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The Impact of Rehabilitation Approaches in the Sustainability of the Management of Small Tanks in Sri Lanka

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***Abstract*—**Small tanks, the ancient man-made rain water storage systems, support the pheasant life and agriculture of the dry zone of Sri Lanka. Many small tanks were abandoned with time due to various reasons. Such tanks, rehabilitated in the recent past, were found to be less sustainable and most of these rehabilitation approaches have failed. The objective of this research is to assess the impact of the rehabilitation approaches in the management of small tanks in the Kurunegala District of Sri Lanka with respect to eight small tanks. A Sustainability index was developed using seven indicators representing the ability and commitment of the villagers to maintain these tanks. The sustainability index of the eight tanks varied between 79.2 and 47.2 out of a total score of 100. The conclusion is that, the approaches used for tank rehabilitation have a significant effect on the sustainability of the management of these small tanks.

***Keywords*—**Minor irrigation schemes, Participatory, Small Tanks, Sustainable, Water resource management.

I. Introduction

SRI LANKA is an Island situated in the northern region of the Indian Ocean near the southern tip of India. It has a tropical climate with a mean annual rainfall of 2024mm and 106 rainy days annually. The total land area is 65,610sq.km with 2905sq.km.s of inland water resources. Being an agricultural country (contributing 16.8% of the GDP and 32.2% of the total population employed in the Agriculture sector), water is a very important and much valued component of the village life [2].

Based on the rainfall of the island there are four main climatic zones; the Wet Zone, Intermediate Zone, the Dry Zone and the Semi-Arid Zone. The Dry Zone spreads across two thirds of the country, from the North Western side to the South Eastern side including the North and Eastern parts. The Wet Zone includes most of the South Western region and the intermediate zone falls in between the dry Zone and the Wet Zone (Fig. 1).

The main rainy seasons are the monsoon periods. The North Eastern monsoons bring rains from November to March, mainly to the Dry Zone spread across two thirds of the country from the coastal line to the central hills. This has the most agricultural significance where the entire paddy cultivation of the Dry Zone depends on this rainy season and locally it is called the *Maha* season. The *Yala* season, on the other hand, brings rain mostly to the Wet Zone from the South Western monsoons usually from May to September. The central hills of the country act as a barrier and prevent rain to the Dry Zone, which is at the wind shadow of the South Western Monsoons. Hence, for the arable Dry Zone, half of the year remains dry with no rains. Excessive loss of soil water happens due to severe evaporation caused by the dry winds developed on the wind shadow area. Hence, heavy rain to the Dry Zone is mostly available during the *Maha* season.

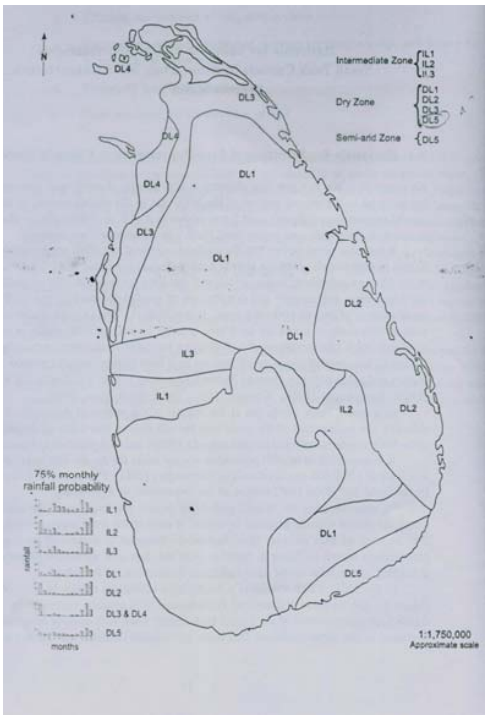

Fig. 1 The map of Sri Lanka showing the Climatic Zones [17]

The water availability to the Dry Zone is of significant importance, because the dry zone is the main agricultural region of the country. The staple diet of the Sri Lankans is rice and it is the Dry Zone which contributes to the mass production of rice for the country. Apart from this, mass scale production of field crops (such as maize and lentils), vegetables and fruits are also cultivated in the dry zone as

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major projects. Hence, the Dry Zone of Sri Lanka contributes to a larger proportion of agricultural production. Thus, irrigation is an important topic to the Dry Zone.

In the ancient times (since about the 3rd century BC), irrigation systems were built to overcome this problem of scarcity of water. These systems included large tanks, small tanks and a network of canal systems spread-across the Dry Zone [1]. Tanks are huge man made water storage systems spreading across acres of flat land in the Dry Zone. This was mainly to store the excess water from the *Maha* rains to ensure availability of water in the Dry Zone throughout the year. These tanks, which were built by our ancestral kings and rulers about 2000 years ago, are functioning even today, to sustain the lives of the people of this area.

