Impacts and Lessons of Uda-Walawe Left Bank Irrigation Upgrading and Extension Project for Water Resources Management

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FOREWORD

Management of scarce water resources is a challenging task and requires innovative ideas and commitment from all the stakeholders to realize that goal. The challenge has inflated with the growing population, accelerated development and climate change. Walawe scheme is traditionally a water deficit scheme and had failed to achieve the planned target of the original project for a long period of time. Therefore, the strategies adopted by the Walawe Left Bank Improvement and Extension Project (WLBP) to address the water scarcity problem using the same quantity of water to cultivate additional 5000ha without affecting the existing water users are noteworthy in the realm of efficient water resources management.

Reusing or recycling of water is one of the promising irrigation technologies promoting water saving, water use efficiency and water productivity. It is well known that our ancient tank cascade system is centred on this concept and working very well in the dry zone areas. The WLBP has appropriately blended the idea of cascade system with the project though the construction of new high tank system and linked to the existing low tank system. The novel idea of dual canal system with a dedicated channel for non-paddy crop cultivation has boosted the low water intensive non paddy crops. Evidence showed that around 70 % of the farmers were satisfied with the interventions and able to double the income. This is a great achievement both in the water resources management and rural development.

The report has very well documented the approach of the intervention and the promising ways of increasing irrigation efficiency and agricultural productivity through the innovative components adopted by the project. Though it is not a panacea for all irrigation water use problems, there is a great potential for using these components as appropriate for many water scarce schemes in the country. I believe, the lessons learned and reported here should be utilized for the benefit of the country and to improve the livelihood of the farming community.

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Director

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EXECUTIVE SUMMARY

The Left bank (LB) area of the Walawe scheme had a gross extent of 30,000 ha, but until 1993, only part of the Northern half (5,350ha) was developed and the Southern half remained undeveloped, where *chena* or rain-fed cultivation had been practised on small patches of land. Irrigation water use in the Udawlawe Right bank (RB) area far exceeded the original expectations and threatens to curtail further development of both banks. The Walawe Left Bank Upgrading and Extension Project (WLBP) was designed and implemented in two phases. The phase-I was launched in 1997 with the aim of rehabilitating and upgrading the "old" irrigation facilities (existing irrigated areas) in the Northern half of the LB. The phase II of the project was designed to develop new areas for cultivation in the Southern half of the LB. The project targeted 5,800 farmer families and 3,150 non-farmer families. The project opened up about 5,150 ha of new lands.

Considering the water use inefficiency and water scarcity in the scheme, the project had experimented several new interventions to increase the water and land productivity, viz; improvement/augmentation of 19 low tank systems and construction of 45 new high tanks (night tanks), construction of the dual canal system considering two different types of lands (one channel is exclusively for paddy and other one is for non paddy crops), introduction of water saving '*parachute'* method of paddy cultivation, cultivation of biennial and perennial fruit crops under irrigation, capacity building of farmers and farmer institutions to change their attitudes on water use and to crop diversification and the introduction of strict water management practices.

The main objective of the research was to evaluate the new hardware and software components adopted in WLBP for irrigation rehabilitation, crop diversification and institutional strengthening. Study sites were selected both from the new extension area and newly rehabilitated old area of the Left bank under the Phase-II of the rehabilitation project.

The findings of the study indicate that, construction of high tank and low tank system using the cascade concept and construction of the dual canal system were successful interventions and have helped to improve the water use efficiency though reusing of water within the scheme as perceived by 70-80 percent of farmers. The project was successful in reducing the water loss and increasing the extent of cultivation through crop diversification and educating the farmers to change the attitudes in neglected water use. 'Parachute' method of paddy cultivation has failed to get popular due to the requirement of skilled labour and increased number of labour days to use the particular technology, though it has provided a higher yield with low water requirement. Agricultural produce marketing centres were not successful and only 10% of the farmers had ever utilized the centres. Providing perennial fruit crops to be cultivated under the irrigation is a success and almost all the plants provided have survived in 40-70% of the farmers' field at the time of survey.

Banana is the most popular non paddy crops (NPC) cultivated under crop diversification and has resulted greater water use efficiency and recorded an enormous income increase. The project has been able to double the farm income of 70% of the farmers in the area. The most serious problem affecting the livelihoods and income earning of the people in the area is the damage caused to the crops and livelihood assets by wild elephants and stray cattle.

One of the important lessons of the project is that, provision of systematic training and awareness to change the attitudes and perceptions of the farmers to shift from paddy mono crop to NPC cultivation while strengthening local level organizations, extension support, demonstration, establishment of market linkages and provision of subsidies at initial stages to motivate the farmers had been a success. It is recommended to persuade farmers to cultivate high value banana instead of low price '*Embul*' variety to entertain higher income. It is not advisable to promote labour intensive techniques in paddy cultivation, unless the economic gain of the technology is higher than the opportunity cost of labour. As soil salinity is building-up in the area, it is important to develop sufficient drainage and empower the farmers to use local and traditional systems to ameliorate salinity problems.

Reduction of conveyance losses and reuse of water by enhancing the capacity of the storage system, concrete lining of the distributory canal system and introducing field level dual canal system are able to improve the irrigation system performance effectively. The project should carry out more advocacies on the lessons and experiences towards commercialization of irrigated agriculture and climate change adaptation.

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CHAPTER ONE

Introduction

1.1 Background

Uda Walawe irrigation and resettlement project was initiated after the Independence with the construction of headworks. The downstream development was initiated during the 1950s. Part of the downstream development progressed with the construction of Chandrika wewa reservoir across the Hulanda River, which is one of the tributaries of Walawe River. The construction of the multi-purpose Uda Walawe reservoir was initiated in the 1960s and completed in 1967. The total area under the reservoir at the full supply level is 3,413 ha. The gross water storage capacity of the reservoir is 268.7 Million m^3. The Walawe scheme has the catchment area of 1,175km^2.

In 1969, the Government of Sri Lanka (GoSL) obtained financial support from the ADB to develop the Right bank area (RB) of 12,369 ha. The project provided water for double cropping and intensive agriculture. However, excessive water use by RB farmers hindered the development of the left bank area. This was very well highlighted in the ADB (1979; in IWMI, 2005, P. 14) that, "*irrigation water use in the project area far exceeds original expectations and threatens to curtail further development of both banks. Only about 70% of RB area envisioned for irrigation at the time of appraisal is actually served and this area is consuming three times the water proposed for the entire RB area. Only the lack of development in the LB has permitted this excessive use*".

The Left bank area had a gross extent of 30,000 ha, but until 1993 only part of the Northern half (5,350ha) was developed, and the southern half remained undeveloped basically covered by thorny scrub, where *chena* or rain-fed cultivation had been practised on small patches of land. In this context, the government decided to further develop the scheme with donor assistance under the Walawe Left Bank Upgrading and Extension Project (WLBP).

1.1.1 Walawe Left Bank Upgrading and Extension Project

The Walawe Left Bank Upgrading and Extension Project (WLBP) was designed during 1994/95 with the financial assistance of JICA and implemented during 1996 to 2008 in order to maximize the utilization of available land and water resources. The government anticipated that the project would solve the problems in water use inefficiency in the scheme and improve the living standards of the farming community.

The WLBP was implemented in two phases. The phase-I was launched in 1997 with the estimated cost of US$ 34million (1995 prices). The major aim of the first phase was to rehabilitate and upgrade the "old" irrigation facilities (existing irrigated areas)

in the Northern half of the LB. The phase-I covered the extent of 2900 ha of existing irrigated lands and the development of 1,040 ha of new lands located in the block areas of Kiri-ibban wewa and Sooriya wewa. The conveyance losses in the old areas were reduced by the concrete lining of the distributory and field channels. On farm water management was improved by rotational water issues and crop diversification.

1.1.2 The Walawe Left Bank Upgrading and Extension Project Phase II

The phase-II of the project was designed to develop new areas for cultivation in the Southern half of the LB. The project targeted 5,800 farmer families and 3,150 non-farmer families. The project opened up about 5,150 ha of new lands. The estimated project cost was US$ 110 million for the establishment of 12 settlement units with irrigation and other basic social infrastructure, construction of 19.5 km of Left bank main canal, development of 45 new high tanks, improvements of 19 low tanks and over 500 km of distributory and field canal networks. The project covered the Mayurapura and Thissapura block areas.

The upgrading and extension project anticipated to achieve the following objectives; i) to increase food self-sufficiency by increasing rice production and production of other field crops (OFCs), ii) to increase employment opportunities, iii) to mitigate environmental degradation, iv) to boost regional economic development and v) to alleviate poverty.

The main feature of the project in the context of water management is that, the same quantity of water utilized only by the existing areas of the Left bank must be used by both existing and new extension areas, after the project. The project adopted a number of innovations and strategies to achieve the objectives through improved water use efficiency.

1. **Improvement/Augmentation of existing low tank systems and construction of new high tanks**

The project made interventions to rehabilitate and augment the 19 existing low tanks in the phase-II area through heightening the tank bunds, repairing and replacing of various irrigation structures (gates, valves, and measuring devices) and development of new drainage canals.

The project had carried out several new constructions and management strategies to increase the water distribution efficiency, including the concrete lining of delivery channels to reduce the conveyance losses.

One of the major innovations in Sri Lanka was construction of high tanks in the upland area primarily to store water during the night time, otherwise which is freely flowing through the channels as drainage water without being used for cultivation. The project constructed 45 new high tanks and connected those to the irrigation network. These tanks were interconnected by the Branch Canals of the Walawe Left

Bank Main Canal. This system facilitates the reuse of the return flow from one tank to the other using the undulating nature of the land. The system was considered as the method to use irrigation water more efficiently and economically.

