly in the face of challenges such as droughts and water shortages (Varitwuttikul et al., 2021). This enables farmers to construct water-retaining barriers for agricultural water storage, mitigating drought-related issues and reducing the risk of forest fires (Panyasean et al., 2023; Nikornkul et al. (2020). Having access to household drinking water reduces the need to purchase water during dry periods (Pilert, & Thanunrum, 2018). The construction of water-retaining structures exemplifies local wisdom and the utilization of natural resources, constituting a form of "community innovation." This involves blending traditional knowledge with sustainable modern technologies for the community's benefit, as knowledge and technology are key to innovation (Chasuwan & Sanpugdi, 2019; Wawan et al., 2023). However, it is essential to consider the issue of check dams during periods of fluctuating water flow in the forest, as the construction of water-retaining structures can disrupt the natural river flow in a similar manner. This necessitates active public participation in reaping the benefits, as described by Khamphilaanont (2007), when the community benefits from various activities or projects, including material, social, and individual benefits derived from development. This active public participation extends to monitoring and evaluating the outcomes, requiring the involvement of villagers in planning, decision-making, implementation, and mutual benefit sharing. This complex process demands communication and cooperation from all involved parties.

Furthermore, active public participation in the monitoring and evaluation process is a critical step that facilitates the provision of feedback and the implementation of improvements. This enables the water barrier project to adapt to the community's evolving needs, thus enhancing its potential for long-term success and sustainability. The interconnection between various aspects, sustainability assessments, and resilience building necessitates a comprehensive analysis (Gunaratne et al., 2023), which aligns with the research by Chunta (2018). It is suggested that public participation should include monitoring and evaluation to keep everyone informed about the progress and any emerging issues. This should be accomplished through appropriate monitoring methods, ensuring continuous community management and care. Without proper maintenance, water barriers are susceptible to damage (Konwong et al., 2021). Therefore, there is a need for knowledge exchange and "knowledge transfer" to promote collaboration across various sectors, including communities, government agencies, non-profit organizations, and the private sector, without seeking profit (Ajui et al., 2019)

From the research findings, it is evident that every step is crucial and requires collaboration from the community and various stakeholders. This is because, in the future, the constructed water barriers will deteriorate over time and have a reduced lifespan without proper maintenance. Thus, a collaborative approach in the entire process, including public participation in decision-making, implementation, benefit-sharing, and monitoring and evaluation, is essential. This aligns with the research conducted by Pricklek et al. (2022), explaining that community involvement includes public participation in decision-making, implementation, benefit-sharing, and public participation in monitoring and evaluation which aligns with the studies conducted by Cohen & Uphoff (1981), Wattanasiritham, & Phetmak (2008) and Puang-ngam (2016), indicating that public participation includes involvement in decision-making, implementation, benefit-sharing, and public participation in monitoring and evaluation. Therefore, the collaborative effort to construct check dams significantly impacts the community's economy, particularly in areas where the community is more prosperous, resulting in a clear increase in water quantity. It aids in flood prevention and effective water flow control, while also enhancing the diversity of fish species encountered. Furthermore, exploring collaborative models serves as a prototype for achieving success (Yotarak et al., 2019). The analysis reveals significant economic impacts stemming from the construction of check dams, as they provide new income sources for the community without incurring water usage costs. Moreover, they create opportunities for tourism and businesses in the area. Socially, the construction of check dams offers chances for communities to meet and share experiences, fostering communication about local knowledge and ways of life. This can serve as a model for other communities interested in tourism and community development (Khaenamkhaew et al., 2023).

Conclusion and suggestions

The thematic analysis highlights the effectiveness of a community-driven approach in constructing water-retaining structures. This approach not only builds infrastructure but also strengthens community bonds, enhances local knowledge and skills, promotes environmental sustainability, and fosters economic and social benefits. It's a holistic model that goes beyond mere construction, touching on various aspects of community development and empowerment.

Policy Recommendations: Pertinent agencies, including the Kamphaeng Sao Subdistrict Administrative Organization and the 15th Irrigation Office in Nakhon Si Thammarat, are urged to take action. They should promote community involvement by clearly explaining roles and responsibilities to the local residents. Enhancing public relations is

necessary to ensure the community comprehends the objectives, principles, and operational procedures regarding the precise and transparent construction of water barriers. This is vital because the research findings indicate that water barriers efficiently store water for consumption and agricultural purposes. The Kamphaeng Sao Subdistrict Administrative Organization should formulate a policy to support the budget for building water barriers or for continuous maintenance and repairs.

Operational Recommendations: The construction of water barriers, despite being backed by extensive research, is currently at a minimal average level in terms of position planning and actual construction. It is crucial to plan the positions and construct water barriers while also specifying and organizing tasks in advance. This process should align with individual capabilities, requiring communication, coordination, and budgeting for execution. Effective public relations should include the operation and summary of activities to ensure community members and the public are well- informed. Active public participation in monitoring operations to identify problems and requirements should be encouraged to mitigate issues and challenges effectively. Collaboration among the community, government sectors, and private sector development organizations should be fostered. This collaboration aims to use collective thinking and public participation to successfully achieve objectives and goals related to ongoing activities and development initiatives. Water retaining structures require adequate design and input of environmental engineering for sustainable environment, effective performance, and durability. This aimed at looking at the design and sustainability of water retaining structure for enhanced environment. Sustainability has always been a question of whether the materials used for construction are of good quality and also whether the design methods used are of high standards. Water retaining structures were designed and checked based on important parameters such as cracking and deflection checks, strength of materials and detailing done with adequate attention to factor of safety and minimum clear distance. Quality materials and latest development in structural engineering must be incorporated with adequate check for sliding, earth pressures, hydrostatic forces, and overturning moments. Appropriate geotechnical tests and checks for factor of safety should be carried out. Global environmental impact was found to be the major problem resulting to the lack of sustainability. It was concluded that water retaining structures can be designed with engineering standards, relevant codes of practice, and application of process engineering for sustainable environment. Quality control, correct workmanship, and appropriate tests should be carried out on all materials during construction and other aspects of project implementation.

