

Local Participation In Agricultural Water Management In The Red River Delta Of Vietnam A Case Study In Que Vo District, Bac Ninh Province

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Abstract: This study aims to investigate the local participation in agricultural water management in Que Vo district in the Red River delta of Vietnam. The study results show that although the farm households did not actively participate in formulating the irrigation & drainage plan, they played quite active role in adjusting irrigation plan, leading the water and keeping water in the fields. The local participation also significantly contributed to maintaining and improving the canal system, especially through the irrigation month in the years. For enhancing local participation in agricultural water management in the district, it is necessary to raise the farmers' awareness on water savings, to provide the training course for irrigation & drainage team members, to assign the canal maintenance task to the farm households, and to improve the mechanism of participation mobility

Index terms: Agricultural water, Drainage, Farm Households, Irrigation, Local People, Participation, Management

1. INTRODUCTION

The attention given to agricultural water management (AWM) has increased in recent decades due to the growing problem of water scarcity worldwide and rising conflicts between water users (Heyd and Neef, 2004). Improved AWM or more-efficient use of agricultural water is thus an important issue in many countries. It is even much more important in the Red river delta of Vietnam since agriculture in the delta plays a very crucial role. According to GSO (2016) around 70 percent of the population in the delta still live in rural areas and depend upon agricultural activities and other related activities. The delta is characterized by high population density rates of around 1,000 inhabitants per square kilometer, heavy agricultural intensity with almost three crops a year, and huge water control infrastructures with around 3,000 kilometers of dykes (Binnie et al., 1995) and around 1,700 irrigation and drainage pumping stations (George et al. 2004) scattered along thousands of kilometers of irrigation and drainage canals. Irrigation systems in delta rely heavily on pumping for the provision of irrigation and drainage services (George et al., 2004). In recent years, AWM in the delta has faced more challenges since natural calamities have happened more often than before, possibly due to the impacts of climate change. Like many other countries, agricultural water in the Red river delta of Vietnam is a common pool resource and its irrigation and drainage schemes are public systems. Although decentralization in managing these systems has been performed in recent years, managers and users of these systems have expressed concerns about the efficiency of their operations. A number of inefficiencies in AWM such as the uneven distribution of water across the system and between farm households, inappropriate timing of water

release to meet crop requirement, the loss of water etc., have been identified through a range of research projects (Harris, 2006; World Bank, 2006; etc.,). One of the reasons leading to these inefficiencies is argued to be the limited local participation in AWM (Bruns, 1997).

Local participation in AWM is recently seen as a crucial prerequisite for the conservation and sustainable use of scarce water resources. Since the late 1990s, participatory and integrated water management has been high on the agenda of national governments and international donors in the Southeast Asian region (Heyd and Neef, 2004). It is argued that a key driver of increased efficiency in water resource management is the involvement of all stakeholders, especially at the local level where resources originate (Hetland, 2008). Although there existed few researches related to current irrigation situation in Red River delta and its impacts on farm household economy (Biltonen et al., 2003) or to irrigation management system in the Red River delta (Harris, 2006; Bruns, 1997), the research on local participation in AWM in Red River delta is still very limited. A number of questions on local participation in AWM in the Red River delta have been emerged such as what the current participation of local farm households and community in AWM in Red river delta is; whether local participations help improve the AWM in Red river delta; which the constraints of local participations in AWM are; and how to improve the local participation for better AWM, etc.,. In response to those questions, this study was implemented to generate knowledge that contributes to the better local participation in AWM in the Red river delta of Vietnam. The specific objectives of the study include (1) to investigate the current institutional arrangement in AWM in the Red river delta of Vietnam; (2) to identify the current situation of local participation in AWM; and (3) to draw policy implications for enhancing relevant local participation in AWM, thus contributing to more efficient use of agricultural water resource and improved crop productivity in Red River delta of Vietnam.