High tanks were constructed mainly in areas with high permeable soil type to cultivate non-paddy crops. These lands are called by the project as UD land. Low permeability soil type areas are primarily for paddy cultivation and called as PD lands.

2. Construction of Dual Canal System

The project has introduced innovative 'dual canal system' considering the two different soil types in the upland and lowland. One channel is designed exclusively for paddy and other one is for other field crops. The technique aimed at promoting cultivation of other field crops by using water more efficiently. Paddy cultivation requires basin irrigation, where as Non Paddy Crops (NPCs) needs furrow irrigation. Irrigation scheduling and water requirement also vary between paddy and NPCs.

3. 'Parachute' Method of paddy cultivation

A new method of paddy cultivation called 'parachute' method, which requires a lower amount of water and produces a higher yield was introduced. 'Parachute' is a rice transplanting technique involves planting of seedlings in a nursery under flexible plastic trays. Two to three pre-germinated seedlings (14-16 days old) with soil are thrown sporadically high in the air in a projectile manner. The soil pug attached to the root provides less stress to the plant compared to the traditional method of transplanting.

4. Cultivation of biennials and perennial fruit crops under irrigation

The project promoted cultivation of papaya, banana, grapes, vegetables and other fruit crops in the irrigated field with the collaboration of Department of Agriculture. Farmers were trained to cultivate banana at eight foot spacing and maintain single plant bushes to obtain higher yield than the traditional method of cultivation. Micro irrigation technologies were also promoted to irrigate banana crops. Cultivation of perennial fruits crops under the irrigation is a new experience to Sri Lankan farmers. The project provided plating materials and other much needed extension support to cultivate perennial fruit crops at the initial stages.

5. Capacity building of farmers and farmer institutions

The project provided training and capacity building for Farmer Organizations (FOs) to change their attitudes on water use and to shift from paddy to NPCs. In the expansion areas of the scheme, FOs were newly created as majority of the farmers were new settlers or new to irrigated cultivation. Training was also given on the operation and maintenance of distiributory canals (DCs) and field canals (FCs),

agricultural development, water management, organizational management, financial management and income generation activities.

6. Water Management

The project made more efforts to implement strict water management strategies at field level, while saving water by using new infrastructure such as concrete lining, augmentation of low tanks, construction of new high tanks and concrete lining of canals. Farmers were trained to follow strict water schedules, especially for rotational water issues.

1.2 Rationale/Justification of the Study

The Uda Walawe scheme is a water scarce scheme and water use amount is also reported to be very high, which was leading to non utilization of the most of the land area for irrigated agriculture. Therefore, improving the water use efficiency with limited available water resources is an important requirement to develop the livelihood of the people in the area. WLBP project has experimented several new interventions to increase the water and land productivity using the limited available water.

The past data shows that, annual extent cultivated in the Uda Walawe project area has increased from 19,388 ha in 2006 to 27,081 ha in 2010, while increasing the average yield of 5.5 mt/ha to 6.4 mt/ha (MASL, 2010). However, the research findings show that, though the irrigation system has operated effectively in the existing areas, the irrigation efficiency with the improvements made is much below the design (Pitigala and Ratnayake, 2009).

Therefore, it is important to know the underlying technical, social, economic, and institutional causes of the existing achievements and setbacks of the project interventions. The lessons learned from the interventions made by WLBP are useful inputs to improve the water use efficiency and also to propose recommendations for disseminating the knowledge on innovative strategies adopted.

1.3 Objectives

The main objective of the research is to assess the new hardware and software components adapted for WLBP for irrigation rehabilitation, crop diversification and institutional strengthening. The specific objectives are:

1. To review the performance and experiences of various innovative interventions made for the project
2. To examine the impacts of the project on cultivated extent, crop diversification and farmers' income
3. To draw lessons for the improved water management in other irrigated areas

CHAPTER TWO

Methodology

2.1 Selection of Study Sites

Site selection was done considering the new extension area and newly rehabilitated old area of the Left bank under the Phase-II of the rehabilitation project (Figure 2.1). A detailed questionnaire survey was conducted in the new extension area, addressing various innovative interventions to find out the relevance and the effectiveness of the interventions. In the selection process, head, tail differences and the UD and PD land areas were considered.

Four FO command areas (DC channel areas) were selected for the detailed questionnaire survey from the Walawe new extension area. Two of the selected FOs were located at the head end of the extension area, while the remaining two FOs were from the tail end areas. Out of the two FOs selected from the head and tail areas, one each represented PD and UD lands.

In addition to the above four sites, another four sites were selected outside the extension area from KiriIbban wewa and Sooriya wewa blocks in the LB canal command for rapid assessment. The areas selected to represent Kiriibban wewa block were Ranketha FO at MD_3 channel and Sri Mevan FO. Other two FO command areas namely Perakum FO located in BBD_5 and Ranketha FO were selected from Sooriya wewa block.

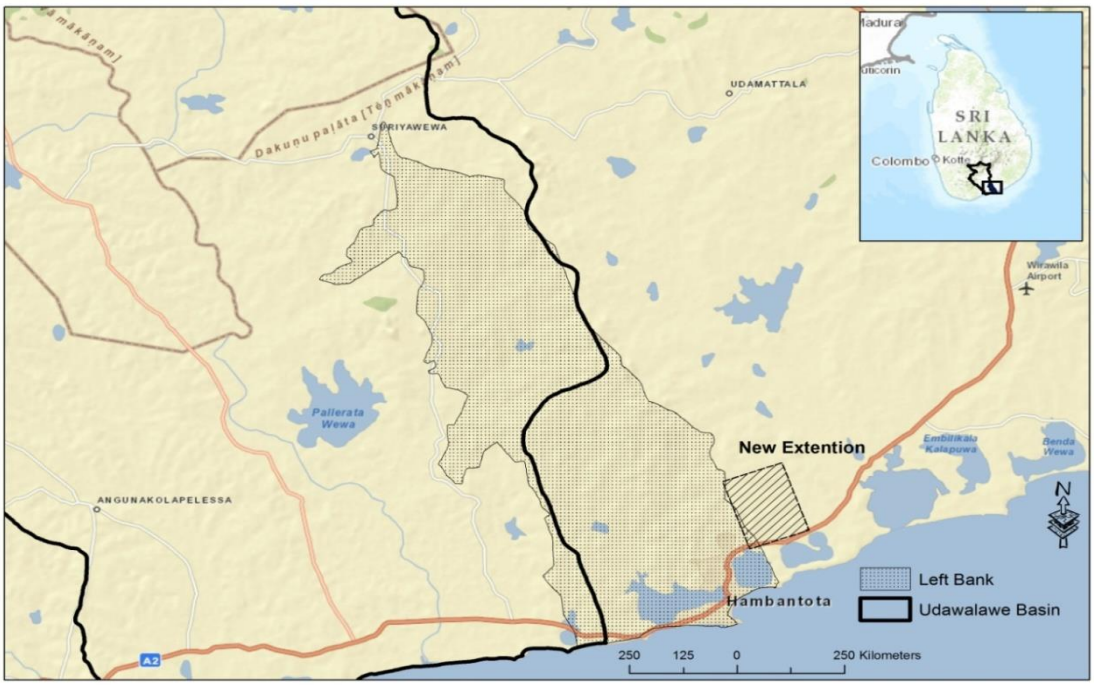


Figure 2.1: Uda Walawe Left Bank and the New Extension Area

2.2 Data Collection Methods

The quantitative and qualitative data necessary for the study were collected from primary and secondary sources. The study has adopted the following technical approaches in the collection of necessary data and information.

i. Review of literature: A methodical literature review was undertaken by referring a number of unpublished reports such as baseline survey report, business plan of the project, partner donor reports, and progress review meeting minutes of the project. Secondary data on water release, water duty, extent cultivated, type of crops cultivated, yield levels, etc. were collected from the Mahaweli Authority of Sri Lanka.

ii. Key informant interviews: Guided interviews were conducted among office bearers of the FOs and other rural organizations in the project sites, and officials of relevant government agencies. A checklist was prepared to guide the interviews using the information gathered from the literature review.

iii. Focus group discussions: A series of focus group discussions were conducted in the selected villages targeting members of the FOs and field level officers, different farmer groups representing paddy, and NPCs cultivators. The focus group discussions were conducted using a checklist prepared from the initial information distilled from the literature review and the key informant discussions.

iv. Questionnaire survey: Primary data was collected from the selected villages (units) in the WLBP phase II area. Four units were selected purposively to represent the head and tail ends of the project area and high tank (UD lands) and low tank (PD Land) areas. A multi-stage sampling technique was applied to the household survey. At the first stage, villages were selected to represent the head and tail areas. At the second stage, Farmer Organization (FO) areas were selected to represent a high tank and low tank areas. At the final stage, households were selected randomly from the selected FO areas. The total sample size was 120. The sample size of the UD land areas (high tank) and PD land areas (Low tank) were 60 each. The sample size of the each FO area under the each land category was based on probability, proportional to the size of the population within the total sample size of 60. The pattern of sample distribution is given in the Table 2.1.

Table 2.1: Sample Size Distribution

Unit Number	Type of Land	Name of the Canal	Location of the Canal	Population Size-No. of Households Settled in the Area)	Sample Size
Unit 1	UD	UD -6	Head end	75	40
Unit 9	UD	UD- 74	Tail end	25	20
Unit 2	PD	PD -10/11	Head end	44	30
Unit 12	PD	PD -88	Tail end	35	30

The variables and indicators for the assessment were finalized after the review of literature and key informant interviews. The following parameters were considered for the detailed analysis.

i. Approach of intervention and the relevance, major components, community mobilization
ii. Establishment of community institutions- strength, suitability, effectiveness of the institutional arrangements, participation and cooperation of the beneficiaries and other line agencies with the established institutional arrangement, problems encountered
iii. Performance of New interventions- dual canal system, up and low tank systems, canal linings, crop diversification, parachute method of cultivation
iv. Water management techniques adopted and farmer perceptions, appropriateness
v. Impacts on rural livelihoods- changes in income
vi. Post project situation- operation and maintenance, continuation of other activities, sustainability

2.3 Data Analysis

The qualitative and quantitative data collected through various techniques was analyzed using simple statistical methods and trend analysis.

