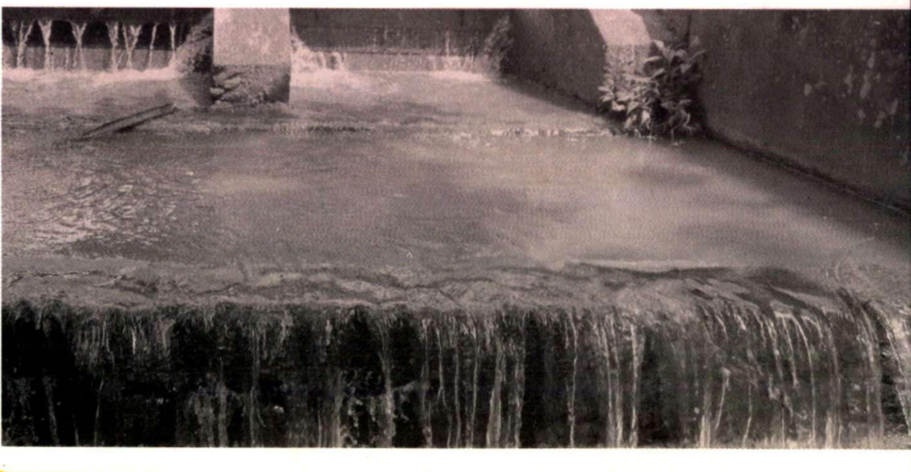
SMALL ANICUT SYSTEMS IN NILWALA RIVER BASIN

G. G. de L. W. Samarasinha
M. A. C. Sidath Bandara



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Tel: 94112696981
94112696437
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G.G. de L.W. Samarasinha
M.A.C. Sidath Bandara

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FOREWORD

As outlined in the "Mahinda Chinthanaya," the development policy of the present government, the food production was aimed to maximize at every potential level. As arable land available for cultivation is sorely limited, the alternative is to use all means possible to maximize production per unit. It is observed that yields in major irrigated areas are significantly higher, compared to minor and rainfed cultivated areas due to various reasons. Therefore, the challenge could be met by increasing the productivity of minor and rainfed lands. However, the small-scale farmers who cultivate under minor and rainfed irrigation are now perceived as key players in achieving household food security in developing countries around the world. Due to high risk of crop failure in rainfed agriculture, more attention should be paid for the minor irrigated areas. Small anicut systems are an important source of irrigation in the wet zone areas of the country. Compared to tank irrigation systems, the small anicut systems have not gain much attention by the policy makers and researchers.

In this context, the present study on "Small Anicut Systems in Nilwala River Basin", describes the current status of functioning of the small anicut systems, reasons for abandoning the anicut systems and status of paddy cultivation under anicut irrigation in the Nilwala River Basin. Further, this reveals the nature of contribution from paddy cultivated under anicut systems for household economy of the respective farmers.

The findings of this study will I presume be of advantage to policy makers in the formulation of future proposals aiming at increasing the productivity of arable land in the wet zone of Sri Lanka.

Lalith Kantha Jayasekara
Director

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G.G.de.L.W. Samarasinha
M.A.C.S. Bandara

ABSTRACT

The village tank irrigation is common in the dry zone of Sri Lanka. In the wet zone, the anicut schemes are dominant while in the intermediate zone, both village tanks and anicut schemes are equally important. Many studies on small tanks in the minor irrigation schemes have been carried out and some of them have been already published. However, the attention paid to anicut schemes by respective government authorities and researchers are very limited and only a few research studies have been conducted on small anicut schemes. In the low country wet zone, the highest density of small anicut schemes is found within the Nilwala ganga basin in the Matara district. Therefore, the main objective of this study was to identify the present state of cultivation under small anicut systems and level of operation and maintenance of small anicut systems in the two sub-watersheds of Middle Nilwala (MN) and Urubokka (UB) in Nilwala river basin.

The research was based on literature surveys, key informant discussions and direct interviews with the farmers using a structured questionnaire. The questionnaire survey was focused on selected socio-economic factors of respective farmers, nature of anicut systems, their maintenance and state of crop cultivation in the area. In addition, the data on cost of production of paddy was also collected during the study period.

Out of eight sub-watersheds in the Nilwala river basin, two sub-watersheds were selected for the in depth study. Selection of the two sub-watersheds was based on the number of anicut systems in each sub-watershed and representing different agro-ecological zones. The study population consisted of 2,089 individuals of 439 households representing 1,530 individuals from Middle Nilwala sub-watershed area and 559 individuals from Urubokka Ganga sub-watershed area. The study was conducted during 2007/08 *maha* and 2008 *yala* seasons. The data was analysed using descriptive and statistical methods.

Paddy is the main agricultural crop under anicut irrigation in the area in both *yala* and *maha* seasons and usually there is sufficient water to cultivate both seasons. There are about 20 to 30 percent abandoned anicut schemes in the study area mainly due to abandoning respective paddy lands and improper placement of the anicut schemes. Participation of the farmers in the maintenance of anicut schemes is poor. Extents under anicut schemes are about 32 percent of the total lowland cultivated in UB sub-watershed area, while cultivated area is 54 percent in MN sub-watershed. Cropping intensity of the low land paddy was substantially higher in the study area with values of 186 and 177 in MN and UB sub-watersheds respectively. Average paddy yield varies between 34 to 54 bushels per acre. About 73 percent of the harvest is used for home consumption and about 10 to 15 percent is used to make payments for various inputs such as seed paddy, agro chemicals, etc. Cost of production is high in the area Rs.29,216 in MN and Rs.27,922 in UB per acre. In MN sub-watershed about 36 percent of the lowlands is less than 0.25 acres and about 71 percent of the lowland parcels are in less than 0.5 acre category. In UB, the lowland parcels with less than 0.25 acres are about 48 percent, while lowlands with extent of less than 0.5 acres are about 76 percent. Farming is the main employment of about 71 percent of the sample in MN and 83 percent of the sample in UB sub-watersheds. Majority of the households are in the income group of Rs.100,000 to 250,000 in both sub-watershed areas. Though the contribution by the anicut irrigated paddy is around 10 percent of total annual household income in majority of the households, continuous cultivation without abandoning their paddy lands indicate the dominant role played by anicut irrigated paddy in meeting the household food security.

In this study, it is proposed that participation in anicut scheme maintenance be made a pre-requisite to obtain subsidized fertilizers by the farmers. Further, the measures should be taken to minimize environmental consequences of the Nilwala flood protection scheme and to recommence cultivation of currently abandoned paddy lands in the MN sub-watershed. The study highlights the importance of systematic investigation of farmers' traditional knowledge and wisdom on the hydrological environment of the area. The introduction of high yielding rice varieties suitable for the locality to increase productivity is also recommended.

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ABBREVIATIONS

ADC	Agrarian Development Center
AER	Agro Ecological Region
DAS	Department of Agrarian Services
DCS	Department of Census and Statistics
FL	Family Labour
GDP	Gross Domestic Production
HARTI	Hector Kobbekaduwa Agrarian Research and Training Institute
Rh	Relative humidity
SNWDR	Sri Lanka National Water Development Report
SW	Sub-Watershed
WL_1	Low Country Wet Zone
WL_2	Low Country Wet Zone
WL_4	Low Country Wet Zone
WM_1	Mid Country Wet Zone

CHAPTER ONE

Introduction

1.1 Small Anicut Systems of Sri Lanka

Rice is the staple food of the majority of the Sri Lankans and paddy is cultivated all over the country under irrigated and rainfed conditions. Irrigation systems can be classified according to various criteria including area or volume of the storage tank, command area or the number of crops that can be irrigated. Further, the irrigation systems are classified based on the primary function of the system (i.e. irrigation, flood control, electricity generation, etc.), and the system of management or the nature of the source of water (canal diversion, ground water or rainfed). However for administrative purposes the irrigation systems of Sri Lanka are classified according to the extent of their command area into major, medium and minor systems. Medium and major systems are the responsibility of the Irrigation Department, whilst minor systems come under the responsibility of the Department of Agrarian Services (DAS, 2000).

Irrigation for cultivation is provided using the network of distributory channels of tanks and anicut systems. In the dry zone, the paddy cultivation is mainly under major irrigation, while in the wet zone, cultivation is based on rains or minor irrigation[1].

According to data for village irrigation systems of Sri Lanka published by the Department of Agrarian Services (DAS) in the year 2000, there were 12,950 small anicut systems distributed over seventeen districts of the country. The total command area of the small anicut systems was about 250,000 acres which was cultivated by about 339,000 farmers in the country.

Though Sri Lanka is well known for its numerous ancient large reservoirs and small tanks; anicut systems are also very prominent features of water use in the island (Molle, *et.al.*, 2003). The anicuts or *amuna* are small dams or weirs built across a branch of a river to pile up water behind it. The anicut keeps the levels of water high enough to feed the canal even in dry periods, while excess water is allowed to spill over and continue downstream during the rainy periods. Village tank irrigation is dominant in the dry zone of the country, while anicut system is dominant in the wet zone of the country (Dayaratne, 1991).

From the total number of anicut systems in the country, 70 percent of the systems were found to be located in the five districts, Badulla, Kandy, Ratnapura, Nuwara Eliya and Matara. Highest number of anicut systems was found in Badulla district and it was about 28 percent of the total number of small anicut systems distributed over the country. In Kandy district, there were about 12 percent of total anicut systems while in Ratnapura, Nuwara Eliya and Matara districts there were about 11, 9 and 6 percent of anicut systems respectively.

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[1] According to the Agrarian Services Act No.58 of 1979, the minor irrigation system can be defined as those benefiting less than 200 acres (80 ha). Design and construction are the responsibility of the Irrigation Department, whilst the operation and maintenance are the responsibility of the Department of Agrarian Services (DAS) which enlists the involvement of the community for the purpose.

The small anicut systems, in each of the above districts when categorized according to size by using the representative command areas of the anicuts as representing the size, highest concentration of anicut systems are in the category of less than 10 acres of command area. Further, the sub-division showed that most of those small anicut systems are even less than 3 acres of command area (Panabokke, *et.al.*, 2007).

Distribution pattern of anicut systems against Agro Ecological Regions (AER) of Sri Lanka shows the highest density of small anicut systems within mid and up country intermediate zones of Badulla, Nuwara Eliya and Kandy districts (ibid). In the low country wet zone the highest density of small anicut systems is found within the Nilwala Ganga basin in the Matara district (Annex 1). In Matara district, there are 825 functioning anicut systems which provide irrigation facilities to about 28,083 acres of command area. The number of benefiting farmer families are 32,808. Percentage of abandoned anicut systems is about 10 in Matara district. Table 1.1 shows the distribution of functioning and abandoned anicut systems among the ADCs. Agrarian development center areas in Matara district with the highest concentration of anicut systems are Hakmana, Kirinda-Puhulwella, Akuressa and Dandeniya.