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2. METHODOLOGY

2.1. Study Area

This research was conducted in Que Vo district, Bac Ninh province in 2017. Similar to other typical locations in Red river delta, agricultural production in Que Vo district still plays the important role as around 75 per cent of its population still engage in agriculture and other related activities. The main crops in Que Vo district include rice, maize, potato, cabbages, kohlrabi, and other vegetables and they are cultivated by the most farm households. AWM therefore plays a very important role as its efficiency can affect the crop productivity and income of most farm households in the district. To secure the representativeness, three communes namely Phuong Lieu, Nhan Hoa, and Mo Dao with the differences in geographical and socioeconomic conditions in the district were selected as the specific research sites. While Mo Dao and Nhan Hoa communes are close to rivers (Duong river and Cau rivers, respectively), Phuong Lieu is located a little bit far from rivers. While farmers in Mo Dao and Nhan Hoa focus on farming activities, farmers in Phuong Lieu have more income from off-farm work (such as room rental, shop services) as Phuong Lieu is quite close to the Que Vo industrial zone.

2.2. Data collection and analysis

Secondary data on agricultural land areas, crop system, current situation of irrigation and drainage system (local canals, pumping stations, dykes), organizational system of AWM and their functions in Que Vo district were gathered from the Department of Agriculture and Rural Development (DARD), the Extension Service Center, and Que Vo Irrigation and Drainage Enterprise. The data and information on agricultural production and irrigation situation at commune level were gathered from statistical units and agricultural cooperatives in selected communes. The primary data were gathered through the field survey of farmers, and focus group discussions. A total of 90 farm households in three selected communes were randomly selected for the survey. The personal interviews with farm householders using a standard questionnaire were implemented. In addition, three focus group discussions (FGDs) with participation of farmers, local staffs of district, communes, agricultural cooperatives, and Que Vo Irrigation & Drainage Enterprise (QVIDE) were held to identify the participation of local farmers and communities in activities related to AWM, the factors affecting, main constraints and implications for enhancing the local participations in AWM in the futures. The descriptive statistics and comparative analysis methods were mainly used in this research. Descriptive statistics method was used to describe the general pictures of agricultural production, current water management and current local participation in the AWM. Meanwhile, comparative analysis method was applied to investigate the difference in local participation in AWM between communes and farm groups, and investigate the relationship between local participation and AWM efficiency

3. Results and Discussions

3.1. Overview of agricultural water management system in Que Vo district

3.1.1. Crop production and irrigation & drainage situation in the district

The crop industry plays the very important role in income generation for most farm household in Que Vo district.

Similar to other regions in Vietnam, agricultural land in Que Vo is allocated to farm households for crop production. Total crop land areas in Que Vo district in 2017 was 8,426 hectares (accounting for 54.3 percent of the natural areas). Of those the annual crop areas accounted for the majority of 99.6 percent (Bac Ninh Statistical Office 2018). There are three crop seasons in Que Vo district, including Spring-Summer season, Summer-Autumn season and Winter season. The dominant crop in spring-summer season and also summer-autumn season is rice. There are various kinds of crops that are planted in winter season such as potato, sweet potato, tomatoes, kohlrabi, cauliflower, cabbages, etc.... Of those, potato crop is the main, accounting for around 40-50 percent of total planted areas in winter season.

Table 1. Areas to be well irrigated and drained in 2017 in Que Vo district

Crop season	Total cultivated area (ha)	Well irrigated and drained area (ha)	Ratio of well irrigated and drained area in total (%)
1. Spring season	8,426	7,249	86.1
2. Autumn season	8,426	6,996	83.3
3. Winter season	4,015	2,174	54.4

(Source: QVIDE 2017)

According to Bac Ninh DARD (2016), there are 1,532 hectares of crop land in Que Vo district that could encounter the drought situation if the weather is not favorable. This area accounts for around 18.2 per cent of total crop land in Que Vo district. In addition, there are also 2,049 hectares (or 24.3 per cent of total crops land) that could face to flooding situation. In 2017, more than 85 of total annual crop land in the district was positively irrigated and drained in spring and winter seasons while this figure in winter season was 54.4 per cent (table 1).

