



# แนวทางการแก้ปัญหาน้ำท่วมซ้ำซากและการขาดแคลนน้ำ โดยกระบวนการมีส่วนร่วมของชุมชน หมู่บ้านจวน จังหวัดกาฬสินธุ์

บทความวิจัย

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## บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อนำเสนอแนวทางการแก้ปัญหาซ้ำซากและการขาดแคลนน้ำของชุมชนบ้านจวน ตำบลโนนนาจวน อําเภอนาคู จังหวัดกาฬสินธุ์ โดยใช้กระบวนการมีส่วนร่วมในการค้นหาแนวทางการแก้ปัญหา ระหว่างเดือนมีนาคม พ.ศ. 2562 ถึง มกราคม พ.ศ. 2563 การดำเนินการประกอบด้วย การสังเกตอย่างมีส่วนร่วม การจดบันทึกภาคสนาม การสนทนากลุ่ม แบบสอบถามข้อมูลพื้นฐานการใช้ทรัพยากรบุคคลและภาพรวมของชุมชน การทำแผนที่ชุมชน และเวทีคืนข้อมูล ผลจากการดำเนินการพบว่า แนวทางการแก้ปัญหาซ้ำซากในฤดูฝนคือ การอนุรักษ์และเพิ่มพื้นที่ป่าต้นน้ำ การสร้างฝายชะลอน้ำบริเวณต้นน้ำ และขุดลอกหนองแม่แก้งและลำห้วยขามเพื่อเพิ่มความจุในการกักเก็บน้ำ แนวทางการแก้ปัญหการขาดแคลนน้ำในฤดูแล้งคือ การซ่อมแซมฝายน้ำล้นที่ชำรุด 2 แห่ง และการสร้างฝายน้ำล้นในลำห้วยขามตอนบนเพิ่ม 1 ฝาย ผลจากการดำเนินงานส่งผลให้ ชุมชนเกิดการแลกเปลี่ยนเรียนรู้ในการจัดการแหล่งน้ำ มีการแต่งตั้งคณะกรรมการบริหารจัดการน้ำชุมชน จากกระบวนการมีส่วนร่วมของคนในชุมชน ทำให้เกิดการร่วมคิด ร่วมประเมินผล ร่วมสำรวจพื้นที่ที่เหมาะสมในการพัฒนาเป็นแหล่งกักเก็บน้ำไว้ในฤดูแล้งและการปรับปรุงฝายน้ำล้นที่สำคัญ 2 แห่ง ซึ่งจะช่วยลดระยะเวลาและปริมาณของน้ำท่วมซ้ำ ซ้ำส่งผลให้ชุมชนทราบถึงแนวทางการแก้ปัญหาที่มีประสิทธิภาพ

คำสำคัญ:

จังหวัดกาฬสินธุ์

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กระบวนการมีส่วนร่วม

น้ำท่วมซ้ำซาก

การขาดแคลนน้ำ



# Community Participation in the Solutions to Recurrent Flooding and Water Shortages of Banchan Village, Kalasin Province

Research Article

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## Abstract

The research aims to propose solutions to recurrent flooding and water shortages by using community participation of Banchan village, Non Na Chan sub-district, Na Khu district, Kalasin province. A participatory approach to the problem has been taken from March 2019 to January 2020. Tools of this qualitative research are observation, field notes, group discussion, informal discussion, individual and community questionnaires of water usage, local mapping, and a community forum to return the information. The research outcome shows that the flooding solutions are to expand and conserve the forest areas, to build temporary check dams upstream, and to dredge the Lam Huai Khum and Nong Mae Kaeng in order to increase the retaining capacity. The drought solutions are the rehabilitation of two weirs and building a concrete weir in the upstream of the Lam Huai Khum. The study result reveals that the people have exchanged knowledge and taken part in selecting the water management committees for their village. They have also participated in decision making, processing and evaluating. From the survey participation, the people have discovered a suitable area for water retention and identified the need to repair two important damaged weirs to mitigate the interval and spatial problems of flood and drought. In conclusion, the effective solutions are found to solve the problems by community participation and concerned organizations.

**Keywords:**

Kalasin province,  
Banchan village,  
Community participation,  
Recurrent flooding,  
Water shortages

## Identifying the existing situation

Water resource is necessary for human well-being and livelihood. It, directly and indirectly, affects human activities (Cai et al., 2016). Water scarcity becomes a major issue in Central Asia, East Asia, Southeast Asia and other regions (Kumar et al., 2015; Boretti & Rosa, 2019). There are developing concerns on the impact of climate change on water resources. Impact of climate on water resources will have significant challenges for water management and planning (Sheikh & Zahurul, 2019). Thailand's economic growth has been generally based on the agricultural product (Chinprateep, 2013; FAO, 2018). Water is a significant factor in agricultural products in terms of quality and quantity. Therefore, the agricultural product relies mainly on climate factors, among them instability monsoonal climate, which in itself is a major factor causing fluctuation in agricultural product. Most agricultural areas in Thailand are non-irrigation approximately 87.4% of the total agricultural area (Office of the National Water Resources, 2019). The report of Thai rice department showed the accumulated data from 1 May 2016 – 15 August 2016 in Kalasin, there was an irrigation area about 29% of total rice cultivation area which (Thai Rice Department, 2016).