CHAPTER THREE

Demographic, Socio-economic and Institutional Characteristics of the Study Areas

3.1 Beneficiary Selection for New Settlement

The main objective of the expansion project was to develop livelihood opportunities to the landless farmers within the Walawe area by providing agricultural lands. According to the survey findings, out of the total sample, 82% of the farmers in the extension area were fulltime farmers and they were dependent on farming activities for their primary income source prior to the settlement in the new area. The remaining 18% were not primarily dependent on agriculture for their livelihood. Out of the total full time farmers, the majority (66%) already lived within the Walawe Left bank command area and 7% were settled in the Walawe Right bank area. However, the rest of the fulltime farmers (11%) were newcomers to the Walawe scheme.

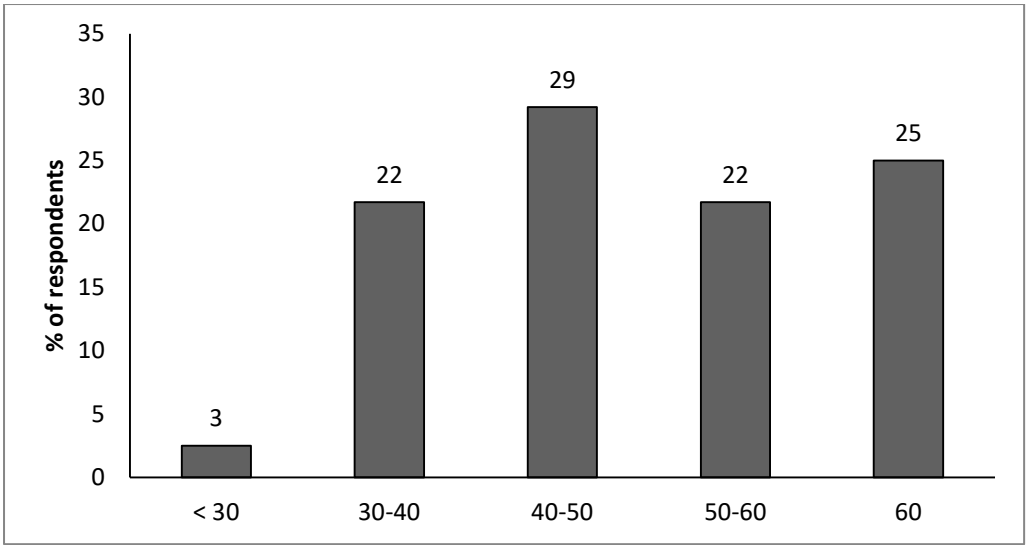
The majority of the beneficiaries (75%) who were settled within the Walawe command area were landless and cultivated in the encroached lands or mortgaged land operators. Out of the total beneficiaries selected from the Walawe area, only 10% had operated their own plots of land and another 12 % had a shared tenancy with their family members prior to allocation of irrigated land in the extension area. Therefore, the project by and large had selected landless families to the settlement.

3.2 Age Distribution (of the Selected Beneficiaries) in the Sample Population

The age distribution of the sample farmers indicated that, the majority of them (75%) were over 40 years of age and about 50 percent were more than 50 years old, signifying the lesser involvement of youth in farming and related activities in the area (Figure 3.1).

3.3 Educational Status

According to the survey results, the level of education of the majority of farmers (53%) was between grade 5 to G.C.E. Ordinary level, while 38% of the farmers had only the primary education. However, there were only 4% of farmers, who had not received formal education.



Source: Authors' Survey Data (2013)

Figure 3.1: Age Distribution of Sample Farmers

3.4 Current Land Ownership

According to the findings, all the farmers responded to the survey had owned lowland slots which were given under the Walawe Left Bank Extension Project (WLBP), and the slots were in the size of 2-2.5 ac each. In addition to that, 24 percent of the sample had operated additional 'lowland' slots acquired through various tenurial arrangements as well as outright purchase. As shown in Table 3.1, out of the total 'additional land' owned farmers, 17 percent had leased land and the value of freehold land was 3 percent.

Table 3.1: Ownership to 'Additional' Lowlands

Type of Ownership	No. of Respondents (N=29)	%
Owned though purchasing	3	3
Leased in	20	17
Share tenancy	3	3
Encroached	2	2
Total	**29**	**24**

Source: Authors' Survey Data (2013)

With respect to 'upland' land slots, the beneficiaries were provided 'upland' slots in the size of 0.25 ac, but, some of the respondents had not received any legal documents for their 'upland' land slots at the time of survey.

According to Table 3.2, around 20% of the sample farmers operate lowlands under the different tenurial arrangement, in addition to their owned lands, indicating that, a considerable proportion of the originally selected farmers have not been settled in

the area. The extent of land cultivated under the different tenurial arrangements accounted for 13% of the total irrigated lowlands and 35% of the total irrigated uplands (Table 3.3).

Table 3.2: Types of Ownership of Lowlands under Different Tenurial Arrangements

Type of ownership	PD Lands		UD Lands	
	No (N=60)	%	No (N=60)	%
Single owner	60	100	59	98
Shared ownership	1	2	-	-
Shared tenancy	3	5	-	-
Leased in	9	15	11	18
Encroached land	-	-	2	3
Purchased land	-		3	5

Source: Source: Authors' Survey Data (2013)

Table 3.3: Total Land Extent Cultivated under Different Tenurial Arrangements

Type of ownership	PD Lands		UD Lands	
	Total Irrigated Extent Cultivated (Ac)	% of Total Irrigated Extent Cultivated	Total Irrigated Extent Cultivated (Ac)	% of Total Irrigated Extent Cultivated
Single owner	145.12	87	110.95	65
Shared ownership	2	1	-	-
Shared tenancy	20	12	-	-
Leased in	-	-	38.5	23
Encroached land	-	-	14	8
Purchased land	-	-	6	4

Source: Authors' Survey Data (2013)

The source of water for the lands operated by single owners, shared owners and share tenants are fully dependent on the Walawe scheme irrigation water, while all the encroached land operators and new and purchased land slots depend on rainfall and drainage canals for the water supply (Table: 3.4). About 8% of the irrigated uplands are encroached, which need attention to manage the future water allocation among legal cultivation areas.

Table 3.4: Relationship between Land Tenure and Source of Water

Type of Ownership	PD Lands		UD Lands		
	Source of Water (% of responses given under the tenancy)		Source of Water (% of responses given under the tenancy)		
	Water Irrigation	Drainage Canal	Water Irrigation	Rainfed	Drainage Canal
Single owner	100	-	100	-	-
Shared ownership	100	-	-	-	-
Shared tenancy	100	-	-	-	-
Leased in	89	11	100	-	-
Encroached land	-	-	-	50	50
Purchased land	-	-	100	-	-

Source: Authors' Survey Data (2013)

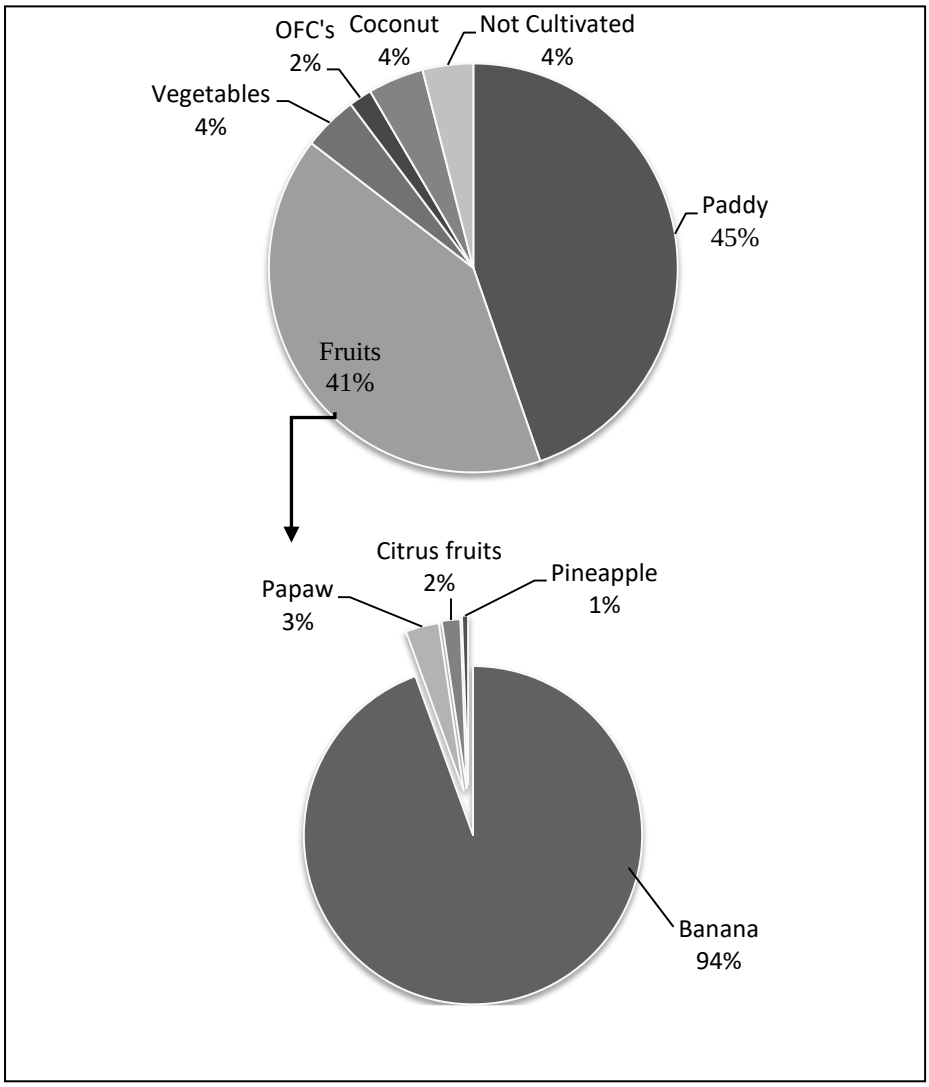
3.5 Land Use Pattern of Sample Area

Among the sample farmers, a total of 347 ac of the lowlands was recorded during the survey under all available land ownership categories. As shown in the Figure 3.2, out of the total available lands, paddy was cultivated in 45% of the area, followed by perennial fruit cultivation (41%). Banana and papaya accounted for the major share of fruit crop cultivation that consisted of 38% and 1.3% of total land respectively. Coconut, vegetables and OFCs were cultivated about four percent each.