According to the *Agrarian Services Act No.58 of 1979*, Small tanks (or Minor Irrigation Schemes) are described as irrigation schemes that serve a command area of 80ha (or 200 acres) or less [13], [17] and [15]. Currently the legal authority of these Minor Irrigation Systems is the Government Department of Agrarian Development. There are about 12,500 small tanks scattered in the dry zone with an irrigation potential of about 100,000ha. [7]. The total command area under minor irrigation systems is 609,213 acres in the country [9]. Thus, small tanks are an irrigation asset with high potential for the Dry Zone of Sri Lanka.

A. Small Tanks in Sri Lanka

The small tanks in the Dry Zone of Sri Lanka, are mainly man made water storage systems created as components of cascade systems or as individual village tanks. Villagers and village level authoritative people were made responsible to maintain these tanks in the past [6].

In the past, these small tanks were maintained by the surrounding villagers themselves, according to the "*Rajakari*" system (community driven management system) [12]. It is through the small tanks the water of streamlets were purified and sent to the large storage tanks, so that the cleanliness of large tanks was ensured. The eco systems around the tanks were also maintained well to ensure the proper functioning of these tanks [5]. At various stages of history, the small tank cascade systems were abandoned by the people due to political, environmental and health reasons such as epidemics [6]. Today, many of these small tanks are being renovated by the government and other development agencies, to reproduce the lush productivity of these areas.

Considering the distribution of small tanks in Sri Lanka, Kurunegala District (in the North Western region of Sri Lanka) has the highest number of Small tanks (4192) out of the total number of 11257 functioning small tanks found in the country [3] (Fig. 2). Thus, 37% of the total number of small tanks is located in the Kurunegala District. The second highest is recorded from the Anuradhapura District with 21%. The total command area of the small tanks rehabilitated recently is about 148,792ha of land, out of which 22.36% belongs to the Kurunegala District [3], [16].

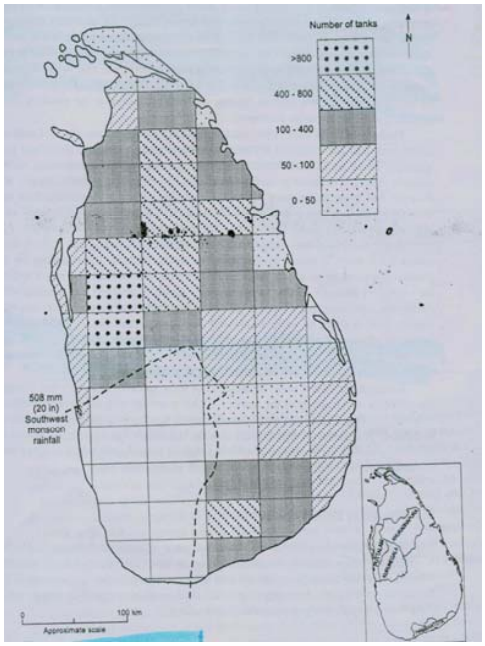


Fig. 2 Cook (1935) and Dumros (1974) map of Small tank classification of Sri Lanka [17]

B. The Purpose of Small Tanks

Small tanks were built by our ancestors, in the past, to fulfill certain objectives. They are;

- To maintain the ground water table at a higher level, so that the villagers could obtain water throughout the year;
  - for cultivations
  - to reduce water drying off during the dry seasons
  - for people to make wells to get water for their needs
  - to ensure a constant water flow to sustain the cascade system
- To manually and systematically clean the water (according to a time plan), which flows to the large storage tanks which are much larger and more difficult to clean manually [23].

Recently, minor tank systems have brought about opportunities for people to enroll in new sources of employment. The flourishing industries based on the tank system are; inland fisheries, flower business, food supply and mat industry [24].These have become supplementary income sources for many people engaged in paddy and vegetable cultivation as their main occupation. During the implementation of the Mahaweli Development Project (A major irrigation and hydropower generation project implemented to trap water from the up-country Wet Zone to feed the irrigation systems in the Dry Zone of Sri Lanka), Inland Fisheries sector was developed at a commercial level in the Dry Zone, with special reference to village tanks. Today, aquatic flowers such as water lilies and lotus have a good demand from the flower industry and from pilgrims visiting religious places. Food items such as lotus stems, lotus seeds and other tank based food products have an increasing

demand especially from supermarkets and hotels [10].

The maintenance of a sustainable eco-system is also a major function of small tanks. These tanks and their ecosystem help to maintain the ground water table to ensure availability of ground water throughout the year, especially during the dry *Yala* season [17].

Small tanks are known as the "Centre of village life" [21]. As water has a socio-cultural significance, the presence of a tank brings pride and dignity to a dry zone village, and it is perceived as a symbol of self sufficiency [12]. These small tanks contribute to village life in many ways. As the main component in a village, it plays a major role in day-to-day needs (personal needs like bathing washing etc.), cultivations, employment and cultural activities of the people [21] , [24]. Small tanks sustain the lives of the people and play multiple roles in a villager's lifestyle. It also provides people with various ways and means of employment and satisfaction [14].