3.1.2. Organizational system for AWM in Que Vo district

According to Bac Ninh DARD (2017), there are nowadays 25 water pumping stations for irrigation and drainages to serve for crop production in Que Vo district. Total irrigation capacity of all stations is 137,000 m³/h while total drainage capacity is 347,000 m³/h. There are four levels of the canals in the districts: the 1st and 2nd level canals are the large or the main canals carrying the water from the big stations to the small ones while the 3rd and 4th level canals are the small ones carrying the water from small stations to the crop fields. The canals are also classified by use purpose, including irrigation canals and drainage canals. The management system for irrigation and drainage schemes in Que Vo district include BIDSME company (Bac Duong Irrigation and Drainage Scheme Management company), QVIDE, irrigation and drainage teams, and farm households in the district (Fig 1). BIDSME company is directed by Bac Ninh provincial people committee. Annually, Bac Ninh provincial people committee could get the irrigation plan from DARD, approve it and then assign the work in approved irrigation plan to BIDSME company. The BIDSME company has responsibilities to manage the 1st and 2nd level canals and provides the water to those canals in accordance to the approved irrigation plan. BIDSME company also coordinates with DARD at provincial level in adjusting the water provision schedules and volumes in the province.

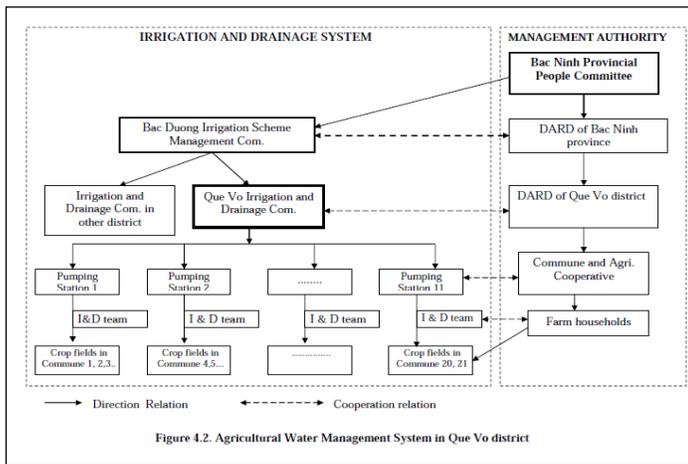


Figure 4.2. Agricultural Water Management System in Que Vo district

Fig 1. AWM Organizational System in Que Vo district

QVIDE is one of the affiliations (Source: FGD 2017) QVIDE has the responsibility to manage the 1st and 2nd level canals and associated schemes in Que Vo district under the direction/management by BIDSMS company. In addition, the QVIDE also cooperate with DARD at district levels to implement the irrigation and drainage plan for the district. The QVIDE is composed of 11 squads that manage 25 pumping stations in whole Que Vo district. Usually, one squad of QVIDE can manage one to three pumping stations that can serve the water for 1-3 communes based on the topography and canal system in those areas. The squads of the QVIDE have close cooperation with DARD at district level and with commune staffs in implementing the irrigation and drainage plans in the communes. Irrigation and drainage services for farmers are provided by agricultural cooperatives in Que Vo district. Each agricultural cooperative has one Irrigation & Drainage team (I&D team) to manage 3rd and 4th level canals, to flow the water into the crop fields when necessary, and to let water out of crop field when flooded. The I&D team usually go the crop fields to see the situation of agricultural water, and also to get information about the water situation from the farmers who often observe their crop fields. The I&D team then sets the specific pumping calendar and requests the station to pump the water to the fields. In some cases where water could not freely go to the crop fields (due to high topography of the fields), I&D team members would inform the farmers the water pumping calendar and remind them when water is available so that the farmers could lift the water into their field by themselves. In addition, farm households play the key role in water management for their crop fields. They have to maintain the earth-bank around their crop fields to keep the water in the fields. They also have to go to observe their fields quite often and in case there is inadequate water (or too much water in their fields), they would inform the I&D team members about the situation and I&D team members then would request the pumping station to pump the water. In some cases, the farm households have to get the water to their fields by themselves (use of their own water pumps or other simple tools). They also have to check their earth-bank often to discover if there is any problem with it (such as there is a hole in the bank so that the water can go out) for improvement. In addition, farm households should pay the fee for the work of I&D team, and also participate activities for the canal improvements.