Recommendations for Subsequent Research: It is advisable to conduct research on the existing issues and potential solutions, assessing ongoing projects to identify specific challenges and potential resolutions in the current context. Research should focus on understanding the needs of leaders, community members, and stakeholders to determine their current requirements and how effective assistance can be provided. Research should be policy-oriented, ensuring precision and efficiency in the measures implemented, which will significantly impact practical applications. Utilize the research findings to benefit both academic knowledge and practical management. This will contribute to the dissemination of knowledge and provide validation for future development initiatives.

New knowledge and the effects on society and communities

From the research findings, it was discovered that every step is pivotal and necessitates collaboration from the community and various networks. This is because, in the future, the constructed weirs will deteriorate and become vulnerable over time, with a reduced operational lifespan without proper maintenance. Therefore, there is a need for a collaborative approach in weir construction, involving the following phases: Public participation in Decision-Making, Public participation in Operations, Public participation in Reaping Benefits, and public participation in Monitoring and Evaluation. To utilize the research findings as a guide for stakeholders, they can be integrated into an efficient water management plan for the benefit of user groups. This has economic implications, generating new income sources for the community and contributing to revenue for local tourism and businesses in the area. Additionally, there are social impacts, including community involvement in activities related to weir construction, promoting public participation, and providing opportunities for people to meet and share experiences. This facilitates knowledge exchange regarding local wisdom and weir construction methods, serving as a model for other communities aiming to enhance tourism and community income. At the same time, there are favorable environmental outcomes, including the enhancement of environmental systems, rainwater collection, and agricultural water utilization. These actions diminish problems linked to drought and alleviate forest fire hazards, as depicted in Figure 2.

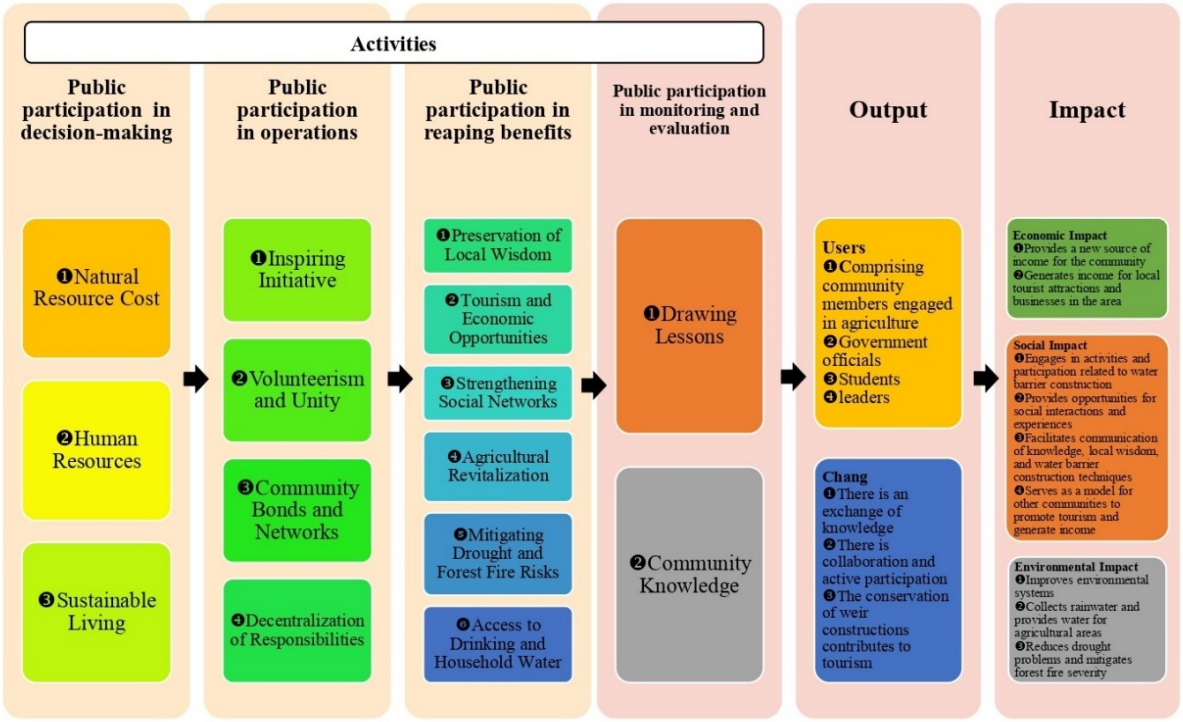

Figure 2 New Knowledge and The Effects on Society and Communities (Researcher, 2024)

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