### Basic information of the study area

The study area locates in the Banchan village, Non Na Chan sub-district, Na Khu district, Kalasin province, northeastern Thailand (Figure 1) and covers an area of 2.4 km<sup>2</sup>. The region covers both agricultural land and residential area with 472 of the population. The research studied the target group contains 52 local people. The results of a personal interview survey were shown in Table 1. Agriculture is the major activities and the major crop is paddy. Other agricultural crops are cassavas, beans, and vegetables. Germinated rice is the One Village, One Product (OTOP) produced from rice cultivation in the village. The 88.5% of people in Banchan village is an agriculturist. They have their cultivated area of about 2–28 rai per family. There is about 1,000 rai of agricultural areas. The 100% of cultivation is wet season rice. Only 7.7% of the farmers can produce dry season rice using water from the stream. The 13.5% of the

farmers produce other cultivation such as cassava, groundnut, and sugar cane. The most income of people is obtained from cultivation. The annual income of people in the village is approximately 9,333 baht per person. Groundwater is used to supply water for consumption. The maps shown in Figure 1 & 2 were created by using QGIS3.6.3 program.

### Climate information

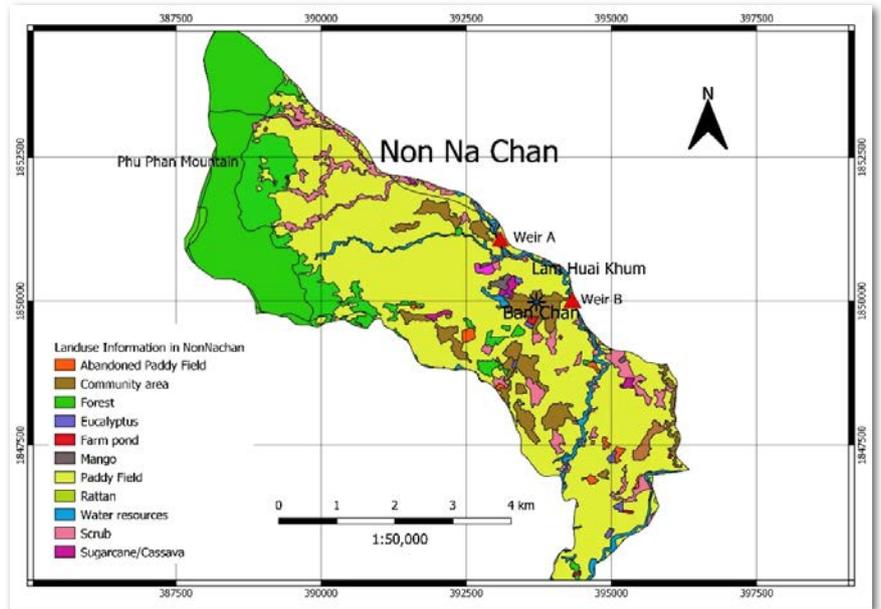
The people have cultivated area along both sides of the mainstream. Lam Huai Khum is only one stream in the village, plays as a key water resource in this region for agriculture. The stream is approximately 30 m of width and 2.5 m of depth. Two weirs were constructed across the stream to raise the water level and named weir A and weir B for this study (Figure 2). Three seasons in Kalasin, northeastern Thailand can be classified as a cool season, a dry season, and a rainy (monsoon) season. The rainy season is generally from June to October with an average annual rainfall of 1,300–1,600 mm. The monthly rainfall data from January 2016 to January 2018 at the rainfall station of Na Khu district was received from Khon Kaen Meteorological Center as shown in Figure 3. There is only one rainfall station at Na Khu district which was used to collect the data of rainfall representing Non Na Chan sub-district. As can be seen, the graph of volume of rainfall showed high intensive rainfall in July which caused the overflow of Lam Huai Khum.