Among the uses of the small tank for the people, the following are prominent [4] and [23]

- For the cultivation of irrigated land crops and paddy
- For bathing washing and other domestic needs
- Providing with a basket of food for the people
- Act as a wet land during the dry season
- Maintain the ground water table, ensuring the availability of water in the wells
- A grazing land for animals
- Provide the protein consumption requirements of the people through inland fisheries (fresh water fish) industry which is also a good income source for the people.
- Maintain the micro-climate and provide recreational function
- Water based industries such as brick making and mat industry
- Sustaining Bio-diversity.

Some initial efforts have been made to rehabilitate these tanks since the early 1900s and they are continuing even today, after the independence. Despite all these initiatives, the modern approaches to develop these tanks have not provided the expected results [5]. According to the Agrarian Development Officers, the reconstructed small tanks do not function to the expected standards, with lack of storage water and lack of proper maintenance.

C. Recent Issues on Small Tank Rehabilitation Programmes

Compared to the ancient times, today the renovated small tanks are not functioning properly nor maintained effectively. People also tend to make (inappropriate) interventional changes to the technical aspects of these small tanks (without realizing the destructive effects that can arise.), as their needs are not met by the tank (eg. Increasing the bund height, changing the location of the spill etc.). Most of all, people have less regard for these tanks and take those for granted due to the governance issues of the tank system and lack of interest; thus, neglect their responsibility towards the maintenance of their village tanks leading to further damage. Most of the villagers have lost their sense of responsibility towards the maintenance of these small tanks. They depend on the Government or the organizations that renovated these tanks to maintain and be responsible for their own village tank [21], [25].

The main reason for this negligence of the people is due to the lack of a sense of ownership towards the tank. They tend to perceive it as a Government property hence, believe it is the Governments' responsibility to maintain it although the tank serves their own village.

The main causes for this are;

- The inefficient communication between the relevant officials and the people
- The lack of knowledge of the people on the technology, functioning and maintenance of the tanks
- The low integration of the approaches used and
- The low interaction between the stakeholders (tank rehabilitation programs) [21],[22],[25]

Apart from the physical rehabilitation of these irrigation structures, a proper operation and maintenance approach should also be established to ensure long term existence of the structures [11], [19]. For this they say, empowering the Farmer Organizations is the best approach. Never the less, the responsibility of tank maintenance is questioned by many, and the training and knowledge of the Farmer Organization members in maintaining these tanks is inadequate. Also the knowledge and training of the village level officers in charge of the supervision of these activities is at a lower standard [11].

With time it was evident that the villagers do not get the expected benefits from the tanks and also the control and maintenance of the tanks were not satisfactory in the long run [8].

With a deeper analysis of this problem, it was realized that the main causes for the malfunctioning of these systems were [20], [25];

- The lack of a long standing water supply
- Lack of a proper tank feeding or outflow system
- The lack of a proper maintenance strategy and
- The lack of ownership for the tank (especially by the villagers, Agrarian Services Department, Village level CBOs etc.)

On the other hand, certain development projects were introduced to rehabilitate these tanks by using existing community based organizations by directly incorporating the beneficiaries and actively engaging them in the rehabilitation process, which gave new hope for the people [18].

Hence, the small tank rehabilitation approaches appear to have a close link with the sustainability or effectiveness of the management of these rehabilitated small tanks.

D. Objective of the Research

Thus, the objective of the study is to assess the impact of the rehabilitation approaches in the management of small tanks in the Kurunegala District of Sri Lanka.

II. Methodology

A. Study Area

The study area included two Agrarian Development Divisions (ADDs) of the Kurunegala District; Nikaweratiya and Kotawehera. These areas were selected from a purposive sample. The Nikaweratiya ADD has the second highest number of small tanks in the Kurunegala District. Nikaweratiya ADD has Development projects implemented by Government Organizations, International Agencies, and Private and local NGOs, but lack Development projects of International NGOs. The Kotawehera ADD differs by having a considerable number of Development Projects implemented by International NGOs. Hence, the Two Agrarian Development Divisions were selected.

B. Sample Selection

A sample of 120 respondents was selected from eight rehabilitated tank areas in the following manner.

1. The two study areas (Nikaweratiya and Kotawehera DS Divisions)
2. Four different approaches used in recent Tank Rehabilitation Projects (two tanks representing each approach).
   a. Government Small Tanks rehabilitation Programme - Government funds allocated through the Agrarian Development Department implemented through the farmer organization contracts
   b. International Agency - working in collaboration with the Government by providing the required funds and new approaches in tank management
   c. Food for work approach in tank rehabilitation
   d. Community Governance Programmes - Community networking (initiated by NGOs)
3. Eight Small Tanks, rehabilitated during the past 10 years from 1997 to 2007

The four different rehabilitation approaches used are represented in symbols in Table I for convenience of reference.

