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IWMI International Water Management Institute

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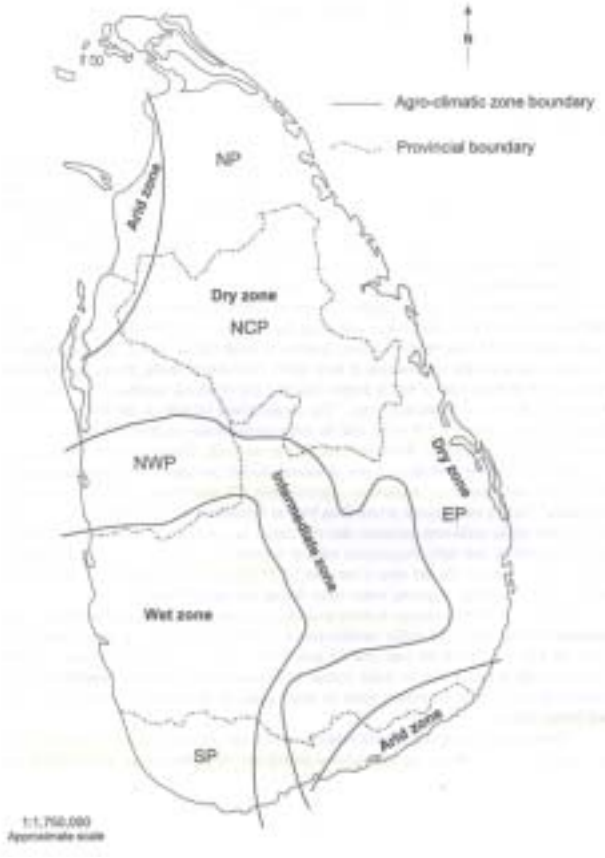
CHAPTER 1

INTRODUCTION

This report on small tank cascade systems is based on a study conducted on seven tank cascades of the Walawe river basin, one of the three main river basins in the Ruhuna benchmark basins[1] selected by the International Water Management Institute (IWMI) for its benchmark basin study. The overall objective of this study is to document the situation of small tank cascade systems in the basin, paying special attention to their evolution under agro-ecological, socio-economic and institutional changes on an unprecedented scale in the country after the introduction of open market economic policies in the 1970s, and thereby to contribute to the existing knowledge on small tank cascades, a key feature of water resources in the Dry zone regions[2] of Sri Lanka (figure 1) since time immemorial.

FIGURE 1. Main agro-climatic zones of Sri Lanka.



[1]IWMI has named basin areas between Kachchigal Ara to Menikganaga as Ruhunu benchmark basins. Walawe, Menik and Kirindi Oya are the main rivers in the Ruhunu benchmark basin area.

[2]Areas receiving an average annual rainfall below 1,905 mm in Sri Lanka are identified as the Dry zone.

A cascade is defined here as "a connected series of tanks (irrigation reservoirs) organized within a micro-catchment of the Dry Zone landscape, storing, conveying and utilizing water from an ephemeral rivulet" and is considered as "one of the traditional land water management systems which has obviously been developed on the basis of catchment ecosystems" (Madduma Bandara 1985). The irrigation reservoirs can either exist independently or be connected to a chain of tanks within a cascade. Tanks with command areas of less than 80 ha are referred to as minor tanks or village tanks in Sri Lanka (Agrarian Service Act of Sri Lanka 1979). They are more or less managed by the farming communities themselves, even though the support of the government and external agencies, like foreign donors and NGOs, is sought for major rehabilitation and improvement activities. The general feature of an irrigation tank is as follows: "tank irrigation utilizes storage of water created by throwing an earth bund or dam across a seasonal or perennial stream at a suitable point. The volume of water stored in such a reservoir depends on the capacity of the tank and the amount of water it receives from its catchment area. Excess water in the tank is allowed to spill over at one or two points on the tank bund, specially designed to release the necessary water to flood the rice fields" (Tennakoon 1974).

Brief History of Small Tanks in the Dry Zone of Sri Lanka

Though the exact period in which the construction of irrigation reservoirs began is not known, there are historical references that they have been in existence since the earliest historical times (Tennakoon 1995). It is sometimes argued that the art of reservoir construction was known by the people in the country even before the arrival of Prince Vijaya, who is believed to be the founder of the Sinhalese nation: the *naga* (cobra) symbol that appeared in the ancient irrigation reservoirs has given rise to a belief that reservoirs were constructed by naga tribes, the prehistoric inhabitants of Sri Lanka living in the country when the Aryans arrived. But some argue that there are no historical references to support these views, pointing out that tank irrigation was introduced in the country in the 6th century BC by the Aryan settlers (Diksith 1986). The Mahavamsa, a historical chronicle of Sri Lanka, refers to the construction of a small tank, Basavakkulama, in Anuradhapura by King Panduvasadeva—an Aryan king who ruled the country in the 5th century BC.

The Walawe basin falls within the area known in the past as Ruhunu Rata, the ancient kingdom in the Southeast part of Sri Lanka. Historical monuments, including tanks, dagobas, stone pillars, stone sluices, Brahmi inscriptions, rock cave hermitages and monasteries, scattered over the whole Walawe basin are indicative of the existence of an ancient civilization similar to the one in Raja Rata (the Anuradhapura and Polonnaruwa areas). Some of these monuments date back to King Mahanaga's reign in the ancient Kingdom of Magama in the 3rd century BC. The names of monarchs, such as Kavantissa and Dutugamunu (2nd centuary BC), appear in the chronicles as those responsible for the construction of some of these irrigation and religious monuments. Some inscriptions attribute some of these works to King Walagamba or Watta Gamini Abhaya (1st century B.C.) who took refuge in the area. It is believed that both large-scale and small-scale irrigation in the area came up during the reigns of these kings, even though the involvement of kings in village irrigation work was minimal. The Uru Sita Wewa (Mahagama Wewa) with its *Biso Kotuwa*,[3] believed to have been constructed during the reign of King Mahanaga and located in the lower Walawe basin, is considered as a prime example of the irrigation engineering skills of the ancient civilization in this part of the country.

[3]Cistern sluice used in ancient tanks to reduce the pressure of water on the tank bund, when discharging water to the main canals from the tank.

Previous Studies on Small Tanks and Tank Cascade in Sri Lanka

Irrigation reservoirs, both small and large, have attracted the attention of scholars since the British colonial period. For example, Cook (1951) attempts to relate the spatial patterns, such as the distribution and density of tanks, to climatologic and ecological factors. Studies carried out later observe 'a greater preponderance of these reservoirs in the ancient kingdom of Rajarata centered around Anuradhapura and in the principality of Rohana in the Southeast part of the island. In some localities, the density of tanks exceeds 15 for an area of mere 10 km2' (Madduma Bandara 1985). As these tanks are numerous, some scholars hesitate to believe that they were operational during the same period of history. Some believe that they were operational but used for storage purposes, rather than irrigation, to support animals and maintain higher ground water levels (Madduma Bandara 1985). It is easy to believe that a village's livelihood systems depended entirely on small tanks. In dry periods, they maintained vegetation and, recharged the shallow wells used by people for drinking and other domestic uses. Also, fish provided the nutritional requirements of people.

The studies further illustrate that while 'a large number of these tanks are operational at present, a considerable proportion lies in an abandoned state under forest cover' (Madduma Bandara 1985). The reasons for the continued and present abandonment of these tanks as pointed out by these scholars are explained in the following lines: 'They lack adequate catchment areas, they lack suitable agricultural soils for viable settlements, they are economically and from an engineering perspective non-viable, they lack approach roads, or are located far away from human habitation, or they are situated in forest reserves and nature reserves or wild life sanctuaries' (Abayasinghe 1982). Panabokke observes that the primary reason for the preponderance of abandoned small tanks in the semi-arid environment in some parts of SP is the occurrence of the readily dispersible sodic soils in the narrow inland valley bottoms across which these small tanks have been constructed (Panabokke et al 2002). Tank bunds made from such soil material are unstable during the rainy period and can cause breaching of embankments and ultimately the abandonment of tanks' (Panabokke et al 2002).

Small tank systems are perceived as human adaptation to rainfall patterns, a water harvesting system that enables, through irrigation, the uneven distribution of water to be changed (as moisture stored at the time of abundance can then be released later on to supply the plant). Finally, the real blessing of the tank system is that it is an ever active "risk minimization process" (Tennakoon 1986). The physical environment of the Dry Zone has also favored an intervention like the small tank as pointed out by Somasiri: 'It is not surprising that tank irrigation systems became a permanent feature in the Dry Zone landscape. The climatic, geomorphologic, soil and surface hydrological conditions all favor the establishment of irrigated systems in the Dry Zone of Sri Lanka' (Somasiri 1979).

The general layout of tank villages in the Dry Zone of the Northcentral Province (NCP) has been described in detail by Ivers (1899), Codrinton (1938), Peris (1956), Leach (1961) and Yalman (1967). As Brow (1968) points out, apart from a recent change in house sites, Rhys Davis' description still holds: "Each village consists, firstly, of the tank and the field below it; secondly, of the huts of the shareholders hidden in the shade of their fruit trees, each under the bund or along the sides of the field; and thirdly, of all the waste land lying within the boundaries of the parish or the village" (Davis 1871).

Some studies highlight the relationship between the tank and the village settlement and the land use pattern (Tennakoon 1974). The social organizations and community aspects in tank villages in the NCP have also been addressed by anthropological studies like "Pul Eliya" (Leach 1961) and "The Vedda Villages in the Anuradapura district" (Brow 1968). These studies on village

communities report that the agrarian economy of villages in the NCP underwent massive changes after 1953. “Increased production for the market and the rapid spread of wage labor, which were the most profound of the changes, seriously threatened a form of social order the fundamental features of which appear to have been continuously reproduced, with only minor modification, through many previous generations. In the absence of paddy cultivation (due to drought conditions, leasing of lands to outsiders etc.) and absence of lands with long fallow periods suitable for chena cultivation, the social relationship of production forged few economic connections among the various households. Most highland cultivation was done by households independently, while wage labor was mainly performed for outsiders” (Brow 1992).

Some of these studies highlight the changes in the management of these tanks. During the post Independence period, village irrigation systems were constructed by their proprietors without aid from the government and maintained by them (Groenfeldt et al 1987). The *Velvidane* system of pre-colonial times, where a water headmen was made responsible for the management of irrigation, continued even after Independence. However, responsibility for maintaining minor irrigation systems was taken over by the Ministry of Agriculture and Food. In 1958, when the Department of Agrarian Services was established with the introduction of the Paddy Lands Act, the age-old Velvidane system was replaced by Cultivation Committees. It is pointed out that the objectives of these reforms could not be achieved due to problems such as poor leadership, discipline and maintenance. More reforms in the organizations came in the 1960s with the introduction of cultivation officers involved in the management activities in small tanks. Many social anthropologists and sociologists note that the post 1970 period was characterized by the intrusion of politics in rural villages: “The post-1970 era in rural Sri Lanka witnessed increased party political intervention in local village organizations. A clear indicator of this process was the move from the election of office-bearers of the cultivation committee (CC) to their appointment by political leaders. This move led to further deterioration of village level irrigation leadership, as the members were appointed by politicians on the criteria of political popularity and the ability to deliver votes in an election. Property ownership, family status and social standing, which constituted the traditional criteria of village leadership, thus became less important, while the ability to be a good “vote bank” became more important in the appointment of CC members. The politicization of rural leadership culminated in the 1979 Agrarian Services Act” (Groenfeldt et al 1987).

Chapter 2

METHODOLOGY AND RESEARCH QUESTIONS

Methods for Data Collection and Analysis

The data collection methods used in this study included the following:

- Review of existing data and information
- Formal and informal interviews with key informants
- Focus group discussions, and
- Questionnaire surveys in selected sample tank systems.

Data, information and maps available at IWMI, the Departments of Agrarian Services, Meteorology and Surveyor-General were reviewed to document the physical systems of the tanks, their location and socio-economic data relevant to this study. The data was further verified and complemented during interviews held with agency officials and farmers. Participatory consultative group discussions with farmers in 7 sample cascade systems selected for the study helped in a more in-depth understanding of the present performance of the cascade systems and their problems. Finally, a household survey was conducted in three sample cascades, Kadawarawewa, Aluthwewa and Metigathwala, to validate the findings from the consultative group discussions and the interviews. The tanks selected from these cascade systems included Andarawewa, Adiyangamawewa and Bolhidawewa from Kadawarawewa cascade, Gurumadawewa, Neraluwawewa and Kukulkatuwawewa from Aluthwewa cascade and Morakanuwawewa, Higurawewa and Metigathwalawewa from Metigathwala cascade system.

