Journal of Posthumanism

2025
Volume: 5, No: 1, pp. 1211–1223
ISSN: 2634-3576 (Print) | ISSN 2634-3584 (Online)
posthumanism.co.uk

DOI: https://doi.org/10.63332/joph.v5i1.658

The Use of Technology and Community Participation in Creating Sustainable Water Management Innovation in the Area of Navamintarachinee Forest, Mae Hong Son Province, Thailand

Nadthanon Chirakitnimit[1], Ornpapha Chutikorntaweesin[2], Silawat Chaiwong[3],

Abstract

Water resource is a vital factor for human survival. The source of water is forests. The coexistence between humans and forests is mutual support. The conservation of forest and water must proceed in parallel to create a balance in the ecosystem. This research aims to study the use of water management innovation for consumption at the community level that does not harm the ecosystem, and to create a volunteer network to participate in water management for consumption at the community level. The researchers conducted the participatory action research. In-depth interview and focus group were used with 80 key informants. The qualitative data were analyzed by using the content analysis, inductive analysis, conclusion generation and verification, with an emphasis on linking data that is true to the facts. The research results show that in the case study area of Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand, the ethnic communities have lived with the forest for a long time. The main problems and obstacles were the area condition which is mountainous terrain; this makes water storage quite difficult. There was insufficient water. The cost for pumping water from low areas to the higher areas is expensive. The solution to the problem is to bring a hydraulic ram pump – which does not require electricity or oil; therefore, it does not harm the ecosystem – to be tested to deliver water from Solop creek up the mountain. In the process of summarizing the problems and finding solutions, the community participated in learning and conducting a practical experiment by themselves. This study took more than 1 year; this shows the connection of processes to solve problems with the community participation through these 5 steps: 1) network creation, 2) network management/co-learning management, 3) problems and obstacles in network management, 4) network relationship, and 5) network relationship development. This empirical result can be expanded to other local areas in the future.

Keywords: *Water Management Technology, Sustainable Water Management Innovation, Community Participation, Improving the Quality of Life of People in the Community.*

Introduction

"Water" is a valuable global resource, as well as an important production factor in the economic system. However, due to the climate change, the natural water disaster becomes more frequent and severe, along with the increase in urban communities, the economic and industrial expansion, resulting in the water shortage, flood, and water pollution. This is consistent with the study of Esteves et al. (2023) which stated that the unprecedented global climate change was gradually increasing the uncertainty of water cycle through extreme weather events that risked the forecast of water quantity and quality. These events threatened sustainable development,

[1] Researcher, Multidisciplinary Research Institute, Chiang Mai University, Thailand.
[2] Associate Professor, Vice President of Agricultural Safety Association. Agricultural Safety Association, Thailand. ornpaphafc@gmail.com. (Corresponding Author).
[3] Lecturer, Mahachulalongkornrajavidyalaya University, Nakhon Lampang Buddhist College, Thailand.

biodiversity, and the global human rights on water and sanitation. In addition, a study on spatial water management have indicated that the weather is more volatile, the temperature is higher, and the drought is more severe. However, some farmers who can adapt themselves, change their mindset, and use a knowledge base that is appropriate for their area condition can overcome drought. The main principle is to having a water storage source and linking the use of water to soil and water conservation (Sangwanna et al., 2024); including creating a balance between the conservation, restoration, and development of water sources, as well as the sustainable use of water resources (Highland Research and Development Institute (Public Organization), 2020). Therefore, it is necessary to give importance to all sectors involving in water usage, both for consumption, production (agriculture and industry), and preservation of the ecosystem (Office of the National Economic and Social Development Council, 2018).

In the northern region of Thailand, there are still abundant forest areas. It is an important watershed area for communities living with the forest, such as the area of Navamintarachinee Forest, Mae Hong Son Province, Thailand. It is a location of royal initiative project of Her Majesty Queen Sirikit The Queen Mother, who granted the royal initiative to conserve teak genetic resources. Navamintarachinee Forest covers an area of over 30,000 rai (about 48 square kilometers) where 319 families of various ethnic groups have lived in. The government has promoted them to do the agricultural occupations, including planting field crops and fruit trees, and also weaving local fabrics (Chiang Mai Provincial Office, Provincial Strategy and Data Division, 2022; Highland Research and Development Institute (Public Organization), 2021). However, this area still has problems on public utilities and people's quality of life. The most serious problem is the adequacy and quality of water for consumption. The root cause of this problem comes from the area having no large water sources. People have to rely on water wells and seasonal rainwater, which causes the water shortage in the draught season (Working group for the project master plan of the teak genetic resource conservation and the development of the quality of life of people in the forest area of Khorng watershed and Pai watershed under the royal initiative (Navamintarachinee Forest), Mae Hong Son Province (2023-2027), 2022). In addition, the natural water sources that store water are located in low areas. The communities in highlands cannot use water because the area is mountainous, steep, and is a watershed forest or forest conservation area, which has the limits in accessibility and area development in both electricity and water supply.