Table 1.1: Number of Functioning and Abandoned Anicut Systems, Benefiting Farmer Families and Respective Command Areas in Each *Govijana Kendra* in Matara District

Govijana Kendraya	Number of Functioning Anicuts	Command Area (Acs.)	Number of Benefiting Farmer Families	Number of Abandoned Anicuts
Kekanadura	17	245	363	14
Dandeniya	73	1,110	1,195	-
Dikwella	7	142	143	23
Talalla	16	809	1,256	5
Weligama	40	2,786	2,571	2
Kananke	32	1,271	1,388	2
Mirissa	15	583	732	1
Malimbada	68	2,959	2,441	-
Wilpita	64	2,072	3,176	-
Akuressa	100	3,822	4,828	8
Kamburupitiya	100	3,098	3,464	2
Medawiyangoda	22	1,017	1,112	1
Kirinda Pahulwella	-	2,200	2,747	10
Hakmana	89	1,588	1,539	6
Pasgoda	34	1,142	1,392	2
Ransegoda	36	680	829	-
Urubokka	-	180	409	4
Deiyandara	45	1,067	1,547	4
Deniyaya	11	260	303	1
Morawaka	36	799	979	6
Beralapanathara	20	253	394	2
Total	825	28083	32,808	93

Source: DAS, 2000

1.2 Research Problem

Many studies on small tanks that falls into the category of minor irrigation systems have been carried out and there are several publications on this theme. However, the attention paid to anicut systems by the relevant government authorities and researchers in the past is very limited and only a few research studies have been conducted on small anicut systems.

1.3 Objectives

1. To study the present state of paddy cultivation under small anicut systems.
2. To investigate the level of operation and maintenance of small anicut systems.
3. To examine the socio-economic status of farmer families benefiting from anicut systems.

1.4 Research Methodology

1.4.1 Data Collection Methods

Data and information were collected both through primary and secondary sources. The secondary sources such as government publications, books, journals and newspaper articles were used for the study. A single visit personal interview using a structured questionnaire was adopted for each sample households. The questionnaire survey was focused on general socio-economic status of farmers, nature of anicut systems, maintenance of the anicut systems and agricultural information of the study area.

The research team interviewed the officers attached to the Agrarian Development Centers who were in the governing body of anicut systems, agriculture officials, and farmer leaders in order to understand the prospects and issues in using and maintaining of anicut systems. This was done with the help of structured and guided schedules. Field survey of this study was carried out during September to December in 2008.

1.4.2 Sample Selection

Out of the eight sub-watersheds in the Nilwala river basin, two sub-watersheds were selected for detailed investigation. From the two sub-watersheds of WL_1, Urubokka Ganga sub-watershed which has the highest number of anicut systems was selected for the study. From the sub-watersheds in WL_2, Gal Oya sub-watershed has the highest number of anicut systems. Since it is located close to the Urubokka Ganga sub-watershed, Middle Nilwala Ganga sub-watershed which has second highest number of anicut systems was selected for the study.

Fifteen percent (15%) of the total number of anicut systems in each of the selected two sub-watersheds was selected for the detailed study. That is eight (8) anicut systems from Urubokka Ganga sub-watershed and twenty (20) Anicut systems from Middle Nilwala Ganga sub-watershed. From the selected anicut systems, 50% or not less than 30 households was selected for the questionnaire survey from each system based on a stratified random sampling technique. The total sample size of the study is

439 as detailed out in Table 1.2. The sample frame was prepared using the registered farmers list maintained by the Agrarian Development Centers in each study area.

Table 1.2: Number of Respondents per Anicut System in each Sub-Watershed in the Sample Survey

Sub-Watershed	ADC	Anicut System	Population (Total No. of Individuals)	Sample Size (No. of Families)
Middle Nilwala	Wilpita	Avuliyadda	148	30
		Ihala Beliketiya	118	27
		Kethiwila	136	27
	Kamburupitiya	Yahamullagedara	142	30
		Galwakkada	99	21
		Miriswatta	146	30
		Kudathota	119	25
		Polkandawella	118	23
	Akuressa	Udahengama	103	21
		Beligahahela	97	22
		Gal amuna	100	22
		Medilla	77	16
		Kuttikubura	127	26
		Sub Total	**1,530**	**320**
Urubokka Ganga	Urubokka	Egodawele	116	25
	Beralapanathara	Koskanda	64	13
	Pasgoda	Illukpathdola	111	26
		Mahadola	128	25
		Andaluwa	140	30
		Sub Total	**559**	**119**
Total			**2,089**	**439**

1.4.3 Data Analysis

Data and information collected by various methods were processed and analyzed by using statistical software of SPSS.

1.5 Limitations of the Study

Literature on this theme was very limited. As in other socio-economic research projects, the data related to household income, expenditure and cost of production given by farmers by re-collecting the past, may not be accurate. Although Middle Nilwala and Urubokka Ganga sub-watershed areas were selected for this study, the respective Agrarian Development Centers belonging to those areas do not completely come within those sub-watershed boundaries. Therefore, the following Agrarian Development Centre areas were selected for the present study. To represent the conditions at Middle Nilwala sub-watershed Akuressa, Kamburupitiya and Pasgoda ADCs were selected, while Urubokka, Beralapanathara and Wilpita ADC, were selected to represent the Urubokka Ganga sub-watershed.

1.6 Organization of the Report

CHAPTER 1: Introduction

This chapter provides information on distribution pattern and the role of small anicut systems in the country, objectives of the study, sampling procedure and methods of data collection and limitations of the study.

CHAPTER 2: Nilwala River Basin

Chapter two presents the background information of Nilwala river basin, Nilwala flood protection scheme, Nilwala rectification programme and the abandoned anicut systems in the study area.

CHAPTER 3: Farming in the Study Area

This chapter consists of land use information of the two sub-watersheds, status of paddy cultivation in the study area, nature of land tenure, size of holding of lowlands, problems related to anicut irrigated paddy cultivation in the study area.

CHAPTER 4: Social Profile of the Sample Farmers

Demographic characteristics of the sample, labour force, literacy and educational levels, employment pattern, household income and expenditure, housing and sanitary facilities, access to water are discussed in this chapter.

CHAPER 5: Summary of Findings and Recommendations

This chapter provides findings and recommendations of the study.

CHAPTER TWO

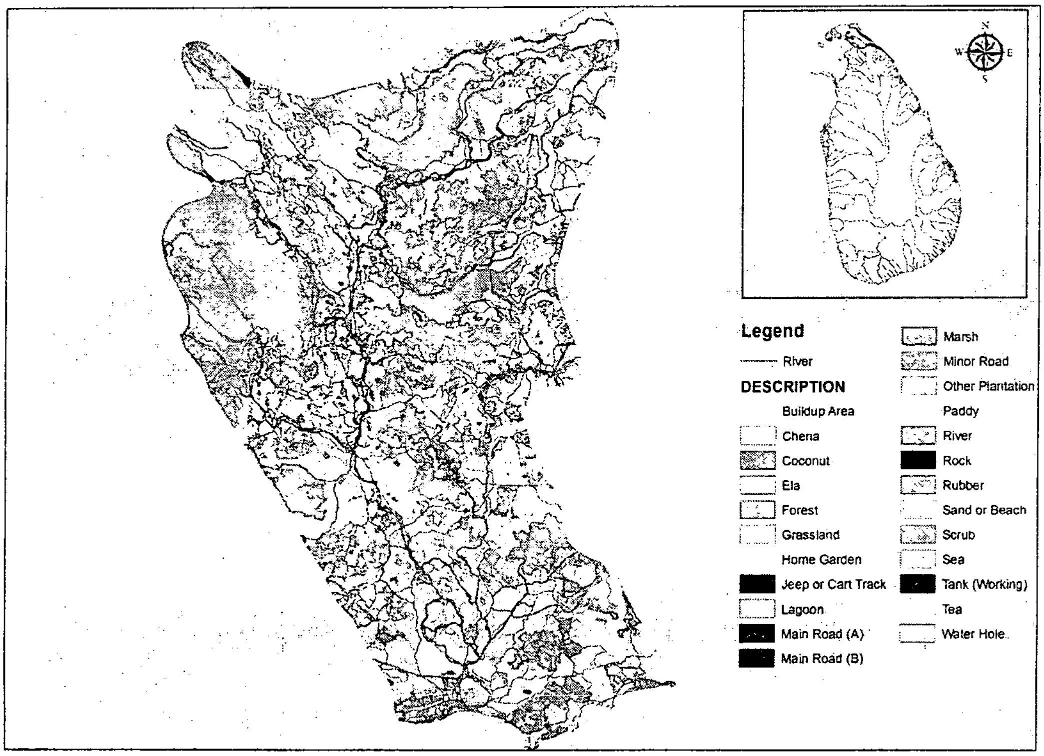
Nilwala River Basin

2.1 Background of the Nilwala River Basin

The river Nilwala which originates from the Sinharaja highland natural forest is the largest in the Southern Province covering a distance of 72 km. Nearly 90 percent of the area covered by the catchment of the river is in Matara District (Abhayaratna, 1996).

Annual rainfall of the selected area is between 1,875mm – 2,500mm. The mean temperature is $25C^0$ and relative humidity (Rh) is 75% - 80%. The Catchment area covers approximately 971.0 km^2 and it falls within the latitude and longitude between the 50□ 55' and 60□ 13' and 80□ 25' and 80□ 38'. Approximately 70 percent of the Nilwala river basin is used to grow paddy, tea, coconut, cinnamon, citronella and rubber (Figure 2.1). Paddy area covers approximately 18,000 ha, including 9,000 ha in the lower part of the basin which is subject to seasonal flooding. Wetland called 'Kirelakele Marsh' is located near the Indian ocean outfall of the Nilwala River.