Research Questions

The study concentrated on answering the following research questions on the physical, socio-economic and institutional evolution of the sample tank cascade systems in the Walawe basin.

- What are the changes in tank cascade systems or independent tanks and associated eco-systems which have led to the present situation? What are the accompanying changes in the socio-cultural and economic systems in the tank based village communities?
- What are the factors that contributed to the increase or decrease of the number of tanks and tank based communities in the cascades?
- What are the problems associated with water resources in tank systems? What are the factors contributing to increasing or decreasing water resources in the tank systems?
- What changes are observed in the production systems under these tanks? For what purposes were they used in the past? For what purposes are they being used at present? Are they

being used for agriculture alone or for domestic and other uses? What are the current production related problems faced by the communities in these tank systems?

- What changes are observed in the institutions managing (especially in operation, maintenance and seasonal cultivation plan implementation) these tank systems?

- What trends can be envisaged with regard to the changes of hydrology and the socio-economic condition of these tank systems and tank based communities in future?

Description of the sample cascades and rationale for their selection

The criteria for selecting the sample cascade included their geographical location in the basin (head, middle and the tail), size of the cascade, size of the command area and number of tanks under them, and their incorporation (or not) into the major irrigation systems. Figure 2 shows the location of the seven cascade systems in the basin. The information on the cascade systems based on these criteria is presented in Table 1. Maps of the individual cascade systems are found in figures 1-7 in Annex 1.

Out of these systems, Kadawarawewa, a system undergoing massive changes under the Walawe Left Bank extension project, Metigahtwala, a system partly incorporated into the Walawe Right Bank system and Aluthwewa, an independent system in the middle of the basin, were selected for the household survey.

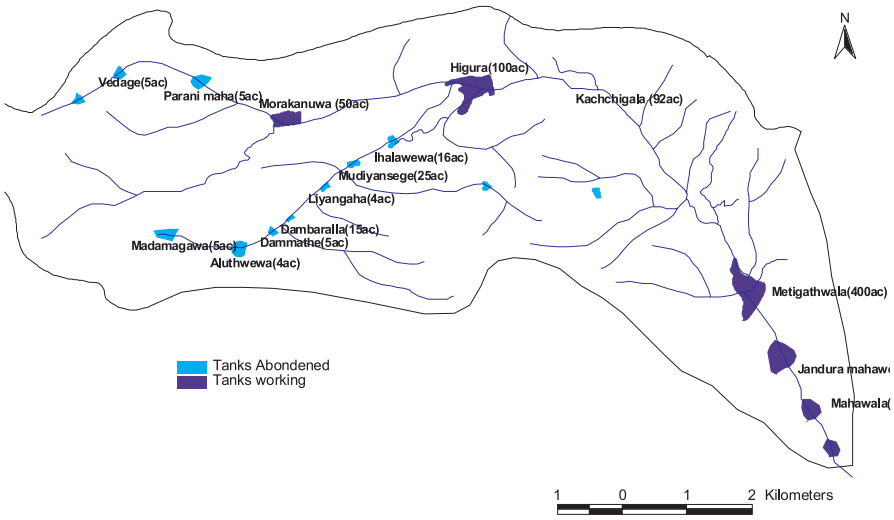
Administratively, the Kadawarawewa Cascade system falls within two DS divisions, Suriyawewa and Ambalantota in the Hambantota district, while Metigathwala cascade system falls within Agunakolapalessa and Ambalantota DS divisions. About 90 percent of the tanks in the Kadawarawewa system are being incorporated in to Uda Walawe Irrigation System under the Walawe Left Bank Irrigation Upgrading and Rehabilitation Project. In Metigahthwala cascade, the tanks below Kachigala Wewa (Metigathwala, Jadura Maha Wewa, Mahawela Wewa and Sadunkatuwa Wewa) started receiving water from the Uda Walawe irrigation system after the

TABLE 1. Information on the sample cascade systems.

Name of the cascade	Location in the basin	Administrative divisions (DSS)	Size (km^2)	Number of tanks	Size of command (ha)	Incorporation in to major systems
Kadawarawewa	Tail	Suriyawewa and Ambalantota	56	18	115	Being partly incorporated
Metigathwala	Tail	Agunakolapalasse and Ambalantota	51	18	346	Partly incorporated
Kiriibbanwewa	Middle	Thanamalwila	30	7	621	Partly incorporated
Kahakurullanpalasse	Middle	Thanamalwila	15	4	28	Independent
Aluthwewa	Middle	Thanamalwila	21	17	62	Independent
Bogaswewa	Head	Thanamalwila	4	6	140	To be partly incorporated
Kandiyapita	Head	Thanamalwila	4	3	172	Independent

Source: Focus group discussions and interviews.

FIGURE 2. Location of the selected cascades.



Uda Walawe Right Bank Main Canal (RBMC) was connected to Kachchigala tank in the 1960s. Kiriibbanwewa, Kahakurullanpalasse, Aluthwewa, Bogaswewa and Kandiyapita cascade systems are located in Thanamalwila DS division. Kiriibban Wewa, in the tail-end of the Kiriibanwewa cascade, was incorporated into the Uda Walawe irrigation scheme and started receiving water from a feeder canal from the Uda Walawe Left Bank Main Canal (LBMC) in the 1960s. Some tanks in the Bogaswewa cascade are to receive water from the forthcoming Weli Oya diversion scheme.

Present Status of Small Tank Systems

Origin and evolution of the small tank systems and tank communities

Almost all the small tank cascade systems studied in the Walawe basin are ancient ruined tanks rehabilitated and renovated by the people who migrated to the area from time to time within the past 200 years or so. Except for two larger tanks, Metigahthwala and Kachchigala in the Metigathwala cascade on Kachchigala ara, which are associated with legends running back to the reigns of King Dutugamunu (2nd century BC) and King Walagambahu (1st century BC), there are no references to the other small tanks in folktales, legends or chronicles. However, some of them appear in the administrative reports and diaries of colonial government officers during the British period. The development of communities and tank systems in the cascade differ from one cascade to the other, hence their development process is discussed separately in detail below.

Except for one tank (Weerege wewa) all the other tanks in the Kadawarawewa cascade can be considered as ancient tanks renovated and rehabilitated during the British period and after Independence. None of the tanks in this cascade appears in Appendix III of the Sessional Papers (1867) indicating the names of existing irrigation systems in the Southern Province of Sri Lanka at that time. Participatory group discussions with the members of these communities reveal that these tank communities migrated to the area after 1950 in search of arable lands for chena cultivation

and later settled down close to the tanks and renovated them. However, some members of the farming community in Adiyangama claimed that they have a long settlement history extending more than 200 years back. Leonard Woolf's diaries (1908-1911) describe the situation of a village known as Andarawewa in this cascade area in 1911: "Walked to Andarawewa. This is a depopulated country which I have not seen before. There is no longer any village at Andarawewa. Inhabitants all died or left some five years ago. One old man who came with me used to live there. He owns land under the tank: its only use to him is that a year or two ago he went to jail for not doing earth work. This tank must be struck off or the lands sold to people who can restore the tank" (Woolf 1911). The farmer families in the cascade area have migrated from Beliatta, Middieniya, Kirama, Tangalle, Katuwana, Bolana, Dickwella and Baragama, all in Hambantota district. Lands under some tanks have been developed by second generation members of families settled in the area in the 1950s.

Farmers in the headstream part of the Metigathwala cascade system (up to Kachchigala tank) claim that these tanks were constructed during the reigns of King Dutugamunu (2nd century BC). Kachchigala and Metigaltwala tanks are claimed to have been constructed during the reigns of King Walagambahu (1st centuary BC). Metigathwala (which means 'clay pit') was called "Menik gathwala" (gem pit) in the past because there was a gem mine at that spot. The other three tanks, Jadura Maha wewa, Mahawela wewa and Hadunkatuwa, are also identified as forming an ancient irrigation system with a history running back to the ancient hydraulic civilization in the country. However, there is no evidence to support the notion that the communities have a historical continuity running back to these ancient periods. Instead, with a few exceptions, the majority of these communities can be considered to have migrated to the area during the early British period and after Independence. The diaries maintained by the colonial administrators during the British period indicate the existence of small tank based village communities in this cascade system. For example, the notes of the Assistant Government Agent, Sabaragamuwa illustrate the situation in the Higura wewa area in 1914 in the following lines:

"The people in this *wasama*[4] are sickly and diseased and appear to live a miserable life owing to the bad climate and the defective rainfall. It was the dream of late Mr. Wace (former AGA) to picture this fever-stricken spot a land of plenty when the Higure-ara wewa was restored. This tank gives an unfailing supply of water. There are over 1,000 acres[5] of irrigable land under it. The work was restored 15 or more years ago but today there is not a single paddy field under cultivation. Some years ago some 200 odd acres was sold under *the Kaltota lease system* but the purchasers only chenaed the land and then decamped. At present the lands are overgrown with thick low jungle. It has been suggested to sell the lands outright after cutting up the lots in to smaller ones but it is practically certain no villager will buy them. He has not the money and even if he had there are not *Goiyas*[6] to cultivate it. Unless a wealthy capitalist comes to the rescue and imports families into the district, I am afraid this excellent work will always remain a failure" (Assistant Government Agent 1914).

The tanks in the Metigathwala cascade system appear in the famous diary of Leonard Woolf, AGA, Hambantota from 1908 to 1911. The following extracts from these diaries, appended below explain the situation in the area in the early part of the 20th centaury: "I started on the Gamsabawa

[4]The administrative unit above the village level during the British period. A wasama comprised of several villages.

[5]1 acre = 0.40469 ha.

[6]Tenant farmers cultivating paddy lands owned by big landlords.

path to Dabarella and then Kiwala wewa, a poor tank, to Kandekatiya. Here or just past it is a fine piece of forest showing what magnificent country this must have been before chenas ruined it …… Just through the jungle is Metigatwala wewa, a really magnificent village tank with a bund as good as many a major work can boast. There are 45 *amunus*[7] under this tank and I believe the whole extent belongs to Mulkirigala Vihare. The Kachchigala ara flows into it …

"From Mwetigatwala wewa rode to Dickwewa (one and a quarter miles) and Abesekaragama. There doubled back through Gopalasse to Agunakolapalasse (four miles). Gopelesse or Bopalesse is an interesting village. It too has a wonderfully good village tank but no water. The people came in a body to me and said they only wanted one thing and that was water to drink. There is however another tank here called Mahajadura the bund of which is badly breached. The people want to restore it as Kachchigala ara flows through it" (Woolf 1909).

Woolf's diaries throw light on the tank restoration activities undertaken during the British period in the tanks under Metigathwala cascade: "Rode to Talawa 10 miles. Inspected on way …… Kudagoda wewa. Poor bund. A year's work should complete this too. Great want of water in Kudagoda. A well has been sunk 30 feet or so only to find rock. …… Inspected Talawa government school: fairly satisfactory.

"In the evening inspected (1) Talawa Madamalanga wewa, (2) Talawa Aluth wewa, (3) Talawa Dammana wewa. All being well restored and should be finished next year. …. (4) Dabarella wewa, ditto. The villagers told me they did not want a pipe sluice; they want a channel cut from the Urubokka oya 10 or 12 miles away" (Woolf 1908).

Some of the tanks in the cascade appear in Appendix III of the Sessional Papers (1867) indicating the names of existing irrigation systems in the Southern Province of Sri Lanka at that time. These tanks include Kachchigala wewa, Liyangahawewa, Dabarellewewa, Higurewewa, Dammanewewa, Madamagawawewa, Aluthwewa, Vedagewewa and Metigathwala Mahawewa.

The communities living in the small tank villages in Kiriibban wewa cascade are new migrants who settled in the area in the 1950s. They came mainly for chena cultivation. Some of them had settled down in the Sevanagala area by the time the government started a sugar factory in Sevanagala. The government allocated them new land, 3 acres of highland for each family in the cascade area after taking over their land in Sevanagala for a sugar cane farm run by the government. These re-settlers made their permanent residence in the cascade area in the 1980s. In addition, people migrating from areas like Katuwana and Middeniya in the Hambantota district also settled down in this cascade. Almost all the people who have migrated to the small tank villages in this cascade came from Hambantota. Although the area was covered with jungle at the time, these new communities settled down in the area. It is evident from the ruined tanks scattered all over the cascade that there were village communities settled there in the ancient past. Almost all the existing tanks in Kiriibban wewa cascade systems are renovated or rehabilitated old tanks. Even though there are some more ruined tanks in the area, there is reluctance on the part of the settlers to renovate these tanks because their lands are in the water spread areas of the tanks.