Therefore, the direction to solve the water problem for the case study community is to use technology and community participation in creating sustainable water management innovation in Navamintarachinee Forest area, by using Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand, as a case study area. This study focused on the management process from upstream, midstream, to downstream; leading to network creation, lessons learned, and expansion to nearby areas in order to further develop the quality of life of people in the highlands.

Research Objectives

1. To study the water problems in Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand.

2. To study the use of water management innovation for consumption at the community level that does not harm the ecosystem.

3. To create a network of volunteers to participate in water management for consumption at the community level.

Literature Review

The Concept of Using Technology in Water Management

Regarding this research project on the use of innovation in water management for consumption at the community level, the technology of hydraulic ram pump was used. The research of Pengjam and Nomnop (n.d.) on the study of the efficiency of a hydraulic ram pump which was used as a tool for pumping water from low areas to the areas higher than the original water source location. The hydraulic ram pump would work only when the water source is higher than the hydraulic ram pump. The characteristics of hydraulic ram pump consisted of a delivery pipe, a delivery valve, a waste valve, an air vessel, a water storage tank and a water supply tank. In addition, regarding the research of Wongpanyo et al. (2016) on a 1½-inch hydraulic ram pump, the results found that the hydraulic ram pump was a water pump from a low place to a high place without using electricity or fuel to pump water. It had a simple structure and could be invented by using parts and equipment which were available in general markets. The experiment of the 1½-inch hydraulic ram pump found that it could pump water to the area at the height of 4, 5 and 6 meters. It could be a solution for those who want to use a hydraulic ram pump. The data can be adjusted for suitability and maximum efficiency with natural water sources. The experimental results show that the hydraulic ram pump can pump water up to a height of 5 meters with a flow rate of 2.92 liters/minute. Moreover, the research of Sitthiritkawin and Treerat (2018) who built a hydraulic ram pump for use in agriculture for Ban Jajor Village, Doi Hang Subdistrict, Mueang District, Chiang Rai Province, Thailand, with an average usable area of 50.6 square meters. The machine was made of PVC pipes and PVC joints using a brass check valve and choosing a 200-liter plastic tank for storing water. The machine could deliver water up to 12.5 meters and had a maximum water pumping volume of 10 liters/minute and a maximum efficiency of 24.1%. The above research demonstrates the use of technology in water management for consumption at the community level.

The Concept of Participation in Integrated Community Water Management

The integration in water resource management must be carried out in an integrated manner by taking into account the quality of life, promoting and supporting public participation as the main principle, and allowing for participation in determining the overall approach. The integration can be divided in 3 forms: integration of resources, integration of organizations, agencies and roles and responsibilities, and integration of problems, project plans, and academics; based on these 5 consistent principles of operation, as follows; (Prakongsri, 1998; Wongmajarapinya et al., 2024)

1) Integration of water resources and other resources, including forest, soil, and human resources.

2) Integration of human resources which are academics and experts, including tools, equipment, information, knowledge, skills, experience, wisdom, technology, operating budget, and other factors.

3) Integration of organizations and agencies; this involves bringing organizations and agencies with missions related to water development and management to work together to achieve the objectives.

4) Integration of problems, project plans, and academic factors; this involves applying knowledge in various fields, appropriate technology, and local wisdom to collect data, analyze problems, and find causes in order to find approaches, models, and methods to use in developing and managing water resources effectively, fairly, and sustainably.

5) Integration of steps in the river management process: the effective and efficient river management has the following main principles: (1) Integrated management of all activities and all related agencies/organizations, (2) Participation of stakeholders at all levels of management, (3) Decentralization of management authorities to the local levels, especially local administrative organizations, and (4) Modern organizational management, consisting of committees at national level, main river level, and tributary river level.

Therefore, the objective of water resource management should cover the related elements, namely, to manage water resources to have sufficient water quantity and good quality by participating in the conservation of natural resources and environment. From these concepts, it can be seen that the integrated water resource management must promote stakeholders to participate fully in the operation. The approach of water resource management must be consistent, supportive, and not in conflict with other related resources. It must be managed by developing, conserving, restoring, and using appropriately, taking into account the management efficiency, transparency, fairness, and sustainability.