### Flood and drought problems

Banchan village locates in the non-irrigation area in Kalasin province. The agricultural sector generates almost 100% of people's income. This area has a tropical climate type with temperature ranging from 19°C to 45°C. Generally, there was high intensive rainfall in the rainy season causing recurrent flooding in every year. The flood period is between 2–15 days depending on the intensity and duration of rainfall. There is one stream in the village called Lam Huai Khum lines downstream of the Phu Phan mountain (Figure 4), so it causes floodplain in the rainy season. However, this village faces drought in the dry season every year. Rainwater is the majority of water resources for rice planting. Therefore, there is no cultivation in the dry season. There is insufficient water in Lam Huai Khum



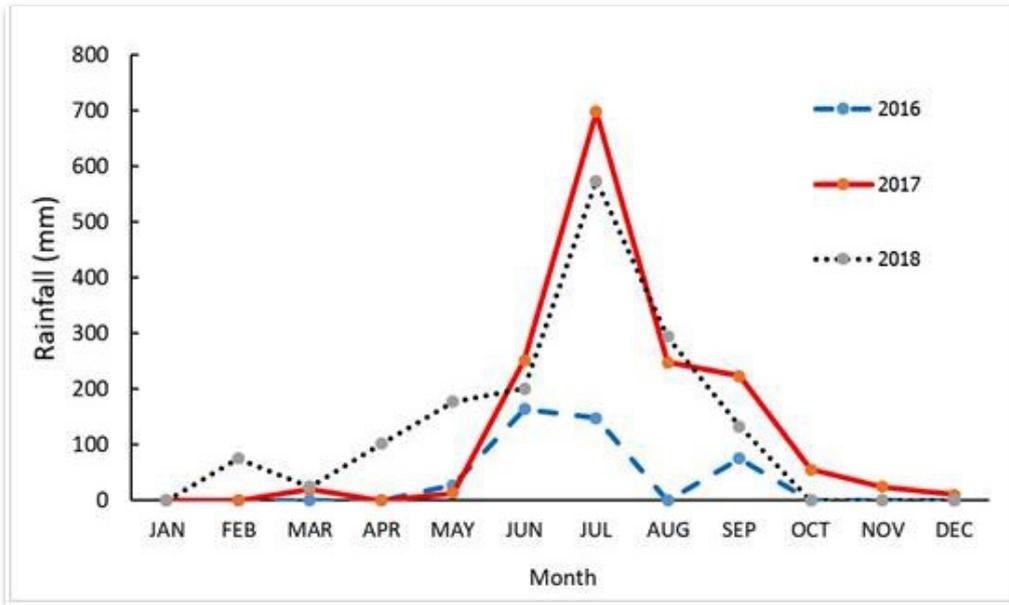
**Figure 1** The map of districts in Kalasin province



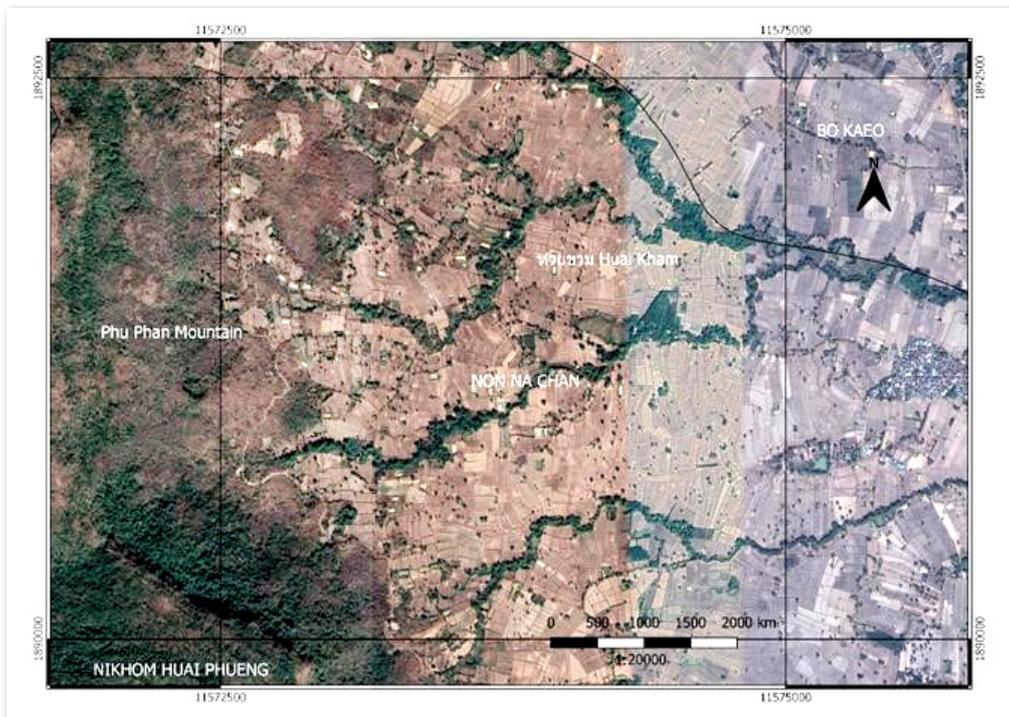
**Figure 2** Land use information in Non Na Chan sub-district

in the dry season even it is an overflow in the past rainy season. High intensive rainfall in the rainy season generates a large amount of water flows downhill from Phu Phan mountain to the

mainstream of the village. There is no water allocation rule and water management for usage. Therefore, the water usage of the stream has a high competition in the dry season for



**Figure 3** Average monthly rainfall in Na Khu district, Kalasin province



**Figure 4** Lam Huai Khum stream

agricultural demand. Water scarcity for agriculture in the dry season has effects on people's income. Most of them then have to leave their land to find a labour job in a big city.

