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Tail-end Farmers' Participation in Collective Action for Local Commons Management: A Case Study of Walawe Irrigation Scheme, Southern Sri Lanka

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Abstract: Participatory Irrigation Management (PIM) is a collective action in which water users/farmers and Irrigation Agency (IA) officers work together to ensure better water management. Farmer Organisations (FOs) are autonomous in forming their rules to enhance farmers' participation in collective action to manage their local commons within an irrigation scheme. However, decreasing the head-tail disparity in water supply, agricultural production, farmer income and farmers' participation in PIM is still challenging. Walawe, one of the PIM-based irrigation schemes in Sri Lanka, is experiencing failures in water management at tail-ends. Therefore, the objectives of this study are to identify the level of tail-end farmers' participation under existing FO rules while examining the spatial variation of their' contribution to collective action. 482 irrigation plots' head farmers of the Bata-atha tail-end branch canal's command area in the Walawe irrigation scheme was selected for the questionnaire survey using systematic random sampling. Focused Group Discussion (FGD) was conducted to choose collective actions to measure Participation Index (PI). According to the study findings, the range of PI spans from 0 to 11, with a mean of 6.61 and a median of 8. The minimum value of PI is 0, and the maximum value is 11. The highest frequency scores are 9 and 8, obtained by 26.1% and 25.3% of respondents. 11.4% of respondents in the study area scored the lowest value of 0 and 1. The study found that 58.9% of the respondents were actively participating, and 41.1% were inactive in participation when considering the minimum number of times specified for participation. The compliance and contribution of tail-end farmers in PIM were significantly varied along with the head and tail-end of the branch canal and the distributary canals compared to the field canal level. Canal rehabilitation failures, seasonal water supply issues, lack of extension services at the field level, absence of farmer training, and lack of coordination among FOs, IA, and farmers at the block level are the identified causes of increased non-participants at tail-ends. This study highlights the needy for capacity building of FOs through focused tail-end farmer group training and extending agricultural extension services through IA.

Keywords: collective action rules; farmers' participation; irrigation canal network; participation index; Participatory Irrigation Management

1.0 Introduction

Mancur Olson first introduced the concept of collective action in 1965, and this concept was widely applied to minimize the destruction of common-pool resources (Muchara et al., 2014). Collective action is "the process by which voluntary institutions are created and maintained and to the groups that decide to act together" (Meinzen-dick et al., 2004). Kurian and Dietz (2004) define collective action as "a concerted action by a group of resource users to comply with rules regulating the use of a common pool system." Moreover, Meinzen-dick et al. (2005) explained that "collective action includes making and enforcing rules for the use (or non-use) of resources, that determine who is included in the use and management of the resources and how the group is managed." Accordingly, collective action is a number of joint activities devised by a group of resource users to ensure better resource utilization and sustainable local commons management.

Araral (2009); Fujiie et al. (2005); Ito (2012), and Muchara et al. (2014) view an irrigation system as a common pool system in which farmers are engaged in collective activities to manage pooled resources (e.g., water for irrigation and irrigation infrastructure) through a decentralized development approach. Bastakoti and Shivakoti (2012) stress a strong rules enforcement mechanism for collective action to ensure better utilisation of irrigation water supply. A successful Irrigation Management Transfer (IMT) or Participatory Irrigation Management (PIM) requires compliance with rules to share water equitably and collective efforts to ensure better performance of an irrigation scheme (Chaudhry, 2018). Farmer Organisations (FOs) are autonomous in formulating their rules and regulations based on their ideas, norms and beliefs aiming to promote farmers' participation in collective irrigation management: for instance, holding internal meetings; collecting seasonal water charges or maintenance fees; coordinating water delivery systems; maintaining the secondary and tertiary canals; resolving disputes within the community; and electing farmer representatives (Arun et al., 2012; Bastakoti & Shivakoti, 2012; Muchara et al., 2014; Nagrah et al., 2016). Moreover, Bastakoti and Shivakoti (2012) categorised rules at the collective choice level into seven categories: position rules, boundary rules, allocation rules, aggregation rules, information rules, payoff rules, and scope rules. Following regulations, farmers' participation in collective action is considered a key factor in determining the success of an irrigation water supply and agricultural productivity. Gyawali (2009) and Gragasin et al. (2006) highlight that the active involvement of farmers is vital for improving irrigation water management and agriculture production. Accordingly, the higher contribution of farmers assures the better performance of FOs, on-farm water use efficiency, conflict resolution, maximising the agriculture return and operation and maintenance (O&M) on a sustainable basis (Bastakoti and Shivakoti 2012).

Nikkhah and Redzuan (2009) elucidate that participation as an end (active, dynamic, and self-mobilisation) is more significant to achieving sustainable development that seeks to empower the communities and improve the quality of their lives through a bottom-up approach. Alam et al.(2012) defined participation as "a process in which people express themselves, share, contribute and act with mutual responsibility to promote a common goal". According to Nikkhah and Redzuan (2009), participation is "the collective effort by the people concerned to pool their efforts and whatever other resources they decide to pool together, to attain objectives they set for themselves". Aref (2011) established typologies of farmer participation in agricultural development policy in terms of three primary levels: genuine participation, symbolic participation, and non-participation, based on the community participation models developed by Sherry R. Arnstein, Jules Pretty, M.B.G. Choguill, and N. Dewar. Among them, interactive participation and self-mobilisation are vital, promoting a participatory approach to community development (Cornwall, 2008).