Figure 2.1: Map Showing Land Use of Nilwala River Basin



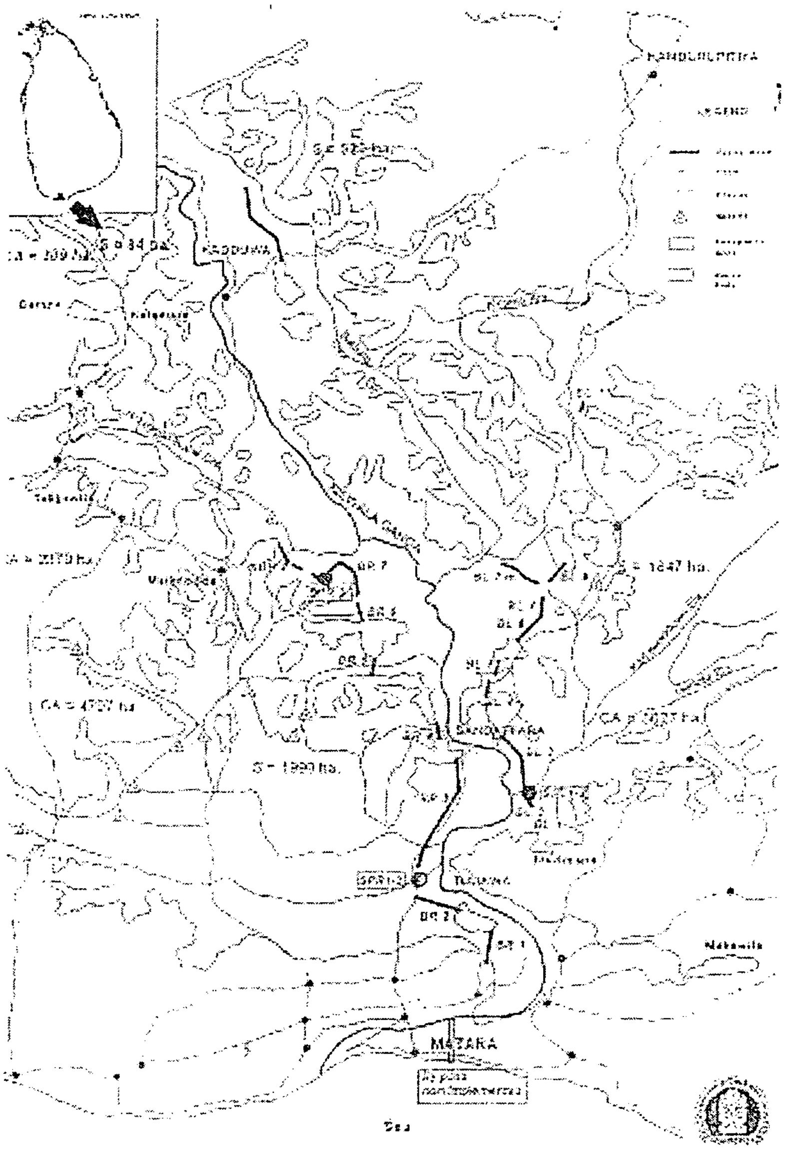
Source: International Water Management Institute

2.2 Nilwala Flood Protection Scheme

In 1979, the Ministry of Irrigation initiated a flood protection scheme in the lower most part of the watershed in the Lower Nilwala sub-watershed (Figure 2.2). The Government of France provided assistance for this project. Objectives of the Nilwala flood protection scheme were to extend the total rice cultivable area to ensure double cropping of rice on lands with elevations more than 0.6m above mean sea level (MSL) and to increase the rice yield through introduction of improved cropping practices. The implementation of the scheme involved the re-conditioning of existing drainage canals and the construction of new drainage canals, bunds, control regulators, access roads and pump houses to drain excess water from the lowest rice lands. The Nilwala flood protection scheme was completed in 1993 but only two phases of the proposed three phases were implemented. The scheme provided drainage facilities for two low lying areas rather than flood protection for the whole area coming under the project.

After completion of the engineering work, the occurrence of major floods was eliminated and the drainage condition of the soil in the project area was improved. However, contrary to the plans, the rice yields sharply decreased on lands of about 1000ha with an elevation between 0.3 and 0.6m above MSL. Due to intense drainage and non availability of irrigated water, the soil problems such as increased salinity and formation of acid sulphate in the protected areas of the scheme were also reported. As a result, large extents of paddy land in Ihala-Athuraliya, Pahala Athuraliya, Kadduwa, Narangoda, Karagoda Uyangoda and Paraduwa areas had to be abandoned. Some paddy lands which were cultivated in both seasons of the year are now cultivated only once a year. Balasuriya (1978) and Dent (1987) drew attention to the problem of acid sulphate soils in the area, the latter recommending a detailed soil survey as a basis for managing the problem.

Figure 2.2: Location of Nilwala Flood Protection Scheme



Source: Department of Irrigation

2.3 Nilwala Rectification Programme

To minimize the negative effects of the Nilwala flood protection scheme, a Nilwala Rectification Committee has been established. The Irrigation Department has proposed the construction of flood control dams upstream of the catchment area to mitigate the ill effects of the previous flood protection scheme. Other aspects of the project proposed by the Irrigation Department include generation of electricity, provision of an additional water supply for use in periods of scarcity of water, supply of drinking water and transfer of water to the neighbouring catchment areas in Hambantota district which experience frequent water scarcity problems (Department of Irrigation, 2007).

2.4 Nature of the Anicut Systems in the Nilwala River Basin

Nilwala river basin has been classified into eight (8) sub-watersheds by the DAS. Sub-watersheds of Nilwala watershed and number of anicut systems in each sub-watershed are given in Table 2.1.

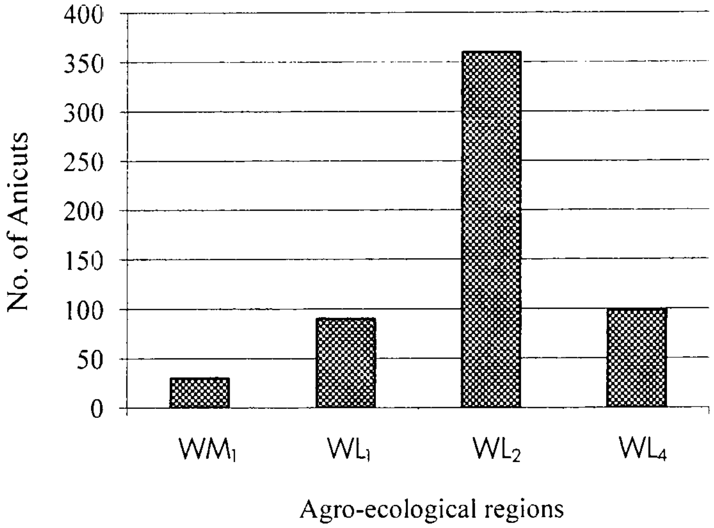
Table 2.1: Sub-Watersheds of Nilwala River Basin and Number of Anicut Systems in Each Sub-Watershed

Name of the Sub-Watershed	Number of Anicut Systems
Urubokka Ganga	54
Katupola Ganga	31
Upper Nilwala/Hulangawa Ganga	48
Digili Ela	40
Middle Milwala Ganga	131
Gal oya	170
Kanduwela ela	42
Lower Nilwala Ganga	48

Source: HARTI/DAS, 2006

Nilwala watershed area consisted of WM_1, WL_1, WL_2, WL_4 agro-ecological regions (AER) and the distribution of anicut systems in each AER is shown in Figure 2.3. The significant finding is that in the low country wet zone, a higher density of anicut systems is present within the less wetter environment of WL_2 which can experience short period of water stress (Panabokke, *et al.*, 2007).

Figure 2.3: Distribution of Anicut Systems in Each AER of Nilwala Basin

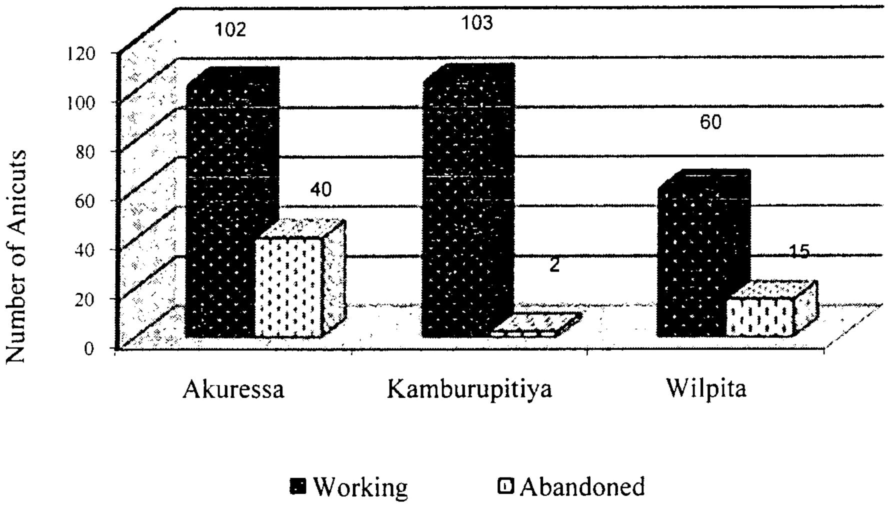


Source: HARTI/DAS, 2006

2.5 Abandoned Anicut Systems in the Area

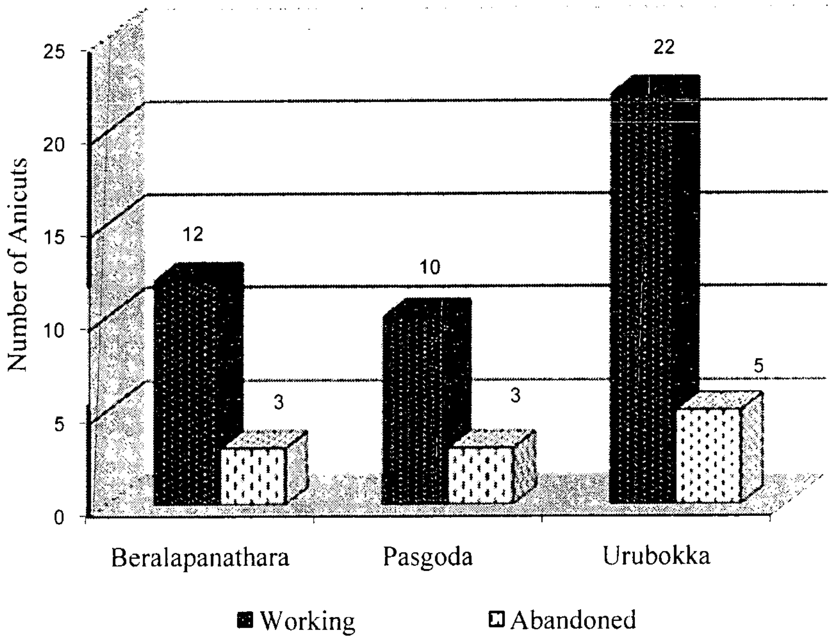
There are about 20 to 30 percent abandoned anicut systems in the study area (Figure 2.4a, 2.4b). According to the findings of this study, one of the major reasons for abandoning these anicut systems is neglect of the paddy lands that were cultivated under those anicut systems as a result of frequent crop failure due to flooding, scarcity of labour, less profitability owing to factors such as high cost of labour and low yield. According to the farmers in the area another important reason for abandoning anicut systems is their improper placement.