3.6 Cropping Patterns of the Sample Area

Findings indicate that, although the lands were given to farmers under two categories as PD (mainly for lowland paddy cultivation) and UD (mainly for upland NPC cultivation), paddy crop can be identified as a prominent crop in both land types. About 88% and 32% of farmers under PD and UD lands respectively were involved in paddy cultivation fully or partially (Tables 3.5 and 3.6). One of the major reasons for allocating some area of the UD land for paddy cultivation was related to attitudinal and cultural reasons. Farmers prefer to have their own paddy for domestic consumption without depending on other sources for their staple diet. Non suitability of land (poor drainage and waterlogged condition) for NPC cultivation was also another major reason for the higher involvement in paddy cultivation.

As shown in Tables 3.6 and 3.7, paddy was cultivated by at least 57% of the farmers in any season of the year in the Walawe extension area. A total of 23% farmers are cultivating only perennials (dominated by banana) and another 10% of cultivated seasonal NPCs and perennials together. On the other hand, some PD lands were also cultivated with seasonal NPCs or perennial crops as those crops generated a higher income compared to paddy.



Source: Authors' Survey Data (2013)

Figure 3.2: Land Use Pattern of the Sample Area

Table 3.5: Cultivation of Crops in PD Lands (2012/13)

Type of Crops	*Maha*			*Yala*		
	No.	% of Farmers (N=60)	% of Total Extent	No.	% of Farmers (N=60)	% of Total Extent
Paddy	53	88	77	52	87	77
OFC	05	08	01	04	07	01
Vegetables	05	08	01	06	10	1.5
Banana/papaya	16	27	20	16	27	20
Other crops	07	12	01	07	12	0.5

Source: Authors' Survey Data (2013)

Table 3.6: Cultivation of Crops in Irrigated UD Lands (2012/13)

Type of Crops	Maha			Yala		
	No.	% of Farmers (N=60)	% of Total Extent	No.	% of Farmers (N=60)	% of Total Extent
Paddy	19	32	17	16	27	17
OFC	09	15	03	03	05	01
Vegetables	17	28	08	12	20	06
Banana/Papaya	23	38	66	23	38	07
Other crops	07	12	06	07	12	06

Source: Authors' Survey Data (2013)

According to the Table No. 3.7, 83% of the farmers and 62% of the total irrigated extent under UD lands are under banana cultivation primarily due to high profit. Cultivation of banana crop is much preferred by farmers compared to other non paddy crops due to less price volatility, established marketing system at the farmgate level and less effort is needed to manage pests and diseases. However, farmers in the Walawe area are mostly cultivating the cheaper variety of Banana locally called as 'Embul" (*Musa* AAB) since it is not susceptible to viral diseases and easy to produce.

Table 3.7: Cultivation of Biennial and Perennial Crops under Irrigation (2012/13)

Type of Crops	PD Lands			UD Lands		
	No.	% of Farmers (N=60)	% of Total Land Extent	No.	% of Farmers (N=60)	% of Total Land Extent
Banana	16	27	19	50	83	62
Papaw	-	-	-	02	03	3
Pineapple	-	-	-	01	02	0.5
Coconut	5	8	2.5	13	22	5
Betel leaf/Areca nut	2	4	0.3	-	-	-
Perennial fruits	-	-	-	05	09	1.5

Source: Authors' Survey Data (2013)

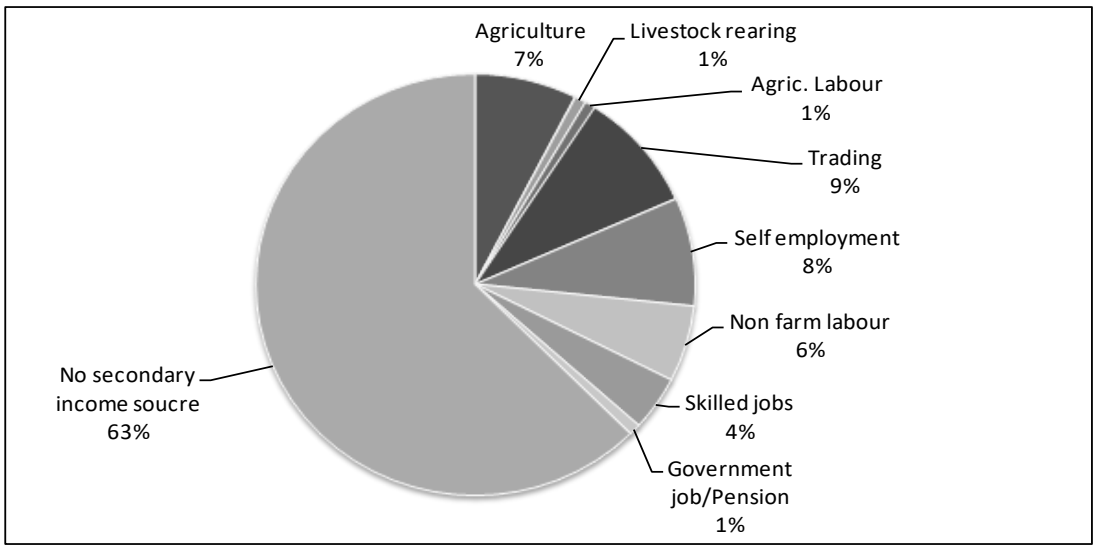
3.7 Income Sources and Income Level Distribution of the Sample

The majority of the farmers in the area (88%) was depending on farming as their primary source of income (Table 3.8). Out of the total respondents, 63 percent were not involved in any secondary income source. About 10 % of the beneficiaries, engaged in some form of secondary income earning activities, while depending on farming or agricultural related income sources as their secondary source of income (Figure 3.3). The findings implicate the importance of farming or related activities as the source of livelihood.

Table 3.8: Distribution of Primary Income Sources of the Sample

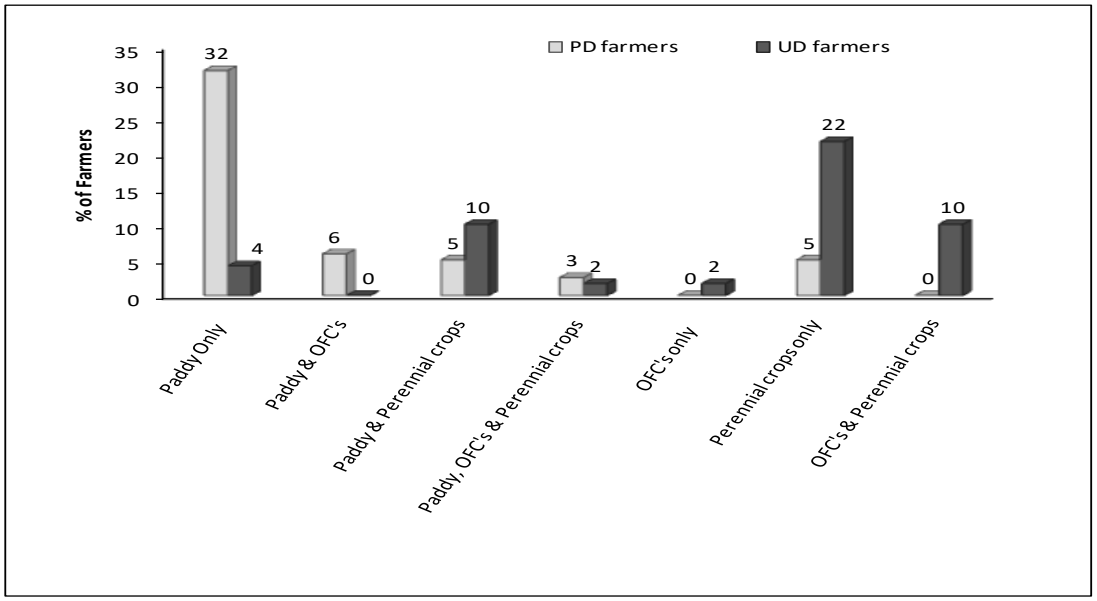
Type of Employment	Frequency	Percentage
Farming	105	88
Self employment	8	7
Private sector job	3	3
Trading	2	2
Government job/Pension	2	2

Source: Authors' Survey Data (2013)



Source: Authors' Survey Data (2013)