Moreover, Aheeyar (2006) points out that beneficiary participation in irrigation management is cost-effective for farmers and the government. It contributes to community development, increases irrigation efficiency, improves fees and fine collection, reduces government costs, and resolves government water disputes. However, some scholars have revealed that a certain level of farmers' participation in PIM at tail-end areas is always a challenge due to irrigation management failures at a scheme level (Dawande et al., 2013). According to Fujiie et al.

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(2005), collective action is not successful where (a) there is an abundant water supply, (b) there is a significant difference in water supply between head-end and tail-end farmers, (c) the size of the farmers' group is large, (d) the population density is low, (e) there are too many non-farm householders, and (f) the farming history of the area is short.

Sri Lanka is one of the agriculture-based economic countries where PIM has been implemented since 1992 (Aheeyar et al., 2012). There are two major cropping seasons: Yala (dry) and Maha (wet). Rice is the staple food for Sri Lankans and provides the livelihood for more than 1.8 million farmers (Aheeyar, 2012). Much of the agricultural land is in the dry zone in Sri Lanka, which accounts for two-thirds of the country's land area (Climate Change Secretariat, 2014; Marambe et al., 2015). By 2008, Sri Lanka was producing about 3.8 million tons of rice per annum, which was predicted to grow to about 4.6 million tons of rice in 2020 to meet the needs of the rising population (Weerakoon & De Costa, 2009). The rice production was required to increase by approximately 40% and 50% in the DZ and WZ, respectively, to fulfil the national rice requirement in 2020 (Weerakoon & De Costa, 2009). Mawilmada et al. (2010) have revealed that paddy production in 2009 declined by 5.8% compared to the total production in 2008, mainly due to insufficient water for cultivation during the Yala season; this was attributed to a delay in the onset of monsoon rains and the ensuing uncertainty in the release of water for cultivation. According to the Department of Census and Statistics (2021), the harvested extent under paddy cultivation during the 2020 and 2021 Yala and Maha seasons were more than 450,000 and 730,000 hectares, respectively. Moreover, the total production of paddy during the 2020 and 2021 Yala and Maha seasons were more than 1,600,000 and 3,000,000 Metric tons, respectively (Department of Census and Statistics, 2021). However, with regards to the contribution to the national Gross Domestic Production (GDP), the agriculture sector contributed about 46% to the GDP in 1950, and this declined to about 11% in 2012, resulting in the growth of the industrial and service sectors (Department of Census and Statistics, 2014). Moreover, increasing demand for water from the domestic and industrial sectors is bound to have a negative effect on the irrigation water requirement. Then the irrigation water supply and management become more critical in the dry zone to increase agricultural productivity in Sri Lanka.

Although PIM has been implemented as a national agricultural policy, still it is found that there are many drawbacks to irrigation water management, especially at the tail-end areas of many irrigation schemes in Sri Lanka (Aheeyar et al., 2012; Jinapala et al., 2010). With the recognition of the improvement of water supply performance through PIM at the tail-end areas, there is a need for research on the spatial distribution of levels of tail-end farmers' participation in local commons management in an irrigation scheme. With the failure of the irrigation water supply at the tail-ends, very little attention has been given to understanding the level of tail-end farmers' participation in collective action across the canal network. Although participation in collective action is mandatory for all farmers, keeping track of their compliance and cooperation in local commons management is complex. Therefore, it is vital to examine the participation intensity of tail-end farmers across the canal network, which helps to identify the degree of their involvement in PIM spatially. Without identifying these critical facts, PIM ever would not be developed on a sustainable basis to achieve national food security. The level of farmers' participation determines the effectiveness of current PIM policy planning and implementation in a country. Understanding which farmers are unwilling to participate in collective action is essential to promoting their participation where irrigation development is more critical. Accordingly, this paper focuses on understanding the collective action rules and tail-end farmers' participation in local commons management in Sri Lanka. This paper addresses three specific questions: (a) What collective action rules are devised for local commons management in Sri Lanka? (b) How do tail-end farmers participate in collective action? (c) How does the level of farmers' participation vary across irrigation canal networks at the tail-end areas? The rest of the paper is organised as follows: Section 2 presents the study area and data collection methods. Section 3 gives results and discussion. Section 4 concludes with proposed strategies to enhance tail-end farmers' participation in PIM.

2.0 Study Area

Mahaweli irrigation system is the most extensive agricultural development program and resettlement program in Sri Lanka (Dissanayake et al., 2016; Paranage, 2019). It is also one of the most extensive agricultural extension programs globally. Paranage (2019) has pointed out that the project has been subject to much criticism in the new millennium about its failures of irrigation targets achievements and overall performance of agricultural development. Walawe irrigation scheme is one of the major irrigation schemes in Sri Lanka in which PIM has been implemented under the Mahaweli system. Walawe irrigation scheme has a dual canal system that consists of the right bank main canal and the left bank main canal. Bata-atha branch canal is the longest tail-end branch canal of the tail-end block of Angunukolapelassa, located between latitude $6^0\ 5^/$ to $6^0\ 10^/$ N and longitude $80^0\ 50^/$ to $80^0\ 54^/$ E. It is around 10.53 km in length and irrigates about 1653 hectares (Figure 1). There are two irrigation units namely Gotaimbaragama and Kattakaduwa.