Figure 2.4(a): Number of Working and Abandoned Anicuts in Middle Nilwala Sub-Watershed



Source: Author's Survey data, 2008

Figure 2.4(b): Number of Working and Abandoned Anicuts in Urubokka Sub-Watershed



Source: Author's Survey data, 2008

CHAPTER THREE

Farming in the Study Area

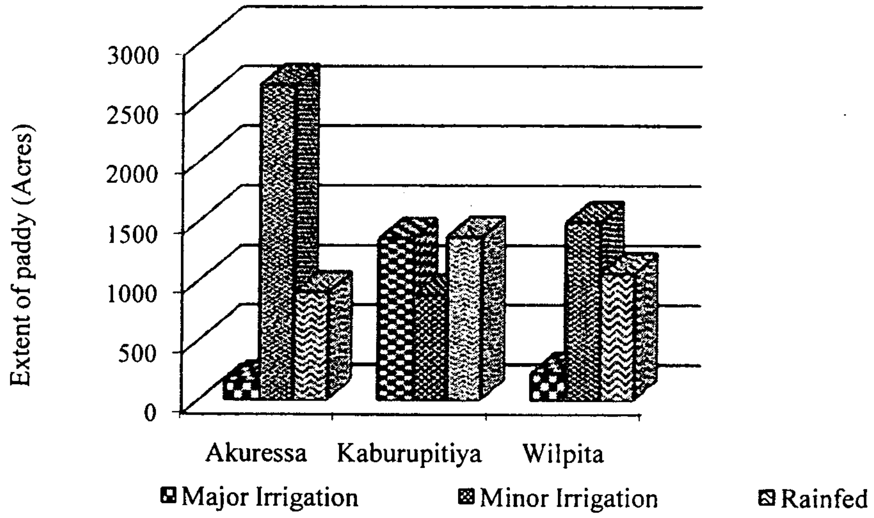
3.1 Status of Paddy Cultivation in the Country

In year 2007, the total extent of asweddumized[2] land available for rice cultivation in the country was 712,111 of hectares (DCS, 2008). Of the total asweddumized land extent, about 46.7% was under major irrigation systems and 28.8% was under rainfed cultivation. Contribution by the minor irrigation systems for paddy cultivation was about 24.5% of asweddumized land (ibid). Furthermore, according to the data published by the Department of Census and Statistics, the contribution to national paddy production by major, minor and rainfed systems were 49, 25 and 26 percent respectively in 2007/08 *maha* season.

3.2 Status of Paddy Cultivation in the Study Area

In the Middle Nilwala SW area, paddy is cultivated under rainfed, as well as under major and minor irrigation conditions. In Akuressa ADC, 2,638 acres (52%) of lowlands is being cultivated under minor irrigation (Figure 3.1). Paddy extent under major irrigation is only 155 acres (3%) in Akuressa ADC area. In Kamburupitiya ADC area, the extent under rainfed and major irrigated paddy is more or less equal, while paddy irrigated with minor irrigation systems is about 1,360 acres (24%). Paddy irrigated with major irrigation systems is about 226 acres in Wilpita ADC, while majority of the paddy lands are being cultivated under minor irrigated systems. Percentage of extent under anicut irrigated paddy is about 54 from the total extent of lowlands in the Middle Nilwala SW.

Figure 3.1: Cultivated Extent of Paddy under Different Irrigation Systems in the Three ADCs of Middle Nilwala SW



Source: Author's Survey data, 2008

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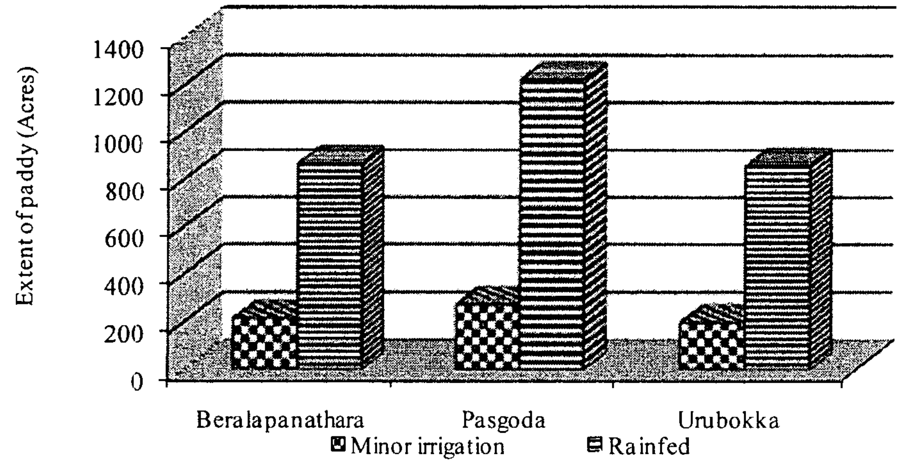
[2] Asweddumized land refers to the total cultivable land available in the country for rice cultivation.

Paddy is cultivated only under rainfed conditions and under minor irrigation in Urubokka SW area. Extent under anicut schemes are about 681 acres (19%) from the total cultivated extent of lowlands in Urubokka SW area. Unlike in Middle Nilwala SW, in Urubokka most prominent type is rainfed paddy (Figure 3.2).

Figure 3.2: Cultivated Extent of Paddy Under Different Irrigation Systems in the Three ASCs of Urubokka Ganga SW



Source: Author's Survey data, 2008

Cropping Intensity

Annual cropping intensity of lowland was calculated according to the formula given below:

$$\text{Cropping intensity} = \frac{\text{Total crop area of paddy and other field crops in a year}}{\text{Total lowland area}} \times 100$$

According to the statistics available with the Irrigation Department, the annual cropping intensities of major irrigation schemes vary from about 200% to less than 100%. Typical cropping intensities are low in rainfed and minor irrigated areas and this is generally contributing to the low national values of cropping intensities (SNWDR, 2006). However, the cropping intensity of the low land paddy was substantially higher in the study area with cropping intensity values of 186 and 177 in Middle Nilwala and Urubokka sub-watersheds respectively. In other lowland wet zone areas such as Kaluthara and Gampaha, the cropping intensity is 127 and 87 respectively in 2007 (HARTI, 2008).

Cost of Production of Paddy

Except in major irrigated schemes and some minor irrigated schemes, the production of paddy has reached a level over the years, where paddy has become an unprofitable enterprise according to the cost of production data published by the Department of Agriculture from 1978 to 2001 (Aheeyar *et al.*, 2005). For calculation of cost of production of paddy from the two categories of fixed costs and variable costs, only variable costs, have been taken into consideration in this study. Activities of paddy cultivation have been divided into eight operations from land preparation to transporting the harvest to the stores. The breakdown of cost for *yala* 2008 for the two sub-watershed areas is shown in Table 3.1. According to the present survey, the cost of cultivation of paddy per acre in the Middle Nilwala sub-watershed area is about Rs.38,908 including the cost of family labour while in Urubokka sub-watershed it is Rs.39,626 (Annex II). In the Middle Nilwala sub-watershed, the labour cost is about 51 percent of the total cost including family labour whereas it is about 45 percent in Urubokka Ganga sub-watershed. Total number of labour days required to cultivate one acre of paddy is about 37 in Middle Nilwala and 32 in Urubokka Ganga sub-watersheds. Machinery cost which is about Rs.12,518 per acre is generally 32 percent of the total cost of production. In Urubokka Ganga sub-watershed, the cost for machinery is about Rs.14,551 per acre (37%). Input cost is about 17 percent in both sub-watershed areas. Weed control also leads to a considerable amount of cost of the total cost of production. The control of weeds and management of pests and diseases require about Rs.6,343 per acre in Middle Nilwala sub-watershed and it is about 16 percent of the total cost of production. In Urubokka Ganga, it accounts for about 10 percent of the total cost of production of one acre of paddy. Cost of production of paddy is more or less equal in the two sub-watershed areas and when compared with the cost of production of paddy in other low country wet zone areas like Kaluthara and Gampaha it is about 35 percent higher (Annex II). However in Middle Nilwala area, ploughing requires more labour days and higher machinery use compared to Urubokka Ganga sub-watershed area.

Table 3.1: Cost of Production of Paddy (*Yala,* 2008)

Sub-watershed	**Activity**	**Cost (Rs./ac)**				
		Labour (Including FL)	**Labour (Excluding FL)**	**Machinery**	**Materials**	
Middle Nilwala	Land preparation	5,929.23	2,146.22	3,702.55	0	
	Broadcasting	2,882.13	1,858.7	0	2,262.36	
	Weeds, pest and diseases control	1,610.06	6,60.42	833.44	3,239.2	
	Fertilizer Application	329.61	0	0	1,045.33	
	Harvesting	4,517.05	3,735.19	0	0	
	Threshing	2,185.64	9,99.61	7,080.38	0	
	Winnowing	1,556.45	510.84	596.54	0	
	Transport	836.49	240	305.26	0	
Total cost with imput cost of family labour (Rs.)						**38,908.72**
Total cost without imput cost of family labour (Rs.)						**29,216.04**
Urubokka Ganga	Land preparation	5,368.9	1,192.21	4,593.5	0	
	Broadcasting	2,809.01	1,124.67	0	3,354.46	
	Weeds, pest and diseases control	690.31	82.75	449.1	2,594.56	
	Fertilizer Application	345.76	0	0	1,001.08	
	Harvesting	4,565.8	2,743.46	0	0	
	Threshing	2180.28	826.32	8,355.09	0	
	Winnowing	1,529.35	451.42	898.34	0	
	Transport	335.8	0	255	0	
Total cost with imput cost of family labour (Rs.)						**39,626.34**
Total cost without imput cost of family labour (Rs.)						**27,921.96**

Source: Author's Survey data, 2008

Paddy Yield

During several years of recent past, the average paddy yield had been recorded as 4.23 tons/ha under major irrigation, 3.45 tons/ha under minor irrigation and 3.02 tons/ha under rainfed conditions (SNWDR, 2006). Although there is an increasing trend in paddy yields, mainly in irrigated agriculture, the present levels of yield remain below the potential yield value of the improved paddy varieties introduced by the Department of Agriculture (Emitiyagoda and Wirasinghe, 2000). The yield potential of high yielding varieties that are being cultivated at present ranges from 7 to12 mt/ha under optimum conditions (Weerasena *et.al*, 2005). In general, the paddy cultivation in wet zone is considered as uneconomical as productivity is lower compared to the dry zone as shown in Table 3.2 (Balasuriya, 1987).