The history of settlement in the Kiriiban wewa area is quite different. It is said that 637 families of the employees of the Land Development Department were settled in Kiriibban wewa area, 101 on the Left bank and one-hundred and five on the Right Bank after renovation of the tank in the 1960s. They were paid their salaries till they reaped their first harvest after cultivating the land under the scheme. The scheme was taken over by the River Valley Development Board in 1970,

[7]Amuna = 150 kg.

when the area was incorporated into the Uda Walawe Irrigation Scheme: the command area under the tank was expanded and new settlers were brought in.

The communities in Kahakurullanpalasse cascade live in Uruhore, Kahakurullanpalasse and Arebekema villages. They have migrated to the area in the 1960s for chena cultivation from Embilipitiya, in the Ratnapura district, and Middeniya, in Hambantota. They set up temporary residence in the area initially and claim to have restored Uruhore and Kahakurullanpalasse tanks, which were in a state of abandon in 1970. Two people, who came to the area for chena cultivation, settled down in Arebekema and constructed two private tanks, the Rangewewa, and H.K.T tanks, during the same period.

Communities cultivating under most of the small tanks in Aluthwewa cascade are settled in Aluthwewa, a fairly old village located close to Hambegamuwa. The interviews with the old villagers in this village revealed that migration into Aluthwewa started in 1850 and continued until the 1980s. The settlers migrated from Haldummulla, Bambarabedda in Balangoda and Hambegamuwa. The other tank villages in the cascade are Kelinbunna, Millagala and Kukulkatuwa. The communities have migrated to these villages from Balangoda and Hambegamuwa. The discussions with them revealed that their ancestors came to this area during the British period in search of land for chena cultivation. The Waste Land Act implemented during the British period and the later takeover of the forest lands by planters for tea cultivation might have had serious impacts on the peasantry in the upcountry areas, who used the forests for chena and highland crop cultivation. It might have driven them to migrate into the isolated Monaragala districts, where the authority of the colonial administration was somewhat weaker. The area had also been an attraction for criminals and those who wanted to earn money by illicit means such as cultivation of hemp (*ganja*); it is said that a lot of people from Hambantota area migrated to this area for such activities through which they expected to become rich within a short period. There are, indeed, a lot of businessmen who started growing hemp and gave up later after becoming rich.

The communities in the Bogaswewa cascade system are settled in Mahanetula, Kudanetula, Divulana and Bogaswewa villages. They are second generation members of the families settled in Medabedde irrigation settlement scheme and areas like Balangoda and Ellepola. Most of the families in these villages are said to have migrated to the area for chena cultivation in the 1960s and settled down there permanently. Abandoned breached tanks in the area were restored in the 1970s.

Communities cultivating under the Kandiyapitiya and Mahakivula tanks in the Kandiyapita cascade are from Welimada and Medabedda irrigation settlement area. The people from Welimada came to this area in 1974 to start a cooperative sugar cane farm under the government youth settlement scheme for rehabilitated youths who took part in the insurrection of the Janatha Vimukthi Peramuna (JVP) in 1971. This was a program implemented by the government to solve the unemployment problem perceived as one main reason for the insurrection. These youths renovated Kandiyapitiya tank and started paddy cultivation along with the cooperative sugar cane farm. Those who developed the Mahakivula tank are the second generation members of the settler families in the Medabedda irrigation scheme. They migrated to the Kandiyapita cascade area for chena cultivation and later settled down there, as they do not own lands in the settlement areas in Medabedda (figure 3).

The data from the household survey conducted on sample tank systems in 3 selected cascades further validate the findings from the focus group discussions that a majority of people in the upstream areas are from Badulla and Ratnapura, while those in the downstream are from Hambantota.They all have migrated to the areas mainly for pursuing livelihood activities like chena farming. Most of the families in these cascade systems have migrated to the area in the 1960s. However, in Aluthwewa and Metigathwala, there are some families with a settlement history of

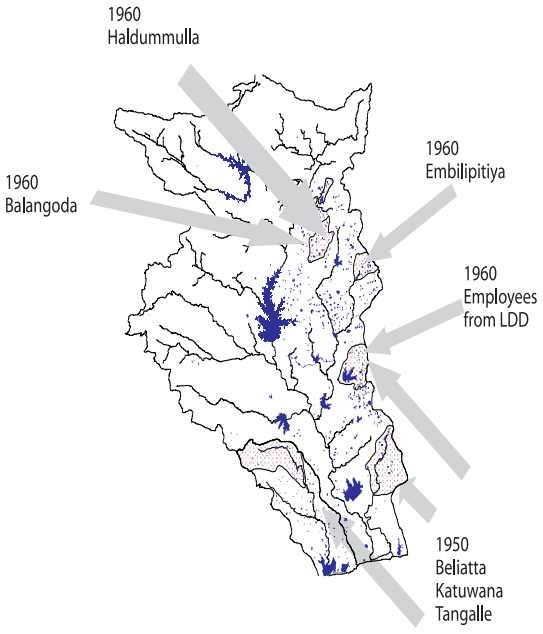
more than a century. For example, out of the 35 sample families in Aluthwewa, 16 percent claim that they have been living in the area for more than 100 years, while only 1 percent of families in Kadawarawewa have such a long settlement history. In contrast to Aluthwewa and Kadawarawewa, the number of families claiming an ancestry over 100 years is significant in Metigathwala (29 percent), a cascade where old villages existed even during the British colonial period.

All the families in the 3 cascades have either migrated to the area for chena cultivation or are descendents of such people. More than 90 percent of the people who migrated to Metigathwala and Kadawarawewa cascades in Hambantota are from other parts in the district, while the rest are from Matara and Trincomale. In Kadawarawewa, migrants came from areas like Hambantota, Weeraketiya and Tangalle (in Hambantota); while in Metigathwala, migrants are mainly from Ambalantota, Beliatta, Hakmana, Hambantota, Tangalle in Hambantota. Almost all the families in the Aluthwewa area are migrants from areas in Badulla, Ratnapura and Monaragala districts or their descendants. These areas include Wellawaya in Monaragala, Haputale in Badulla and Balangoda in Ratnapura.

Tank Density

Tank density in the seven cascade systems under the study are given in table 2. It can be observed that there is one tank for 1.6 km^2 in Kadawarawewa, 4.25 km^2 in Metigathwalawewa, 0.8 km^2 in Kiriibbanwewa, 14 km^2 in Kahakurullanpelesse, 2.0 km^2 in Aluthwewa, 1.0 km^2 in Bogahawewa and 7.5 km^2 in Kandiyapita. Highest tank densities are observed in Kiriibban wewa and Bogaswewa cascade system, while the lowest tank densities are observed in Kahakurullanpalasse and Kandiyapita cascade systems. Alhough tank density is high in Kiriibban wewa cascade, 60 percent of the tanks in this cascade system are not used for agriculture.

FIGURE 3. Migration flow in 1950 to 1960.



It is also noteworthy that in the cascade systems falling within the Hambantota district, tank density ranges between one tank per 0.8 km^2 to one tank per 4.25 km^2. In the basin area falling in the Monaragala district, tank density is higher and ranges between one tank per 1 km^2 to one tank per 14 km^2.

A comparison of tank densities in different districts is given in Table 3. The highest tank density of one tank per km^2 is observed in the Kurunagala district falling within the intermediate zone. In Anuradhapura, tank density is one tank per 3 km^2, against one tank per 5.8 km^2 in Hambantota and one tank per 20 km^2 in Monaragala, the two districts in which the cascade systems under this study are located. Lower tank densities are observed in Monaragala compared to Hambantota. As Panabokke points out, average tank density is one tank per 2.6 km^2 for the Northern Province (NP), North Central Province (NCP) and (SP) Southern Province (Panabokke et al 2002). For the North Western Province (NWP), the density is around one tank per 1.2 km^2'. In Panabokke et al's (2002) view, distribution pattern of small tanks in these districts "conforms to both the nature of the overall rainfall regime as well as the nature of the geomorphology of the region".

Functional tanks and abandoned tanks

As shown in table 4, out of 18 tanks in Kadawarawewa cascade, six (33 percent) are abandoned, two of them from the time people migrated to the area some 20 years back. Three functioning tanks were abandoned due to water shortage and not restored as this would have decreased water in the main village tank, further downstream. The larger tank in the tail–end was abandoned after it was incorporated into a major irrigation scheme. The command area of this tank now receives irrigation water from the irrigation system. In Metigathwala cascade too, 33 percent of the tanks in the upstream areas have been abandoned due to water shortage. However, comparison of the command areas of some of these tanks with those of the British period show that the crop area

TABLE 2. Tank density in Cascade systems in Walawe basin.

Name of the cascade	Number of operational tanks	Cascade area in km^2	Area per tank in km^2
Kadawarawewa	13	21	1.61
Metigathwala	12	51	4.25
Kiriibbanwewa	5	4	0.8
Kahakurullanpalasse	4	56	14.0
Aluthwewa	15	30	2.0
Bogahawewa	4	4	1.0
Kandiyapita	2	15	7.5

Source: Focus group discussions and interviews.

TABLE 3. Tank densities in different districts in Sri Lanka.

Name of the district	Number of operational tanks	District area in km^2	Area per tank in km^2
Anuradhapura	2,334	7,205	3.0
Hambantota	446	2,613	5.8
Monaragala	285	5,758	20.2
Kurunagala	4,188	4,901	1.1

Source: Data Books, Agrarian Services Dept.

has increased tremendously in recent times. This may have been the main reason for the declining water levels in these systems and their abandonment at present. Out of the seven tanks in Kiriibbanwewa cascade, 2 are not functional now. This has happened after the construction of Mau Ara canal, which disturbed the natural drainage canals flowing into these tanks. In the Kahakurullanpalasse cascade, one tank out of four is not functional. This is due to the breach of the tank bund after heavy rains several years back. In Aluthwewa cascade, 2 tanks out of 17 are not operational. The people are not interested in restoring one tank in this system as the land area to be developed under it is marginal. The other tank in the tail–end of the cascade is located in the wildlife reserve in which people are not allowed to engage in cultivation activities. Out of the 6 tanks in Bogaswewa, two are abandoned since 1975, when they breached after heavy rains. In Kandepitiya, one out of three tanks is in a state of abandonment from the time people migrated to the area.

Previous studies on small tanks in Sri Lanka report that the number of abandoned tanks is high in "Northern Province (NP) and Southern Province (SP), where over 50 percent of the approximately 1,400 small tanks in each province are in an abandoned state" (Panabokke et al 2002). It is pointed out that "the mean annual rainfall as well as the *maha* season rainfall is lower in the SP and NP than in the NCP and NWP. The tanks also tend to be less stable because of the sodic soils that are prevalent in the SP" (Panabokke et al. 2002).

The major reason for abandoning tanks in the cascades studied may be the expansion of the command areas of these tanks under different programs from time to time without adequate attention to the hydrology of the entire cascade system. The expansion of the command area may have been required to meet the needs of the growing population. However, the tank rehabilitation and improvement programs have not brought the expected benefits when command areas were increased without a reliable water source. Positive changes are observed in tank rehabilitation and improvement programs in tanks such as Metigathwala, Kachchigala and Kiriibbanwewa which are supplied by the Uda Walawe major irrigation scheme. Also Madduma Bandara's argument that the abandoned tanks in Rajarata might not have been used in the past entirely for irrigation, but for storage purposes, to support animals and maintain higher ground water levels, may hold true for the abandoned tanks in the Walawe basin too (Madduma Bandara 1985). Attempts at a later stage to use these tanks for irrigation purposes might have led to failures and abandonment . It is also noted that once a tank breaks after heavy rains, the tank communities have no capacity to renovate it and have to seek government assistance. This takes a considerably long time, sometimes till a donor funded tank rehabilitation program comes into operation. Some tanks in these cascade systems lie in an abandoned state due to this reason too.

TABLE 4. Functional tanks and abandoned tanks in sample cascade systems in Walawe basin.

Sample cascades	Abandoned	Operational	Total	Abandoned (%)
Kadawarawewa	6	12	18	33
Metigathwala	6	12	18	33
Kiriibbanwewa	2	5	7	29
Kahakurullanpalasse	1	3	4	25
Aluthwewa	2	15	17	12
Bogahawewa	2	4	6	33
Kandiyapita	1	2	3	33

Source: Focus group discussions and interviews.