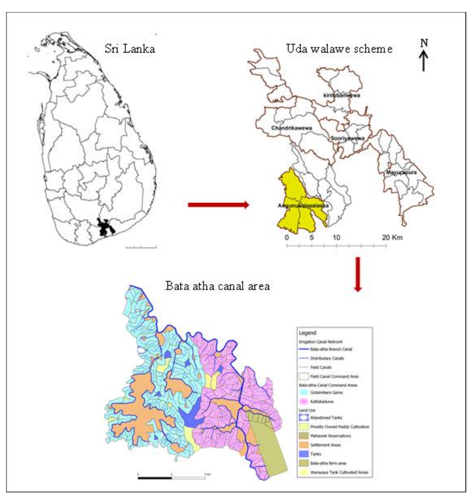

Figure 1: Location of the study area

3.0 Materials and Methodology

Primary data collection methods, such as questionnaire survey, key informant interviews, Focused Group Discussion (FGD), field observations and informal discussion, were used to collect data for this study. The questionnaire survey was done to collect information about the sampled farmers' participation in collective activities in the area. Key informant interviews were conducted to gather information about the collective activities practised in the area, rules and responsibilities of irrigation management, and farmers' contributions to the PIM. FGD was conducted to validate and scale the importance of farmers' participation in the collective activities practised in the area. During the FGD, the accuracy of data collected through the survey and field observations were cross-checked with the Irrigation Agency (IA) officers and FO leaders.

3.1 Materials

The study used irrigated land plots as the sample unit, and the respondents were the head farmers of selected irrigated plots. Further, the sample size of the study was determined by using the Yamane formula as follows.

$$N = \frac{N}{1 + N\,(e)^2}$$

Where,
n = Sample size
N = Total population
e = the level of precision (5%) (Braimah et al., 2014; Aydogdu, 2017).

According to the Yamane formula, the sample size was 531 irrigated plots. A systematic random sampling technique was used to draw a sample of 531 irrigated plots from among the 1573 total plots in the Kattakaduwa and Gotaimbaragama irrigation units of the Bata-atha branch canal command area. Whenever it was too difficult to reach the head farmer or a family member during the data collection, the 49 irrigated plots were excluded from the analysis as no data could be collected from them. Accordingly, the study is based on a survey of 482 sample plots in the Bata-atha branch canal command area.

3.2 Methodology / framework / theory

3.2.1 Selection of collective action to determine Participation Index (PI)

First, 18 collective activities in PIM were identified based on the previous literature. 13 collective actions out of these 18 were considered more relevant to determine PI after the key informant interviews. Then, the FGD and face-to-face discussions were conducted to obtain IA officers' and FO leaders' opinions and assign average weights to identify the importance of collective activities in PIM. 14 Mahaweli field officers and 11 farmer leaders were asked to rate all collective actions using a five-point Likert scale marked as extremely important, very important, moderately important, slightly important, and least important ("extremely important" scaled at five and "least important" scaled at one) (Muchara et al., 2014). Table 1 shows the weighted average values for each collective activity according to the judgment of FO leaders and Mahaweli officers.

Table 1: Weighted average values for collective activities of PIM

	Collective activities	**Weighted average values**
1	Obtaining FO membership	0.097
2	Maintenance fee payment	0.097
3	Attending Seasonal General Meeting (SGMs)	0.097
4	Attending Annual General Meeting (AGM)	0.097
5	Canals cleaning and de-silting	0.097
6	Contact extension services (e.g., canal maintenance and repairs and solving water disputes)	0.088
7	Attending field based seasonal meetings	0.080
8	Attending farmer trainings	0.074
9	Attending monthly meetings	0.063
10	Holding a position in an executive committee	0.059
11	Attending water schedule preparation	0.058
12	Inspection of field canals' function	0.051
13	Attending FO financial clearness (Checking and auditing)	0.042

Based on the judgment of Mahaweli officers and FO leaders, five collective activities of the 13 collective activities were assigned the highest weighted average value of 0.097. Getting annual FO membership, paying maintenance fees, attending AGM, attending SGMs, and cleaning the distributary and field canals were given equal scores, confirming that these five activities were good indicators to determine the PI of each farmer in collective action. Engaging in these activities is considered essential and even mandatory for all farmers who depend on the irrigation scheme to engage in their cultivation. Accordingly, the score for participating in these five collective activities during the cultivation year 2020/21 was used to measure the PI of each respondent. Other collective activities such as contacting extension services, attending field-based seasonal meetings, farmer training, monthly meetings, holding a position in an executive committee, preparing the watering schedule, inspecting the field canals, and attending FO financial clearance were excluded from the PI calculation. That was because the executive committee members of the FO were assigned to engage in these latter activities.