### General practice of water management

The community enterprise group was settled by the farmers in the village to produce germinated rice products from their rice cultivation. The germinated rice is generated by rice processing using their transfer of local wisdom. The germinated rice has been developed and becomes the signature of the village or the One Village, One Product (OTOP). This development of rice processing increased the farmers' income. The germinated rice produced by the group was soft, aromatic, and non-toxic. Therefore, the demand for the product is higher than the supply because of the product's quality. Unfortunately, the production was limited by water resources for rice cultivation, significantly affecting on the group's income. Some farmers have attempted to pump water from Lam Huai Khum for dry season rice cultivation without any rule of water allocation and water retention. Some of them built a pond for water retention as following the government policy, but there is not enough water for cultivation in the dry season.

As a result of a personal interview survey, the knowledge of water management was required. For example, a part of questionnaire was used to ask about an available retention or pond and its condition in the agricultural area. It was found that less than 50% of farmers have water retention pond in their own land. Some ponds were empty in the dry season because of their size and high water evaporation. The capacity of the pond was not well suited to annual plants and the size of cultivated areas. The ponds were built without a good knowledge of selecting location and design. The location of pond was selected from the area that has not been used for agriculture. Some ponds were built on the upland areas where water runoff is not able to flow into the ponds. On the other hand, the overflowing of the upland ponds flows into the lowland area. In addition, the ponds are not deep enough to keep the pond water from overflowing in the monsoon season. Almost ponds were found about 1.5–2 meters of depth. Therefore, rainfall is only an input collected in the ponds.

**Table 1** Basic information collected from a personal interview survey of 52 people

Basic Information		Result	
		No.	%
Gender	Man	12	23.1
	Woman	40	76.9
Career	Agriculture	46	88.5
	Other	6	11.5
Rainy season crops	Wet season rice	52	100
	Vegetables	11	21.2
	Other	4	7.7
Dry season crops	Dry season rice	4	7.7
	Vegetables	10	19.2
	Corn	4	7.7
	Other	7	13.5
Livestock	Not planted	32	61.5
	Cow	23	44.2
	Poultry	29	55.8
Available water in ponds	Fish	30	57.7
	Rainy season	29	55.8
	Dry season	11	21.2
Water resources for Agriculture	Rain water	52	100
	Pond	29	55.8
	Lam Huai Khum	21	40.4
Flood duration	$\leq 2$ days	25	48.1
	$\leq 7$ days	19	36.5
	$\leq 15$ days	8	15.4
Agricultural areas (rai)	Average	9.6	–
	Maximum	28	–
	Minimum	2	–
Agricultural annual income (Baht)	Average	9333	–
	Maximum	45000	–
	Minimum	3000	–

## The process used to change and the acceptance of the target community

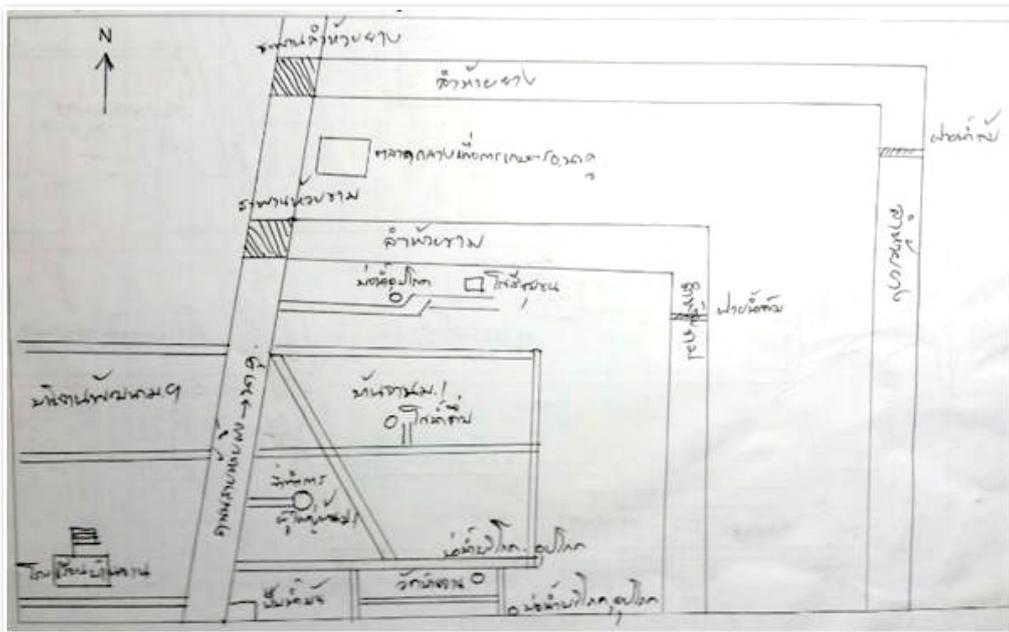
This research focused on community participation in water resources management in the non-irrigation area where faces the problem of recurrent flood and drought every year. Tools of the qualitative research are observation, a community forum, group discussion, interview, and local mapping have been used in this research. As a result, the local stakeholders participated in selecting the solutions that were identified by people in the community. Community participation in Banchan village is really important to be learned in order to improve a better quality of life in the environment.