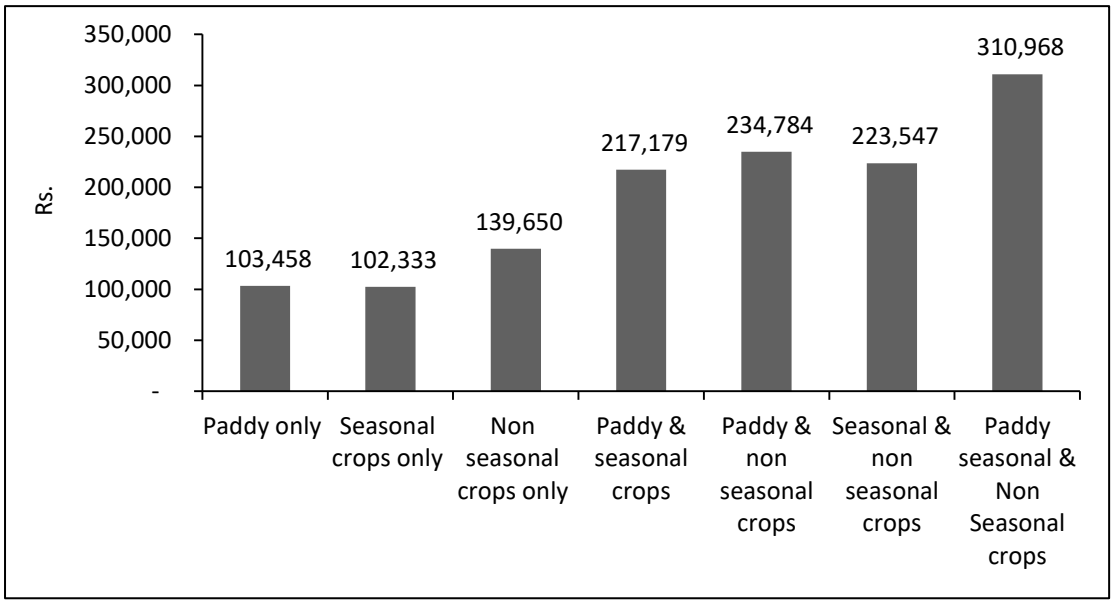
Figure 3.3: Distribution of the Secondary Income Sources of Sample Farmers



Source: Author's Survey Data, 2013

Figure 3.4: Distribution of the Cropping Pattern of the Sample Farmers

As shown in Figure 3.5, income from farming activities shows an upward trend towards shifting to crop diversification. Average annual income from farming under mono cropping situations of paddy, seasonal NPCs and non seasonal NPCs were Rs. 103,000, 102,000 and 310,000 respectively, which was comparatively lower than the situations of having crop combinations. In combination of 'three crop types' situation (paddy, seasonal NPCs and non seasonal NPCs) was given a higher average income (310,000) than the situation of two crop combinations. It was evident that, domination of non seasonal NPCs component in the cropping system has produced a higher farming income, compared to the contribution from paddy or seasonal NPCs.



Source: Authors' Survey Data (2013)

Figure 3.5: Distribution of Annual Average Income Earned from Farming Activities (Rs/ac)

Table 3.9 and 3.10 describe the level of income earned from different cropping systems separately for PD and UD land cultivators. The table indicates that the income earned by NPC cultivation by PD farmers with different combination have provided a relatively higher income, which shows the entrepreneurship of the farmers and a relatively higher water supply in PD lands.

Table 3.9: Annual Income Earned from Crop Cultivation in the PD Lands (2012/2013)

Type of cropping system (N = 60)	Average Annual Income (Rs/ac)	Income range of the groups (Rs/ac)
Paddy only (N = 38)	106,440	44,755 – 177,333
Non-seasonal crops only (N = 7)	197,000	48,000 – 560,000
Paddy and seasonal crops (N = 12)	217,179	90,490 – 388,655
Paddy and non seasonal crops (N = 6)	211,499	78,000 – 407,900
Paddy, seasonal and non seasonal crops (N=3)	350,706	218,268 – 559,897
No cultivation(N = 2)	-	-

Source: Authors' Survey Data (2013)

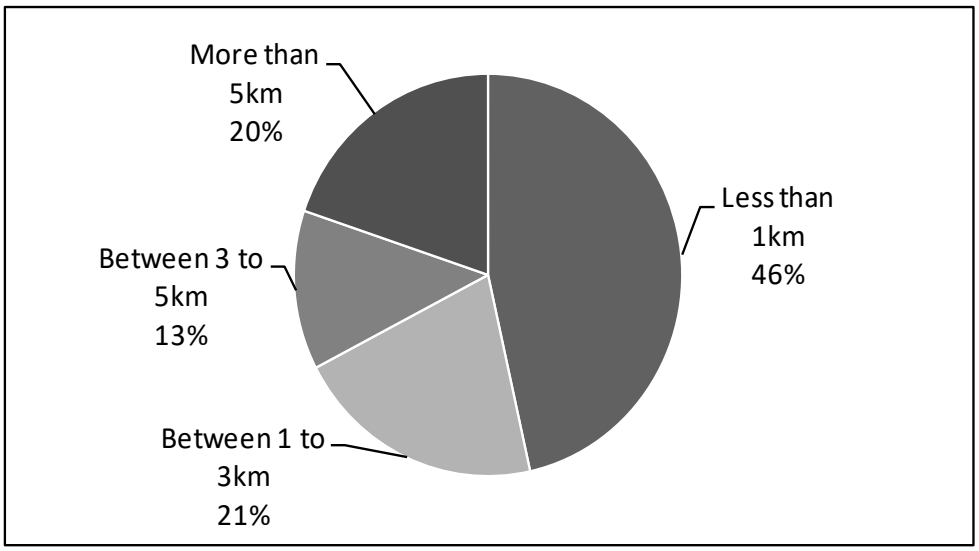
Table 3.10: Annual Income Earned from Crop Cultivation in the UD Lands (2012/2013)

Type of cropping system (N = 60)	Average Annual Income (Rs/ac)	Income range of the groups (Rs/ac)
Paddy only (N = 5)	80,792	45,000 – 129,333
Seasonal crops only (N = 2)	184,666	40,000 – 164,666
Biennial and perennials (Non seasonal crops) (N = 23)	129,676	10,000 – 654,545
Paddy and non seasonal crops (N = 12)	246,426	65,500 – 640,168
Seasonal and non seasonal crops (N = 12)	223,547	29,500 – 585,725
Paddy, seasonal and non seasonal crops (N = 2)	251,362	142,300 – 360,424
No cultivation (N = 4)	-	-

Source: Authors' Survey Data (2013)

3.8 Variations of the Distance from the Homestead to the Field

It was reported during the study that, permanent settlement of farmers located away from irrigated field was highlighted as one of the reasons for abandonment of land and cultivation of low value and low input crops. As shown in the figure, 3.6, over 50% of the farmers have to travel more than one km to access their fields, while 20% of the farmers had to travel more than five km to their fields from their homestead. There have been difficulties in both accessing and protecting the cultivations. The situation is a consequent to the increasing damages on crop cultivations by wild animals and theft. Lack of necessary basic facilities in the irrigated area (school, health centers, transport), life threats caused by wild animals and the non provision of legally valid land plots for homestead development have prevented them from constructing permanent houses in the irrigated area.



Source: Authors' Survey Data, 2013

Figure 3.6: Distance from the Homestead to the Irrigated Field

3.9 Institutional Development

The project has made much efforts to create the Farmer Organizations in the new extension area and has strengthened the existing FOs in the old area through a series of training programs and appointing of field level catalysts. There are 84 new FOs developed in the extension area. FOs were provided continuous training during the project period on various aspects of organizational management, financial management, operation and maintenance (O&M), timely cultivation of crop on scheduled calendar, paddy cultivation, Non paddy crop cultivation, water saving techniques and crop diversifications. About 32 % of the sample farmers had received training from the project. The majority of the recipients has received training on cultivation of NPCs, cultivation of paddy, water management and O&M.

The strength of the FOs was evaluated by a number of indicators in the selected organizations. About 98% of the farmers in the selected areas were willing to accept the current FO leadership and to provide their fullest cooperation. Nearly 97% of the farmers are satisfied with the financial transparency and transaction carried out by the FOs. It was observed that the FOs have maintained a proper system of book keeping and accounts are annually audited by the Mahaweli Authority of Sri Lanka.

About 50% of the farmers have experienced the irrigation water problem for NPC crops during *Yala* seasons, mainly related to lack of adequate water issues after the end of the paddy cultivation season. Regular payment of O&M fees to the FOs was made by 83% of the farmers and 3% of the farmers pay irregularly while 14% do not make payments.

All the FOs in the extension areas have been integrated to form a Farmer Federation to make decisions and to act on common issues and also to increase the bargaining power of the farming community.

Table 3.11: Some Features of Selected FOs

	PD 88 FO (Unit 12)	**UD 74 FO (Unit 9)**	**PD 10/11 FO (Unit 2)**	**UD 6 FO (Unit 1)**
No. of Farmers allocated land	35	95	44	204
No. of farmers currently settled	32	34	42	100
No. of FO members	35	73	44	100
No. of active members	25	35	25	95
Member participation for FO meetings	85%	62%	75%	50%
Fee collection for FO (excluding salaries)		Rs. 550/year	Rs. 620/year	Rs. 920/year
FO fund (Rs)	81,000	37,000	140,000	
Payment for *Jalapalaka*	25 kg of paddy/season /farmer	Rs.500/ farmer/year	Rs.500/ farmer/year	Rs.200/ farmer/ year
Penalties for violators	Available and implemented	Available and implemented	Available and implemented	Available and implemented

Source: Authors' Survey Data (2013)

CHAPTER FOUR

Irrigation System Performance in Walawe Left Bank

4.1 Water Supply Performance

As mentioned earlier, WLBP was designed to provide the services for existing and new areas using the same quantity of water that was earlier utilized only in the existing areas. Therefore, water supply performance is an important parameter to assess the achievements of the intervention. The study used the following indicators to assess the water supply performance.