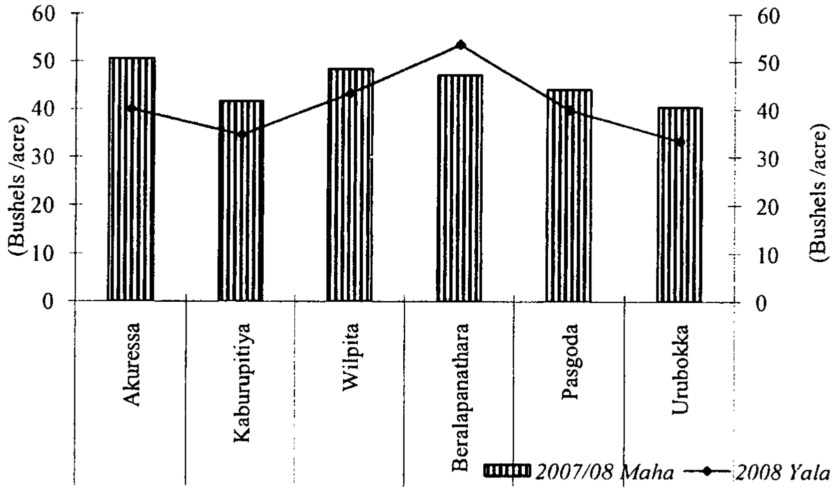
Table 3.2: Productivity of Paddy Lands by Type of Irrigation

Type of Irrigation	Average Yield per net Hectare (kg)	
	2007 *Yala*	2007/08 *Maha*
Major irrigation schemes	4,915	4,803
Minor irrigation schemes	3,776	3,812
Rainfed systems	3,320	3,357
Sri Lanka (Average)	4,543	4,181

Source: Department of Census and Statistics, 2008

Average paddy yield in the study area varies between 34 to 54 bushels per acre (1.76 MT/ha to 2.8 MT/ha) (Figure3.3). In other low country wet zone areas such as Kaluthara and Gampaha, the average paddy yield is about 48 bushels per acre (2.48 MT/ha). The main problem associated with lower productivity in the wet zone is the climatic factor that creates excess water leading to poor drainage and bronzing (ibid).

Figure 3.3: Average Paddy Yield in the Study Area

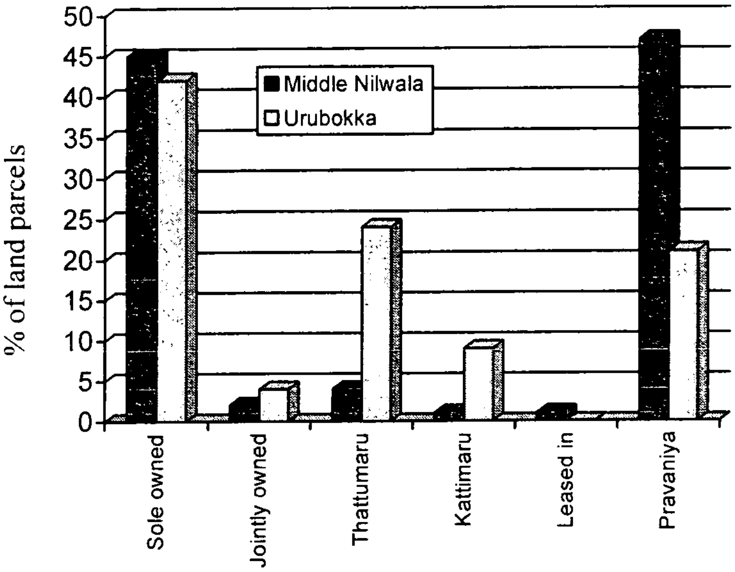


Source: Author's Survey data, 2008

3.3 Land Tenure

The Sri Lankan peasant farm sector was characterized by complex systems of land tenure other than single ownership (Thilakarathne, *et al.*, 1997). Descriptions of each tenurial agreement are shown in Annex IV. In Middle Nilwala sub-watershed area *praveniya*[3] and individual ownership[4] are the prominent type of land tenure (Figure 3.4). Ownership is recognized as *praveniya* when the operator cultivates a holding owned by someone else on a mutual agreement made between them. In the study area it was observed that provision of 1/4 of the harvest (¼ *Ande*) to the owner as *praveniya* or the rent for the land is the most common type of agreement. With reference to the land ownership, the percentage of sole ownership is 45 and *praveniya* type ownership is 47 percent in Middle Nilwala sub-watershed. In Middle Nilwala SW area *thattumaru* system is not much popular. In Urubokka sub-watershed, the percentage of individually owned land parcels is 42 and second most significant category is *thattumaru* with 24 percent of the land holdings. *Praveniya* type of ownership accounts for 21 percent in Urubokka sub-watershed area.

Figure 3.4: Extent of Lowlands under Different Types of Land Tenure



Source: Author's Survey data, 2008

3.4 Size Distribution of Lowlands

According to Figure 3.5, the lowland parcels that are within the size category of less than 0.5 acres are 71 percent and 76 percent in Middle Nilwala SW area and Urubokka SW area respectively. The small land parcel size also has an impact on productivity of paddy lands in the wet zone as shading from nearby trees affects the availability of sunlight (ibid).

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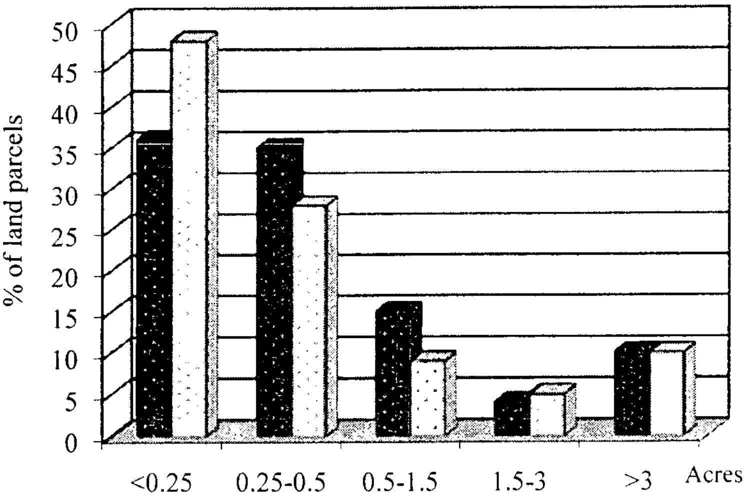
[3] Rent given to the land owner.

[4] Individual ownership of the property is recognized as sole ownership.

Figure 3.5: Size Distribution of Lowlands in the Study Area



Source: Author's Survey data, 2008

3.5 Problems Related to Anicut Irrigated Paddy Cultivation in the Study Area

Maintenance of the anicut systems is not systematic and problems related to side walls and anicut weirs and delivery channels are common. In most cases, the diversion weirs of the anicut systems were made out of wood and these have to be repaired quite often, normally before every cultivation season. Usually these were repaired by the respective farmer organization after the *kanna* meetings. However, it was learnt from the key informants and the farmers that these farmers' societies are not functioning adequately in this regard. Farmers complain that they have to individually attend to canal maintenance work and the decisions made at the *kanna* meetings are not always put into action. As a result, during rainy seasons drainage water flows across the paddy lands because capacities of drainage canals have been reduced over time due to siltation.

Rice varieties cultivated in the wet zone area are susceptible to fungal diseases. Lack of quality seeds at the proper time is also an issue faced by the farmers in the area. Part of Middle Nilwala area is prone to flood and about 800 acres of paddy land that was cultivated successfully earlier has now become uncultivable. This problem has arisen after the implementation of Nilwala flood protection scheme.

3.6 Highland Crop Cultivation in Middle Nilwala Sub-Watershed

In Kamburupitiya ADC area paddy occupies 3598 acres of lowland and major highland crops are cinnamon and rubber. Tea occupies only 668 acres of highland in Kamburupitiya. Extent of lowland under paddy is 5,058 acres in Akuressa ADC area. Tea is the main highland crop occupying 15,516 acres. Rubber occupies 4080 acres while the extent under cinnamon is about 2,409 acres. Paddy occupies about 1,124 acres of lowland in the Wilpita ADC area. Area under coconut is 7,629 acres, while rubber occupies 1,400 acres.

3.7 Highland Crop Cultivation in Urubokka Ganga Sub-Watershed

According to the composition of crops in the selected ADC areas in Urubokka SW, tea is the main highland crop occupying the highest extent of land in Beralapanathara ADC (5,526 acres), while rubber is cultivated in 62 acres of land. Cultivated extent of coconut and cinnamon is 428 acres and 200 acres respectively. In Pasgoda ASC, tea is cultivated in 56 percent of the total cultivated extent, while 520 acres of highland is under rubber. Clove is also cultivated in the area in about 101 acres. Cinnamon is widely cultivated in the Pasgoda ASC area and extent under cinnamon is 1,218 acres. Rubber is not popular in Urubokka ASC area, while about 31 percent of the cultivated extent comprises mixed crops. Percentage under paddy is almost same in all three ASC areas.

3.8 Status of Animal Husbandry in the Study Area

In the study area the livestock farming is practiced in addition to crop cultivation. The extent of livestock farming in the two sub-watershed areas are shown in Table 3.3. According to the study findings only 8% and 11% of the population in Middle Nilwala and Urubokka sub-watersheds respectively are engaged in some kind of animal husbandry. From the small numbers who practice animal husbandry only 8% do it for the purposes of income generation. Rearing cattle and buffalo for milking and other domestic agricultural purposes, poultry farming for eggs could be observed in the Middle Nilwala area. In Urubokka sub-watershed area in addition to those; swine and goat farming were also observed. Animal husbandry is not popular within the study area mainly due to their personal dislike towards it. Therefore, no effort has been made by the livestock officials to popularize this on a commercial scale. The main problems faced by the farmers involved in animal husbandry are lack of labour and high cost of animal feed.

Table 3.3: Type of Animal Husbandry in Each Sub-Watershed Area

Name of Sub-watersheds	Type of Animal Husbandry	No.	%
Middle Nilwala	Cattle for milking	37	23
	Cattle for other uses	5	3
	Buffalo for milking	69	44
	Poultry farming (layers)	48	30
Urubokka Ganga	Milk cattle	16	11
	Cattle for other uses	3	2
	Buffalo for milking	2	1
	Swine farming	4	3
	Goat farming	6	4
	Poultry farming (layers)	115	79

Source: Author's Survey, 2008.

CHAPTER FOUR

Social Profile of the Sample Farmers

4.1 Gender and Age Distribution of the Sample

Average family size of the sample households is 4.8 in Middle Nilwala sub-watershed area and 4.7 in Urubokka Ganga sub-watershed area. A well balanced gender distribution could be observed in the population in both sub-watersheds with 51.3 percent of males and 48.7 percent females in Middle Nilwala sub-watershed and 53 percent of males and 47 percent females in Urubokka Ganga sub-watershed. The masculinity ratio of the study population is almost 100.

Age distribution pattern is very much similar in the two sub-watersheds. According to the age profile of the respective population, the youth population within the age group 20 to 30 is 18.48 percent. Children who are in the age of schooling is about 21 percent of the population. Population below the age of 16 years and above 65 years of age accounts for 34 percent of the total population. About 22 percent of the total populations are over 55 years which is considered as the age for retirement. Age dependency ratio was about 53 percent when calculated according to the following equation.

$$\text{Age dependency ratio} = \frac{\text{Age group (0-14)} + \text{Age group (65 and above)}}{\text{Age group (15-64)}}$$

Age structure of the sample farmers are shown in Table 4.1. Prominent age group is 41 to 65 years in both SW areas. In Middle Nilwala SW area, the percentage engaged in farming above 65 years of age is 28 and 31 in Urubokka SW areas. Young farmers in the age group of 20 to 30 years are only 1 percent in Middle Nilwala and 2 percent in Urubokka SW areas indicating the younger generations dislike farming.