### Community participation in the basic information

#### 1) Finding causes of drought

As a result of the survey, the map of Banchan village was sketched by the leader (Figure 5). The map was used during the area-survey participation and describing the flood problem. Agricultural sector in Banchan village is non-irrigated

agriculture consisting of both upland and lowland cultivated areas. Therefore, rainfall is mostly used for rice cultivation in this region. The only public water resource is Lam Huai Khum. The water was used by some farmers who have land along the stream. As a result of the survey showed that the water distribution system was poor management for agricultural areas. However, its water level was very low in the dry season and its volume has not been used for crops growing. Therefore, there was about 800 rai of cultivated areas faced drought issue in the dry season. The deposition of sediment impacted on the efficiency of water retention at weir B, so this affected to a water depth of the stream (Figure 6). Therefore, water insecurity happened in every dry season especially from December to May. Some farmers used water from a small pond in their land for growing some vegetables in the dry season. However, most artificial ponds were not adequate for the whole period of dry season rice and crop cultivation. Another cause of water shortage was the lack of sufficient water resources in this region such as an individual pond and a public pond for agricultural demand. However, water scarcity does not impact on water consumption in the dry season. The



**Figure 5** The map of Banchan village sketched by the leader

groundwater was used for water supply in the village. The water scarcity of water supply only impacted people who live in the upland areas.

## 2) Finding causes of flooding

The group discussion and survey gave the information on the flooding situation (Figure 7). The flooding affects rice cultivation and rice crop production. The annual flooding in the

village was caused by an overflow of Lam Huai Khum and heavy rainfall. The high volume of water fast-flowed down from Phu Phan mountain in Sakon Nakhon province. Sediment deposits in the stream reduced water depth. Therefore, lack of removing sediment deposits also can cause floodplain surrounding areas. The village has been faced the last extreme flooding over 15 days in 2017 covering almost cultivated areas or about 1,000 rai. The deposition of sediment reduces the



**Figure 6** The deposition of sediment in front of the weir B



**Figure 7** The survey of the construction at (a) weir A and (b) weir B

stream capacity. In the period of high intensive rainfall and water fast-following down then easily causes overfull of the stream. The flooding happens every year in July covering people's cultivated areas along the stream. It was found that there is no check dam in the upstream of Lam Huai Khum to reduce water velocity of the stream flowing down from Phu Phan mountain. Nong Mae Kaeng is a small pond found in the upper of the village that receives water flowing down from the

mountain. The water releases from Nong Mae Kaeng to Lam Huai Khum. The pond was also lack of removing sediment of deposit impacted on reducing the water depth and its capacity. Two important reinforced concrete weirs in Lam Huai Khum were damaged, so this caused a reduction of the efficiency of water retention and slowing down the flow (Figures 8–9). In addition, the construction of roads and bridge influenced the natural flow obstructions on the flooding phenomenon.



**Figure 8** The damaged weir A closed to Nong Mae Kaeng



**Figure 9** The damaged weir B closed to Banchan Village

### 3) The local water management committee

The water management committee was selected by the community engagement in order to be the representative of villagers. The committee has been appointed for the first priority action during participating in this research. The committee of 10 members was voted by the local community participation. The water management committee consists of the multi-stakeholder groups involve one leader of the village, one leader of the community enterprise group, four farmers, three villagers, and one assistant to the president of the sub-district administrative organization. The water management committee was authorized by the president of Non Na Chan sub-district administrative organization. The functions of the committee include identifying the principle of operation, providing the water management regulations, monitoring and controlling the project, organizing the activities, and coordinating the relevant organization. In addition, the important roles of the committee are planning of water resources development and resolving conflicts of stakeholders.