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3.2.2. Farmer Participation Index (PI) calculation

The PI index was adapted from Hossain and Jaim (2011). During the questionnaire survey, sampled respondents were asked to give information about their participation in each collective activity in the cultivation year 2020/21. Accordingly, PI was calculated based on the actual attendance score for each activity.

$$\text{PI} = \sum_{i=1}^{n} CAWAS_{\text{i}}$$

Where:
PI = Participation Index
CAWAS_{i} = Collective activity weighted average score
i=1 = number of activities ranging from 1 to 5

Moreover, the PI score was used as a proxy to determine whether the respondent was active or inactive in participation. A PI score of 8 was set as the cut-off value to determine whether participation was active or inactive while also considering the minimum number of times specified for participation.

4.0 Results

4.1 Collective action and FO rules practised in the area

The Agrarian Services Regulations of 1993 require every FO in Sri Lanka to prepare and follow organisation rules that two-thirds have approved by the organisation's members at an Annual General Meeting (AGM). Before the rules come into effect, it is necessary to get approval from the Commissioner of Agrarian Services. FOs have made several efforts to encourage their members' participation in collective action. After discussing with IA officers and FO leaders, it was revealed that providing proof of occupancy of agricultural land to get free fertiliser subsidies to obtain credit facilities for land ownership and imposing penalties for non-attendance in collective action were the strategies the FOs employed to encourage farmers' participation in PIM.

As for the collective action practised in the area, the contribution of labour or money to repair or clean fields and distributary canals is one of the collective activities delegated to the water users through PIM. Purchasing construction materials, repairing damages, and the FOs supervising collection fees from water users. During the field survey, every farmer is responsible for maintaining a portion of the distributary and field canal adjacent to his plot by clearing the overgrowth and de-silting it. FOs decide the period for canal cleaning at the beginning of each season, and they are also responsible for supervising the canal cleaning activities of all farmers. As for the FO rules, all water users are minimum required to clean their section of the distributary canal and field canal at least twice a year under the supervision of the FO, just before the Yala and Maha seasons begin to regulate the canals' water flow satisfactorily. If they fail to do that, they are not considered eligible for fertiliser subsidies provided by the government, credit facilities given by the banks, and land permits issued by the Mahaweli Authority of Sri Lanka (MASL). During the field observation, it was evident that the tail-ends of the distributary canals in the area had not been cleaned more than once since the previous season ended. Moreover, it was revealed through informal discussions that the extreme tail-enders at Tract 17 and 18 distributary canals had not cleaned their canals for various seasons. Among those reasons were long-term canal water inadequacy during the Yala season, cultivation of low water-consuming crops like Banana or cereals, more accessible access to the village tank or drainage canal water, ineligibility to receive the government fertiliser subsidy, and waiting until the FO or neighbours clean the whole canal using machinery.

Contribution to fees for operation and maintenance (O&M) of the canal was another collective activity practised in the area under PIM. The farmer leaders regularly collected the maintenance fee from all water users in the area. Every FO would have a bank account operated by the MASL. With the consent of FO members and MASL officers, a farmer leader could withdraw from the accumulated funds amounts required for the repair or maintenance of secondary and tertiary canals. The amount set as a maintenance fee is changeable and not equal for all FOs in the area. Accordingly, the members of a FO decide the amount at the AGM according to their requirements and willingness to pay. FO leaders collect maintenance fees once or twice per season with the consent of FO members. According to the survey, amounts collected as fees for canal maintenance ranged from LKR 120 to LKR 400, while annual FO membership fees ranged from LKR 60 to LKR 200. As for the FO rules, if a farmer did not pay his annual membership fee, he had to pay a fine to get the all-important proof of occupancy. The FO decides the amount of penalty with the concurrence of all members at a SGM. In addition, the FO has the authority to issue proof of agriculture occupancy for farmers as that is needed to get free fertiliser or subsidised fertiliser provided by the government. Accordingly, every farmer is required to pay an annual membership fee and maintenance fee for these privileges.

Moreover, attending the AGM and SGMs serve as good platforms for all farmers to gather and discuss matters related to their cultivation. At the AGM, all farmer members can nominate, vote, and select new organisational hierarchies to enhance organisational strength. Holding an AGM is a legal requirement, and the attendance of two-thirds of members is compulsory to form a quorum (Minister of Agricultural Development and Research, 1993). According to the Agrarian Services Act no.58 of 1979, every FO is required to elect a president, vice-president, secretary, treasurer, and a few committee members. Furthermore, all respective officers in the Mahaweli block office participate in the AGM to oversee the FOs' election and discuss matters raised by farmers relating to the irrigation water supply, canal maintenance, and other agricultural issues. Additionally, every FO must hold SGMs to discuss farming and water-related matters, financial matters, water schedule preparation, field-based seasonal meetings, and framer training. According to the Agrarian Services Act No. 58 of 1979, holding SGMs at least once every four months is required (Minister of Agricultural Development and Research, 1993). Accordingly, all FOs should hold not less than three meetings per year. Therefore, attending SGMs is vital for its members to discuss how to mobilise and utilise money effectively for irrigation infrastructure maintenance, repairs, and operation. During the key informant interviews with FO leaders, it came to light that all members needed to attend at least two-thirds of the SGMs held in a cultivation year. According to the Agrarian Services Act No. 58 of 1979, some FOs imposed fines if anyone failed to participate in the SGMs without a reasonable excuse.