Size of the Command Areas

It can be observed from the data on the size of the command area in Table 1 in Annex 2 that most of the tanks in the sample cascades are in the 6-20 ha size range. In Kadawarawewa, Metigathwala, Kahakurullanpalasse, more than 70 percent of tanks are in this category, while in Aluthwewa, Kandiyapita and Bogaswewa, they are 90, 50 and 25 percent respectively. Tanks in the class of 20-40 ha are found in Kadawarawewa (23 percent), Metigathwala (6 percent), Kahakurullanpalasse (25 percent), Aluthwewa (6 percent) and Bogaswewa, (25 percent). Larger tanks exceeding 40 ha are found in Metigathwala (22 percent), Kiriibbanwewa (20 percent), Bogaswewa (50 percent) and Kandiyapita (50 percent). In these systems, larger tanks are found in the tail–end of the cascade systems or upstream areas of the basin receiving water from the Balangoda hilly areas. It can be observed that the dominant size class of tanks in the middle and downstream areas of the basin is 6-20 ha. These systems, Aluthwewa, Metigathwala, Kadawarawewa and Kahakurullanpalasse are in flat terrain and are characterized by low rainfall which may be the primary reasons for the preponderance of small tanks.

Table 5 shows that command areas of these tanks have changed from time to time. For example, in the Metigathwala system, the command area increased in the past and has now decreased in the upper reach of the cascade, which has not been incorporated into the Uda Walawe Irrigation Scheme. This decrease is mainly due to the abandonment of the command areas due to water shortage and physical system deterioration.

Tank Capacity

With the exception of a few tanks, there are no data on tank capacity or the extent of the water holding area and the depth of the tanks at the agencies. In the focus group discussions, since the farmers expressed different opinions on the extent of the water holding area and the depth of the tanks, the information appeared to be less reliable. The common view held by the farmers, as well as the agency officials, was that tank capacities have decreased significantly due to the silting and sedimentation of tank beds with the development activities in the tank catchments. After clearing up forest cover, communities use the tank catchments for chena cultivation and residential purposes.

TABLE 5. Change of the command area in cascade systems.

Sample	Extent (ha)		Change (%)	
cascades	Present	Past	Increase	Decrease
Kadawarawewa	115	127	-	9
Metigathwala	346	521	-	34
Kiriibbanwewa	621	253	145	-
Kahakurullanpalasse	28	40	-	30
Aluthwewa	62	29	114	-
Bogahawewa	140	97	44	-
Kandiyapita	172	32	437	-

Source: Focus group discussions and interviews.

Physical Conditions of the Tanks

Physical system deterioration is a major problem in these tank systems. Based on their observations and local knowledge of the systems, the farmers pointed out at the focus group discussions that some components of the physical system have deteriorated in each tank. They claim that bunds have deteriorated in 46 percent of tanks in the Kadawarawewa cascade and the tank bed has silted, reducing the tank capacity; in 92 percent of the tanks, the sluices are damaged and inoperable or leaking in a further 46 percent; and the tanks spills are damaged or not in good condition in another 37 percent. The canals are physically deteriorated in 92 percent of the cases, as shown in table 6. The main problems reported in all these systems are silting and sedimentation of tank beds due to soil erosion in the catchments. The second most common problem is the deterioration of canal systems, which are rarely addressed by tank rehabilitation programs. There is no effort on the part of farmers to improve the conditions of canals and their maintenance activities are limited to routine maintenance. In many privately owned tank systems in Aluthwewa, spillways are made of clay; consequently, they are washed off during rainy periods creating problems for the farmers in these systems. Farmers also find it difficult to manage water because some tanks haven't proper sluices.

Rehablitation and Renovation

The small tank systems in these cascades have been rehabilitated from time to time either by the farmers themselves, or government agencies and donor funded projects implemented either by NGOs or the government. For example, out of the 13 functional tanks in Kadawarawewa, 7 (54 percent) have been rehabilitated during the period from 1995 to 2001, one by a NGO, 4 by the Agrarian Services Department (ASD), one by the National Irrigation Rehabilitation Project and one by the Samurdhi Authority. Similarly, more than 90 percent of tanks in Matigathwala, 66 percent in Kahakurullanpalasse, 100 percent in Bogaswewa, Kiriibbanwewa, Kandiyapita and Aluthwewa have been rehabilitated from time to time by farmers or through special projects implemented by the government or NGOs. Most of these rehabilitation activities have been implemented during the past 2 decades. Much of this work focused upon strengthening tank bunds and sluice and spill improvements. These programs seem to have rarely carried out improvements on canals. It is noted that only the tanks rehabilitated or improved during the last five years or so are in good condition. In systems like Metigathwala, most of the tanks in the upstream area are likely to deteriorate further in the near future because of poor maintenance.

TABLE 6. Physical system deterioration in cascades (% of tanks deteriorated).

Sample cascades	Bund	Bed	Sluice	Spill	Canals
Kadawarawewa	46	92	46	37	92
Metigathwala	92	100	67	50	67
Kiriibbanwewa	0	100	40	20	80
Kahakurullanpalasse	50	100	50	0	25
Aluthwewa	73	100	73	80	100
Bogahawewa	0	100	0	0	75
Kandiyapita	0	100	0	0	100

Source: Focus group discussions

Sources of Water

Several main streams have been tapped to construct tanks under the Kadawarawewa cascade system. They include Weerege ara (stream), Kenganga ara, Maha ara, Andara ara and Palubedda ara. These streams have not been much affected in the past by human interventions like chena farming and settlements because the area was scarcely populated. With the population increasing, these catchments have been encroached upon for chena cultivation and settlement. As a result, streams feeding the tanks in the cascade such as Andara ara, which drains into Andara wewa and Kengaga ara, draining into Vedi wewa, are silted up due to soil erosion in the catchments.

The main streams in the Metigathwala cascade system are Talawa ara, Middeni ara, Kachchigal ara and Bogal ara. They drain into Higura wewa and finally to Kachchigala wewa, which has been incorporated into Uda Walawe irrigation scheme in 1960s by constructing the Right Bank Main Canal (RBMC) of the scheme through this tank. In addition to drainage water, tanks below Kachchigala receive a regular water supply from Uda Walawe system too.

Tanks in the the Kiriibbanwewa cascade system receive water from Idunilpura ara, Siyabalagas ara, Naiwala ara and Weli ara originating in the Uda Walawe wildlife reservation. The cascade was severed in 2001 by the construction of Mau ara canal[8]. However, it is reported that the latter has been constructed in such a way as not to disturb the drainage canals running into the tanks and there is no evidence to support the contention that abandonment of tanks in the cascade is due to the construction of the canal. These tanks are believed to have been abandoned even prior to the Mau ara irrigation development project implemented from 1999–2001.

Uruhore ara, which originates in the Devagiri hills, is the main stream feeding Kahakurullanpalasse cascade. After feeding Uruhore wewa, it drains into Kakurullanpalsse and from there to H.K.T. wewa and Rangawewa, two privately owned tanks in the downstream area. Rangawewa, in the tail, drains into Galkada ara, which finally flows into a tank constructed recently in the wildlife reservation area called Galamuna wewa. The main streams feeding the tanks in Aluthwewa cascade system also drain through the National Park and empty into the Mau ara at the Galamuna wewa. Kavudueliya wewa, located in the Uda Walawe wildlife reserve area, and Rotamada wewa have been abandoned for a long time. A major characteristic of this cascade system is the existence of several privately owned tanks.[9]

Since the main streams of the Bogahawewa cascade receive runoff from the Wellankada, Mahanetula and Rankatuwa hills located in the Balangoda region, the cascade has an adequate water supply for cultivating paddy during almost every *maha*[10] season and, in some years, during the *yala*[11] period too. Excess water in the Bogahawewa and Kandiyapita cascades drain into the Walawe river through the Weli Oya.

[8]This canal diverts water from the Mau ara to the adjacent water short Malala basin. The starting point is the Galamuna wewa.

[9]They include Heenwewa, Kelinbunna, Gerioluwa, Mawuwewa, Thanakoratuwa, Udaha Aluth wewa, Pahathwala wewa, Rakinawale wewa, Wadurangala wewa and Behethmule wewa.

[10]This term is used with different meanings according to the area.

[11]This term is used with different meanings according to the area.

Water Availability and Cropping Intensity

All the farmers in these small tank systems, except for those receiving water from Uda Walawe Irrigation Project, reported water shortage as their major problem in agriculture. They tried to explain this situation as a new phenomenon due to shortage of rainfall. Old farmers claimed that they had a 100 percent cropping intensity both in the maha and yala seasons about 20 years ago. This does not really accord with historical records, but it illustrates the farmers' creed that water conditions were better in the past. They tried to relate the shortage of rainfall to the disappearance of forest cover due to the chena farming and clearing operations conducted under the major irrigation schemes and settlements. However, Leonard Woolf's diaries report recurring droughts and crop failures in this part of the country even during the British period. Nevertheless, the farmers' argument may hold true for the past, when the command areas of these tanks were limited to a few acres.

Cropping intensity can be used as an indicator of water availability. It is apparent from table 2 in Annex 2 that only one cascade has a 100 percent cropping intensity in contrast to many systems, which have a rate above 50 percent during the maha. A very low cropping intensity (of 28 percent) was reported from Metigathwala cascade in which a large number of upstream tanks suffer from acute water shortage There is no cultivation during yala season in the majority of the systems (57 percent). Around 20-28 percent of tanks in the two cascades which receive water from Uda Walawe have a 100 percent cropping intensity during yala. One cascade has a 50 percent in the yala. The interviews with farmers and household survey data substantiate that the cropping intensity in tanks incorporated into Udawalawe system has increased in both seasons, while there are some increases in rehabilitated and renovated tanks during the maha.

Different Water Uses

Water from functional tanks is presently used mainly for irrigation, as shown in table 7, followed by washing and bathing and thirdly, for livestock. Fishing is pursued as an economic activity in only some tanks. Tank water is not used for drinking as it is muddy and full of sediments due to soil erosion in tank catchments. Instead, people use water from shallow wells or water provided by the authorities through water tankers. Farmers turn to brick making when the water level is low.

TABLE 7. Different uses of water in the cascades at present (percentage of responses).

Sample cascades	Irrigation	Bathing, washing	Livestock	Fishing	Drinking	Brick making
Kadawarawewa	100	85	54	46	0	38
Metigathwala	33	17	22	22	0	28
Kiriibbanwewa	60	100	0	40	0	0
Kahakurullanpalasse	75	50	75	25	0	25
Aluthwewa	87	67	0	0	0	13
Bogahawewa	100	0	75	0	0	50
Kandiyapita	100	100	50	0	0	50

Source: Focus group discussions and interviews.

TABLE 8. Different uses of water in cascades before 1980s.

Sample cascades	Irrigation	Bathing, washing	Livestock	Fishing	Drinking	Brick making
Kadawarawewa	100	92	54	54	54	0
Metigathwala	94	94	94	74	74	0
Kiriibbanwewa	60	100	0	40	20	0
Kahakurullanpalasse	100	50	50	50	25	0
Aluthwewa	100	73	0	0	20	0
Bogahawewa	100	100	0	100	100	0
Kandiyapita	100	100	0	100	50	0

Source: Focus group discussions and interviews.

A comparison of tables 7 and 8 shows significant changes in water uses, especially in drinking and brick making over the years. Tank water has not been used for drinking purposes since the 1970s for erosion in upstream areas (caused when jungles were cleared for chena farming) muddied the waters. Brick making has emerged as a new activity in these systems at present.

CHAPTER 3

SOCIO–ECONOMIC CONDITIONS OF THE TANK COMMUNITIES

Population and Population Increase

Population and Population Increase

Population increase can be considered as a main reason for the current ecological and socio–economic changes in the basin area. While vast areas of jungle have been cleared for chena, irrigated rice crop cultivation and settlements, the existing water resources have been tapped for irrigation and domestic uses to meet the basic needs of the growing population. The data collected through focus group discussions (Table 9) shows nearly a two–fold increase of families in the cascade systems.

It further shows that, in many cascades, the number of families increased nearly two–fold during the past two or three decades. Around 1980, the population increased mainly due to migration, while subsequently, it was mainly due to natural growth. Control of malaria in the 1940s, irrigation development and land alienation activities toward the end of the British administration and after Independence, and land pressure in certain areas of Hambantota (due to slash and burn cultivation) have attracted people to the Walawe basin.