### 4) The possible solutions to flooding

It was known that the flooding phenomenon cannot be immediately eliminated. However, the solutions were proposed to alleviate the impact of flooding on agriculture activity. The fast-flowing water from the Phu Phan mountain is one of the flooding causes, so the decelerating water velocity was presented as below.

#### 4.1) Expanding and conserving the forest areas

The forest area was lost because of agriculture expansion. Expanding and conserving the forest area in the upstream and along with the Lum Huai Kham can absorb more water and reduce runoff. Therefore, tree plantations in the upstream area of Lam Huai Kham can reduce water flows in high rainfall to the river system. This action can be done by the villagers' participation without using the budget.

#### 4.2) Temporary check dam construction

A temporary check dam can be built from natural materials such as stone, sandbags, wood or bamboo. Temporary check dams can be constructed to reduce the velocity and erosive power of runoff in the upstream of Lam Huai Kham. This action can be also done by the villagers' participation without using the budget.

### 4.3) Development of water retention area

Figures 8–9 show a large amount of suspended sediment and weed in the front of the weirs which decreased the receiving capacity of the stream. Water retention areas should be developed before the monsoon season. Dredging the Lam Huai Kham and Nong Mae Kaeng to remove the sedimentation and weed can increase the capacity of water retention and decrease the water level in the monsoon season. This approach can be managed and requested the budget later. However, the villagers can help to remove some waterweed in the stream as a short-term action without requesting a budget.

### 5) The possible solutions to water scarcity

As a result of the survey, the water scarcity issue in Banchan village has impacted economic benefits and food security. The water management for drought mitigation was presented by group discussion as a following.

#### 5.1) Knowledge of proper pond construction

The knowledge of pond construction has been already presented in the community forum. The farmers have obtained the knowledge that an appropriate lowland should be selected to construct a pond to contain water runoff and rainfall in their area. In addition, the size and depth of a pond have to be enough to contain a volume of water for the water demand of cultivation planed in the dry season. The depth of the pond should be about 3–4 meters and the size depends on the water requirements of the cultivation area.

#### 5.2) Identifying a water allocation system

Water-saving irrigation techniques were provided by the experts in the community forum such as drip irrigation systems. An integrated farming system was recommended. The dry season crops also recommended such as watermelon, bean, corn, etc. However, some farmers want to grow the dry season crops and apply the water-saving irrigation techniques if there is enough water in their pond or the stream. However, this is the long-term action that needs the budget. The water requirements of cultivation should be surveyed and collected in order to consider the type, size, and seasoning of planting. This information could help the committee in planning for water allocation. The regulation of water allocation should be identified to minimize the loss in economic benefits and food security by efficiently

sharing water supplies when the inevitable drought occurs.

### 5.3) Repairing weirs

Weirs retain water that increases the moisture levels of surrounding soil for a longer period after the monsoon season is over. Weirs also conserve as much water as possible during the post-monsoon season that would increase water available for water allocation. As a result of observation, two important concrete weirs were damaged (Figures 8–9). Some parts of the weirs were broken. The damaged weirs affected cultivated areas because they could not retain the amount of water as their capacity. Therefore, to avoid more severe impacts of the droughts, the two damaged weirs need to be repaired. Moreover, the floodgate should be installed in order to control water releasing. However, this action needs a high budget to repair.

### 5.4) Development of water resources

As a result of the survey, water resources such as Nong Mae Kaeng should be increased the water- retaining capacity of the pond where is close to cultivated fields. This pond would collect water runoff during the monsoon season and be used for water allocation of agriculture activities in the dry season. There was no water delivery system to deliver water from the stream to individual ponds to retain water in the monsoon

season. However, this action needs a high budget to repair.

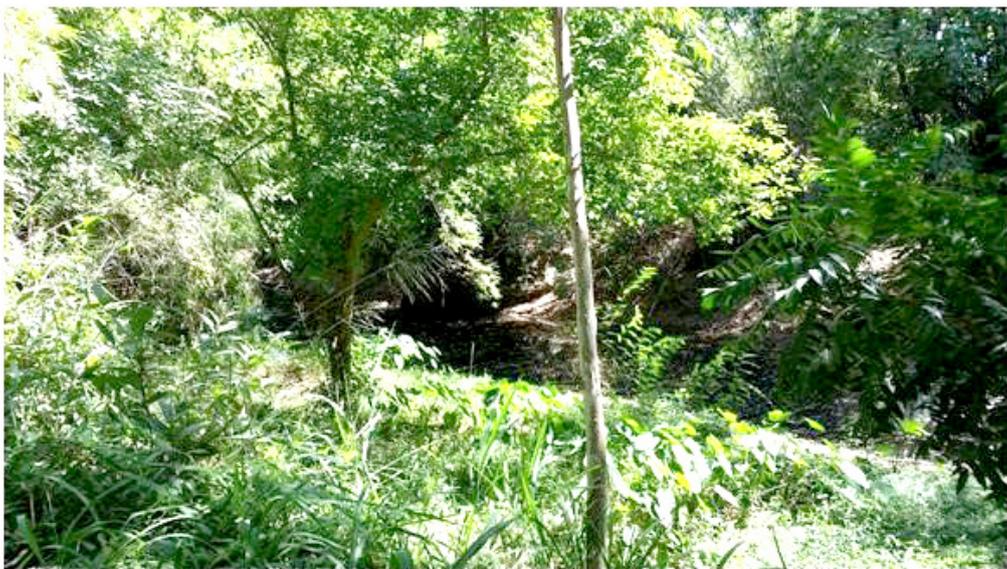
### 5.5) Building a public water retention