Table 4.1: Distribution of Sample Farmers by Age Groups

Sub-watershed	Age group	Number of farmers	Percentage of farmers
Middle Nilwala	20-30	4	1
	31-40	28	9
	41-65	198	62
	>65	90	28
Urubokka Ganga	20-30	3	2
	31-40	14	12
	41-65	65	55
	>65	37	31

Source: Author's Survey Data, 2008

4.2 Labour Force

According to International Llabour Organization, the labour force consists of those who are already employed plus those who are unemployed during a period under discussion. It is the economically active segment of the total population.

In the study area, the individuals within the age group of above 14 years and below 64 years are taken as the labour force. Labour force is 64 percent in both sub-watersheds.

From the labour force 44 percent is currently employed. There are about 6.3 percent of the labour force who are looking for employment, while about 23 percent are students. People with disabilities, infants and pensioners is 11 percent. Dependency ratio when calculated according to the equation given below is about 1.3 in the sample population which is high.

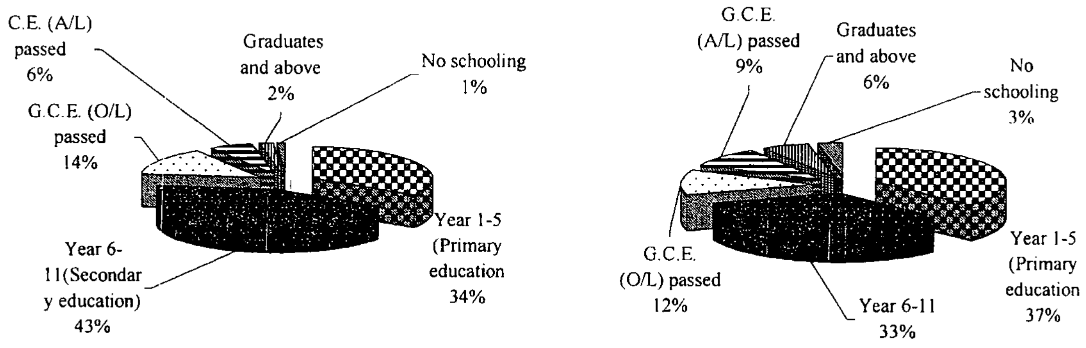
Economic dependency ratio[5] = $\dfrac{\text{Unemployed+Housewives+students + discouraged + others*}}{\text{Total Employed}}$

* Below 6 years and above 55 years of age

4.3 Literacy and Educational Level

Literacy level of the individuals of Sri Lanka, who are over 10 years old is 91%, while the literacy level in Matara district is about 90.3. Literacy rate of the study population was 92. This indicated that the sample population is within the average literacy level. Figure 4.1 provides information on levels of education of the sample farmers as reported by 119 households in Urubokka and 320 households in Middle Nilwala sub-watersheds. In both sub-watersheds the significant fraction of sample farmers had received only primary education. In Middle Nilwala sub-watershed the majority of them had received education up to secondary level, while in Urubokka, the percentage who had received education up to secondary level is 33.

Figure 4.1: Level of Education of the Sample Farmers



Middle Nilwala SubWatershed

Urubokka Ganga Sub-Watershed

Source: Author's Survey data, 2008

4.4 Employment Pattern

Majority of the sample farmers do farming as their primary employment (Figure 4.2). Other than paddy, they are engaged in growing of tea, rubber, coconut and cinnamon.

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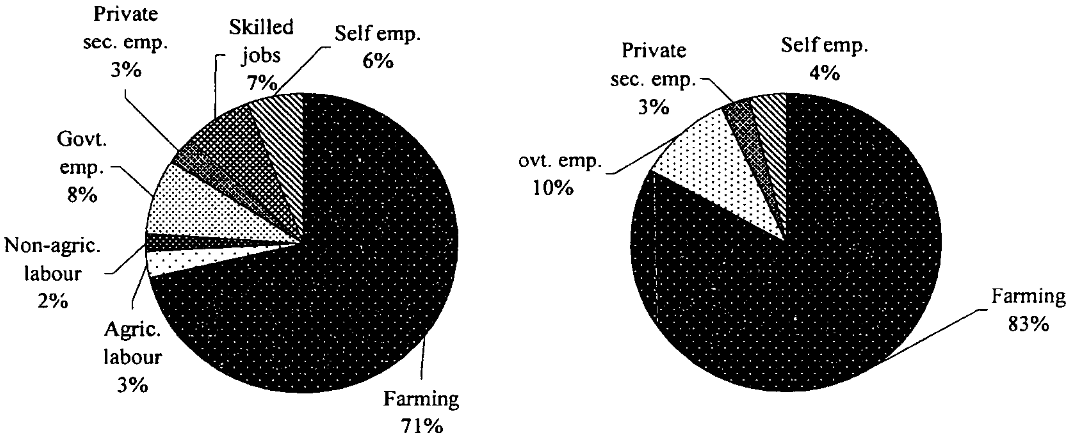
[5] Source: Aheeyar, *et.al* (2007)

However there were about 8 percent from Middle Nilwala and 10 percent form Urubokka SW areas whose main employments were in government service. They reported to do farming as their subsidiary source of income.

Figure 4.2: Primary Employment of the Sample Farmers



4.2a Middle Nilwala Sub-Watershed **4.2b Urubokka Ganga Sub-Watershed**

Source: Author's Survev data. 2008

Other than farming, the most common category of secondary employment among the sample farmers is agricultural labour (Table 4.2) and it is about 21 percent in Middle Nilwala and 36 percent in Urubokka SW areas.

Table 4.2: Secondary Employment of the Sample Farmers

	Middle Nilwala (%)	Urubokka Ganga (%)
Agriculture	48	45
Agricultural labour	21	36
Non agricultural labour	8	9
Skilled jobs	12	1
Self employment	11	9

Percentages are based on the number of farmers with a secondary employment
Source: Author's Survey data, 2008

4.5 Household Income

Information on annual household income was collected by using the annual earnings from January to December 2007 from both agricultural and non-agricultural sources. According to the income data shown in table 4.3, the majority of the households are in the income group of Rs.100,001 to 250,000. About 41 percent of the households in Middle Nilwala sub-watershed and about 37 percent of the households in Urubokka sub-watershed are within the above income group.

Table 4.3: Annual Average Household Income from All Sources

Income group (Rs.)	Middle Nilwala		Urubokka Ganga	
	No.	%	No.	%
<25 000	20	6	0	0
25,001 – 100,000	62	19	18	15
100,001–250,000	130	41	44	37
25,0001–500,000	72	23	36	30
>500,001	34	11	21	18
Total	318		119	

Source: Author's Survey data, 2008

More than 85%of the households in both sub-watershed areas get more than 75% of their annual household income from non-farm activities. Most common income generating activities of this nature is employment in government and private sectors for monthly wages.

Majority of the households are in the non-farm income group of Rs 100,001 to Rs.250,000 in both sub-watersheds (Table 4.4).

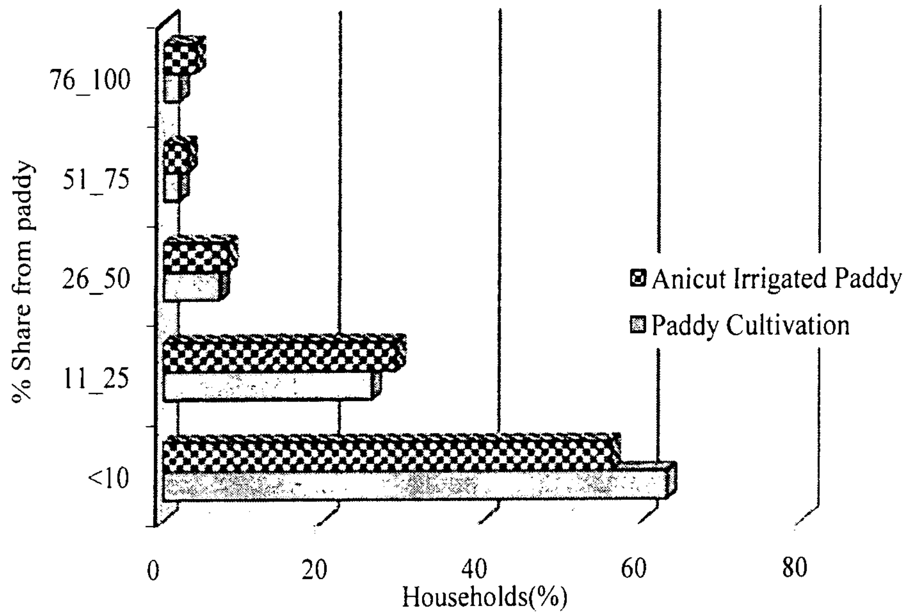
Table 4.4: Annual Income from Non-Farm Activities in the Sample Households

Income group (Rs.)	Middle Nilwala		Urubokka Ganga	
	No.	%	No.	%
<25 000	39	14	12	14
25,001 – 100,000	56	20	26	30
100,001–250,000	105	38	31	36
25,0001–500,000	54	20	13	15
>500,001	20	7	4	5
Total	274		86	

Source: Author's Survey data, 2008

Economic contribution of paddy cultivation is very small in the study area (Figure 4.3). Contribution by the anicut irrigated paddy to annual income is less than 10 percent in majority of the households (63%). There were 89 percent of households getting less than 25 percent of the annual household income from anicut irrigated paddy. However, there were about 4 percent of the households earning more than 50 percent of their annual household income by this means.