Practically, every FO would hold seasonal meetings to draw in groups of farmers to exchange field-based practical knowledge like Integrated Pest Management (IPM), cultivation methods for traditional crop varieties, and field-based irrigation water management. All resource persons in the MASL would usually participate, and the number of seasonal meetings conducted mainly depended on the

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effectiveness of FOs. However, during the field survey, it was revealed that no seasonal meetings were taking place during the cultivation year 2020/21 due to the COVID 19 pandemic. Moreover, the monthly meetings of the FO, another collective action, are very significant, as they are held to take decisions at an executive level to help overcome the challenges farmers face in accessing irrigation water supply. All farmers are not required to attend the monthly meetings, as only the executive committee members are responsible for discussing and planning FO's financial or canal maintenance activities. According to the Agrarian Services Regulation of 1993, this committee is required to meet at least once a month. Accordingly, the president, secretary, treasurer, and water masters attend the monthly meetings of the FO. To be an executive committee member is a rare chance for the FO members, as only seven of ten members are appointed as executive members through FO election.

In a FO, a president chairs the FO committee meetings and acts as the official signatory for the committee for all legal and financial purposes. A treasurer in charge of the FO budget is appointed to maintain accurate records of all income and expenditures of the FO. The treasurer must prepare and present the FO's budget to the MASL's auditors, ensuring transparency in all the money transactions with the members; this is a compulsory requirement. Though all members are not required to attend the budget preparation, a two-thirds quorum is required to approve the FO budget at the AGM. A secretary maintains records of all meetings and submits the FO details to the MASL when called for. There is usually one distributary canal water master and several field canal water masters in each FO. The numbers of water masters in a FO depend on the number of field canals belonging to that FO. Water masters are appointed to inspect and regulate water distribution, prepare the water supply schedule, and report all the water issue problems faced by the water users in the area. All executive committee members are water users who work closely with MASL officers to get extension services for water distribution and cultivation-related matters. Accordingly, obtaining annual FO membership, paying the maintenance fee, cleaning the canal, and attending AGM and SGMs are the activities in which all farmers must participate collectively. Besides these five common activities, all farmers have a rare chance to participate in other activities during a cultivation year, such as contacting extension services, attending field-based seasonal meetings, obtaining farmer training, attending monthly meetings, holding FO leadership, preparing water schedules, inspecting function of canals, and preparing the FO budget. All these activities are done mainly by the executive committee members of the FOs.

4.2 Frequency distribution of the levels of tail-end farmers' participation in the area

The range of PI spans from 0 to 11, with a mean of 6.61 and a median of 8. The minimum value of PI is 0, and the maximum value is 11. The highest frequency scores are 9 and 8, obtained by 126 and 122 respondents. Meanwhile, 37 respondents in the study area scored the lowest value of 0. Figure 2 shows the frequency distribution of PI scores for all respondents in the area.

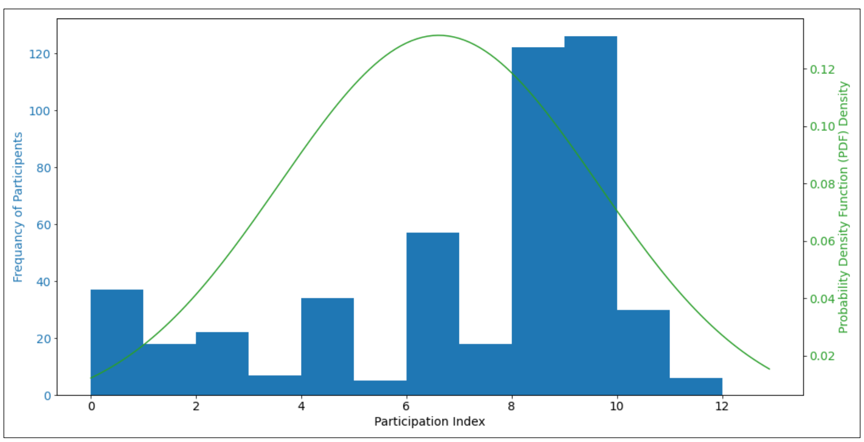

Figure 2: Frequency distribution of PI scores

The plot cultivators, who scored the lowest PI value of 0, did not participate in the AGM or SGMs during the cultivation year 2020/21. They accounted for 7.7% of the total number of respondents. They paid neither membership nor maintenance fees due to extreme water deficit at the tail-ends during the Yala and Maha cultivation seasons compared to other areas. Despite their failings, they had cleaned their canals one time per year. But this was below the stipulated minimum number of times according to the collective action rules. This finding is consistent with Muchara et al. (2014). They also found farmers who did not participate in collective action in the Mooi River irrigation scheme in Kwazulu-Natal province in South Africa.