(a) Gross water duty
(b) Quantity of water used to cultivate unit area
(c) Percentage of land extent cultivated in dry seasons (*yala*)

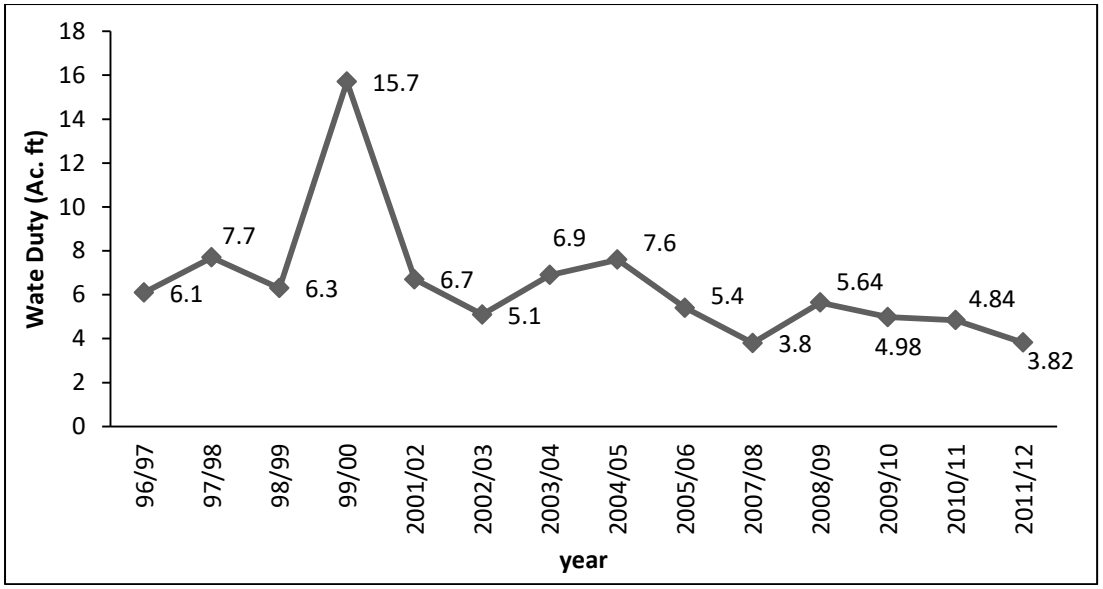
4.1.1 Gross Water Duty

Gross water duty is one of the indicators that can be effectively used to assess the water supply and utilization in an irrigation scheme.

$$\text{Gross water duty} = \frac{\text{Actual quantity of irrigation water issued (ac.ft)}}{\text{Actual extent cultivated (ac)}}$$

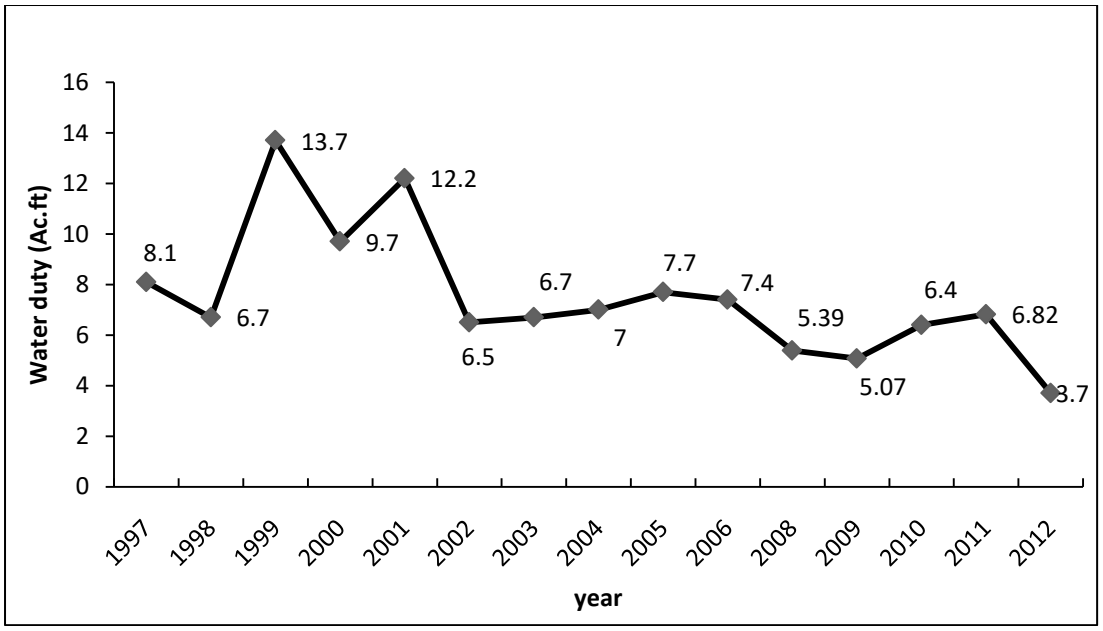
Figure 4.1 and 4.2 indicate the trend of gross water duty in the Walawe Left bank irrigation schemes. The figures clearly illustrate the drop in water duty after 2002 and again in 2007. Phase I of the Left bank rehabilitation project, which mainly concentrated on the improvement of the northern half of the scheme was completed in 2003 and Phase II of the extension project targeting the development of new areas in the southern half of the scheme was completed in 2008. Therefore, the drop in water duty could be directly linked to the rehabilitation projects.

According to these figures, water duty of Walawe Left bank, which was more than 8 ac.ft before 2002, has reduced to 3.7 by 2012. This is a remarkable achievement that coincided with the area expansion as well. Almost all the farmers in the northern half of the scheme expected to improve reliability and timeliness of irrigation supply after the rehabilitation despite they are already enjoying the abundant irrigation water as clearly illustrated in water duty figures. Similar expectation was also recorded by Pitigala and Rathnayake (1999). The project has succeeded in changing attitudes and water use pattern of the farmers. According to the focus group discussion and key informant interviews conducted in the northern half of the scheme, farmers are satisfied with the performance of the project and the current water allocation system.



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

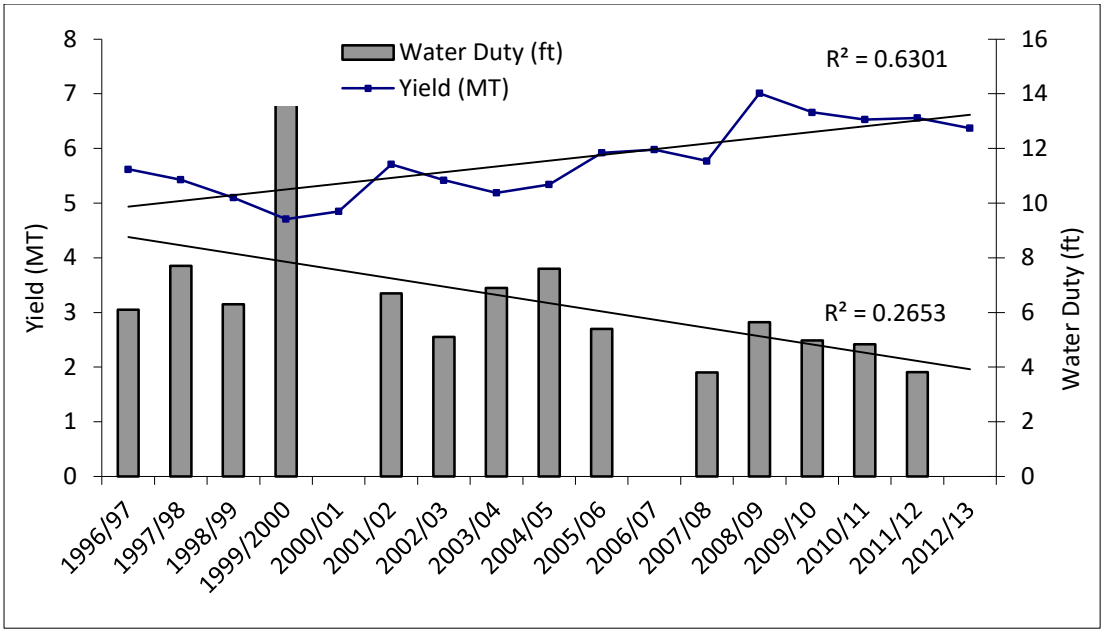
Figure 4.1: Gross Water Duty – Walawe Left Bank (*Maha* Seasons)