TABLE I
Different Approaches used in Tank Rehabilitation, Selected for the Study

Approach	Symbol
Government Small Tanks rehabilitation Programme	a
International Agency - working in collaboration with the Government	b
Food for work approach	c
Community Governance Programmes - Local	d,i
Community Governance Programmes - INGOs	d,ii

Six tanks were selected from the Nikaweratiya Agrarian Development Division. Two tanks were selected from the Kotawehera Agrarian Development Division. From each of the eight tanks, 15 beneficiaries were selected. The eight tanks represented the four tank rehabilitation approaches.

TABLE II
Description of the Selected Samples

Agrarian Development Division (ADD)	Tank Name	Recent Development Approach
Nikaweratiya AD Division	Diwullewa *Maha Weva*	a
	Danikithawa Diwulle weva	c
	Unagaha Weva	b
	Siyambala Gaha Weva	c
	Diyagama Maha Weva	b
	Gallewa Weva	a
Kotawehera AD Division	Unale Gurugoda Weva	d,i
	Meegaha Kapaapu Weva	d,ii

The tanks were selected using stratified random sampling, representing two each from the approaches which were most widely used in the respective ADDs (Table II). The Development approaches used by the NGOs were selected from the Kotawehera ADD as Nikaweratiya ADD lacked projects done by NGOs.

C. Primary Data Collection

Primary data were collected using the following methods.

1. Questionnaire Survey – For Small Tank beneficiaries and Farmer Organization office bearers.
2. Focused Group Discussions with Farmer Organization office bearers, Agriculture Research and Production Assistants (ARPA) and village level Government officers such as the *Grama Niladhari* (Village headman) of the area.
3. Informal discussions with tank beneficiaries and farmer organization office bearers.

A Sample of 120 respondents was selected representing 15 beneficiaries from each tank including 2 to 3 Farmer Organization Office bearers. The respondents were selected using a stratified random sample representing all age groups, farmers and non-farmers, direct beneficiaries (paddy and other crop cultivating farmers) and people who use the tank for general and domestic needs. The number of total beneficiaries of all selected tanks ranged between 35 to 55 members including farmers, and others depending on their use of tank water for general needs.

The Questionnaires for the beneficiaries were pre-tested and were structured, interviewer administered questionnaires. It included attitude testing questions, open ended questions, closed ended questions and semi-open ended questions.

The Dependent Variables of this study are;

1. Perceived ownership of the tank
2. Perceived level of responsibility
3. Beneficiaries willingness to contribute to tank rehabilitation
4. Level of cooperation between the stakeholders of the tank
5. Perceived uses of the tank

6. Level of knowledge on tank management
7. Level of training on Tank management

The Independent variables (Socio- economic Factors) include;

1. Demographic factors such as
    a. Age of the respondents
    b. Education of the respondents
2. Occupation of the respondents
3. Income from Paddy cultivation
4. Income from other crop cultivation
5. Agricultural land use
6. Tank water use for cultivations

D. Secondary Data Collection

The Secondary data were collected through the records of the Department of Agrarian Development, the Records of the Agriculture Research and Production Assistants (village level agricultural extension officers) and the updated unpublished survey data of the Village Small Tank Survey conducted by the Department of Agrarian Services.

Data were also collected from the records maintained by the Farmer Organization Office Bearers, and the *Grama Niladhari* (Village Headman) of certain areas.

E. The Sustainability Index

The sustainability index was developed through a weighted scale of the dependant variables. These seven variables were considered from the literature survey and by the data obtained by the focus group discussions and in depth interviews done with relevant village level officers and higher level government officers, especially, in the Department of Agrarian Development. Higher weight to lowest weight was given in the following sequence;

1. The perceived sense of ownership of the tank
2. Perceived level of responsibility of the stakeholders on tank maintenance
3. Willingness to contribute to tank maintenance (financial, decision making and labour)
4. Perceived level of cooperation between the stake holders of the tank
5. Perceived uses of the tank
6. Level of knowledge on tank management
7. Level of training obtained on tank management

The index was developed as a scale where the sustainability of each of the tanks was calculated to obtain a value between 0 to 100.

F. Data Analysis

The Dependent variables were used to develop a weighted Sustainability Index. The weight was allocated with respect to the level of contribution to tank management by the villagers. Relationships were calculated using Spearman Correlation and Frequencies. Data analysis was done using the Statistical Package for Social Sciences (SPSS) and observations and discussions (in-depth interviews) with the villagers.

III. Results

A. General Description of the Respondents and their Socio-Economic Factors

1. The Population of the Villages

The population of these areas ranged between 200 – 250 villagers. All villages had more than one small tank, and the number of tanks per village, varied between three to nine tanks. Hence, it was rather difficult to demarcate the actual beneficiaries of each tank. Hence, the number of direct beneficiaries of each tank varied. Out of the respondents, about 90% were traditional settlers in this area, while all others had bought land or acquired paddy lands from the *Swarnabhumi* (Government scheme for agricultural land distribution) deeds about 25years ago (in 1980s).