3.2. Local participation in AWM in Que Vo district

3.2.1. Local participation in formulating the I&D team

As agricultural cooperatives are responsible for managing the agricultural water in the crop fields, I&D team is one of the essential components of agricultural cooperatives in Que Vo district (as well as in the Red River delta in general). The members of agricultural cooperatives would discuss about the I&D team formulation in the biannual meeting and decide the number of people in the I&D team, the duration of one working term of I&D team, the tasks of I&D team as well as the payments (salary) for I&D team. Usually, I&D team in each cooperative in Que Vo district includes 2 or 3 people upon the total agricultural areas that the cooperative is responsible for. The duration of the working term is usually 2-3 years. The payments for I&D team is based on the current income level in the village and the agreement between members in the cooperative. The potential applicants for becoming I&D team would be proposed by cooperative members, then they would discuss and vote to draw the I&D team from the potential applicants in the cooperative meetings. In the meeting, the cooperative members also discuss about the charge for the I&D service provision. All cooperatives in Que Vo district nowadays collect the charge for I&D service based on the agricultural land areas of the farm households. However, the charge per one unit of land varies by cooperatives, between 1-2kg of paddy per sao (or 360m²) per crop season due to differences in agri-land area of the cooperatives and proposed payment levels for I&D team members.

3.4.2. Local participation in formulating irrigation and drainage plan

The farm households need the irrigation and drainage services for their crop fields and the BIDSMS company provides the irrigation and drainage services for farm households through the contract signing. However, the BIDSMS company does not directly sign contracts with farm households. Instead, QVIDE (on behalf of BIDSMS company) signs the contract with agricultural cooperatives that are representative for farm households in one commune or in one village. The content of the contract include area for service provision and the irrigation fee. However, according to the Decree 115/2008/ND-CP of Vietnamese government, farm household is currently exempted for irrigation fee and the BIDSMS company would receive the compensation for that irrigation fee from the government budget. The stakeholders that participate in irrigation and drainage plan formulation mainly include QVIDE, Que Vo district DARD, communal staff, I&D staff of agricultural cooperatives, and farmers (Fig 2). The preliminary irrigation plan is formulated based mainly on the crop calendar of the district and approved by the QVIDE and the Que Vo district DARD before the crop seasons. Usually, Que Vo district DARD would formulate the calendar crop based on the direction by Bac Ninh Provincial DARD, and also based on the agricultural production plan proposed by the communes. The preliminary irrigation plan includes number of water provision times, timing and duration (number of days) of each time during the crop season. In general, the number of watering time in one rice crop season is between 5-8 times upon the weather.