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

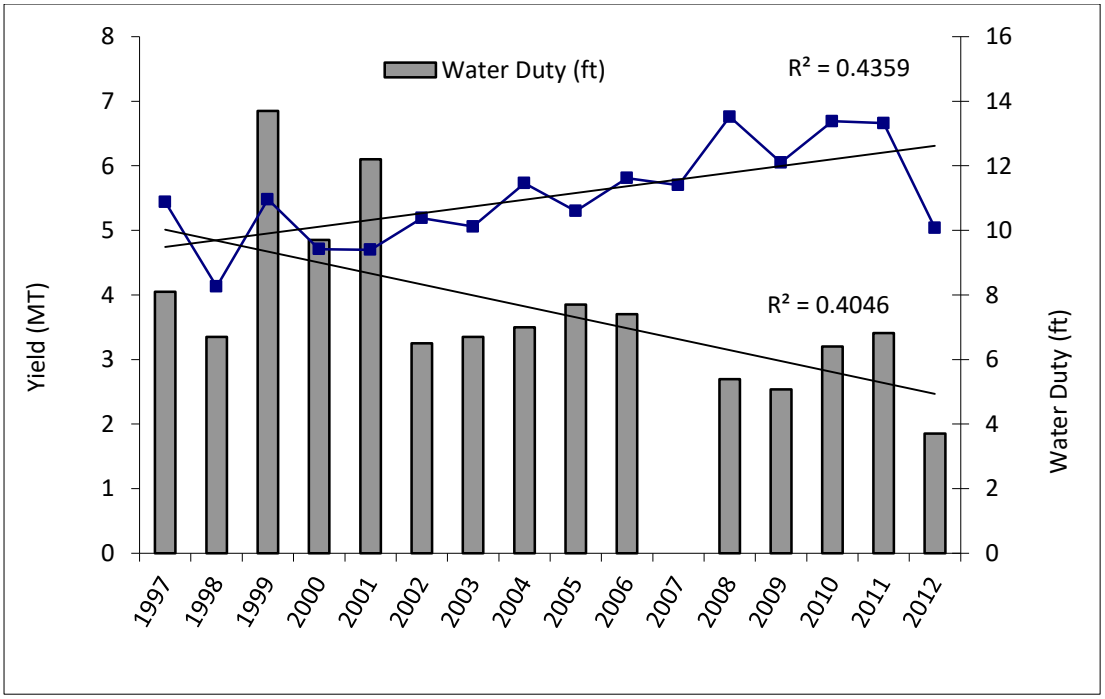
Figure 4.2: Gross Water Duty – Walawe Left Bank (*Yala* Seasons)

To counter the argument that, reduced water duty would cost yield reduction, paddy yield data was analyzed in relation to water duty. Figure 4.3 and 4.4 describe that, paddy yield displays a slight upward trend despite the reduction in water duty.



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.3: Water Duty and Paddy Yield (*Maha* Seasons)

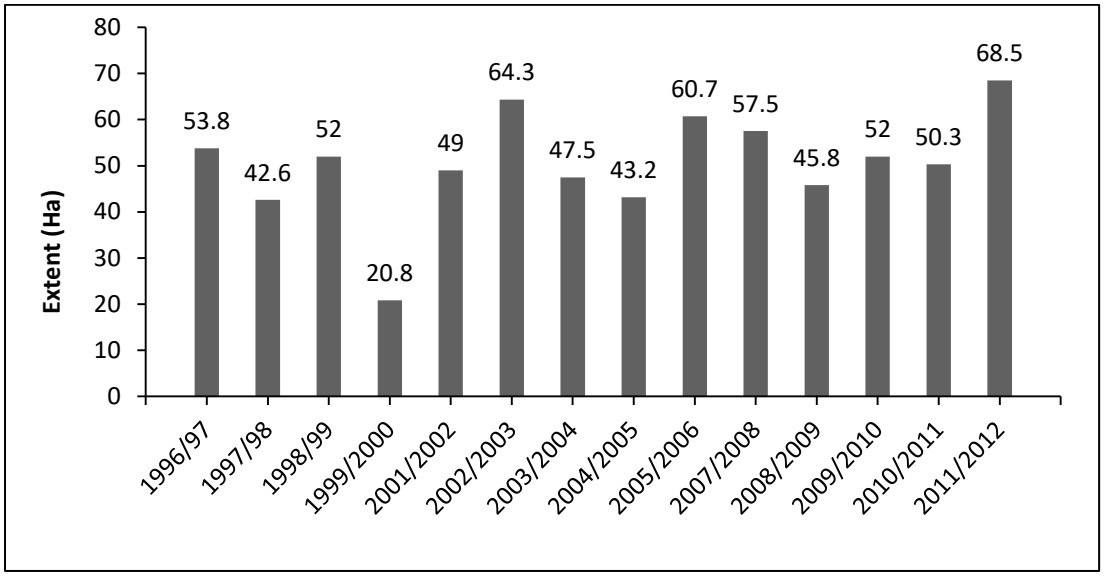


Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.4: Water Duty and Paddy Yield (*Yala* Seasons)

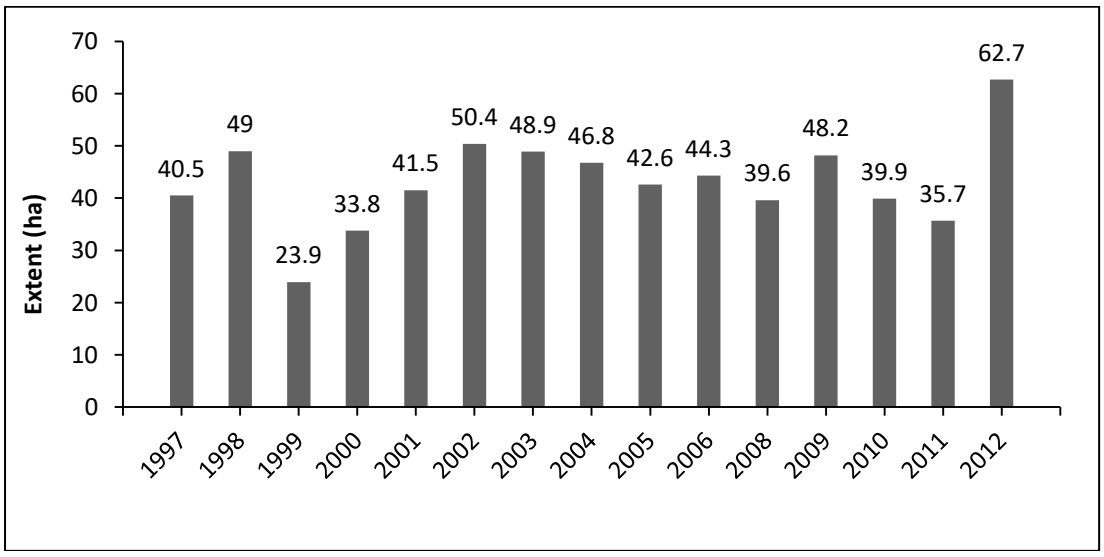
4.1.2 Quantity of Water Used to Cultivate Unit Area

The extent of land cultivated per Million m^3 of irrigation water both in *maha* and *yala* seasons over the years are described in Figure 4.5 and 4.6. The figures show that the number of hectares cultivated per Million m^3 of water after the project has expanded in both seasons. The extent cultivated per unit quantity of irrigation supply is comparatively higher during *maha* seasons, indicating a better utilization of *maha* rain by the farmers in order to conserve reservoir water. The shorter rainfall season (*yala*) is highly dependent on supplemental irrigation. The lower value shown in year 2011 is primarily due to the drought condition that prevailed in the year.



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.5: Extent of Land Cultivated per Million m^3 of Water (*Maha* Seasons)

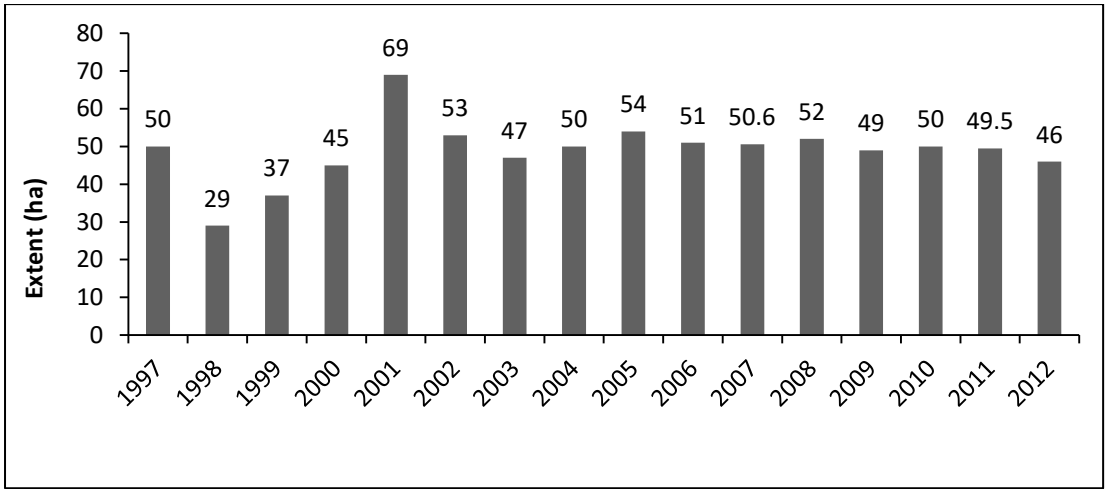


Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.6: Extent of Land Cultivated per Million m^3 of Water *(Yala* Seasons)

4.1.3 Extent of Land Cultivated in Dry Seasons (*Yala*)

Implementation of the WLBP had to face resistance and agitation of the farmers on the extension of the scheme and opening up of new areas using the same amount of water at the early stages of the project since the Uda walawe scheme is already a water scarce scheme. Farmers fear about the difficulty in cultivating in *yala* seasons after the opening up of new irrigated areas. According to the project completion report of the WLBP (MASL, 2009), over 50% of farmers had responded that, adequate irrigation water was not available before the project, but it has decreased to 2% after the project, mainly due to reduction in conveyance losses. The trend of *yala* season cultivation is shown in Figure 4.7. The figure shows that dry season cultivation has in fact increased after the project and it is almost 50% of the total land available in most of the seasons.