The Concept of Community Network Development

Charoenwongsak (2000) mentioned the process of networking, which was refered in this project to create a community network in water management for consumption in Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand. It consists of 4 steps, as follows;

1) Network Forming: it can occur in two ways, which are a state-initiated network and a citizen-initiative network. For the second type of networking, the government agencies may also provide support and facilitators to enable the network's operation.

2) Network Organizing: it will help the network operate smoothly. The components are (1) network mapping, (2) role and responsibility, (3) communication system, (4) learning system, and (5) information system.

3) Network Utilization: the network can be used as platform (1) for coordination, (2) for exchanging information and knowledge, (3) for exchanging and mobilizing resources, (4) for creating and developing new knowledge, and (5) for creating trends to push new issues.

4) Network Maintenance: it can be done by organizing activities that are continuously carried out in order to maintain good relationships among network members. It may create a mechanism for motivating members to participate in activities, which the network must provide sufficient supporting resources, including the assistance and help to solve problems. It should also focus on creating new generations of leaders continuously to maintain the network and continue its operation sustainably.

Methodology

This research used Participatory Action Research (PAR) consisting of 4 steps: research planning, acting, collecting data by observing, and reflecting the knowledge, findings, and observations. The research tools were to do the in-depth interview and focus group with stakeholders of the case study area of Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand. The study was conducted from March 2023 to December 30, 2024.

The researchers selected a sample of 80 people, consisting of key informants from (1) 10 representatives of local government agencies, (2) 50 villagers in the community who were interested in participating in this project, and (3) 20 opinion leaders in the community. The data collection process included both primary data from the empirical facts and secondary data from the documentary research and recorded data. The steps are as follows:

Step 1: organize the forum meeting by doing focus group with representatives of opinion leaders in the community, villagers, and researchers with the method of brainstorming, questioning, and observation to find causes, obstacles, and limits then summarizing the issues.

Step 2: bring the data obtained from Step 1 to the meeting to consider, to understand and to decide on the solutions that the group members agree on the most; and create an action plan for activities to solve the problems according to the specified solutions.

Step 3: do the focus group to brainstorm and find directions to create innovation in social management processes for the environment management and the sustainable water management for consumption.

Step 4: the operation team uses the water management technology for consumption at the community level by using a hydraulic ram pump to send water to higher areas without harming the ecosystem, along with the community participation in managing the environment, organizing trainings to provide knowledge on water management for consumption to people in the community, creating networks, learning lessons, and expanding results in other community areas.

Regarding the qualitative data analysis, the researchers used the content analysis, presented the data by using the descriptive method and analytic induction by systematically organizing and classifying data, generating and verifying conclusions, with an emphasis on linking data that is true to the facts.

Results

The findings from brainstorming and focus group of stakeholders in Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand, show that:

1) With regard to the context of Ban Huai Solop community, people in this community have been promoted to do occupations, for example, growing vegetables, planting upland rice for household consumption, and growing industrial crops such as garlic, animal-feed corn, and fruit trees such as avocado, in order to generate income for the community. Although Ban Huai Solop community has a lot of resources, it still got impacts from (1) the area condition is mountainous terrain; this makes water storage quite difficult; (2) it is not possible to use water from the water source. The cost for pumping water from low areas to the higher areas is expensive. The problem of water shortages has expanded due to the need for water for living and the expansion of agricultural areas; and (3) the water for consumption still has contaminants from underground

raw water which is turbid and rusty. Therefore, people in the community have kidney stones, poor health, and children have slow intellectual development.

In addition, regarding the participatory observation during the exchange of opinions from various stakeholders, it was seen that people in the community expressed their need for water management, their strength of participation in water management that everyone can access and is fair for people in the community to use it together.

2) With regard to the urgent and important problems that need to be solved are the provision of water source and the storage of water to be sufficient for usage. The use of water management innovation for consumption is proceeded with these following steps:

(1) Training to provide knowledge to people in the community and searching for knowledge and innovation that will be used to solve community problems.

(2) Applying innovation in water management for consumption at the community level that does not harm the ecosystem by cooperating with the community to plan and design the water storage and apply innovation to send water to higher areas.