On the other hand, plot cultivators who scored the lowest value of 1 had FO membership. In contrast, respondents who scored 2 (4.6%) had FO membership and attended the AGM. Some of the cultivated land plots in other areas of the irrigation scheme as leaseholders or tenants, while others would apply for FO membership yearly, hoping to get a Mahaweli land permit. Moreover, head farmers scored 3, had FO membership and paid seasonal maintenance fees but failed to attend the AGM and SGMs and clean the canals. Farmers who scored four had participated in AGM paid maintenance fees and membership fees. Furthermore, it was revealed that farmers, who scored from 2 to 7, had not attended more than once in SGMs. Through informal discussions with FO leaders, it came to light that most Other Field Crops (OFC) cultivators, especially banana cultivators, had not engaged in canal cleanings or attended SGMs. The reason for that was the crop water requirement for banana cultivation was very low, and further, OFC cultivators had not received any fertiliser subsidy through FO intervention. Moreover, it was revealed that FO leaders were dissatisfied with the inadequate participation of banana cultivators in collective action. Additionally, farmers who scored eight had participated in the minimum required attendance times in all five collective actions. Respondents who scored from 9 to 10 had participated in the activities more than the minimum required times. Farmers who scored 11 had participated fully in all collective actions during the cultivation year 2020/21. Through informal discussions held with FO leaders, it was found that paddy

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cultivators had followed collective action rules, specifically intending to get free fertiliser subsidies and credit facilities through the FO. Moreover, the study found that 284 (58.9%) were actively participating, and 198 respondents (41.1%) were inactive participants.

4.3 Spatial distribution of farmers' participation along with the canal system

The area along the main canal in an irrigation scheme has been divided equally into head-end, middle reach, and tail-end for many study purposes (Shantha & Ali, 2011; Wijesekera & Wickramaarachchi, 2003). Accordingly, farmers whose farms are situated at the main canal head are called head-enders, while those farther down to the main canal are called tail-enders. The area of each reach can be demarcated based on the total length of the relevant canal and its command area. Likewise, branch canal, distributary canals, and field canals have a head, middle, and tail end (Meher, 2011). According to the field survey, Figure 3 shows the variation in the spatial distribution of farmers' participation in collective action across the canal network.

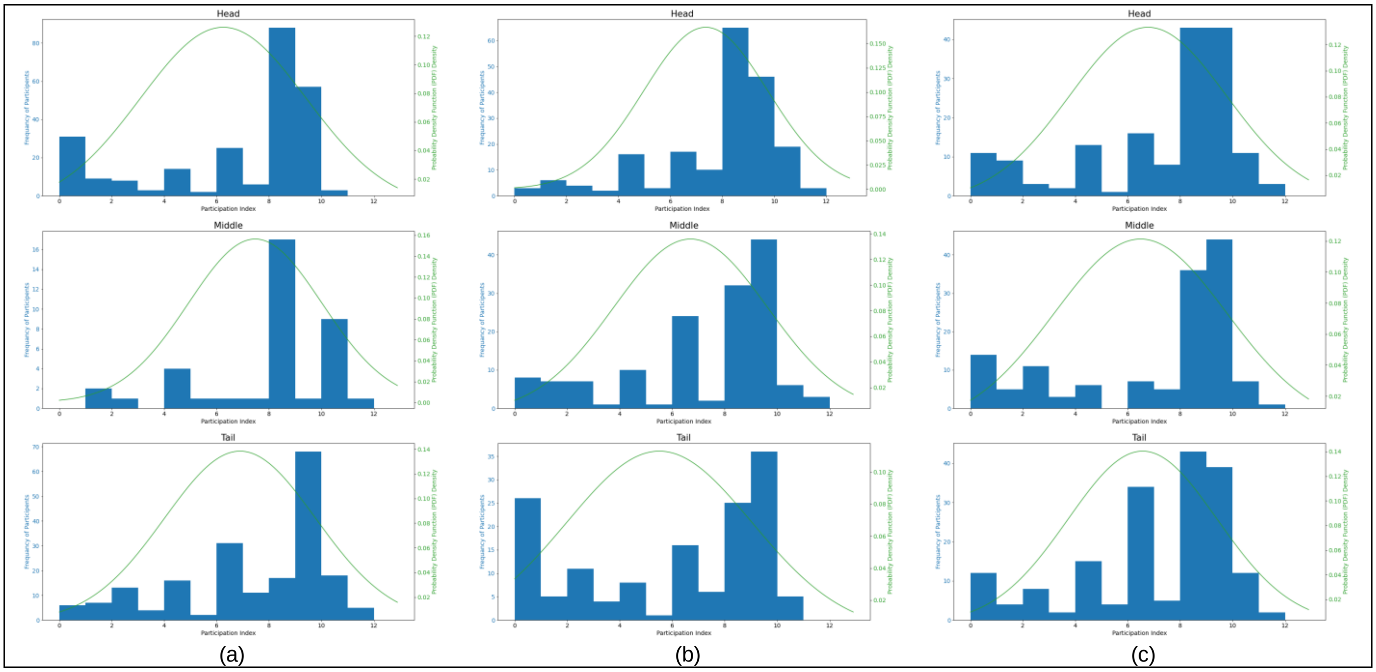

Figure 3: The levels of farmers' participation along with the branch canal (a), distributary canals (b), and field canals (c)