The water management committee and local people have participated in the survey to find the solution to develop the water resources. As a result of the survey, the proper space for building public water retention pond was found nearly the junction of streams. A proper design of a concrete weir could be considered in that area to accumulate runoff flowing down (Figure 10). This approach could slow down the water in Lam Huai Khum in the monsoon season. The public water retention pond is a long-term solution because of funding. However, this approach would increase the volume of water in this water resource.

## Implementation of knowledge or expertise

### Water management principles

The meeting at the international conference on water and the environment was conducted in Dublin, Ireland in 1992. The output from this conference was a declaration regarding



**Figure 10** The area was found to build the public water retention pond by the weir construction

water with four principles. The 2nd principle was applied in this study. The principle has been documented that the participation of multi-stakeholder groups is very important in water development and management. The participation approaches are methods that can ensure public engagement in increasing awareness, decision making, planning process, policy-making, and implementation concerning water issues (The Dublin Statement, 1992).

Therefore, stakeholder engagement has been used as a tool in this research to give the opportunity of sharing local people's ideas, opinions, and concerns. The water resources directly affect agriculture activities, that many stakeholders interact in water requirements (Michailidou et al., 2016). The stakeholders take the benefit of water resources, so they should also have the capability to manage water resources (Jeong et al., 2017). Therefore, the participatory approach was the essential process for investigating the appropriate solutions, is well respond to the local problems (Rahman et al., 2017). However, the decision making of the stakeholder is very important for water resources management because any solution requires knowledge and sufficient financial and technique. The stakeholders are part of the decision-making process in a participatory approach which can reduce the conflicts between water users (Nsubuga et al., 2014). Additionally, some information obtained from the observation was used to coordinate with other methods to meet the objective of the research. Participant observation allows the researcher to understand what people do rather than rely on what people say they do (Olga & Mader, 2014). There are some areas in Thailand that have employed the participation approach to solving water management problems. For example, the problems of public retention management and water delivery system were commonly found in rural areas. These problems have also happened in Ban Lim Thong in Buriram province (Bureau of Research, Development and Hydrology, 2009) as well as Sai Na Wang sub-district in Kalasin province. Nowadays, both areas have already altered the water issues by the community. Therefore, participation in their own area was motivated by a good sample of the successful water management areas, for example, the study of water management in Sai Na Wang and Ban Lim Thong (Mankoksung, 2017).

### Community-based participation for water resources management

Several researchers have studied the community participation in Thailand (Rattana, 2011; Suwannakwaw, 2013; Mankoksung, 2017). The participatory approach is a key method in this research to investigate the water issues by local participants. Participatory action research is a collaborative method to train, practice, and implement that researchers and participants work together to address problems and identify solutions in community settings (Trott et al., 2018). An appropriate participatory approach increases motivation, feeling of ownership and community empowerment (Ahmad & Talib, 2016). Focus group discussion is commonly used as a tool in the participatory research to receive an indepth understanding of local issues (Nyumba & Mukherjee, 2018). The impacts of water scarcity and concern factors in the previous time, in the present and in the future based on data from the survey were presented and discussed by using focus group participation. To overcome potential challenges, participants require a good understanding of the problems and the knowledge required to address them (Wilk & Jonsson, 2013).

The community-based natural resource management (CBNRM) approach has been used by Pandey & Sharma (2016) in order to study resolving water problems through three principles; Stakeholder involvement, Public participation, and Inter-organizational collaboration. These principles inspired and encouraged local people to overcome the prejudices and limitations in the traditional environmental planning styles by incorporating the ideas, giving knowledge, collaboration and assistance. Therefore, the forum also has been created in this study as an effective tool for a public participation to educate and share experience in solving water management issues with other experts. A community forum is a tool of the participatory approach to access local knowledge, the impact of a problem, and decision-making through a modified public involvement process (Becker et al., 2003). Bhadwal et al. (2013) have also used a multi-level and participatory approach in order to develop adaptation options in changing water resource availability and climate in Northern India. The results of involving stakeholders from multiple levels were obtained

the understanding of the risks, identification of the adaptation responses, and prioritization for risk reduction.