2. The Demographic Features of the Respondents

i. Age of the respondents

The age of the respondents ranged between 22 to 83 years of age. About 25.2% of the respondents were in the age category of 51 to 60 years of age.

ii. Education of the respondents

About one fifth (19.3%) of the respondents had only primary education. Majority of the respondents (43.7%) have been educated up to the secondary school (Grade six to nine). About 22.7% of the respondents had ordinary level qualification (Grade 10 to 11). About 10.1% of the respondents had Advanced level Qualification while the rest had tertiary education including University Degrees and Diplomas and certificates from technical colleges and other higher education institutions (Fig. 3).

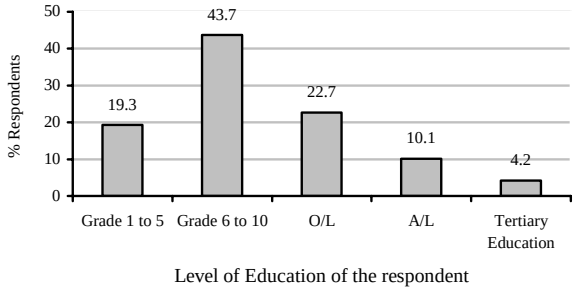


Fig. 3 The Education level of the respondents

3. The Occupation of the Respondents

Majority of the respondents (78.2%) are occupied as farmers; mainly paddy, vegetables and other field crops. The rest were involved in other occupations (Fig. 4). Almost all respondents have home gardens and coconut, for domestic consumption. About 10% of the respondents involve in self employment mainly mushroom cultivation, and Cow's milk production and Buffalo milk collection. The rest included respondents employed in Armed Forces, in skilled work such as masonry and technical work and Government officers

including teachers, *Grama Niladhari* (village headman) and *Samurdhi* Officers (Officers of the *Samurdhi* - Government loan scheme).

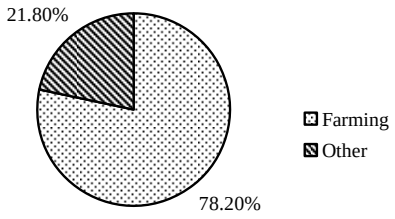


Fig. 4 Occupation of respondents

Out of the respondents involved in farming, about 60 respondents involved in animal husbandry; either cattle rearing, Buffalo rearing or poultry farming. All respondents from the tanks areas of Diyagama Maha Weva, Gallewa Weva, Unale Gurugoda Weva and Meegaha Kapaapu Weva, involved in Brick making throughout the year (for the past two years 2006 and 2007), as water availability for Paddy cultivation was much less than the requirement.

4. Agricultural Land Use and Income from Paddy

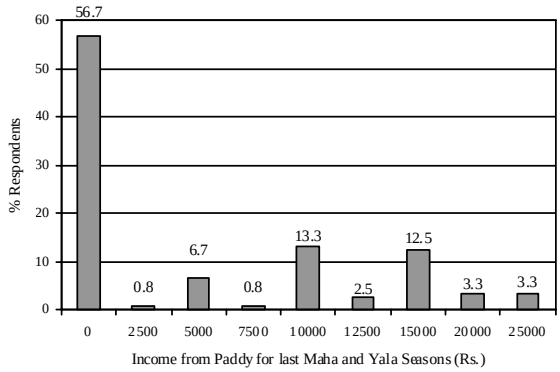


Fig. 5 Distribution of the income from paddy during the last *Yala* and *Maha* seasons

The Paddy land use level was only 50% of the total paddy land owned by all the beneficiaries who responded. Four out of the selected eight tank areas did not cultivate paddy throughout last year. They also could not cultivate *Chena* due to Wild Elephant attacks. On the other hand, the rest of the four villages could cultivate paddy during the rainy *Maha* season, and vegetables and other field crops during the dry *Yala* season. Hence, they obtained a better income from their agricultural land. The income from paddy (with a variation of Rs.500 plus or minus in each income category) during the last *Yala* and *Maha* seasons are shown in Fig. 5. About 28.3% of the farmers earned an income ranging between Rs.10,000 to 15000 annually from Paddy cultivation. This amount is obtained only by cultivating during the rainy *Maha* season.

B. The Sustainability Indicators and Sustainability of the Small Tanks

1. Distribution of the respondents with respect to the perceived sense of ownership of the tank and the expected ownership of the tank

About 30% of the respondents perceived the ownership of the tank to be with the Government, as they need to get permission from the Department of Agrarian Development (DoAD) or other Government institutions to involve in any activity regarding the village tank. About 46.7% of the respondents stated that the tank belongs to the villagers as they have to face all the benefits as well as costs. About 11.7% of the respondents perceived the tank belongs to both the DoAD and the villagers as the DoAD provides the instructions to maintain, and the villagers get the benefits. About 10% of the respondents stated the tank belongs to the DoAD, the Farmer Organization and to the villagers (Fig. 6).