Figure 4.3: Percentage Share from Paddy Cultivation to Annual Household Income

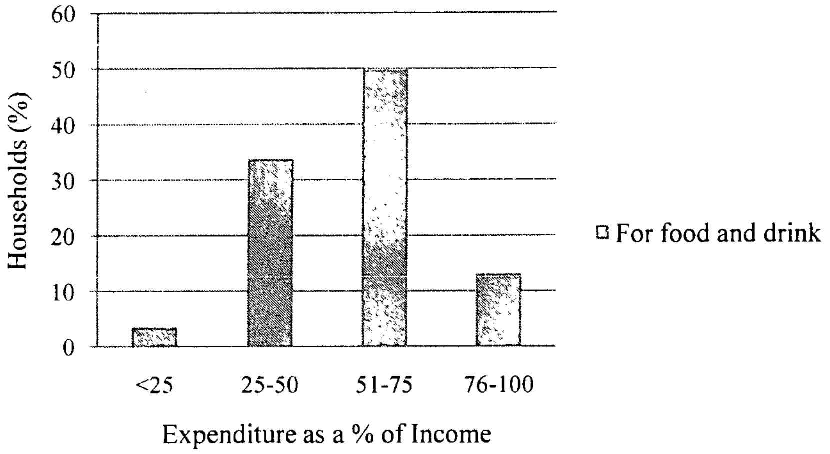


Source: Author's Survey data, 2008

4.6 Household Expenditure

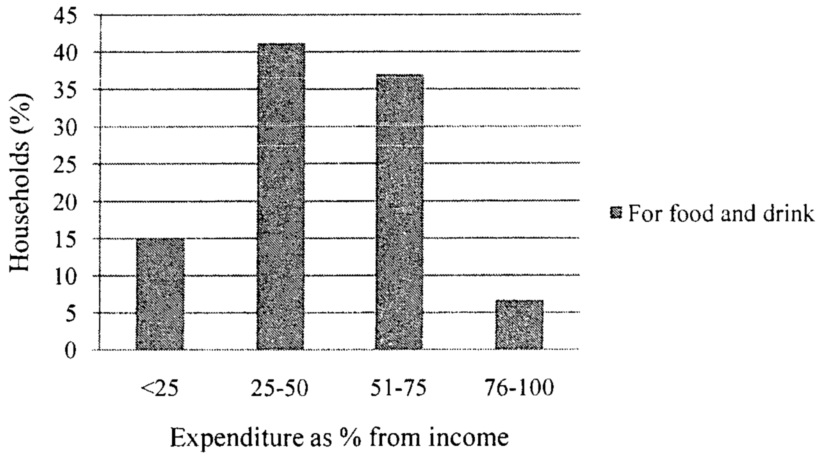
About 63 percent of the sample households in Middle Nilwala SW area and 44 percent in Urubokka SW area spend more than 50 percent of their annual income on food (Figures 4.5 and 4.6). This is true for about 44 percent in Urubokka SW area. Households which are spending more than 76 percent of their income for food items are 13 percent and 6 percent in Middle Nilwala and Urubokka SW areas respectively indicating hand to mouth existence.

Figure 4.4: Expenditure on Food and Drink items in Middle Nilwala S.W.



Source: Author's Survey data, 2008

Figure 4.5 Expenditure on Food and Drink items in Urubokka Ganga S.W.



Source: Author's Survey data, 2008

4.7 Obtaining Loans for Farming

Obtaining loans for agricultural purposes was 22 percent in Middle Nilwala SW and 31 percent in Urubokka Ganga SW areas. Tea growers had obtained the highest percentage of loans for agriculture. Loans obtained for paddy cultivation is about 8 percent and 7 percent in Middle Nilwala and Urubokka SW areas respectively (Table 4.5).

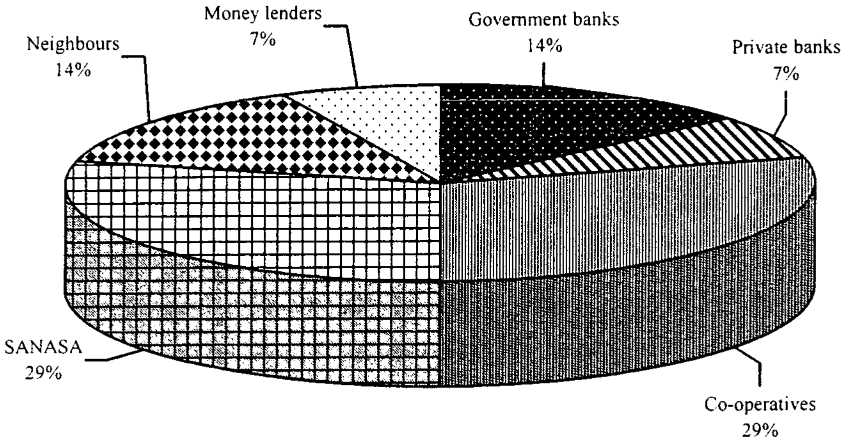
Table 4.5: Purpose of Obtaining Loans in the Two Sub-Watershed Areas

Purpose of the loan			Sub-watershed		Total	
	Middle Nilwala		Urubokka Ganga			
	No.	%	No.	%	No.	%
Paddy cultivation	9	8	5	7	14	8
Tea cultivation	10	9	15	21	25	14
Cinnamon cultivation	2	2	0	0	2	1
Other crop cultivation	3	3	2	3	5	3
Other needs	83	78	48	69	130	74
Total	107	100	70	100	176	100

Source: Author's Survey data, 2008

Loan amounts taken for paddy cultivation varied from Rs.5,000 to Rs.100,000. Majority of these loans had been obtained from *SANASA* development bank and co-operatives in the area (Figure 4.6). *SANASA* development bank had provided loans ranging from Rs.10,000 to Rs.100,000 for cultivation of paddy.

Figure 4.6 Source of Loans for Paddy Cultivation in the Study Area



Source: Author's Survey data, 2008

4.8 Housing and Other Facilities

Housing can be defined as living environment which consists of the dwelling unit and supporting facilities such as water supply for domestic uses, sanitary facilities and basic community facilities. Housing situation of the sample farmers is at a satisfactory level. Almost all the houses are owner occupied and permanent houses had been built on their ancestral land. Walls of about 76% of the houses were made of bricks. Another 10% of the houses had walls made from cement blocks, while 14% had other materials such as cabook, mud, etc. Type of roof was tiles in about 85% of the houses, while others had asbestos sheets, metal sheets etc. as roofing material. Safe sanitation is mainly influenced by the type of access and type of latrine available. At present in Sri Lanka, there are about 93-94% of people who have access to some type of latrine, while about 72% have access to water sealed type latrines (DCS, 2002a). All houses under the survey had water sealed toilets. In Urubokka sub-watershed, about 8% of the houses had latrines inside the houses and about 16% in Middle Nilwala sub-watershed. According to the respondents in both sub-watershed areas about 90% are satisfied with the health facilities available in the area. Access to local facilities such as electricity and telephones were at a satisfactory level.

4.9 Access to Water

Source of domestic water can be considered as a measure of quality of life. Access to safe drinking water is an important factor effecting good health of people. In Sri Lanka, lack of access to safe drinking water has been identified as an important factor contributing to high morbidity from diarrhoeal diseases (SNWDR, 2006). Generally in Sri Lanka, there are about 75% households with access to safe drinking water. However, there are variations between different sectors in the country (DCS, 2002b). In the study area, water for domestic uses is taken from wells, public water supply and common water bodies such as rivers and streams. About 64% of the population's source of domestic water supply is a well which is either situated inside or outside their homesteads. Others obtain water for domestic requirements from water supply pipes, rivers, etc.

CHAPTER FIVE

Summary of Findings and Recommendations

Findings

Paddy is the main crop cultivated under anicut systems both in *yala* and *maha* seasons in the study area. Cultivation of other crops in the irrigated area is only on a small scale for home consumption. Generally, there is abundance of water to cultivate paddy in both seasons. Cost of production of paddy is high in the area due to lower levels of yield per acre. Though the contribution by the anicut irrigated paddy to the annual household income is only a small proportion, the farmers have not shifted to other field crops (OFCs). Main purpose of the farmers cultivating paddy is provision of their own rice requirement. More than 70 percent of the produce is for home consumption, while another 10 to15 percent is used to settle payments to local merchants for inputs such as seed paddy, agro-chemicals, etc.

There are no serious issues regarding water sharing as there is no scarcity of water. However, the maintenance of the system is generally poor and participation of the respective farmers in maintenance of the system is not adequate. Though farmers' societies exist in the area, the farmers use those mainly for obtaining the subsidized fertilizer from the government.

In the study area, there are about 20 to 30 percent abandoned anicut schemes. Main reasons for abandoning these anicut systems is abandoning of paddy lands that were cultivated under those anicut schemes and improper placement of these anicut systems.

Economic diversification is high at the household level. Though majority of the sample are involved in farming as their main employment, the majority of the households in both sub-watershed areas get more than 75 percent of their annual household income from non-farm activities. However in the study area, there was no marked difference in socio economic status as well as economic diversification from one sub-watershed to the other. Situation is more or less equal from one anicut to the other even among the two sub-watersheds.

The fact that they have cultivated these paddy lands continuously without abandoning, even with the lower economic output, indicate the important role played by the anicut irrigated paddy in maintaining the household food security. Therefore, necessary changes should be implemented to increase the productivity of these paddy lands to get the maximum return for the huge investment made on subsidized fertilizers, while assuring the food security at household level.

Recommendations

- The participation of the farmers in anicut system maintenance should be made a pre requisite to obtain subsidized fertilizers. Then they will take an interest in anicut maintenance.
- Renovating anicut systems should be done after a systematic prior investigation of the farmers traditional knowledge and wisdom on the hydrological environment of the area and the location of the existing irrigation works.
- Productivity of lowland in the Nilwala river basin should be increased by introduction of high yielding rice varieties suitable for the locality and strengthening the agricultural extension service to provide instructions to overcome frequent pests and diseases.
- Measures should be taken to minimize the environmental consequences that had taken place after the implementation of the Nilwala flood protection scheme so that currently abandoned paddy lands in the Middle Nilwala sub-watershed could be re-cultivated.