(3) Sending water to higher areas by using a hydraulic ram pump; according to the results of the experiment using water management innovation in the area, which divided the roles of the members in this project, prepared the area for the experiment by inspecting the water source to be used for installing the hydraulic ram pump and finding an area for the water storage, as well as various tools and materials. The operation of the hydraulic ram pump is shown in Figure 1.

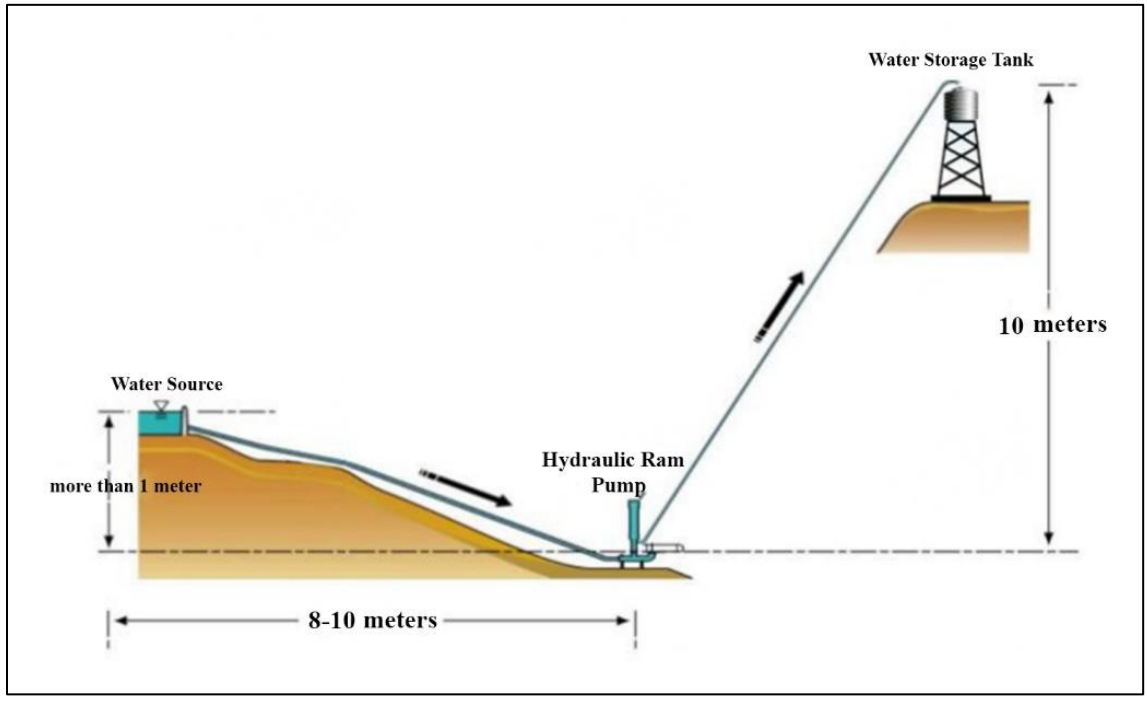

Figure 1 shows the installation of hydraulic ram pump.

Source: Research for Social Development Institute (2021);
as cited in Natthanon Chirakitnimit et al. (2023)

In terms of condition and efficiency, the information retrieved from experts from relevant agencies in the area, it was found that for the effective use of the hydraulic ram pump, the water source should be at high land or its height level can be raised. It should be a natural water source with a large amount of water flowing, such as a flowing stream, waterfall, or spillway. With an ability to push water up high, the hydraulic ram pump is suitable for use in steep areas and the areas where water needs to be pulled up high. Therefore, this equipment is suitable for use in water management in Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand, which the area condition is a mountainous with a stream flowing all year round.

(4) Evaluating the innovation usage results by checking and observing the performance of the hydraulic ram pump over a period of 1 month. Members of the network and the sustainable water management operation team in the Navamintarachinee Forest, Mae Hong Son Province, Thailand, were assigned to cooperatively monitor the performance of the installed hydraulic ram pump by recording data and taking photos/video clips of its performance, with details as follows:

(4.1) Continuity of use

(4.2) Completeness of equipment

(4.3) Changes in the amount of water stored at the destination storage

(4.4) Impacts in areas near the experimental location, such as the reduction of upstream water source, the amount of water lost during the use of the hydraulic ram pump, the soil erosion in the experimental location or nearby areas, etc.

3) With regard to the creation of a volunteer network to participate in water management for consumption at the community level in the Navamintarachinee Forest area, Mae Hong Son Province, Thailand, it was found that the network in the area has a connection to the participatory process to solve community problems as follows:

3.1) Network creation: most people in the community gave the information in the same direction that the network was formed by people in the community who were aware of problems on water shortages for consumption and the current decrease of forest area due to illegal logging for sale.