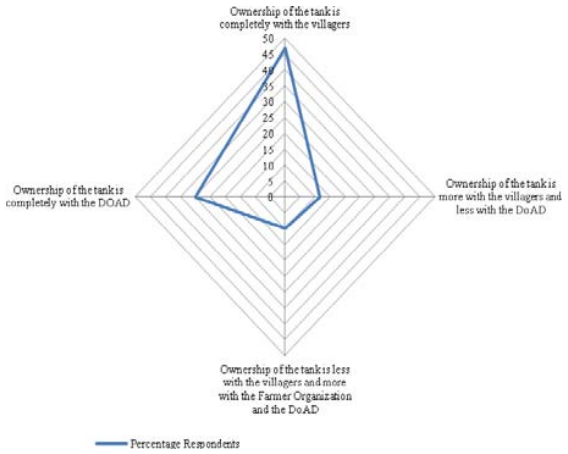


Fig. 6 Distribution of respondents with respect to the perceived sence of ownership of the village tank

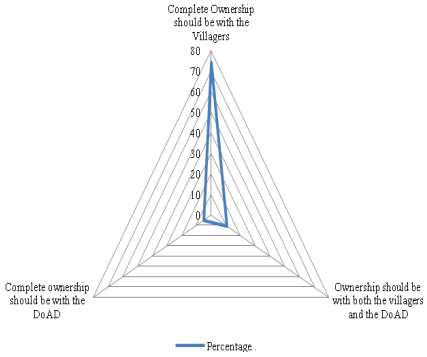


Fig. 7 Distribution of respondents with respect to the perceived expected of ownership of the village tank

About 5% of the respondents believed the ownership of the tank should be with the DoAD, while 74.2% thought it should be with the villagers. The reason stated was, as the benefits and losses are faced by the villagers, the ownership also should be with them. About 10.8% of the respondents

expected the tank to be owned by both the DoAD and the villagers (Fig. 7).

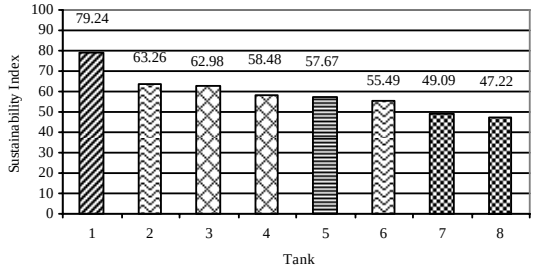
2. The Perceived Responsibility of Maintenance of the Tank

About 25% of the respondents perceived the responsibility of the maintenance of the tank is with the villagers themselves, as they are the main party gaining the benefits as well as the costs from the tank. About 18.3% perceived the responsibility is with the DoAD, as they provide all the instructions for tank maintenance and believe it is proven by appointing the Government paid position of Maintenance Controller (Government appointment financed by an International Agency). Majority (43.3%) of the respondents stated the responsibility of tank maintenance should be shared by both the villagers and the DoAD as the villagers alone cannot afford the cost for maintenance.

C. The Sustainability of Selected Small Tanks

1. The Sustainability Index

The sustainability of the selected Small Tanks varied as follows, with respect to the sustainability index. According to Fig. 8, the highest sustainability score of 79.24 was obtained by the Unale Gurugoda Weva. Diwullewa Maha weva and Diyagama Maha Weva had a sustainability of 63.26 and 62.98 respectively. Unagaha Weva, Meegaha Kapapu Weva and Gallewa Weva had obtained 58.48, 57.67 and 55.49 respectively. The lowest sustainability indexes were obtained by Danikithawa Divulle Weva and Siyambala Gaha weva with 49.09 and 47.22 respectively.



Tank Name	*Approach (Refer Table II)*
1. Unale Gurugoda Weva	Type – d,i
2. Diwullewa Maha weva	Type – a
3. Diyagama Maha Weva	Type – b
4. Unagaha Weva	Type – b
5. Meegaha kapaapu Weva	Type – d,ii
6. Gallewa Weva	Type – a
7. Danikithawa Diwulle Weva	Type - c
8. Siyambala Gaha Wewa	Type - c

Fig. 8 The Sustainability Index of each selected small tank

Several relationships were obtained with respect to three aspects.

1. Relationship of the impact of the most recent tank rehabilitation projects with the sustainability of the tank
2. Relationship of socio-economic factors with the sustainability of the tank
3. Relationship of the socio-economic factors on the respondents willingness to contribute to tank maintenance

2. Relationship of the Effects of the Most Recent Tank Rehabilitation Projects with the Sustainability of the Tank

The quality of the most recent tank rehabilitation projects was measured in five aspects giving weight to participatory approaches. The indicators used were;

1. The participatory nature of the Needs assessment
2. The level of contribution by the people
3. The level of decision making by the people
4. The community based nature of the operation and maintenance approach implemented by the rehabilitation projects
5. The training provided by the project with respect to tank maintenance.

TABLE III
RELATIONSHIP OF THE EFFECTS OF THE MOST RECENT TANK REHABILITATION PROJECTS WITH THE SUSTAINABILITY OF THE TANK (N=120)

Variable	Rank Correlation (R)	P – value
The participatory nature of the Needs assessment	0.886	0.000
The level of contribution by the people	0.634	0.000
The level of decision making by the people	0.822	0.000
The community based nature of the operation and maintenance approach implemented by the rehabilitation projects	0.582	0.000
The training provided by the project with respect to tank maintenance.	0.282	0.002

As shown in Table III, all the aspects considered in the rehabilitation programme had a positive and significant relationship with the sustainability. All aspects except training on tank maintenance showed a strong relationship.