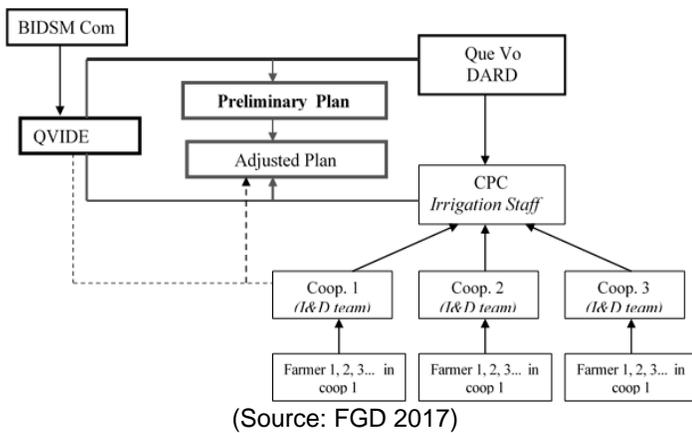


Fig 2. Local participation in irrigation and drainage plan formulation

Despite the existence of preliminary plan, in fact the water provision by the QVIDE is mainly based on the request of I&D teams of the agricultural cooperatives. The I&D teams have the responsibility to inspect the water situation in the crop fields. When they find the water in the crop fields not enough, they would make the request to the QVIDE for water provision through the commune staff who is responsible for irrigation work in the commune. The QVIDE would consider the relevance, then adjust the irrigation plan and pump water into 1st and 2nd level canals for that crop fields. The participation of the farm households in the irrigation plan formulation is indirect and can be fallen into two cases. The first case is that when farmers find water in their fields not enough or too much, they would inform the I&D team of the agricultural cooperatives, then I&D team in collaboration with the communal staff would request the QVIDE to adjust the irrigation or drainage plan for the relevance. The second case is that the farmers can require the adjustment of irrigation and drainage plan for more relevance during the biannual meetings of agricultural cooperatives (or also in village meetings). The biannual meetings of the cooperatives are often organized after crop harvest with the participation of all farm households in the cooperatives. At the meetings, the farmers can discuss on all issues for agricultural production and services such as plant protection services, electricity services, irrigation/drainages services, etc.,. If farmers think that the irrigation/drainage activities in the previous crop were not good or sometimes inappropriate, they can raise the issue in the biannual meetings for discussion on how to make the service better and propose for irrigation/drainage plan adjustment. Based on their proposal, the cooperatives can require the QVIDE to adjust the irrigation/drainage plan in the next crop for more relevance.

Table 2. Farmers' participation irrigation and drainage plan in 2017 (%)

	Phuong Lieu commune (n = 30)	Nhan Hoa commune (n = 30)	Mo Dao commune (n=30)	Total (n = 90)
1. Farmer's participation in plan formulation				
- Directly inform to I&D team	50.0	33.3	36.7	40.0
- Discussion in the biannual meeting	46.7	36.7	46.7	43.3
- No participation	30.0	40.0	26.7	32.2
2. Assessment on timing of water provision				
- Very good	43.3	16.7	36.7	32.2
- Good	43.3	73.3	50.0	55.6
- Not good	13.3	10.0	16.7	13.3
3. Assessment on volume of water provision				
- Very good	50.0	20.0	33.3	34.4
- Good	33.3	70.0	60.0	54.4
- Not good	16.7	10.0	6.7	11.1

(Source: Farm survey 2017).

According to the survey, there were significant share of farmers (32.2 per cent) who did not participate in plan formulation and adjustment. This is because some farmers had another work than farming and did not care much on farm work. In addition, some farmers had the fields at favorable irrigated areas (near to the good canals), and they did not need to care much on irrigation. Other households whose fields is in the high areas or in the end of canals (where the water is difficult to come) often informed the I&D team directly and required for water pumping. They also raised this issue in the biannual village meetings for discussion. In general, the majority of farmers thought that the timing and volume of water provision in 2017 were good and very good. Only a small share of farmers (less than 14 per cent) thought it was not good. This was because their fields were quite high or very far from water pumping station. Farmers also released that the water was generally provided in time after their requests to I&D team (table 2).

3.4.3. Local participation in leading water to the fields

As mentioned above, the QVIDE has responsibility to provide the water to the 1st and 2nd level canals, and the I&D team of the cooperatives has responsibility to lead the water to the 3rd and 4th level canals. At first, the QVIDE would inform the communal staff or I&D team of the cooperatives the timing of water provision, then the I&D team of the cooperatives would have to check the water in the 1st and 2nd level canals. The I&D team also has to inform the farmers the timing of water provision, usually through the loudspeakers in the village. When the water comes on the 1st and 2nd level canals, the I&D team will open the main sewers so that the water can flow into the 3rd and 4th level canals that can irrigate the crop fields. When the fields become irrigated quite adequately, they will close this sewer gate and open other gates so that water can go to irrigate other field areas. Through the opening and closing the sewer gate at the right time, the I&D team could play the very important role in saving water. If they close the gate too late, the water will be too much for one field area, then water will go to the drainage canal as the wasted water. As the consequence, there will be not enough water for another field area or the QVIDE and its pumping station will have to pump water in more time.

Table 3. Means and cost for leading water into the farmers' field plots (%)

	Phuong Lieu commune (n = 30)	Nhan Hoa commune (n = 30)	Mo Dao commune (n=30)	Total (n = 90)
1. Share of farmers having own pumps (%)	86.7	76.7	63.3	75.6
2. Share of farmers having the bamboo buckets (%)	23.3	36.7	23.3	27.8
3. Share of farmers have to pump or bail water in (%)	83.3	76.7	56.7	72.2
4. Average cost for pumping water (thous. VND/sao)	20-40	20-40	12-40	12-40

(Source: Farm survey 2017).