3.2) Network management/co-learning management: taking into account the mutual benefits of people in the community. Any agreements made by the network must not affect the livelihood and well-being of the members in terms of activities to solve problems and efforts to implement activities related to improving the quality of life and the environment.

3.3) Problems and obstacles in network management: the problem and obstacle in the operation of network members is time. In the past, they have responsibilities for both work and family care; therefore, the participation in community activities was not very high. In addition, there were not many continuous meetings, and members did not understand the benefits of meeting for discussion, thus they decided not to participate. Another reason was that some people did not trust each other in terms of the benefits they would receive.

3.4) Network relationship: the process of grouping people usually starts with talking to relatives or neighbors who had similar ideas or encountered similar problems.

3.5) Network relationship development: it was found that if there were continuous activities to promote community participation, it would create awareness on the importance on natural resource conservation, leading to the creation of volunteer network to restore and conserve the environment in that area, and the increased amount of member participation. This could lead to a potential network in the future.

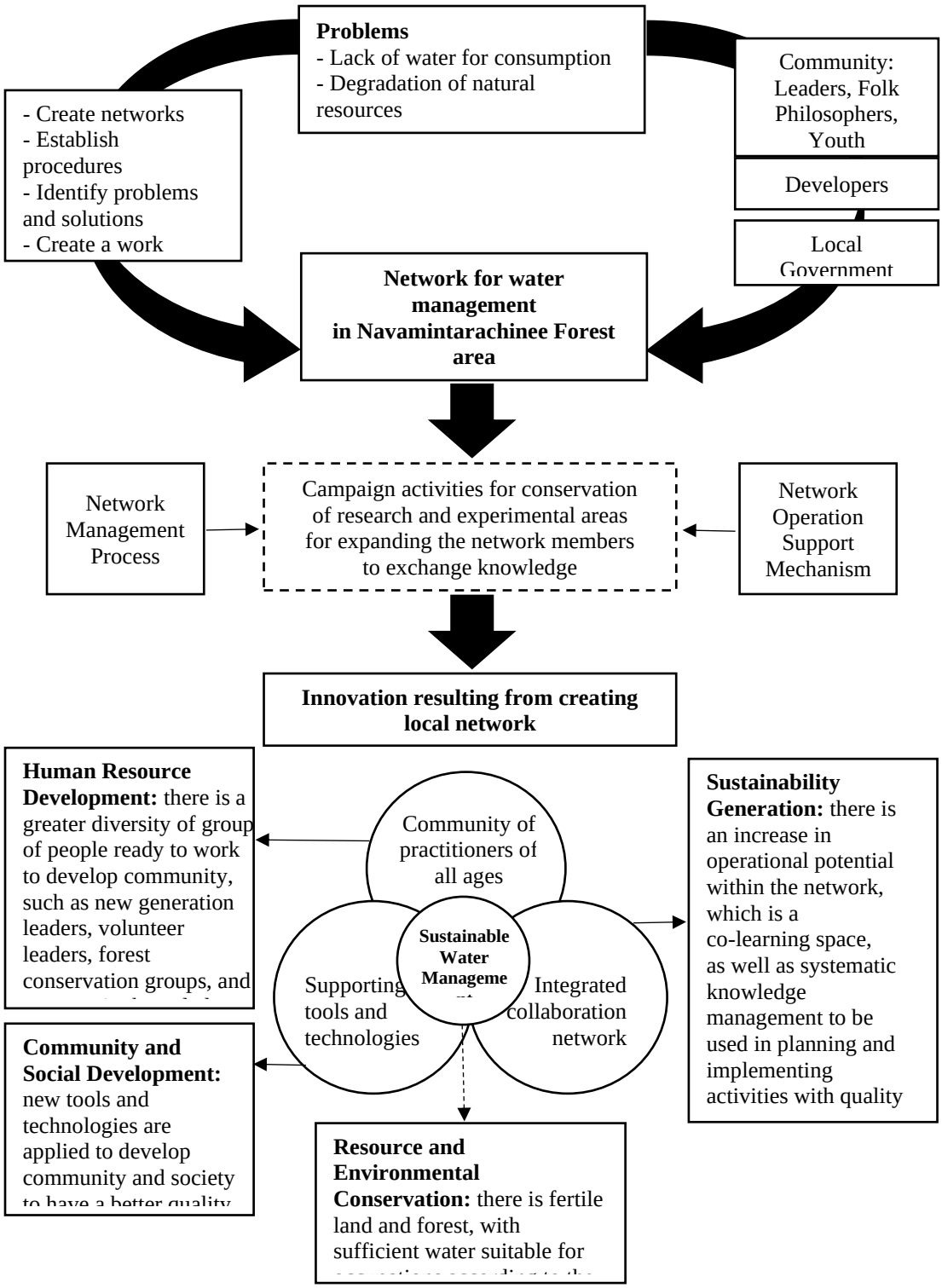
Problems
- Lack of water for consumption
- Degradation of natural resources
- Create networks
- Establish procedures
- Identify problems and solutions
- Create a work
Community: Leaders, Folk Philosophers, Youth
Developers
Local Government
Network for water management in Navamintarachinee Forest area
Network Management Process
Campaign activities for conservation of research and experimental areas for expanding the network members to exchange knowledge
Network Operation Support Mechanism
Innovation resulting from creating local network
Human Resource Development: there is a greater diversity of group of people ready to work to develop community, such as new generation leaders, volunteer leaders, forest conservation groups, and
Community of practitioners of all ages
Sustainable Water Manageme
Supporting tools and technologies
Integrated collaboration network
Sustainability Generation: there is an increase in operational potential within the network, which is a co-learning space, as well as systematic knowledge management to be used in planning and implementing activities with quality
Community and Social Development: new tools and technologies are applied to develop community and society to have a better quality
Resource and Environmental Conservation: there is fertile land and forest, with sufficient water suitable for