3. Relationship of Socio-Economic Factors with the Sustainability of the Tank

The socio-economic factors had varying relationships with the sustainability. According to Table IV, the demographic factors did not show a significant relationship with the sustainability of the tank. The economic factors showed a negative significant relationship with the sustainability of the tank. Thus, the demographic features of the respondents had no significant impact on the sustainability of the tank.

TABLE IV
RELATIONSHIP OF SOCIO-ECONOMIC FACTORS WITH THE SUSTAINABILITY OF THE TANK

Socio-economic factor	Correlation (N=120)	P – value (N=120)
Occupation of the respondent	- 0.071	0.445
Education of the respondent	0.062	0.500
Paddy water source during the wet season	- 0.230	0.013
Paddy Income *Maha* Season	- 0.237	0.009

4. Relationship of the Socio-Economic Factors on the Respondent's Willingness to Contribute to Tank Maintenance

The willingness of the respondents to contribute to tank management is important when considering the future sustainability of the tank. Thus, the relationship between the socio-economic factors and the respondent's willingness to contribute to tank management was observed. According to Table V, the socio-economic factors showed a positive and significant relationship with the wiliness of the respondents to contribute to tank maintenance. The higher the education and the age of the respondent, the willingness to contribute to tank maintenance was high. The more the respondents are occupied in non-farming (high income) activities; the willingness to contribute to tank management was higher.

TABLE V
RELATIONSHIP OF THE SOCIO-ECONOMIC FACTORS ON THE RESPONDENTS WILLINGNESS TO CONTRIBUTE TO TANK MAINTENANCE (N=120)

Socio-economic factor	Correlation	P – Value
Occupation of the respondent	0.219	0.016
Education of the respondent	0.275	0.002
Age of the respondent	0.213	0.020

IV. DISCUSSION

The study area consisted of traditional villages with ancestral occupants for many generations. The main livelihood of these people is agriculture and with the recent developments and creation of new livelihood opportunities, some of the younger generation has migrated to cities for employment.

The major issue for the agricultural productivity of these villages is the effects of the wild elephants (Human-Elephant conflict) affecting their cultivations and livelihood. The human-elephant conflict is one major threat to these villagers. In all these four tank areas, homestead gardening or *Chena* cultivation was not done due to wild elephant attacks. Other issues are the land fragmentation from generation to generation. Individuals invest on small land areas for cultivation which is not cost effective. Hence, the cost of production is very high. The use of cultivation methods such as the *Pellamaaru* (a system of sharing responsibility in cultivation practices, especially, done by small scale land owners) and the lack of a communal spirit among the villagers have caused further degradation of arable lands.

Paddy is the only promising cultivation, that the people depend on, hence, there is much potential in developing these areas through minor irrigation schemes. According to Fig. 5, about 50% of the respondents had no income from paddy during the last year, which also indicates that the paddy lands are left barren and unproductive due to lack of water. If the land can be cultivated even during the dry *Yala* season, the farmers can earn a much higher income from paddy which will ensure them a better living. A higher stable income will motivate people to invest in new ventures. Thus, rehabilitating the small tanks in an effective manner, to ensure a continuous supply of water, is important. Also for this to be effective, the rehabilitated tanks need to be managed in a sustainable manner.

The sustainability of the rehabilitated small tanks depends on many factors. Out of these, seven significant factors stated by previous authors (secondary data) and by village level officers and government authoritative officers (primary data) were considered to develop the sustainability index. With respect to the sustainability of tank management, the sustainability index gives a guide on the most important aspects that affect the sustainability of the tanks. According to Fig. 8, the tank obtaining the highest score had been rehabilitated by the approach "d,i"; implemented by a village level NGO funded by an INGO. The primary fact about this approach is that almost all the proceedings from planning, decision making, implementing to participatory evaluation was done by the villagers themselves, including the Farmer Organization members. Even during data collection these villagers were highly motivated and interested to share the details and they were all aware of the various stages of the rehabilitation process and had a complete sense of ownership towards the entire rehabilitation process. This approach is highly participatory in all project aspects. Thus, the higher the participation of the people, the sense of ownership of the people towards the tank was high.

The villages with the lowest two scores were of the same rehabilitation approach, "c"; food for work. Many of these villagers had a very low interest towards maintaining their tank. Most of the people were motivated only for the food rations (which were provided for labour) and it was not a sustainable motivation towards the entire tank rehabilitation process. The villagers were not involved for any other aspect apart from labour; only the Farmer Organization members were involved in other aspects. This was evident during the data collection process and was also stated by the village agrarian officers. These areas are more commercialized and the people are dependent on institutions to provide them with items rather than rehabilitate their tanks with their own interest. In villages where the only water source is the tank, the people know the value of the tank, whereas in areas where other water sources are available, people tend to ignore the village tank.