The demographics of the cascade areas is presented in Table 10. The data reveals that areas like Metigathwala and Kiriibbanwewa receiving irrigation water from a regular source (like the Udawalawe irrigation system) have a higher density.

Education

Table 3 in Annex 2 shows that the majority of people in these cascade systems has primary and secondary education. There are more people with higher educational achievements in the Kadawarawewa and Metigathwala cascade systems in Hambantota than in the Aluthwewa cascade, in Monaragala district. This is probably due to the better educational facilities available in Hambantota.

TABLE 9. Increase in the number of families.

Name of the cascade	Families around 1980	2002	Increase (%)
Kadawarawewa	407	1283	215
Metigathwala	280	960	242
Kiriibbanwewa	1221	3224	172
Kahakurullanpalasse	122	296	142
Aluthwewa	125	275	120
Bogaswewa	170	500	194
Kandiyapita	103	248	140

Source: Focus group discussions and interviews.

Economic Status and Poverty

Table 11 provides information on the people receiving Samurdhi assistance—aid to the absolute poor provided under the government's poverty alleviation program. Except in Metigathwala, where several tanks have been incorporated into Uda Walawe major irrigation system, more than 50 percent of households are below the poverty line and receive Samurdhi assistance under the Government poverty alleviation program.

Household survey data for three sample cascade systems are presented in table 12.

There is a high percentage of Samurdhi recipients in cascade systems like Kdawarawewa where the majority of farmers cultivate under rain-fed conditions. A shortage of rainfall and droughts have serious negative impacts on rain-fed farming system, reducing farmers to chronic poverty. Previous studies in the area too reports chronic poverty situation in this area (JBIC 2002).

TABLE 10. Population in cascade areas (2002).

Cascade	Population			Population
	<18	>18	Total	density
Kadawarawewa	2,393	3,375	5,768	75
Metigathwala	3,889	6,262	10,151	315
Kiriibbanwewa	1,440	1,979	3,419	115
Kahakurullanpalasse	592	820	1,412	65
Aluthwewa	704	933	1,637	21
Bogahawewa	1,659	2,785	4,444	56
Kandiyapita				

Source: DS offices (2002).

TABLE 11. Samurdhi recipients.

DS division	Number of families		
	Samurdhi recipients	Total	Percentage
Kadawarawewa	879	1,727	51
Metigathwala	1,362	2,824	48
Kiriibbanwewa	519	911	57
Kahakurullanpalasse	245	358	68
Aluthwewa	251	421	60
Bogahawewa	923	1,256	73
Kandiyapita			

Source: DS offices (2002).

TABLE 12. Poverty in sample households.

Status	Number of families (percentage)			
	Aluthwewa	Kadawarawewa	Metigathwala	Total
Recipient of Samurdhi	42	83	30	51
Not a recipient of Samurdhi	58	17	70	49
Total	100	100	100	100

Source: Household survey.

Livelihood activities

The main livelihood activity of the majority of inhabitants in all the cascade systems is farming. The number of families with members involved in public and private sector activities is not significant. In systems like Kadawarawewa, a significant number of farmers rear cattle. They are reluctant to provide information on their cattle farming activities, afraid that revealing their income might deprive them of Samurdhi assistance. Therefore, this income earning activity is not reflected in the household survey. However, interviews with farmer leaders in the Andarawewa area showed that out of the of 237 families so far settled there, 20 families are involved in cattle farming and the number of cattle (adult animals) owned by them is around 3000, excluding the calves estimated at 60 percent of the whole herd.

The maximum number of cattle owned by a family is around 150. Farmers also rear goats, as in Andarawewa area, where 12 families herd about 300 goats among them. The major problem faced by pastoralists is the shortage of grazing land due to project development activities under the ongoing Irrigation Rehabilitation and Upgrading project in the Walawe Left Bank area. The farmers in the developed and irrigated part of Udawalawe scheme, like the Metigathwala cascade, have similar problems over grazing their cattle. They feed their cattle in Hambegamuwa and Aluthwewa in the upstream areas of the Walawe basin by hiring people to look after them. It was reported in our discussions with farmers in Aluthwewa that 90 percent of the cattle in their area belongs to farmers in Padalangala, Kachchigala and Katuwana in the downstream part of the basin. Earlier, these cattle herds occupied the wildlife reservation area; however, the wildlife authorities have begun to fine the owners if they find animals grazing within the reservation. Fishing used to be a main income earning activity for some families in systems like Bogahawewa and Kandiyapita (in the upstream areas), until a severe drought some years back reduced the number of fish. Fishing is not pursued as a main income activity in the downstream area cascades. Furthermore, people living close to forest areas collect firewood, fruits, yams, honey and so on. They are also involved in wage labor and different kind of self-employment activities like carpentry and masonry work.

A special case is that of the cultivation of ganja (cannabis), a very high income generating activity in the cascade system areas like Kahakurullanpalasse and Aluthwewa. Farmers never mention their income from cannabis, because this activity is illegal. On average, the expenditure involved in one acre of ganja is around Rs.100,000: the total return is around Rs.600,000–800,000 (US$ 8000). The return depends on the quality of the crop. The selling price of good quality ganja is around Rs. 5,000 per kilo. When it is transported to Colombo and other major towns, the selling price climbs to around Rs. 12,000 per kilo. Commenting on the development of ganja cultivation, a resident in the area said that “prior to the 1950s, a few people in the area cultivated ganja on a small scale. After 1950s, however, migrants to the area from Katuwana, Middeniya, Walasmulla and Beliatta in Hambantota started growing ganga on a large scale. In those days, people were afraid to come and settle down because of the ganja growers, many of whom were criminals. The nearest police station in Wellawaya is about 35 km away from these cascades; therefore, ganja growers can operate as they wish. But, there was a huge raid on ganja growers by the police and the Department of Excise, (Government agency dealing with illicit liquor and narcotics) in 1956 which destroyed the ganga cultivation in the entire area. Ganja growers were discouraged and people started to migrate to the area for chena cultivation. Now the situation is entirely different. The majority of the people in the area grow ganja again, even in their home gardens. Rich people from other regions invest in ganja. They hire people from the area or provide them money to grow ganja. People in the area have been able to build luxurious houses, because they have a very high income. There are raids by the police, but people continue to cultivate ganja”.

TABLE 13. Employment.

Type of employment	Number of persons (percentage)			Total
	Aluthwewa	Kadawarawewa	Metigathwala	
No employment	22	9	19	17
Farming	68	81	60	69
Public sector	3	2	9	5
Private sector	0	2	6	3
Self employment	5	2	5	4
Other	2	4	2	2
Total	100	100	100	100

Source: Household survey.

Most families in the sample cascades earned a living by farming, as shown in table 13. However, the number of families with members involved in public and private sector employment is high in Metigathwala. These individuals are either workers at garment factories or minor employees in Public sector organizations, and their earnings are a major source of income for those families. It should also be noted that there is a significant number of abandoned tanks in the upstream area of Metigathwala cascade, compelling people to seek employment elsewhere. More than 90 percent of farmers work as wage laborers in adjoining major schemes like Uda Walawe and Ridiyagama.

Family income (first source)

The first and secondary sources of family income in sample cascade systems, as revealed in the household survey, are shown in table 14. Paddy farming is the first or second main income source for many of the household, while chena farming is the second in two sample cascades, Aluthwewa and Kadawarawewa. Public sector employment is an important source of income for households in Metigathwala. Self-employment, like carpentry, masonry and livestock keeping, appear under other income sources. They, too, are a significant income source for some families.

TABLE 14. Sources of income.

Status	Number of persons (percentage)					Total
	Paddy	Chena	Public/Private sector employment	Government assistance	Other	
Main source of income						
Aluthwewa	57	20	6	0	17	100
Kadawarawewa	57	23	6	0	14	100
Metigathwala	45	10	28	2	15	100
Secondary sources of income						
Aluthwewa	29	17	3	0	51	100
Kadawarawewa	34	26	3	0	37	100
Metigathwala	30	5	2	0	63	100

Source: Household survey.

Land Use Pattern and Land holding

It can be observed from the data in table 15 that there is a very limited amount of irrigated land in all the DS division within which these cascade systems are located. The dominant land use categories in the cascade area are arable crop lands, which include homesteads and other highland crops cultivated either under rain fed conditions or sometimes supplemented with lift irrigation, and irrigated land used for paddy and other field crop cultivations.

Land Holdings (Home Gardens, Highlands and Chena)

Table 4 in Annex 2 shows that more than 50 percent of households in Kadawarawewa and Metigathwala cascade systems have homesteads of less than 1 acre. The reason for this situation is that both Kadawarawewa and Metigathwala are partly incorporated into the Walawe irrigation system, where farmers have been allocated half an acre of land for homesteads. In Aluthwewa, where there are no such restrictions, on the other hand, a majority of households (72 percent) have land over 1 acre in extent. The household survey data further reveals that more than 60 percent of households in the Metigathwala and Kadawarawewa systems belonging to Udawalawe irrigation system have no highlands other than the homesteads, while a majority in Aluthwewa has other highlands ranging from half an acre to more than 2 acres (table 5 in Annex 2). The areas that have been incorporated into major irrigation and settlement schemes have not much land other than the reservations to encroach on.

The highest percentage of farmers encroaching upon government owned lands for chena cultivation is reported in the Kadawarawewa cascade, a large area of which is now being incorporated in to the Udawalawe scheme under the ongoing Walawe Left Bank Irrigation Upgrading and Extension project (Table 6 in Annex 2). This is due to the fact that there is a limited amount of irrigated land under the tanks belonging to this cascade system; they are cultivated only in the Maha season and farmers depend mainly on chena farming in the absence of irrigated land. In Aluthwewa, the remaining jungles are mainly forest reserves, where there are restrictions by the government on chena cultivation. There is little arable land for chena in Metigathwala, a large part of which has been developed as irrigated rice fields under the Uda Walawe scheme. Although farmers do not have legal rights over chena lands, they have an informal right over these lands because of a community norm that these lands are the property of he who cultivates them. These norms have come into operation in areas where chena lands are scarce.

TABLE 15. Land use in cascade areas.

DS division	Land area (ha)		
	Arable crop area	Irrigated	Total
Kadawarawewa	1,561	612	4,496
Metigathwala	-	-	4,375
Kiriibbanwewa	1,187	663	2,038
Kahakurullanpalasse	1,375	639	2,696
Aluthwewa	2,449	209	4,854
Bogahawewa/Kandiyapita	2,145	613	8,012

Source: DS offices (2002)

The majority of households in cascade systems that have not been incorporated into the major irrigation schemes have more than 2 acres of highlands that include homesteads, highlands and chena lands as shown in table 7 in Annex 2. However, land holdings in systems incorporated in to Udawalawe system in 1960s have decreased in size. This is due to land fragmentation, shortage of chena lands and other highlands due to the impact of irrigation development activities under Uda Walawe scheme (table 7 in Annex 2).

Paddy lands

Household surveys showed that the average holding of a family differs from one system to the other based on the availability irrigated land and the land distribution pattern in a given system. The average size of holding is low (0.32ha) in Kadawarawewa, where irrigated lands are scarce. In Aluthwewa, a system with a large number of privately owned very small tanks, the average size of holdings is around 0.36ha. The highest average (0.44ha) is in the Metigathwala cascade, which has a large tank (Metigatwala). Farmers are tenants of temple lands owned by Mulkirigala temple. The general observation in these systems is that more than 50 percent of farmers have less than 0.4ha of paddy land (table 16).

Land tenure

The patterns of land ownership and tenure in the cascade systems have been influenced by colonial policies and land related regulations and Acts during the after Independence. The people in these systems have freehold, Swarnabhumi, Jayabhumi titles, LDO permits or are encroachers on crown lands. Freehold titles came into being during the British colonial period, when the authorities sold government owned lands (crown lands) to the people. The issue of LDO permits began with the implementation of the Land Development Ordinance in 1935, after which lands were allocated to farmers in new irrigation schemes, as well as to farmers in small tank systems and extended villages. Apart from these land ownership categories, there are also temple lands and nindagama lands in some of the cascade systems. For example, 300 acres of the command area under the Metigathwala tank is owned by Mulkirigala Vihare. Farmers cultivating these lands pay a quarter of paddy yield as rent to the temple. Recently, there was pressure from some farmers cultivating in the foreshore area of the tank to reduce the height of the spillway to avoid submergence of their paddy fields when the tank is full. The priest of the temple said that those cultivating the foreshore area are

TABLE 16. P.addy land holdings.