Figure 2 shows the volunteer network creation to participate in community water management for consumption in Navamintarachinee Forest area.

Discussion

Regarding the context of Ban Huai Solop community which is ethnic communities that have lived with the forest for a long time. Thai government agencies have promoted people in the community to do occupations by mainly farming. Despite a large number of resources, they are still affected by (1) the area condition is mountainous terrain; this makes water storage quite difficult; (2) it is not possible to use water from the water source. The cost for pumping water from low areas to the higher areas is expensive. The problem of water shortages has expanded due to the need for water for living and the expansion of agricultural areas; and (3) the water for consumption still has contaminants from underground raw water which is turbid and rusty. Therefore, people in the community have kidney stones, poor health, and children have slow intellectual development. This is relevant to the study in other areas of Thailand, entitled "Synthesis of Research Knowledge and Water Management of peasant in Nakhon Si Thammarat Province" of Khunweechuay (2013) that water-related problems in Thailand have been increasing all the time and tended to be more severe. The water is a basic factor for people's livelihood. Part of the problem is that in Thai society, there is still little knowledge about water, and also a set of knowledge that is consistent with the specific geographical condition of the area. For example, the knowledge about water means success in rice farming for people in the central region of Thailand, while people in Nakhon Si Thammarat Province which is located in the southern region of Thailand created methods to access water resources for groups of people living around the peat swamp; while people in lowlands and coastal areas of Thailand had knowledge about water and other forms of management along with new development trends. In addition, the participatory exchange of opinions from various stakeholders shows the expression of the community's need for water management, the strength to participate in water management that everyone can access and is fair for the community's shared use. This is relevant to the study entitled "Community participation in sustainable water management in Phetchabun Province in line with the Philosophy of Sufficiency Economy" of Thammathiwat and Suthirak (2012), that regarding the level of participation in management in line with the Philosophy of Sufficiency Economy in a sustainable manner according to the specified criteria, the overall participation of the sample group of people was at moderate level, followed by the participation in consultation. The problems found in water management in line with the Philosophy of Sufficiency Economy in a sustainable manner were that people did not give importance to group meetings of organizations or groups of water users were ineffective in water management of related agencies. Therefore, the awareness of water management in line with the Philosophy of Sufficiency Economy should be created for the public, by emphasizing that all sectors of society should know the value of water, use water moderately, and have reasons so that water resources are available for widespread use, with full efficiency, and with a balance of both quantity and quality.