Villages with rehabilitation approach Type "a"; had varying results of 63.26 and 55.49 on the sustainability index. Here, the approach is Government implemented approach which totally depends on the Farmer Organization. The Farmer Organization acts as the intermediary Community Based Organization involved in the rehabilitation process from the time of requesting for tank rehabilitation to the time of completion. In this approach, only the Farmer Organization office bearers were completely involved and villagers were considered only for paid skilled or unskilled labour. Hence, the sense of ownership was less as the results mainly depended on the efficiency of the Farmer Organization office

bearers and their relationship with the villagers.

The Type "b"; approach of international agency funded projects is similar to type "a". This approach does not give full powers to the Farmer Organization contrary to approach "a". The farmer Organization acts as an intermediary party in the rehabilitation process.

Type "d,ii" has a medium score. Even in this approach, the villagers do not have the complete ownership of the rehabilitation project and were involved in certain aspects of the process. Thus, the most sustainable was the most participatory approach.

Most of the people believed that the ownership of the tank is with the villagers and not with the government, as villagers need to play a main role in tank maintenance. Yet they tend to believe the Government has to do the needful in rehabilitation and maintenance to support the villagers. Another major group feels that, the ownership of the tank is with the DoAD as they instruct the villagers. This has caused a dilemma for the people regarding the ownership of the tank and the level of their responsibility. This itself is a factor that keeps the villagers away from tank rehabilitation programs. Most of the villagers believed the tank should belong to them. Thus, appropriate communication is necessary when authorities deal with the villagers on tank maintenance.

The demographic features of the respondents did not show a significant impact on the sustainability of the tank. The higher the level of education and the age of the respondent, the willingness to contribute to tank maintenance was high. Also similar attitude was seen if the respondents are occupied in non-farming (high income) activities.

With understanding of the factors that rehabilitation program implementers need to know, future programs can be improved and dealt with more responsibility and insight. These factors can be considered in the future in creating rehabilitation approaches to promote sustainable management of these tanks to ensure the effectiveness of the rehabilitation programs and maximum benefits of the large amounts of money invested.

V. Conclusion

1) The majority of the respondents have only primary education while a few had secondary education and tertiary education including Advanced Level, diplomas and bachelors qualification
2) Majority of the people are occupied in farming activities while a few respondents are occupied in Armed forces and village level Self Employment
3) Majority of the respondent families had four to five members in the family.
4) About half of the Paddy lands were not used in both seasons due to lack of water and in these areas the Homestead land and *Chena* lands were also not used due to wild elephant attacks. In all other areas paddy lands are cultivated during both *Maha* and *Yala* seasons and homestead land is used for commercial level cultivations such as vegetable, Other Field Crops, coconut and betel.
5) Majority of the respondents believed that the ownership of the tank should be with the villagers as they face the benefits and the cost, while a few believe the DoAD owns the tank as the controlling is mainly done by the rules and regulations of the DoAD. Many villagers believe the responsibility of maintaining the tank is with them, but some villagers expect the DoAD to share the responsibility as the people are not economically capable of maintaining the tank by themselves.
6) The higher the participatory nature of the tank rehabilitation projects, it has a positive and significant effect on the sustainability of the tank.
7) The education and the occupation of the respondents do not significantly affect the sustainability of the tank.
8) When the socio-economic factors such as the people's education, occupation and age are higher, they significantly affect the people's willingness to contribute to tank management.

VI. Recommendations

1) The use of participatory approaches in tank rehabilitation projects helps to create a sense of ownership and responsibility of the people in maintaining their village tank. Thus, participatory approaches should be used in needs assessment, as getting the participation of the villagers in decision making, cash contribution and non-wage labour (skilled and unskilled) help to reduce their dependency on the DoAD or any other Institute.
2) Creating more participatory activities involving the entire village (not only FO Office bearers), can create a closer link between the villagers and the farmer organization, thus, helping the village to be more united, rather than separated into two sections. Hence the rehabilitation programmes should get the involvement of the villagers as well, for the tank rehabilitation activities.
3) Having training programmes regarding the village level tank rehabilitation activities to all villagers (at least at the seasonal meetings) rather than providing knowledge only to selected FO Office bearers, will disseminate the knowledge to all. This can prevent the narrowing down of the knowledge which the people need to have on tank management.

VII. Limitations

1) Due to the time limitation only 15 respondents were selected from each tank areas, whereas a higher number (30) may have provided the opportunity to test relationships in each tank separately by using statistical techniques.
2) For the sustainability index, only seven indicators were used. More indicators may provide better results.
3) When considering the responses, majority was based on the perception of the respondents, and this may lead to biased information. However, in depth interviews were done to minimize this effect.

4) The technical, institutional and environmental indicators were not included in the sustainability index, which may have a significant influence on the index.
5) This research was done in 2007, before the civil war ended (2009) in Sri Lanka, hence, the socio-economic data and lifestyle of the selected respondents and regions may have changed now.

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