Size of holding (acres)	Number of households (percentage)		
	Aluthwewa	Kadawarawewa	Metigathwala
< 0.20	37	9	30
0.21 – 0.4	20	69	23
0.4 – 0.8	29	17	23
> 0.8	14	5	24
Total	100	100	100
Average Holdings	0.91	0.8	1.1

Source: Household survey.

illegal farmers and the authorities have assured him that the height of the spillway will not be reduced. The lands under this tank are identified as temple lands in administrative reports during the British administration too. There is temple land near Ramba Viharaya, in the Right Bank system of Walawe and near Sankapala Viharaya in the upstream of Udawalawe reservoir. Farmers holding lands under Andarawewa claimed that their lands were formerly nindagama lands. However, they have become the owners and are no longer tenants of a nindagama holder (a member of a feudal family).

It is also observed that lands under some tank systems are still considered crown land encroached by people. One fine example is the land under Rangawewa in the Kahakurullanpalasse cascade system. This is a privately owned tank with a command area of 16ha. The farmer has constructed the tank and developed the command area himself without any assistance from the government. He has been trying to get a long lease title (99 years lease) for the land, but the authorities are refusing to give such a long lease permit, because his tank and the paddy fields are in the wildlife reservation area. However, this farmer is of the opinion that his tank and its command area became a part of the reservation only after the government extended the area under the reservation recently. He blames the authorities for keeping quiet till he developed the tank and the command area at his expense.

The land ownership pattern in the area differs from that in many old tank villages in Nuwarakalaviya in the NCP, where land often belongs to the category of *paraveni* (lands in active use when the Cadastral survey was done in 1900 by the British; these lands were treated as private property from ancestral times). The absence of this type of land in the Walawe cascade systems substantiates the hypothesis that there were no communities occupying lands in this part of the country at the start of the British administration.

Most of the home gardens in Metigathwala (88 percent), Aluthwewa (83 percent) and Kadawarawewa (63 percent), where the household survey was conducted, have permanent titles under freehold, Swarnabhumi, Jayabhumi and LDO permits, while the rest are encroachers on government lands. As discussed above, most farmers—40 percent, 65 percent and 60 percent respectively in Aluthwewa, Kadawarawewa and Metigathwala—have no highlands other than home gardens. In Metigathwala, 25 percent of those with highlands other than home gardens have permanent titles, against 26 percent and 18 percent in Aluthwewa and Metigathwala respectively. Others are encroachers on government lands. It is also evident from the survey that 51 percent of farmers in Aluthwewa, 37 percent in Kadawarawewa and 75 percent in Metigathwala have permanent titles for their paddy lands, while the rest are encroachers on government lands. Household surveys further show that majority of these paddy lands—97 percent in Aluthwewa, 91 percent in Kadawarawewa—are owner operated. About 75 percent in Metigathwala are operated by tenant farmers cultivating the lands owned by the temple. In Kadawarawewa, 6 percent of the land is cultivated by legal tenants under the Agrarian Service Act. About 25 percent of lands under the Metigathwala tank have been rented out by farmers who are the legal tenants of temple lands. There are farmers with mortgaged land (3 percent) only in Kadawarawewa.

Houses and property

The survey shows that a majority of houses—69 percent in Aluthwewa, 57 percent in Kadawarawewa and 82 percent in Metigathwala—are permanent ones (table 17 in Annex 2). The Metigathwala area has houses of a more permanent nature than the other two cascade systems. This is mainly due to the fact that Metigathwala is an older, more established settlement and a part of the system receives regular irrigation water supply from the Udawlawe system.

Table 17 provides information on machinery, equipments and other household possessions. It reveals households, owning high value machinery like tractors and cars in Metigathwala, which has regular irrigation.

Infrastructure and other facilities

All the farmers in the Aluthwewa cascade have drinking water either from tube wells, common wells or private dug wells, the private wells being the main source for 71 percent of households. In Kadawarawewa, 66 percent of farmers depend on common wells and private wells, while 34 percent are supplied water by the local government agencies using water tankers. In Metigathwala, 5 percent have access to pipe borne water, 85 percent depend on tube wells, common wells and private wells, while 10 percent are supplied water through water tankers. Shortage of drinking water is a serious problems faced by farming communities in these cascade systems during drought periods.

A large number of households in these cascades have no access to electricity and telephone facilities. Only 14 percent in Aluthwewa and 5 percent in Metigathwala have electricity, while only 9 percent in Aluthwewa have telephone facilities.

As for sanitation facilities, 40 percent in Aluthwewa, 74 percent in Kadawarawewa and 98 percent in Metigathwala have water sealed toilets. The number of households using temporary toilets is high (49 percent) in Aluthwewa area, as shown in Table 9 in Annex 2.

Community Characteristics, Norms and Values

As discussed above, a majority of people in the upstream cascade areas like Bogaswewa, Kandiyapita and Aluthwewa, are from the Badulla and Ratnapura districts, while those downstream are from Hambantota. Except in a very few cases, the families in tank villages have no settlement history exceeding 100 years. However, in Kadawarawewa and Metigathwala, where villages existed even during the British period, people claim a history of over 100 years.

TABLE 17. Equipments, machinery and vehicles in possession.

Equipments/machinery/vehicles	Number of households (percentage)		
	Aluthwewa	Kadawarawewa	Metigathwala
Car	0	0	5
Three wheels	3	6	3
4 wheel tractors	0	0	25
2 Wheel tractors	3	0	0
Threshers	0	0	13
Motor cycles	23	11	25
Bicycles	94	83	100
Televisions (color)	9	0	30
Televisions (black and white)	0	31	5
Radio	74	80	100
Sprayer	34	43	45
Winnowing fans	26	31	15

Source: Household survey.

The fact that the relationship between the tank and village community is not as strong as it is in the Dry zone villages of the NCP, where the village is synonymous with the tank is a significant discovery. In many of the villages in the Walawe downstream region, irrigated lands under the tanks are held not by the people living close to the tank, but by villagers residing far away from the tank. For example, most of the land under Andarawewa is owned by people living in areas like Ambalantota, whom the villagers call *gambarayas* (land owning people). In these circumstances, the relationship between the village community and the tank is very weak, diminishing the material conditions required for cooperative action is absent in the community.

In cascade systems like Kahakurullanpalasse and Aluthwewa, some people are reported to be involved in the cultivation of cannabis (ganja). Although there was no evidence of serious conflicts between people cultivating ganja and ordinary people, Mudalalis (businessmen) used to be involved in this illegal activity. They are said to have cultivated ganja in remote jungles hiring people from outside. If a worker hired by Mudalalis tried to return home with his salary, the Mudalali would hire men to kill him on the way to prevent him from imforming the authorities. There used to be many such incidents in the past but they seem to be rare at present. However, we met a Mudalali who had become extremely successful by investing in ganja cultivation. He no longer cultivates it, preferring instead to organize transport for other people's crops, earning a huge income through the transaction. He has a privately owned small tank, under which he also cultivates paddy, other field crops and banana.

The Janatha Vimukthi Peramuna (JVP) has been active in all the cascade systems since 1970s, and there are still ruins of buildings burnt and demolished during the uprisings of the 1980s scattered through out the region. Wealthy individuals, like the Mudalalis referred to above, had to flee the area at the time. Thanamalwila and Suriyawewa remain JVP strongholds to this day and JVP election offices were in many villages during the General Election of April 2004.

Community organizations

There are a large number of community organizations in these cascade systems established from time to time by the government and other external agencies. Rural Development Societies, although still in existence, are largely inactive today. The funeral associations, Farmer Organizations, Samurdhi associations and SANASA (Cooperative Thrift Societies), on the other hand, operate in these villages. The funeral associations are the strongest and most effective, providing financial and other assistance on the death of a family member. The village Farmers' Organizations are weak, mainly due to the lack of water to cultivate crops even in Maha according to farmers. However, when cultivation activities are implemented in tanks, they become active—holding cultivation meetings, attending to routine maintenance activities, managing water and even implementing water rotations at times of scarcity.

While cattle farmers' organizations are very strong in places like the Lunugamwehera scheme in Tissamaharama (Birner 1996), cattle owners in these cascades have not yet formed formal organizations for collective action. In Lunugamwehera, cattle owners organized to voice their grievances when faced with difficulties over grazing lands after Lunugamwehera project was developed. Similarly, cattle owners in WLB extension area are now organizing themselves to deal with project authorities to find solutions over shortage of grazing grounds after the area was developed for irrigation.

Evolution of organizations and institutions in the management of small tank systems

The system of Vel Vidanes (water headmen) introduced by the British used to be in force in these tank systems. Since Vel Vidanes were chosen on the basis of economic and social status—wealth, caste status and family background—they were generally the traditional leaders of the community and the farmers acknowledged the Vel Vidanes' authority. Their responsibilities included operating the system and maintenance, according to the decisions reached at the cultivation meeting. Later, farmers experienced the cultivation committee systems and various other reforms introduced by the government. With political intervention, individuals were selected to head agricultural activity on political calculations. Leadership and institutions deteriorated, creating problems in the operation and maintenance of the small tank systems. Data shows the persons responsible for these activities in the past and present. Farmers and their representatives became involved in some systems, because the latter came into operation after the Vel Vidane system was abolished. In such a system, farmers knew only about the farmer representatives handling these responsibilities. Farmers owning very small tanks and tanks handled these tasks themselves.

In the past, farmers made payments to Vel Vidane for activities like system operation and maintenance and water management through implementation of rotations during dry periods. Now the farmers' representative or the person attending to these functions is often paid by the farmers themselves. However, there are incidents of non-payment too. When a farmers' representative attends to these functions conscientiously, farmers tend to pay him. The payment made to Vidane or farmer representative is called *uvandiram*. Previously, farmers had to pay a quarter of a bushel (6 kg) as uvandiram; today, it has been increased to half a bushel (12 kg) per acre.

Law enforcement against farmers violating decisions made at cultivation meetings and rules and regulations related to the O&M of the systems were handled in the past by Vel Vidanes and now by leaders among the farmers. The rural courts deterred farmers against free riding and violating the decisions of the cultivation meetings etc. With the abolition of rural courts, the relevant agency officers have to sue the culprits at district courts on complaints by the farmers' representatives. This is a time-consuming process. Therefore, there is a tendency among farmers to violate irrigation laws and cultivation decisions at present.

Evolution of the Production System and Technology Used

Crops cultivated and technologies used

The paddy varieties cultivated by farmers in the past were H 4, 34/8 and 34/6, which were high-yield varieties developed in the 1960s during the Green Revolution. At present, BG 352 and 300—high-yield varieties—are cultivated in these cascade systems. Very few farmers said that they cultivated indigenous varieties in the past.

Other field crops (OFCs) were not cultivated even in the water short, dry seasons (yala) in the past. In the 1990s, OFC cultivation was introduced in minor irrigation systems in the yala period. Farmers initially cultivated high value crops, like chilies, in their paddy fields but gave it up because of high occurrence of pest attacks and marketing problems. Today, a very limited number of farmers (28/110) cultivate crops such as eggplant, okra, different kinds of pumpkins and cowpea under several tanks. Problems such as water scarcity, marketing and wild animals are major constraints upon crop diversification programs in these systems.

Chena cultivators face serious problems due to degradation of forest cover. In places like Metigathwala cascade, chena farming has been totally abandoned due to a shortage of arable land.

Table 18. Persons responsible for O&M, past and present.

	Number of households (percentage)							
	Person responsible for O&M							
	Present				Past (40 years back)			
Cascades	Vidane	President of FO	Farmer rep.	Farmers	Vidane	President of FO	Farmer rep.	Farmers
Aluthwewa	0	0	94	6	31	0	0	26
Kadawarawewa	0	3	97	0	23	0	20	57
Metigathwala	0	3	90	8	63	0	3	35
Total	0	2	94	5	40	0	7	39

Source: Household survey.