Regarding the use of water management innovation technology for consumption at community level that does not harm the ecosystem by cooperatively planning and designing water storage and using innovation to send water to higher area by using the hydraulic ram pump, the principle of using the hydraulic ram pump effectively is that the water source should be at high land or its height level can be raised. It should be a natural water source with a large amount of water flowing, such as a flowing stream, waterfall, or spillway. With an ability to push water up high, the hydraulic ram pump is suitable for use in steep areas and the areas where water needs to be

pulled up high. Therefore, this equipment is suitable for use in water management in Ban Huai Solop community, Huai Pha Subdistrict, Mueang District, Mae Hong Son Province, Thailand, which the area condition is a mountainous with a stream flowing all year round. This is relevant to the study in foreign country that the hydraulic ram pump is one of the easiest and most environmentally friendly systems to use, as it does not require internal energy to propel water. It has the potential to be used to solve water-related problems for drinking, agriculture, etc. (Othman, et al., 2020).

Regarding the creation of a volunteer network to participate in water management for consumption at the community level in the Navamintarachinee Forest area, Mae Hong Son Province, Thailand, it was found that the network in the area has a connection to the participatory process to solve community problems as follows: 1) Network creation from that the community were aware of the problems of water shortages for consumption and the current decrease of forest area. This leads to 2) Network management/co-learning management, which has to take into account the mutual benefits of people in the community. Any agreements made by the network must not affect the livelihood and well-being of the members. This may occur 3) Problems and obstacles in network management because in the past, people had responsibilities for both work and family care; therefore, the participation in community activities was not very high. They did not understand the benefits of meeting and some people did not trust each other in terms of the benefits they would receive. 4) Network relationship starts with talking to relatives or neighbors who had similar ideas or encountered similar problems; and for 5) Network relationship development, it was found that if there were continuous activities to promote community participation, it would create awareness on importance on natural resource conservation. It can be seen that community participation is very important in solving various community problems. This is relevant to the study of many scholars that community participation is a driving force behind the success of the projects. It instills a sense of ownership and proudness, and encourages the transmission of traditional knowledge, skills, and practices from generation to generation. Local communities are crucial in implementing actions to actively involve members in the project in their local areas (Channuwong, 2018; Zhang, 2023). This is also consistent with the findings from the study of Zhang et al. (2023) which emphasized the importance of community participation as an intermediary for technological infrastructure and in achieving sustainable development goals and improving urban and rural systems.

Conclusion

Sustainable water management innovation has involved the community participation from upstream, midstream and downstream; this is a community adaptation approach for survival that may be consistent with the concept of Posthumanism, where people in the community still maintain their traditional way of life, wisdom and spirits that are connected to the forest. This shows the relationship between humans and non-humans. Regarding this study, non-humans are local nature. This research project is a study of the use of water management innovation for consumption at the community level that does not harm the ecosystem. The purpose is to solve problems of human living, which are considered the center of the project. Nevertheless, at the same time, the solution must not harm non-humans or local nature for this study. This will create a relationship similar to that found between humans, showing what is called “care”. In this situation, non-humans are the recipients of care, but the target of care is humans. In addition, for the relationship between humans, this research project focuses on creating a network to solve problems in a community-based way, which is a mutual care of people in the community and allows people in the community to participate in showing responsibility for

non-humans or local nature (Ciobanu and Juhlin, 2022). Moreover, according to the study of Dedeoğlu and Zampaki (2023), the relationships built on the concept of sustainable development do not serve to create a life model that is sustainable, fair and comprehensive on this world. There are still many factors that have an effect on the imbalance of nature and are challenges that humanity has to face. Therefore, this study focuses on activities that create sustainable development.

Recommendations

Policy Recommendations

1. Government agencies should have a policy to support the budget for innovation in water management for consumption at the community level so that people can use water sustainably.

2. Local agencies should have a long-term plan for area development in order to enable the local development to be systematic and continuous, and have clear goals.

3. The government should have an approach for integrated policy implementation that is consistent with the local context, people's way of life, and livelihoods.

Practical Recommendations

1. There should be the study on the process model for creating a network of people for sustainable water management for consumption in the area.

2. There should be the study and analysis on the impacts of using innovation in the area for sustainable water management for consumption in Navamintarachinee Forest area, Mae Hong Son province, Thailand.

References

Charoenwongsak, K. (2000). The Educational Philosopher: Synthesizing, Analyzing, and Applying Royal Speeches on Education and Human Development. Bangkok: Darnsutha Press.

Channuwong, S. (2018). The relationship between good governance principles and organizational justice: A case study of Bangkok Government Officials. Asia Pacific Social Science Review, 18(3): 43-56.

Chiang Mai Provincial Office, Provincial Strategy and Data Division. (2022). Chiang Mai Provincial Development Plan (2018-2022) Revised 2022 Edition. Chiang Mai: Provincial Strategy and Data Division.