Bormann et al. (2016) have recommended the CapWEM project or “Capacity Development in Water Engineering and Environmental Management” to six Latin American Universities and two European Universities in order to increase the efficiency of development in the water sector in Latin America. The methodological framework of the CapWEM project contains literature reviews, different kinds of surveys, interviews and workshops. The purpose of conducting the interview is to produce the responses of the people to gather indepth information (Szolnoki & Hoffmann, 2013). The received information encouraged the researchers to understand the cause and effects of water management issues.

## The change of new situation

The major water issues faced by the Banchan village are droughts and floods, which affect the farmers every year. However, these problems have never been solved by the involved people. This research has employed the community-based participatory approach to encourage the local people to realize their problems and to analyze the possible solutions to flooding and droughts problems. The participation approach was conducted from March 2019 to January 2020. The approach of this research impelled community participation in selecting the water management committee for their village. The people have participated in decision making, processing, and evaluating. The effective solutions were found for solving the problems by community participation. The water management committee plays an important role to lead the ways for an effective problem-solving process.

### Short-term actions plan

1) The necessary solution which has been performed in this research was building a network with the water management model in a nearby area. The next action that can be done by the committee is to continue the connection with the leader of the water management committee at Sai Na Wang. The water

management committee should learn the operating guidelines from the leader’s experiences. Therefore, they can get guidance and funding source information for water resources management.

2) The water management regulations and planning for requesting the funding or the budget should be defined by the water management committee.

3) The local people need the knowledge and information of a drought situation. The short-term action that can be done by the water management committee is to take any action to coordinate with relevant government agencies for drought warning and protection planning.

4) The committee and local volunteers should increase forest areas in the upstream of Lam Huai Khum and along the stream.

5) The temporary check dams should be built in the upstream area. Therefore, the committee should manage and lead the local volunteer to build the check dams by using some natural materials such as stone, bamboo, and sandbags.

### Long-term actions plan

1) The committee must request the budget for removing the sedimentation and weed along the Lam Huai Khum, the front of weirs and around Nong Mae Kaeng.

2) The rehabilitation of two damaged weirs should be done. The control gate of the weir should be installed. The height of the weirs should be increased to retain more water for the cultivation area. The water management committee should find the funding source or request the budget for this action.

3) The committee must request the budget for finding the funding for building public water retention. A concrete weir with the control gate should be designed in a proper area around the junction of the Lam Huai Khum.

4) The water allocation system should be designed by the committee and local participation after these weirs are constructed.

## Impact and sustainability of change

Water resources management activities were conducted by the participation of local people in the village. The research

process played as a guideline for participation activities. The researchers provided the basic knowledge and tools of water management for participants' decisions. The power of team working in setting community enterprise groups has been applied to integrate with research participation. Therefore, the community participation method in this research motivated people to work together in setting goals and planning in the development of water resources management. Flooding annually occurred in Banchan seemingly becomes an uncontrolled natural phenomenon. However, its rigor may be managed and reduced by community participation. The absence of the water committee management was one factor of failure in flood management. Lack of collaborative and responsible committee impacted on receiving information and prevention plan. The agriculturists needed water allocation for their cultivated fields in order to obtain income from agriculture products as much as possible. According to the reasons mentioned above, the water allocation rules and water management system should be well-identified by the responsible committee.

Water retention in cultivated fields was very important and the knowledge of its construction was required to educate. Most agriculturists wanted to have cultivated field as large as possible. Some of them believed that pond construction wasted their land and ponds were not able to retain water for the dry season cultivation. The water delivery system was not constructed in Lam Huai Khum to deliver water to ponds. Therefore, rainfall was one main source of water for most cultivated fields. A major challenge of water management is the development of water resources in order to retain water during the monsoon and deliver to meet the demand for

cultivated fields in the post-monsoon season. The creativity of a temporary check dam and repairing two existing concrete weirs were urgent required funding and collaboration. The main advantages of the check dam and weirs are it reduces flow velocity in channels, it retains excess water flow during the monsoon in a small catchment area and remains water availability in the post-monsoon. In addition, a public water retention pond in the catchment area of Lam Huai Khum was considered in order to increase water availability to meet water requirements.

The communication participation approach in the development of water resources would make more efficient water management to mitigate the effects of floods and droughts. Community committees play a significant role in organizing and managing as described in this paper. This study realized important findings on the role of community participation that has a lot of influence on flood and drought management. There is a need to settle an integrated drought and flood warning system with an action plan so that local people can get drought and flood warning information early, timely, and adequately. Further studies should deeply evaluate the metrics of successful community participation in drought and flood management as well as a warning system.

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