Forests consist mainly of bushes with short fallow not exceeding 3–4 years in areas such as Kadawarawewa, Aluthwewa,and Kahakurullanpalasse. Formerly, traditional chena cultivators used virgin forests or forest above 20 years fallow and are reported to have followed systematic forest clearing, which was less damaging to the natural vegetation. These chena under long fallow were known as *Navadeli hena*[12] (newly-burnt chena). They grew traditional crops like kurakkan (millet), maize, cereals like meneri and thanahal, chillies, mustard, different kinds of pumpkin and a wide variety of vegetables. With population growth, the chena cycle was first reduced to 10-15 years fallow. Such chenas were known as *athdaduwawa* (chena cultivated by lopping trees of the size of human arms). The same crops cultivated in navadeli henas were grown in them. Farmers started mono-cropping (mainly chillies) in 1968, when the import of chillies was restricted. Today, farmers in these cascade systems cultivate hybrid tomatoes, pumpkins, watermelon, eggplant, snakegourd and bittergourd etc using seeds imported from Malaysia and Thailand. The fallow periods of these chenas are less than 3 years in most of the cases. In some cases, it is around 8 months as the farmers cultivate the same land every maha season. Their perception is that traditional crops like millet cannot be grown in chenas of short fallow periods due to soil fertility related problems. With the introduction of hybrid varieties, some traditional varieties have been lost forever. Farmers began to grow hybrid varieties under the guidance of the government extension services as there was a high demand for such crops. Now farmers complain that input costs for these hybrid crops are very high due to pest attacks and diseases. In addition, they have to purchase seeds at high prices every season.

Attacks by wild elephants are a serious problems in these systems. Human-elephant conflicts are highest in the Kadawarawe system area in the WLB extension area. However, damage to crops by stray cattle is not much reported in any of these systems. It is observed that the fences around the chena are strong enough to keep the cattle away.

Use of fertilizer

The survey data shows that only a very few farmers (5/110) used artificial fertilizer like urea, TDM or V-1 before the introduction of Green Revolution technologies. However, at present almost all farmers use V-1 at the time of sowing, urea (20 days after sowing) and TDM after 40 days of sowing.

[12]The term 'Navadeli chena' today means any chena land cultivated for the first time after cutting and burning the forest. In the past, it was used for chena lands cultivated for the first time after cutting and burning virgin forests (forests under long fallow periods).

The use of organic fertilizer is rare among these farmers. They incorporate weeds and crop residue in the field when plowing the land. Nevertheless, we noted special efforts for incorporation of straw left after threshing or organic matter, such as cow dung, only among 5 percent of the farmers in the whole basin. The officers of the extension services now make efforts to introduce environment friendly farming practices, such as Integrated Pest Management (IPM), and teach farmers how to use organic fertilizer. Some paddy farmers, especially those in the Kadawarawewa cascade have a better understanding of the negative impacts of pesticide and other agrochemicals through their experience and some are adopting IPM technologies.

Weed and pest control

The survey reveals that the use of herbicide and pesticide was not known to the farmers in the area prior to the introduction of Green Revolution technologies; even then, it was a while before the technology trickled down to them. Weeds were controlled in the past through manual weeding and submerging weeds in water by storing water in the paddy fields to the maximum possible height. Now, almost all the farmers use different kinds of herbicide for weed control. Previously, farmers used indigenous technologies (use of adhesives from plant species etc), magic and rituals to control pests.. At present, farmers are accustomed to pesticides. Paddy farming, in the farmers' opinion, has become less profitable due to the very high expenditure involved in weed and pest control.

Land preparation technologies

Farmers used to prepare land by mudding with cattle; some plowed the ground with cattle or prepared the soil with a mammoty. After the Green Revolution, these technologies were replaced by tractors as shown in table 10 in Annex 2. Today, the majority uses 2 wheel tractors.

Yields

The yield reported by farmers in these systems ranges between 4–7 MT per ha. These figures are high compared to both the national averages and the average of the dry zone parts of the country shown below in table 19.

The farmers in these cascade systems reported that they have higher yields today in comparison with the past. Traditional varieties cultivated in the past gave them low yields (1.8–2.1 t/ha) and, those varieties, which were 4–4 ½ months, required more water.

TABLE 19. Paddy yield (average) for wet and dry zones of Sri Lanka.

Area	Average Yield (MT/ha)	
	Maha	
Sri Lanka	3.4	3.1
Dry zone	3.4	3.3
Wet zone	3.4	2.8
Hambantota	4.0	4.0
Monaragala	4.0	3.2

(Source: Census and Statistics Dept. Maha 2001, 2003 & Yala 2000, 2002)

Chapter 4

CONCLUSIONS

This concluding section focuses on answering the research questions formulated in chapter 2, based on the data and information presented in this report.

- When the major changes taking place in the physical system are considered, it is clear these tank systems, which were abandoned after the fall of ancient civilizations in this part of the country, were occasionally renovated and rehabilitated in recent years by migrants to the area in search of livelihood opportunities like chena farming. This process started 200 years ago or so. Government support for rehabilitation came during the British period and after Independence to bolster migration to these less populated areas to alleviate poverty and curb practices like chena farming. The greater part of the settlements, however, occurred in the 50s and 60s. Tank systems from the upper part of the basin were re-colonized by people from Ratnapura and Badulla districts, while those from the south were settled by migrants from Hambantota.

- As a result, the command areas in most of the cascade systems have gradually increased. Nevertheless, it is doubtful whether adequate attention was paid to the hydrology of the cascade or the purpose for which these tanks were used in the past, when expanding the command areas for irrigated agriculture. In cascade systems like Metigathwala, which depends on Kachchigala Ara, increase in the command area of upstream tanks resulted in water shortage and abandonment of cultivation under some tanks by the farmers. In addition, reduction in forest cover due to chena cultivation has had serious negative impacts and repercussions, such as soil erosion and sedimentation of tanks and streams, drying up of streams, leading to degradation of tank ecosystems. Consequently, cultivation in the Yala season has declined dramatically.

- Secondly, some parts of the tank cascades, like Metigathwala and Kiriibbanwewa, have been incorporated into the Uda Walawe irrigation scheme, which has alleviated the water shortage problems of these tanks. But, the development of the area for irrigation has drastically reduced forest cover and the size of holding of highlands and chena. Similarly, in places like the Kadawarawewa cascade that is currently being developed for irrigation, the transformation of chena and scrub jungle into irrigated land has created a shortage of grazing lands for livestock, a main livelihood activity of the people in the region.

- Major changes in socio–economic terms include population growth, which has in some places exceeded the carrying capacity of the cascade systems and the basin as a whole. Due to the lack of employment in urban areas, people in these cascade systems involve themselves in farming activities and have to depend on the limited water and land resources. As it is evident from the employment pattern, the main employment of nearly ninety percent of people in the cascades is farming.

- Except for a few old villages, the communities are comprised of migrants to the cascade systems from different villages in the same district. Some of them were close relatives even before migration. Those who were not close relatives have either become relatives through marriage or developed close socio–economic ties through reciprocal labor exchange and also by living as neighbors in the same village for a long period. They have established a sense of community and solidarity in the process and developed formal social organizations for interactions in spheres where such close communication and interaction is required. However, there exist some villages where lands under tanks are not held by the village community, but by residents of other villages. In such situations, the people's relationship with the tank is not as strong as in tank villages of the North Central Province and other Dry Zone areas.

- The second research question examines the reason for the increase or decrease of tanks under these cascade systems. Except in Aluthwewa where most of the tanks are farmer owned, there is a significant number (over 25 percent) of abandoned tanks. The main reason for abandonment, in the farmers' opinion is water shortage due to the decrease of rainfall in the area, but the command areas of these tanks were expanded under different rehabilitation and renovation programs implemented and this is the major cause of the water shortage. Farmers report that they used to cultivate the entire command areas under these tanks in both Yala and Maha seasons, without serious problems over water. However, there are historical references to water shortages, droughts and crop failures in the area even in the past and water shortage cannot be considered a new phenomenon. This, combined with a perceived decline in rainfall, has led to imbalance between supply and demand and to the abandonment of tanks or part of the command areas under these tanks, due to inadequacy of water for the entire command areas under them.

- The third question refers to the water resources endowment of these cascade systems. Except for the tanks receiving water from Uda Walawe scheme, all others are short of water and cultivation under them is limited to the maha season. In some systems, the entire command area cannot be cultivated even then. This cannot be considered a new phenomenon. It cannot be assumed that the tanks in these cascade systems were originally developed for irrigation purposes alone. They might have been used for domestic and other purposes. However, degradation of tank catchments at present may have some impact on water resources endowment in these systems.

- Water in these tank cascade systems is used mainly for agriculture as it was in the past. In addition, it is used for bathing and washing, livestock keeping and fishing. Though water in the tanks was once used for drinking, this is no longer true as water quality has deteriorated, mainly due to soil erosion in the tank catchments after clearing the jungles for chena farming and other development activities. Though fishing was once a main income activity in Bogaswewa and Kandiyapita, there have been no fishing in these waters since a severe drought depleted the fish population. The problem is aggravated by the lack of programs for releasing fingerlings to small tanks by the government or fishing societies. Brick making has emerged as a new income earning activity in most of the tank systems studied.

- The main crop cultivated in these systems is paddy. Other field crops are cultivated very rarely even in the water short yala season. Before the Green Revolution, farmers in some

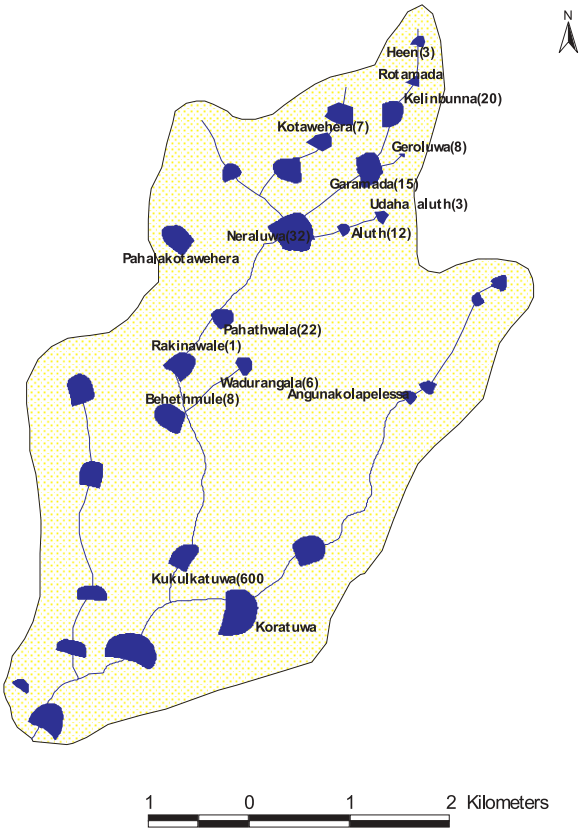
of these systems are said to have cultivated traditional paddy varieties. Use of fertilizer and agro chemical was not known to them at that time. They used simple technologies such as mudding of lands with cattle, plowing with cattle or tilling the land with a *mammoty*– a digging tool–for land preparation. They used cattle for paddy threshing too. However, most of the farmers in these systems are new migrants and they are said to have used Green Revolution technologies introduced in 1960s. Farmers have cultivated new varieties (H4) in these periods and experienced high yields compared to the traditional varieties used in the past. At present, they cultivate varieties created through new technologies. Simple technologies previously used for land preparation have been totally replaced by two-wheel and four-wheel tractors. Pesticides, fungicides and chemical fertilizer are used intensively for paddy cultivation as well as other highland crops. Farmers report very high production costs for paddy cultivation and complain that they have low profit margins. There is a move now towards integrated pest management and organic fertilizer in response to increasing production costs, and also based on the understanding that these new technologies have negative impacts on health and the environment.

- The fifth research question deals with the evolution of the institutions managing these systems. Tanks are managed in various ways in these cascade systems. Except for some major tanks like Kachchigala and Kiriibbanwewa, which are jointly managed by the Mahaweli Authority and farmers' organizations in the Uda Walawe scheme, all other tanks are farmer managed. Some of them are totally owned and managed by farmers. There are some farmer-managed tanks, in which the Department of Agrarian Services has a role in organizing cultivation meetings, system rehabilitation and improvement activities. In the past, the Vel Vidane system introduced during the British period was responsible for operation and maintenance activities as well as law enforcement. Vel Vidanes were paid by the farmers for these functions. Now the O&M activities of the tanks under the supervision of ASD are handled by a farmers' representative selected by the Farmers' Organizations (FOs). In the systems owned by individual farmers, O&M is handled by the owners themselves and water management is reported to be successfully handled. A major problem observed in small tank systems is the lack of proper maintenance of tank bunds, regulatory wares and canal systems by the farming communities. In many cases, their maintenance activities are limited to a pre-seasonal routine type of maintenance. This has led to dilapidation and deterioration of these systems. The practice is to rehabilitate them either with funds from the government, donors or lending agencies.