The farmers have the responsibility to lead the water to their field plot (by opening the field bank) and to close the field bank when water in the plot becomes adequate. In case, the water cannot go itself to their field plots (for the high land areas), farmers have to use their own water pumps to pump up water to their plots or they have to bail/get water into the field plots by using the bamboo buckets. Therefore almost farmers have bamboo buckets or small pumps (table 3). Many farmers released that it took quite a lot of time to wait for water flowing into the field plots. Sometimes, they could not afford waiting, instead they pumped the water to their plot for saving time, especially for the people they had the off-farm work since they had to go for their work at daytime. Some farmers they only opened the field bank and they could not wait to close the bank when water in the field plot was adequate. In that case the water could overflow the banks and then flow to the drainage canals. The water was therefore wasted, and it was also a reason why the water could not go to other field areas.

3.4.4. Local participation in water control in the field plots

As agreed between farmers and cooperatives and the QVIDE company, the farmers have the responsibility to lead the water into their fields and keep the water in the fields. If the water in the crop field go away due to the farmers' carelessness or negligence in keeping water, the farmers have to pump/take water into their fields by themselves. Therefore, the farmers have to make the efforts to keep the water in their plots. For this purpose, when the water is provided for land preparation, the farmers have to clean the earth-bank (from the grass). Then after land preparation but before rice transplantation, the farmers have to improve the earth-bank to ensure that the water in their field could not leak out. In addition, the farmers also have to make the border-edge between the plots in order to easily recognize their own plot and to keep water in their fields by themselves (Fig 3).

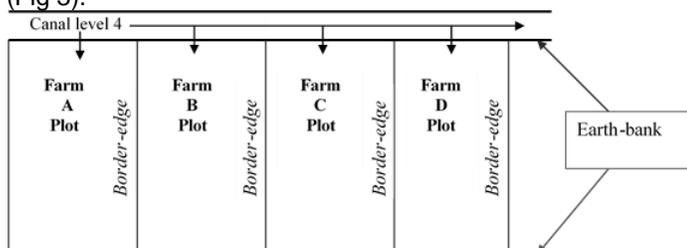


Fig 3. Earth-bank and border-edges in the crop fields

During the crop season, the farmers should go to visit their fields often to check if the water in the field is enough for crop or not. According to the survey result, the farmers usually went to visit their field once a week or once in two weeks to

check the situations of water, pest and diseases, and the growth of the crops in order to have relevant response to their crop field. In case the farmer discovers the water in the whole field area (not only his/her plot, but also many other plots in the field area) is inadequate, the farmer could inform that situation to the I&D team, then the I&D team would contact to the QVIDE for providing the water to the whole field. If the response of I&D team and QVIDE is rapid, the farmer only have to lead the water to her/his field after receiving the information on timing of water provision from I&D team. However, sometimes the QVIDE does not pump the water immediately after receiving the request. They would wait until other next field areas become dried, then they pump water for several field areas (not only for one field) to save the water and pumping time. In that case, the farmers in the dried field may need to use their own pumps/bamboo buckets to provide water to their plot by themselves (if the water in the 3rd and 4th level canals was available) and wait for the water pumped by QVIDE. In case a farmer discover that the water in only his/her field plot is not enough (quite dried) while water in other farm plots is adequate, then the farmer needs to check if there is a leakage in his/her plot earth-bank, then fix it. In this case, the farmer needs to use their own pumps/bamboo buckets to get water into their plot by himself/herself. In case the water in the field plot is too much for crop growing, the farmers can drain water out (only happening in the low land areas). If the field is flooded due to the heavy rain or typhoon, the I&D team will open the sewer gate so that the water will flow to the drain canals. The QVIDE may use the pump to pump out the water to the river in the urgent case.