The study found that active farmers who scored PI value 8 or more than 8 were higher at the head of the branch canal than in its tail-end area. Similarly, the distribution of active farmers was higher at the head of the distributary canal than at its tail-ends. Moreover, non-participants are higher at the head of the branch canal and the tail-ends of the distributary canals. Unlike farmers' participation at the branch canal and distributary canal level, there was no significant difference in the participation that could be found at the field canal level. Furthermore, the survey found that 11.4% of the total sampled plots had faced extreme water deficits. Figure 4 shows the spatial distribution of the plots of cultivators who scored the lowest PI values of 0 and 1. 8% and 2% of the plots were located at the tail-ends of Track 17 and 18, respectively. Additionally, 1.4% of farmers in the tail-end of Track 19 did not participate in collective action due to long-term water inadequacy. However, they cleaned their canal at least once a year, although they did not engage in FO activities.

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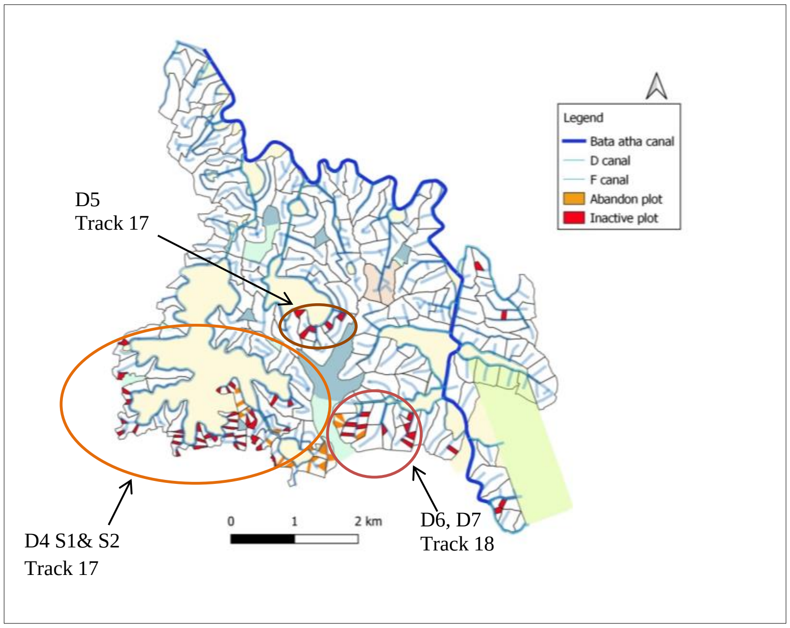

Figure 4: Spatial distributions of plots of head farmers who scored lowest values 0 and 1

D4 was the longest distributary canal in the Bata-atha area, 11,457 meters long. The issue was further exacerbated as the canal was divided into two sub-branches, D4 S1 and D4 S2. Farmers at the tail-ends of the D4 S1 and S2 canals suffered severe water deficits, resulting in low land productivity. The tail-end farmers received canal water only three or five days per season when the canal passed the optimum quantity of water. According to the survey, these tail-end plots accounted for 7% of the total sampled plots. The farmer leader of the area at D4 S1 in Track 17 said the canal could not pass the required amount of water for the tail-end plots because of shortcomings in the canal design and construction. Therefore, the FO had proposed the construction of a bypass canal to overcome this issue. But lack of action from relevant authorities caused this problem to persist. Because of the extreme water deficit, many farmers practised Chena cultivation by growing low water consumption crops like Finger Millet, Mung bean, Cowpea, and sesame seed. Besides, they also planted Banana as an intercrop in the Coconut cultivation plots. The further problem was that the land tenure of the cultivators in D4 S2 was illegal because they did not have MASL land permits. The situation arose because the previous landowners had abandoned these fields due to extreme water deficit, and landless people from outside areas had moved into the scheme and settled down. During an informal discussion with the FO leader of the area, he stated that they were now eligible to get land permits as they were currently practising cultivation. Nevertheless, farmers at the tail-end of the D4 S1 and S2 canals in Track 17 were unwilling to participate in collective action due to the long-term water inadequacy and land insecurity. In addition to tail-end farmers in the D4 S1 and S2 canals, 1% of the cultivators of sampled plots at the tail-end of the D5 canal in Track 17 also suffered from water deficit caused by canal rehabilitation project failure. Informal discussions with the plot owners revealed that a canal water deficit problem had emerged after the canal rehabilitation process. During the field observation, it was observed that some farmers were cultivating their plots with pumped from a small tank. Similarly, cultivators of 2% of the total sampled plots adjoining the D6 and D7 canals of Track 18 were also confronted by a water deficit problem due to canal construction failure.