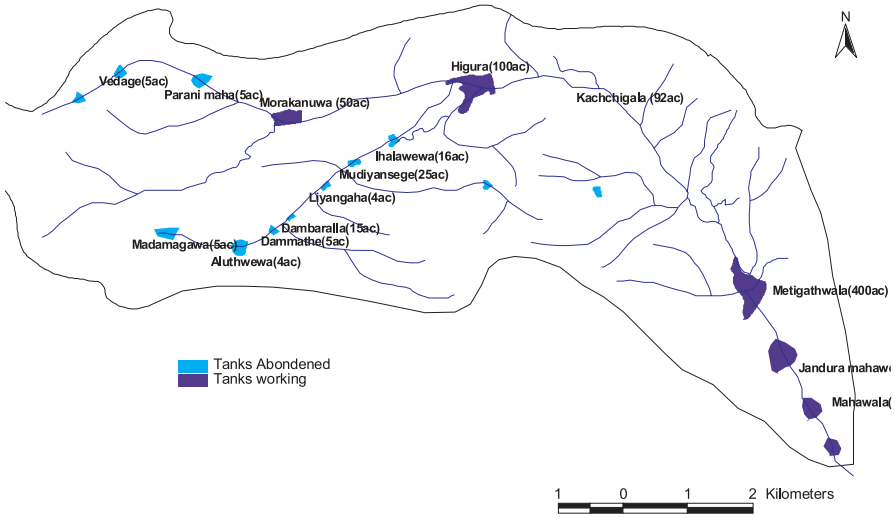
- The sixth question examines the future trends in these systems with regard to the changes of hydrology and socio–economic conditions. The trend in some systems like Kadawarawewa and Bogaswewa is to have supplementary irrigation from major irrigation systems and diversions to find solutions to water scarcity problems faced by the systems. Most of the tanks in the Kadawarawewa system are being incorporated into the Uda Walawe system under the ongoing Irrigation Rehabilitation and Upgrading Project implemented in Walawe LB area. Other Field Crops (OFCs) are to be promoted in the WLB region as a solution to water shortage problems and facilitate the socioeconomic development of the poor rural masses in the area. Some tanks in Bogaswewa are to receive supplementary irrigation from the Weli Oya diversion and this will lead to higher cropping intensities. A trend followed by people in water short areas like upstream of Kachchigala is to find public and private sector employment outside as reflected in their employment pattern.

Annex 1

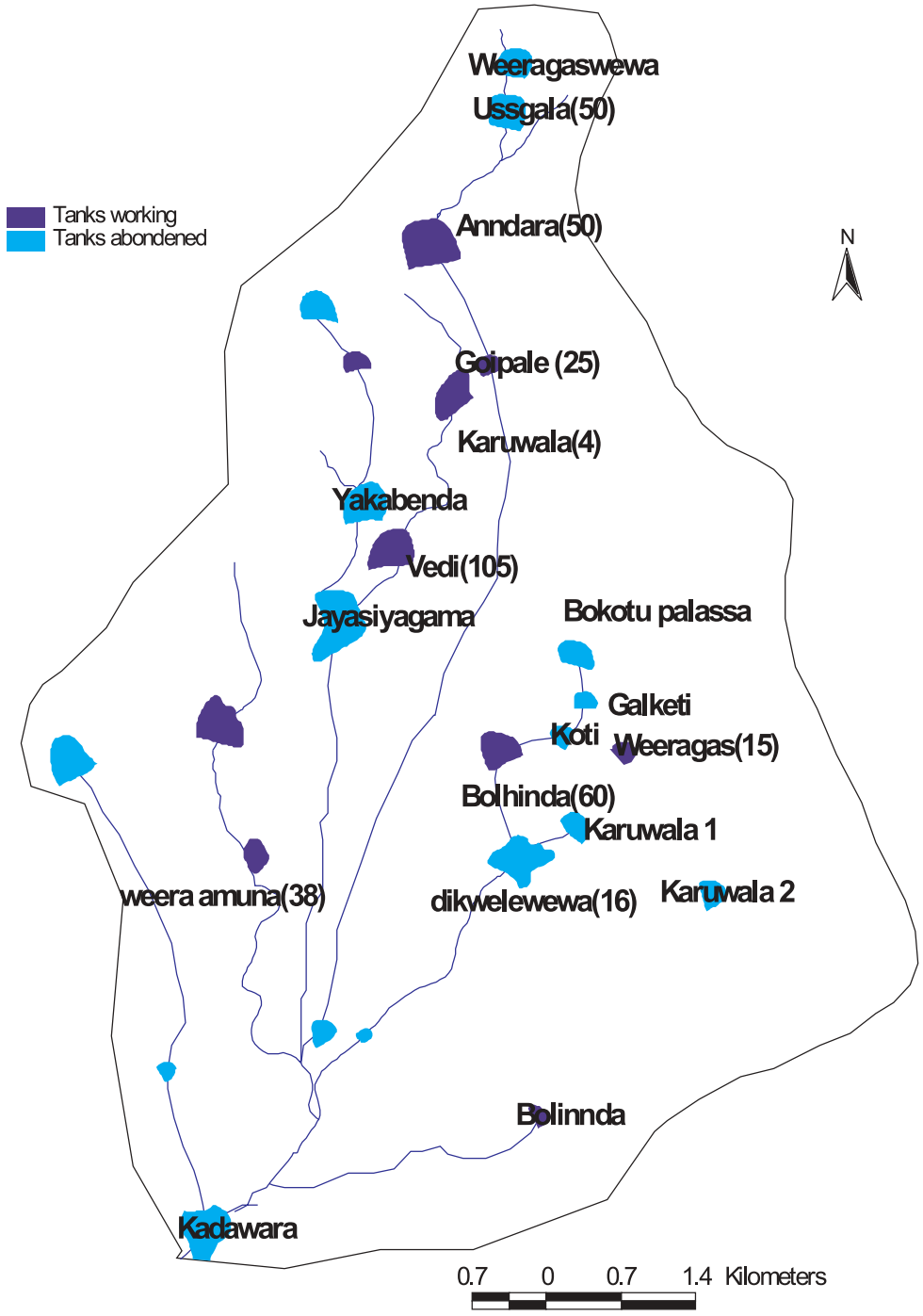
ALUTHWEWA CASCADE



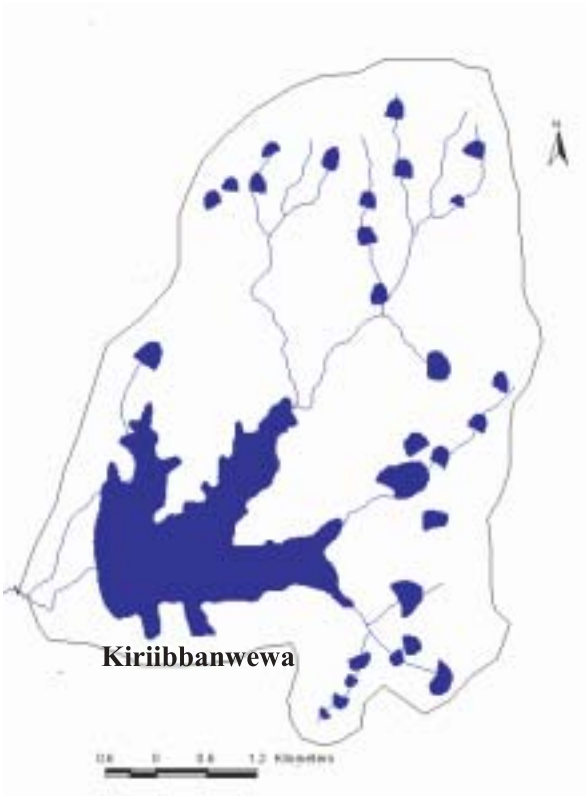
MATIGATHWALA CASCADE



KADAWARAWEWA CASCADE



KIRIIBBANWEWA CASCADE



KAHAKURULLAN PALLASSA CASCADE

Annex 2

TABLE 1. Size of the command areas of small tanks in the sample cascade systems in Walawe basin.

Sample cascades	Number	Command area distribution (in ha)					
	Percentage	< 6	<=6<10	<=10<20	<=20<30	<=30<40	>=40
Kadawarawewa	Number	5	3	2	3	0	0
	Percentage	39	23	15	23	0	0
Metigathwala	Number	9	3	1	0	1	4
	Percentage	50	16	6	0	6	22
Kiriibbanwewa	Number	3	0	1	0	0	1
	Percentage	60	0	20	0	0	20
Kahakurullanpalasse	Number	1	1	1	1	0	0
	Percentage	25	25	25	25	0	0
Aluthwewa	Number	10	3	1	1	0	0
	Percentage	67	21	6	6	0	0
Bogahawewa	Number	0	0	1	0	1	2
	Percentage	0	0	25	0	25	50
Kandiyapita	Number	0	0	1	0	0	1
	Percentage	0	0	50	0	0	50

Source: Focus group discussions and interviews.

TABLE 2. Cropping intensity in cascade systems (% of tanks with different cropping intensities).

Cascade	Maha (% tanks)			Yala (% tanks)		
	100	~50	0	100	~50	0
Kadawarawewa	77	15	8	0	0	100
Metigathwala	28	39	33	28	0	72
Kahakurullanpalasse	75	0	25	0	50	50
Bogaswewa	100	0	0	0	0	100
Kiriibbanwewa	60	0	40	20	0	80
Kandipitiya	50	50	0	0	0	100
Aluthwewa	93	0	7	0	0	100

Source: Focus group discussions.

TABLE 3. Education levels.

Education level	Number of persons (percentage)			
	Aluthwewa	Kadawarawewa	Metigathwala	Total
No education	9	15	09	11
Grade 1-5	29	22	17	23
Grade 6-11	46	35	28	37
G.C.E. (Ord.L)	8	16	26	16
G.C.E.(A.L.)	6	11	17	11
Degree	2	01	03	02
Total	100	100	100	100

Source: Household survey.

TABLE 4. Size of land holding (homestead).

Size of holding (acres)	Number of households (percentage)		
	Aluthwewa	Kadawarawewa	Metigathwala
> 0.50	11	31	23
0.51 – 1.00	17	20	40
1.00 – 2.00	46	29	28
< 2.00	26	20	9
Total	100	100	100

Source: Household survey.

TABLE 5. Size of land holding (Other highlands).

Size of holding (acres)	Number of households (percentage)		
	Aluthwewa	Kadawarawewa	Metigathwala
No lands	40	66	60
> 0.50	3	0	15
0.51 – 1.00	23	0	13
1.00 – 2.00	28	20	12
< 2.00	6	14	0
Total	100	100	100

Source: Household survey.

TABLE 6. Land holdings (chena lands).

Size of holding (acres)	Number of households (percentage)		
	Aluthwewa	Kadawarawewa	Metigathwala
No chena lands	74	54	73
> 0.50	0	0	0
0.51 – 1.00	11	14	15
1.00 – 2.00	11	26	8
< 2.00	4	6	4
Total	100	100	100

Source: Household survey.

TABLE 7. Total land holdings, highlands.

Size of holding (acres)	Number of households (percentage)		
	Aluthwewa	Kadawarawewa	Metigathwala
> 1.00	3	9	28
1.00 – 2.00	20	14	33
2.01 – 4.00	51	57	33
< 4.00	26	20	6
Total	100	100	100

Source: Household survey.

TABLE 8. Condition of houses.

Condition of houses	Number of houses (percentage)			
	Aluthwewa	Kadawarawewa	Metigathwala	Total
Permanent	69	57	82	77
Semi-permanent	20	27	18	23
Temporary	11	16	0	10
Total	100	100	100	100

*Source:*Household survey.

TABLE 9. Sanitation facilities.

Cascade	Number of persons (percentage)				
	No facilities	Water sealed	Permanent pit	Temporary pit	Total
Aluthwewa	0	40	11	49	100
Kadawarawewa	6	74	3	17	100
Metigathwala	0	98	2	0	100

(Source: Household survey)

TABLE 10. Land preparation technologies

Cascades	Technologies									
	Present					Past				
	1	2	3	4	5	1	2	3	4	5
Aluthwewa	0	0	6	88	57	54	11	20	0	0
Kadawarawewa	0	0	3	97	46	100	43	17	6	6
Metigathwala	0	0	0	100	48	100	33	26	5	5
Total	0	0	3	95	50	85	29	20	7	7

1.Mudding with cattle, 2. Plowing with cattle, 3. Mamotty, 4. 2-wheel tractors, 5. 4-wheel tractors

Source: Household survey.

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