3.4.5. Local participation in improved canal system

Canal system in Que Vo has four levels between 1 and 4 with the total length of around 500 km. Most of the canals have only earth-banks and they could be collapsed under the impacts of water flowing and some human activities. Moreover, the canal-bed could become shallower due to the sediments. Sometimes, the canals are also filled with grasses or hyacinths. These can possibly lower the water speed, thus placing the negative impacts on irrigation and drainage for crop fields. To improve its canal system, the DARD in Que Vo district in coordination with QVIDE and agricultural cooperatives in every commune in the district annually organizes the Irrigation Month from 15 Nov to 15 Dec. The main activities that are implemented in Irrigation Month include (1) cleaning out the canal; (2) improving the canal banks; and (3) deepening the canal-bed where exists the sediment. The farmers are mobilized for participation in implementing these activities. Usually, in October (before the rice crop harvest), DARD and QVIDE go to check the 1st and 2nd level canals (that are managed by QVIDE) inside the district to discover where the canal earth-bank should be upgraded and where the sediments or water hyacinths should be taken out from the canal bed. Then, they would formulate the plan for improving the 1st and 2nd level canals. In parallel, the commune staff in collaboration with the I&D team in each village also go to check and to assess the situation of the 3rd and 4th level canals (that are managed by the communes) for recognizing the collapse of canal earth-banks and poor canals (shallow due to sediment, blocked due to hyacinth or grasses, etc...). Then, the plan for cleaning or upgrading the canals would be formulated. These

upgrading or cleaning works would be assigned to each village during the Irrigation Month. The head of the village would make the plan to mobilize the farmers' participation in doing that work under the collaboration/consultation of I&D team in the village. Thanks to the irrigation month, a total of 19.110 m³ of mud was taken out from the canal bed in whole Que Vo district in 2016 (Van Duong and Quang Hoa, 2016). In addition, 8.800 m³ of water hyacinth and lotus were fished out from the canals. Around 100 thousand working days of local people have been mobilized during the Irrigation Month for the whole district. In survey communes, each village usually set up the canal upgrading plan in 2-3 days, then mobilized the participation of the farmers in the villages. Survey results reveal that 78.9 per cent of farm households participated the canal upgrading (table 4). In case the members of farm households were busy and they could not participate the canal upgrading, they should contribute the money to the village with the rate of 50-100 thousand VND for 1 day-off. The village could use that money to hire other local people to upgrade the canals.

Table 4. Local Participation in improved canal system in survey commune

	Phuong Lieu commune (n = 30)	Nhan Hoa commune (n = 30)	Mo Dao commune (n=30)	Total (n = 90)
1. Participation of HH in irrigation month (%)				
- No participation	20.0	16.7	26.7	21.1
- 1 day participation	16.7	20.0	23.3	20.0
- 2 day participation	43.3	40.0	33.3	38.9
- 3 day participation	20.0	23.3	16.7	20.0
2. The contribution for one day-off (thous. VND)	80-100	50-80	80-100	50-100

(Source: Farm survey 2017).

3.4.6. Local people's payment for irrigation services

Although irrigation fee is exempted for farmers according to Decree 115/2008/ND-CP of Vietnamese government, the farmers have to pay irrigation service fee provided by I&D team in the village. The level of irrigation service fee per sao is discussed and approved in the biannual cooperative meetings. Currently, the service fee was between 1.5-2kg of paddy per sao (table 5). The farm households had to pay in cash at the end of each crop (at the market price). The cooperative will use this financial resource to pay the allowance for I&D team members.

Table 5. Local people's payment for irrigation service per crop

	Phuong Lieu commune (n = 30)	Nhan Hoa commune (n = 30)	Mo Dao commune (n=30)	Total (n = 90)
1. Payment level (kg of paddy per sao)	2	1.5	2	1.8
2. Average area for one household (sao)	6.8	6.5	7.2	6.8
3. Total payment in kinds (kg of paddy)	13.5	9.6	14.3	12.5
4. Total payment in cash (1000 VND)	80.2	57.4	85.1	74.3

(Source: Farm survey 2017).

Several farmers thought that the irrigation service fee was quite high because the work of I&D team was only to open and to close the water gate when to be informed. However, according to the local commune staff, the payment to I&D team was just right as each member of I&D team could receive only around 1.5 million VND per month (or 1 ton of paddy per one crop season) while the prevailing wage rate in the local area was between 4-5 million VND per month. If the payment is less, I&D team member may not want to do the work anymore.