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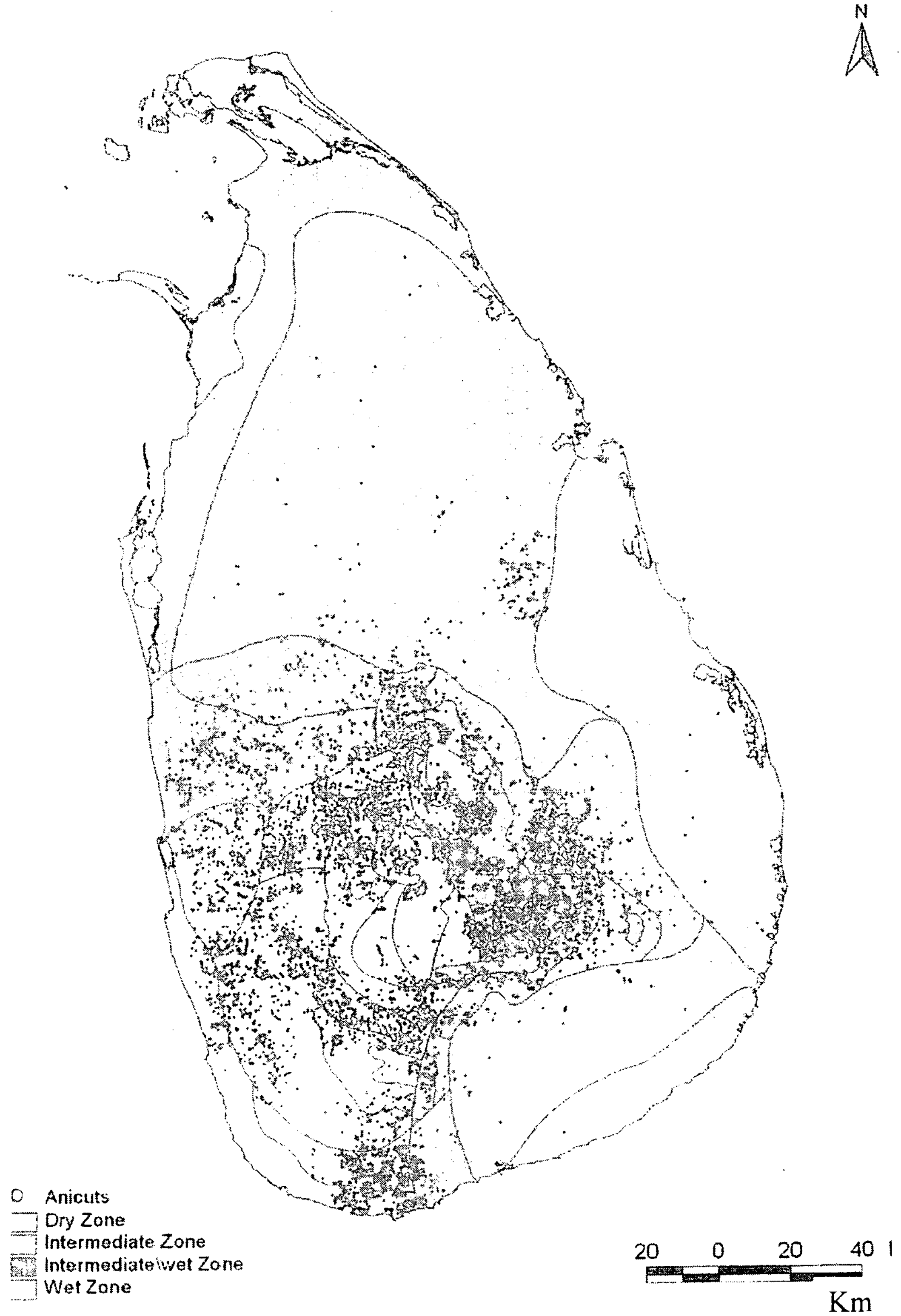
Annex 1: Distribution of Anicut Schemes in Sri Lanka



Source: International Water Management Institute

Annex II: Cost of Cultivation of Paddy in Nilwala River Basin - 2008 Yala

Sub Watershed	Activity	Mandays per acre	Cost (Rs./Ac.)			
			Labour (with family)	Labour (without family)	Machinery	Input
Middle Nilwala	Cleaning bunds and canals	3.53	1847.36	529.73		
	1st and 2nd Ploughing	2.72	1482.72	500.01	3702.55	
	Plastering bunds	3.60	1953.55	889.81		
	Leveling	1.25	645.90	266.67		
	Broadcasting	4.94	2882.13	1858.70		2262.36
	Weed controlling (hand)	1.75	1008.33	566.67		
	Weed controlling (weedicides)	0.69	364.75	64.58	416.72	1663.79
	Application of fertilizer	0.66	329.61	0.00		1045.33
	Pest and diseases controlling	0.46	236.98	29.17	416.72	1575.41
	Harvesting	7.52	4517.05	3735.19		
	Threshing	3.79	2185.64	999.61	7080.38	
	Winnowing	2.82	1556.45	510.84	596.54	
	Transport	1.59	836.49	240.00	305.26	
	Total cost (with imput cost of family labour)				**Rs. 38,902.72**	
	Total cost (without imput cost of family labour)				**Rs. 29,216.04**	
Urubokka Ganga	Cleaning bunds and canals	3.20	1684.21	387.03		
	1st and 2nd Ploughing	1.95	980.31	51.62	4593.50	
	Plastering bunds	4.21	2215.23	717.85		
	Leveling	0.98	489.15	35.71		
	Broadcasting	4.56	2809.01	1124.67		3354.46
	Weed controlling (weedicides)	0.72	362.41	42.75	224.55	1738.10
	Application of fertilizer	0.66	345.76	0.00		1001.08
	Pest and diseases controlling	0.66	327.90	40.00	224.55	856.46
	Harvesting	7.68	4565.80	2743.46		
	Threshing	4.04	2180.28	826.32	8355.09	
	Winnowing	2.88	1529.35	451.42	898.34	
	Transport	0.67	335.80	0.00	255.00	
	Total cost (with imput cost of family labour)				**Rs. 39,326.32**	
	Total cost (without imput cost of family labour)				**Rs. 27,921.95**	

Source: Author's Survey Data, 2008

Cost of Cultivation of Paddy in Nilwala River Basin - 2007/08 *Maha*

Sub Water shed	Activity	Mandays per acre	Cost (Rs./Ac.)			
			Labour (with family)	Labour (without family)	Machinery	Input
Middle Nilwala	Cleaning bunds and canals	2.85	1502.07	508.70		
	1st and 2nd Ploughing	2.52	1335.94	413.79	3549.37	
	Plastering bunds	3.73	2030.16	935.74		
	Leveling	2.02	1070.99	590.27		
	Broadcasting	4.92	2834.11	1833.01		2163.74
	Weed controlling (hand)	3.43	2143.33	1626.67		
	Weed controlling (weedicides)	0.45	224.52	6.06	416.90	1551.30
	Application of fertilizer	0.65	324.43	17.24		1056.43
	Pest and diseases controlling	0.52	268.14	57.14	416.90	1289.02
	Harvesting	7.17	4274.99	3515.79		
	Threshing	3.58	1973.81	907.16	6884.45	
	Winnowing	2.56	1381.07	400.64	569.13	
	Transport	2.10	1116.37	400.00	286.10	
	Total cost (with imput cost of family labour)				**Rs.38,663.28**	
	Total cost (without imput cost of family labour)				**Rs.29,395.56**	
Urubokka Ganga	Cleaning bunds and canals	2.86	1498.46	316.62		
	1st and 2nd Ploughing	1.85	965.51	88.06	4557.67	
	Plastering bunds	4.04	2086.24	619.67		
	Leveling	0.95	502.84	64.29		
	Broadcasting	4.22	2527.14	1088.81		2925.38
	Weed controlling (hand)	0.50	250.00	0.00		
	Weed controlling (weedicides)	0.73	363.76	45.00	294.71	1667.76
	Application of fertilizer	0.63	329.28	0.00		1011.27
	Pest and diseases controlling	0.68	337.77	35.56	294.71	1092.58
	Harvesting	7.67	4528.13	2881.76		
	Threshing	4.51	2356.17	1026.57		7901.78
	Winnowing	3.06	1614.47	536.35		916.39
	Transport	0.53	262.88	0.00		255.00
	Total cost (with imput cost of family labour)				**Rs.38,539.88**	
	Total cost (without imput cost of family labour)				**Rs.27,619.92**	

Source: Author's Survey Data, 2008

Annex III: Cost of Cultivation of Paddy in Gampaha and Kalutara Districts

Activities and Inputs	**Gampaha**		**Kalutara**	
	Labour days	**Cost (Rs.)**	**Labour days**	**Cost (Rs.)**
Labour Cost Land preparation	6.8	3,282	5.47	2,710
Planting	4.87	2,352	4.42	2,190
Fertilizer	1.07	517	0.54	268
Weed control	1.26	608	1.47	727
Pest control			0.94	465
Harvesting	12.98	6,267	12.27	6,072
Threshing	4.58	2,212	4.04	1,999
Winnowing	2.46	1,186	2.16	1,071
Transport				
Total	34		31.32	15,502
Input Cost				
Seed		1,490		1,429
Fertilizer		1,009		792
Agro-chemicals		1,732		2,402
Other				
Cost of machinery		7,785		7,015
Total cost (IIC)		**28,440**		**27,142**
Total cost (EIC)		**13,588**		**16,677**

Source: HARTI Data Bank, 2008

Annex IV: Explanation of Different Land Tenure Types

Jointly owned:
Ownership is shared among the shareholders of a particular immorable property. Individual decisions which can affect the property cannot be taken. There are different kinds of joint ownership categories such as;

Tenancy rotation (*Thattumaru* system):
By making a mutual agreement or according to a court order, the owners of the holding take turns to cultivate the paddy land. The individual who cultivate the land takes the total harvest alone.

Benefit rotation (*Kattimaru* system):
When several holders share the ownership of several plots of land in different locations or in the same location under different facilities, those lands are rotated among the holders for an agreed period to equalize the benefits of lands. For example if A, B, and C own the land called X, Y and Z, the utilization of these lands are agreed on yearly rotation basis. Three years in one each of A, B, and C operates the land X, Y and Z.

Land leasing system (*Badu*):
Badu is "leasing". Under the *badu* system, a farmer can use the leased land for a defined period according to an initial agreement. The beneficiary (farmer) has to pay leasing payment monthly or annually irrespective of profit or loss.

Land mortgage system (*Ukas*):
Ukas is the term for mortgage. Under this system, the person to whom property is mortgaged can enjoy the benefit of the land until the mortgagor make the payment to redeem his land. If the mortgagor fails to redeem the land under the agreed person, title is transferred to the mortgagee.

Share cropping (*Ande*):
Under the *ande* system, a farmer cultivates a holding owned by another party subject to the conditions agreed upon mutually between the farmer and the land owner. Agreed condition may be based either on a cash rental or on the basis of share cropping. Before 1956, the law obliged a property owner to supply the tenants with seeds, fertilizer, half the labour cost, etc. in exchange for half of the harvest. But in 1956, the Paddy Lands Act changed the conditions. At present, the owner has a right to the tenant to bear all the expenses of cultivation.

Annex V: Distribution of Working and Abandoned Anicuts, Anicut Command Areas and Number of Benefiting Farmer Families

District	Number of Working Anicuts	Number of Abandoned Anicuts	Command Area (acres)	Number of Benefiting Farmer Families*
Colombo	210	49	4848	7,226
Gampaha	395	165	11448	15,292
Kalutara	401	105	14695	22,968
Kandy	1586	118	21175	31,849
Matale	759	42	13687	19,198
Nuwara Eliya	1112	30	21267	32,130
Galle	504	26	16973	17,155
Matara	825	93	28083	32,808
Hambantota	32	1	893	892
Jaffna	-	-	-	-
Mannar	3	6	61	61
Vavuniya	9	1	694	506
Mullativu	3	1	277	99
Batticaloa	17	14	1885	554
Ampara	46	37	4162	1,568
Trincomalee	-	1	250	151
Kurunegala	657	104	19697	23,423
Puttalam	63	33	3428	2,256
Anuradhapura	8	1	398	152
Polonnaruwa	119	17	10983	5,221
Badulla	3571	71	32089	55,757
Monaragala	325	47	5400	6,173
Ratnapura	1436	67	28173	45,825
Kegalle	809	32	10522	18,095
Kilinochchi	-	-	-	-

* Number of farmers working under the schemes as per farmers opinion and verified with the paddy land register and share list.

Source: DAS, 2000