5.0 Discussion

Better water allocation rules ensure adequate water supply for all head-enders and tail-enders of the scheme. Accordingly, all system members are required to participate in working out practical water schedules within their watercourse level. Then FO representatives need to find solutions for water allocation issues prevailing in the respective command areas to ensure the participation of all members in collective action. However, this study revealed that farmers' participation in collective action varied from location to location within the canal network of the Uda walawe irrigation scheme. This finding is confirmed by Muchara et al. (2014). They have found that the compliance and cooperation of all water users in the Mooi river irrigation scheme, South Africa was a challenge even though their participation in collective action was mandatory. Ruth Meinzen-Dick (2000) revealed that variation in canal water supply strongly affects agricultural productivity and willingness to participate in collective action.

Moreover, this study found that non-participants and active participants were distributed in head-ends, middle reaches, and tail-ends at the field canal level. Further, this study revealed that non-participants are higher at the head of the branch canal and the tail-ends of the distributary canals. This finding aligns with Miao et al. (2015) and Nagrah et al. (2016). They reported that an inverse U-shaped relationship between extreme water scarcity and farmers' participation results in canal water availability being very scarce or very abundant. Moreover, it was revealed that severe water scarcity leads to discouraging farmers' participation in collective action; meanwhile, water scarcity at a moderate level, to some degree, has been recognised as one of the key factors to succeed in the collective action when irrigation is essential for their livelihood (Fujiie et al., 2005; Takayama et al., 2017). Furthermore, Arun et al. (2012) have pointed out that water inadequacy lowers the farmer's incentive to participate in collective action. Muchara et al. (2014) have found that farmers who experience occasional short-term water scarcity are more likely to participate in collective activities to minimise the risk of crop losses. In marked contrast, when the water deficit persists over long periods, it discourages the farmers from actively participating in collective action. Sserunkuuma et al. (2009) found that this experience determines to a great extent farmers' participation in collective action. The findings of that study suggest that since older farmers have greater experience in tail-end farming, they are less likely to participate in collective action. Contradictory findings were reported by Sheikh et al. (2014), who claimed that the tail-end farmers' participation was higher than the head-end farmers' since they exerted more effort into getting the canal water.

Furthermore, this study found that tail-end farmers at the tail-end of the distributary canals had faced extreme water deficits due to canal rehabilitation failures and unequal water distribution. Therefore, it is required to pay much more attention to tail-end farmers to solve their problems and build their capacity. Bastakoti and Shivakoti (2012) provided empirical evidence from the Khurkhuriya Irrigation System and Kamal Khola Irrigation System in Nepal, where tail-end farmers' problems have been minimized. The first strategy was to prioritise the tail-end farmers by starting canal water issues from the tail-end to the head-end. The second method was to reduce water inadequacy by providing a distance incentive of one to four hours to the tail-end farmers. Moreover, Etwire et al. (2013) and Nhundu et al. (2015) posited that contact with the extension services increased the probability of farmers' participation. Since institutional services contribute to the capacity building of farmers, it is expected that access to extension services will have a significant positive effect on farmers' participation in PIM.

6.0 Conclusions

Collective action in PIM ensures efficient and effective irrigation infrastructure management and agricultural sustainability. Collective activities such as getting annual FO membership, paying maintenance fees, attending AGM, attending SGMs, and cleaning the distributary and field canals were mandatory for all farmers who cultivated in the irrigation plots within the Walawe scheme. Although participation in collective action is mandatory for all water users in the scheme, keeping track of their compliance and cooperation is difficult. Farmers' participation varied significantly along the branch canal and the distributary canal levels compared to the field canal. A farmer who receives adequate water supplies is more likely to engage in PIM activities; meanwhile, a farmer who receives extremely inadequate water is less likely to participate in collective activities. The reasons for increased non-participants in collective action were canal rehabilitation failures, seasonal water supply and distribution failures, lack of extension services for the extreme tail-enders at the distributary canal level, absence of farmer training, and lack of coordination among FOs, IA and farmers.

Based on these key findings, this study highlights the needy for capacity building of FOs through focused farmer groups training and extending agricultural extension services through IA. When FO plays a significant role in irrigation water management in the area, farmers depend more on FO and are motivated to engage in collective activities. Moreover, it is required to identify the factors affecting non-participants in collective action, and IA officers should prioritise them to solve their cultivation matters. The findings of this study will be a boon to all relevant irrigation managers, field officers, researchers and policymakers who are eager to do the long-term specific planning required to develop the tail-end areas and effectively manage irrigation water supply. This study contributes to developing PIM policy implementation effectively and efficiently through enhancing tail-end farmers' participation in collective action.

There is no sufficient analysis of farmers' participation in collective irrigation management activities in Sri Lanka. Therefore, potential research should focus on evaluating the country's IMT/PIM policy implementation by examining and comparing the level and intensity of farmers' participation in different locations. Many scholars have tried to focus on the overall successes of PIM at the scheme level rather than looking at its success and failures at the block level or unit level. It is more desirable to identify the exact causes of changes in irrigation management at the block level rather than assessing them at the scheme level. Previous studies in Sri Lanka have not applied high-accuracy mapping techniques such as Geographic Information System (GIS) and Remote Sensing (RS) to assess locational and physical factors affecting farmers' participation in PIM. Therefore, it is required to adopt advanced mapping techniques to examine canal networks and area potentials more accurately to overcome the head-tail disparity in participatory common pool resource management and initiate development projects for the sustainable PIM policy in the country.

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