Ciobanu, P., and Juhlin, O. (2022). Forms of Care in Human–Nature–Technology Environments. Journal of Posthumanism, 2(3), 249–266.

Dedeoğlu, Ç., and Zampaki, N. (2023). Posthumanism for Sustainability: A Scoping Review. Journal of Posthumanism, 3(1), 33–57.

Esteves, F. A., Cardoso, J., Leitão, S., and Pires, E. (2023). Impact of artificial intelligence in the reduction of electrical consumption in wastewater treatment plants: a review. Journal of Information Systems Engineering and Management, 8(3), 21855.

Highland Research and Development Institute (Public Organization). (2020). Solving the drought crisis on high mountains…with cooperation from all sectors. Retrieved from https://www.hrdi.or.th/Articles/Detail/129

Highland Research and Development Institute (Public Organization). (2021). HRDI conveyed "Smart Farming System" for farmers in the highlands. Retrieved from https://www.hrdi.or.th/Articles/Detail/129

Khunweechuay, M. (2013). Synthesis of Research Knowledge and Water Management of peasant in Nakhon Si Thammarat. Faculty of Education, Nakhon Si Thammarat Rajabhat University.

Office of the National Economic and Social Development Council. (2018). National Strategy 2018 - 2037 (Summary). Bangkok: Office of the Secretary of the National Strategy Committee.

Othman, M., Halimee, N., Sobri, M., Suif, Z., and Ahmad, N. (2020). Hydraulic Ram Pump: A Practical Solution for Green Energy. Retrieved from https://www.researchgate.net/publication/342146991_Hydraulic_Ram_Pump_A_Practical_Solution_for_Green_Energy

Pengjam, W., and Nomnop, C. (n.d.). Study and Development of Water Ram Pump from Commonly Available Materials. The irrigation engineering project. Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom.

Prakongsri, P. (1998). Subdistrict Community. Bangkook: Matichon.

Research for Social Development Institute. (2021). as cited in Natthanon Chirakitnimit et al. (2023). The Sustainability of Water Management for Consumption in Pa Sak Nawamin Rachini Mae Hong Son Province. Science and Technology Research Institute, Chiang Mai University.

Sangwanna, S., Yodthong, T., Chitikorntaweesin, O., and Maidam, K. (2024). Guidelines for Sustainable Agriculture of Thai Farmers in Non-irrigated Areas. Universal Journal of Agricultural Research, 12(1), 148-158.

Sitthiritkawin, P., and Treerat, S. (2018). Study of Hydraulic Ram Pump for Using in the Mountain People Community: A Case Study of the Ban Ja-Jor, Doi Hang Subdistrict, Muang District, Chiangrai Province. Rajabhat Chiang Mai Research Journal, (19)2.

Thammathiwat, A., and Suthirak, B. (2012). Community participation in sustainable water management in Phetchabun Province in line with the Philosophy of Sufficiency Economy. Research Report, Office of Research Project Administration in Higher Education and National University Development: Phetchabun Rajabhat University.

Research Administration, 6(1), 5097-5106.

Wongmajarapinya, K., Channuwong, S., & Pratoomsawat, T. (2024). The model of modern management influencing sustainable organization development of Thai Smile Bus Company Limited. Migration Letters, 21(S2), 385-399.

Wongpanyo, W., Sroyngern, S., Suttarat, J., and Ruampara, P. (2016). Hydraulic Ram Pump 1½". Journal of Science and Technology Mahasarakham University, 32(5), 617-621.

Working group for the project master plan of the teak genetic resource conservation and the development of the quality of life of people in the forest area of Khorng watershed and Pai watershed under the royal initiative (Navamintarachinee Forest), Mae Hong Son Province (2023-2027). (2022). Project master plan of the teak genetic resource conservation and the development of the quality of life of people in the forest area of Khorng watershed and Pai watershed under the royal initiative (Navamintarachinee Forest), Mae Hong Son Province (2023-2027). Office of the Royal Development Projects Board.

Zhang, Y. (2023). Reviving folk music of the southeast in Shanxi: cultural revitalization and citizen engagement through digital platforms and facilitation through information systems. Journal of Information Systems Engineering and Management, 8(2), 22993.

Zhang, J., Yusoff, M. M., Hamzah, T. A. A. T., Noor, N. M., Shi, Q., and Wang, Z. (2023). The impact of SDGs triggering the geographical information system (GIS) innovation influencing urban and rural system mechanism and socio-economic growth. Journal of Information Systems Engineering and Management, 8(2), 22547.