3.5. Measures for enhancing local participation and better AWM

a. Raising the farmers' awareness on agricultural water savings

Many farmers did not make the efforts in saving the water since they did not have to pay the water or irrigation fee, and they did not well recognize the increasing water shortage due to the effects of changing climate. Therefore, it is necessary to raise the farmers' awareness on the water shortage situation nowadays and on the negative effects of their waster wasting on other farm households, thus enhancing their responsibilities in saving water. At first, the water shortage situation and farmers' responsibility in water saving and how to save the water should be well disseminated through the mass media and local media (TV and radio program). The local staff (especially cooperative and village staff) should raise those issues and discuss more about them in the biannual meetings with farmers. The local staff also should also remind farmers about their responsibility to check and upgrade the earth-bank of the crop plot more often.

b. Organizing the training course for I&D team members

I&D team members played the quite important role in AWM through their opening and closing the water gate, proposing the plan for canal improvements, etc.. However, almost all of I&D team members were farmers and they did not participate any trainings on I&D management. They did not know exactly when they should close the gate in this field and open the gate in another field to save the water, but they worked mainly based on their experience. The training course on AWM on the field should be provided to I&D team members in the district so that they could act more properly and efficiently.

c. Assigning the canal maintenance to the farm households

The canals usually attach to the field plots of the farm households for easily bringing the water to the field plots. The discussions with the QVIDE staff and local staff reveals that it will be better if each household should be responsible for maintaining one canal section that is attached to the field of that household. The farm households should clear the grass or take hyacinths out of that canal section, upgrade the canal banks when it becomes weak, and take the mud out of canal bed when necessary. By doing so, the water will keep flowing inside the canal well, and rapidly go to every plot, thus better saving the water and its flowing time.

d. Encouraging more participation of farm households in maintaining and upgrading the I&D infrastructure

I&D infrastructure including the canal and sewer system was quite old in Que Vo district and needed to be upgraded often to avoid the water stuck due to the collapse of canal earth-bank, mud sedimentation, and uncontrolled growth of water hyacinth and grass. With the total length of canal system reaching up to more than 500 km in Que Vo district, mobilizing the local participation is the principal and effective way to maintain and upgrade the canal system. In this light, Que Vo district should keep the event "Irrigation Month" for raising the local people's awareness and responsibility on AWM and for mobilizing their participation in maintaining and upgrading the canal system. However, the detail plan for the

Irrigation Month should be formulated such as which canal section should be upgraded or cleared from grass or hyacinth, and the work should be assigned to specific villages and cooperatives.

e. Adjusting irrigation plan based on the field practice

As mentioned above, the QVIDE would propose irrigation plan based on the proposed crop calendar set by the district DARD. However, in some communes where farmers plant winter crops (potato, tomato), the farmers may possibly delay the rice spring crop in 1-2 week (compared with the proposed calendar). If the QVIDE followed the proposed irrigation plan, the farmers in the communes did not get the water into their fields and the water would wastefully go to the drainage canal. Therefore, the QVIDE should consult with commune staff to understand well the field practice and farmers' planting schedule, then adjust the irrigation plan for more relevance.

4. CONCLUSION

AWM in Que Vo district were managed by several key players such as Que Vo district DARD, QVIDE, I&D team of agricultural cooperatives and local farm households. Although the local farm households did not actively participated in formulating the irrigation & drainage plan, they played quite active role in adjusting irrigation plan, leading the water to and keeping water in the fields. The local participation also significantly contributed to maintaining and improving the canal system, especially in the irrigation month of the years proposed and directed by authorities of Bac Ninh Province and Que Vo District. It is also reveals that the water was sometimes still used wastefully as some farmers think it was free of charge. Several implications have been drawn for enhancing local participation and better AWM in the Que Vo district such as raising the farmers' awareness on agricultural water savings, organizing the training course for I&D team members, assigning the canal maintenance to the farm households, encouraging more participation of farm households in maintaining and upgrading the I&D infrastructure, and adjusting irrigation plan based on the field practice.

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