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.7: Percentage of Land Extent Cultivated in Past *Yala* Seasons

4.2 Performance in Productivity

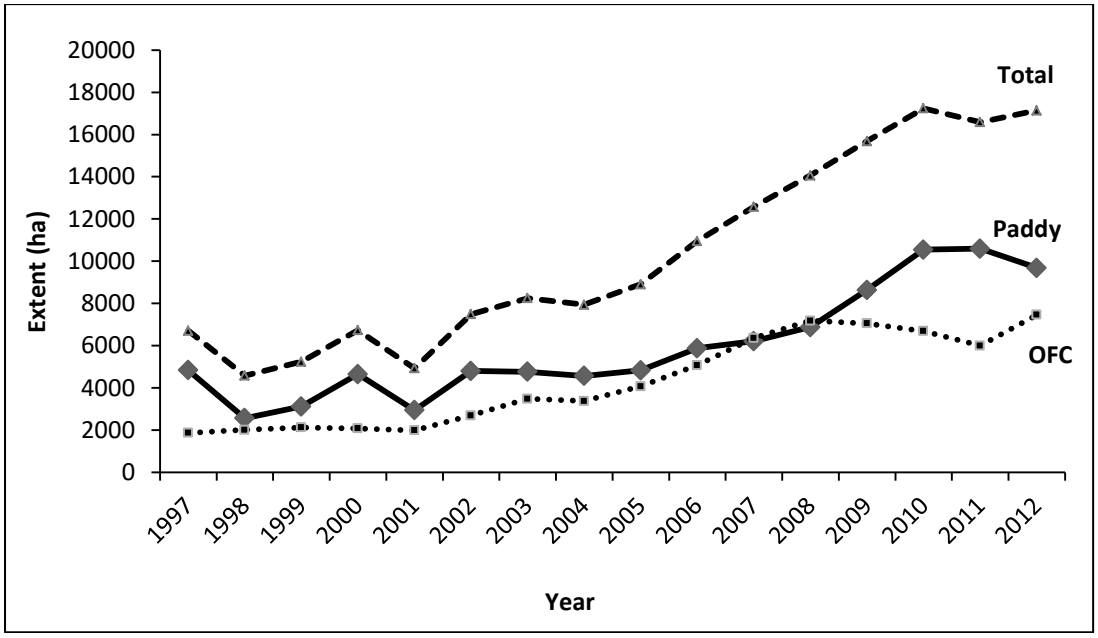
4.2.1 Changes in Extent of Cultivation and Cropping Pattern

Extent of cultivation, both paddy and NPCs have shown an enormous increase after 2002. The increasing trend has continued over the years with a sharp increase after 2008. Introduction of fertilizer subsidy for paddy cultivation has caused a sudden shift in the cropping pattern from NPC to paddy after 2008. However, there is a reverse after 2011 (Figure 4.8).

Banana and papaya cultivation has taken a major share in total extent (80-85%) of NPC cultivation. Uda Walawe area has become famous for banana production. According to Figure 4.9 and 4.10, the cultivation of banana and papaya has significantly increased after 2007. According to the project completion report of WLPB (MASL, 2009), the cultivation of banana in the Phase I and the Phase II areas

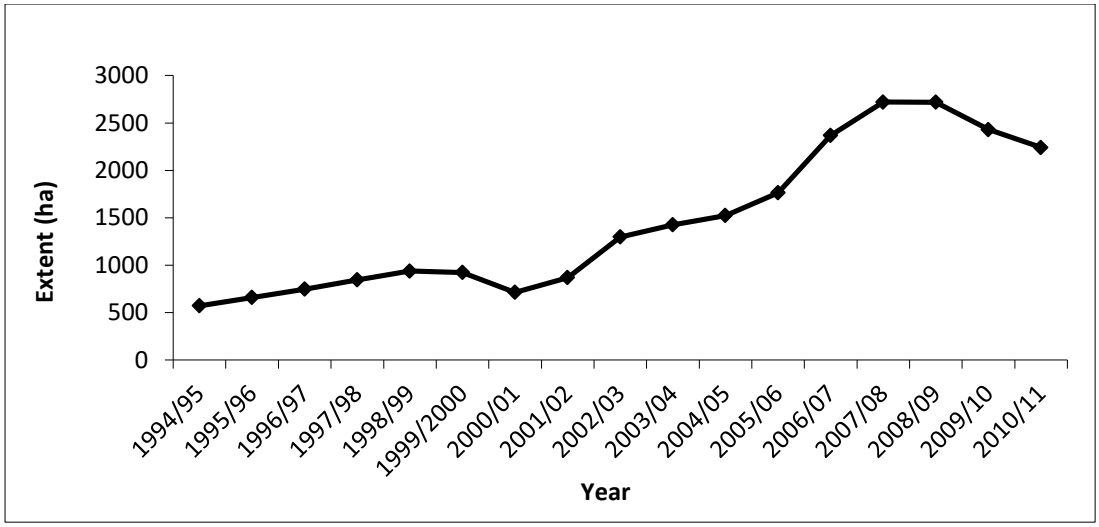
has exceeded 2-5 times and 3 times respectively compared to the original target volume. In addition to papaya and banana cultivation, farmers have cultivated a number of other field crops such as cereals (corn, finger millet, meneri), pulses (green gram, black gram, cowpea), oil crops (groundnut, gingerly), tuber crops (manioc, sweet potato, traditional yams), spice crops (chillie, red onion), and vegetables.

The project initiated various strategies in addition to training and awareness to promote NPCs, especially banana cultivation in the LB area. A subsidy of Rs. 1000 was granted to the selected farmers to cultivate a quarter acre of banana under irrigation as demonstration sites. The level of income earned by the selected farmers provided a demonstration and diffusion effects to other farmers. Further, the farmers were provided real field experience on banana cultivation, through exposure visits to the banana fields in Chandrika wewa areas.



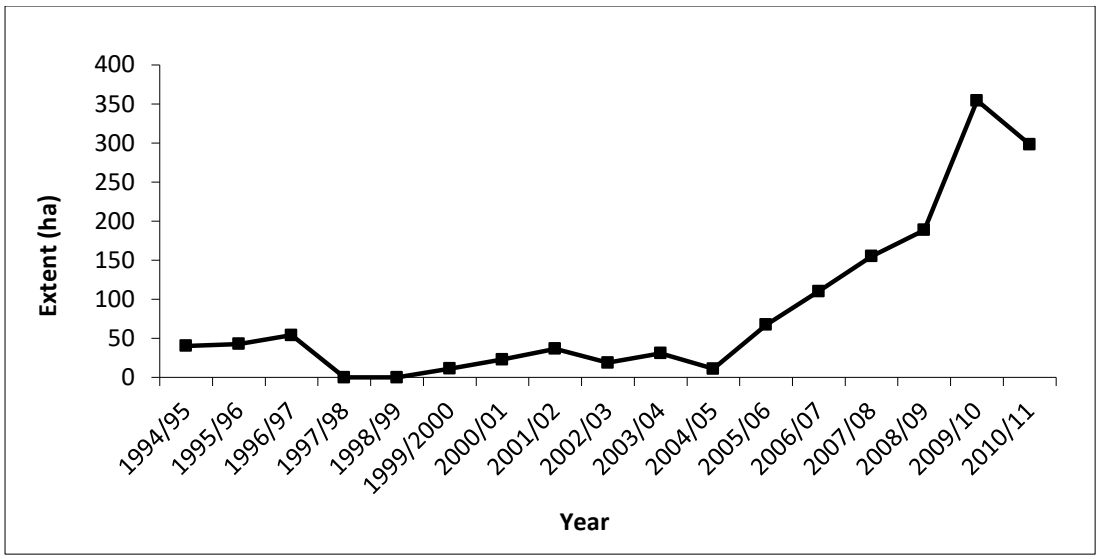
Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.8: Changes in Annual Extent of Cultivation



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.9: Trend of Banana Cultivation in Left Bank

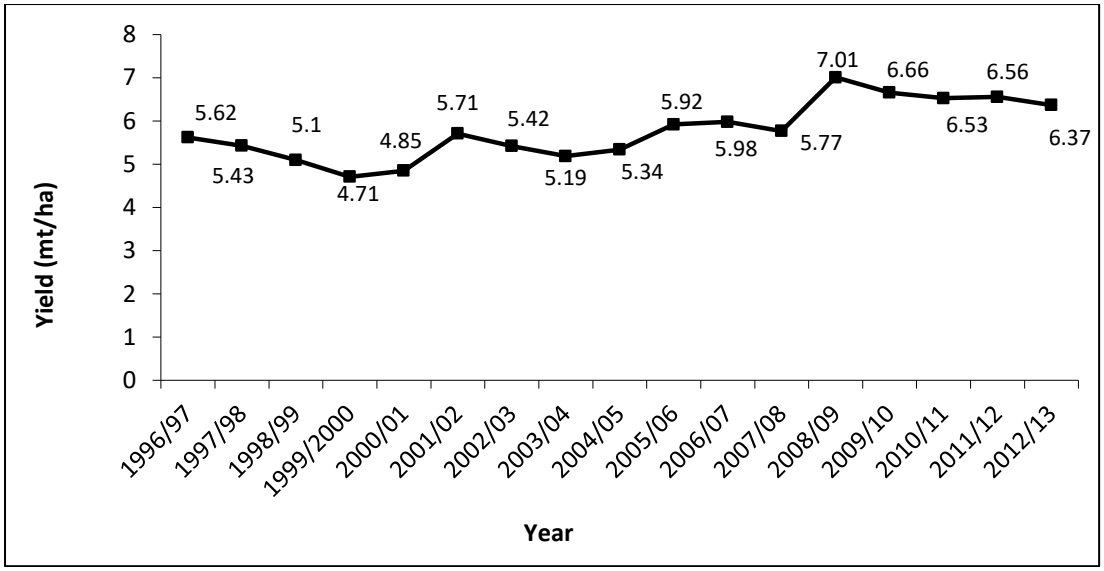


Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.10: Trend of Papaya Cultivation in Left Bank

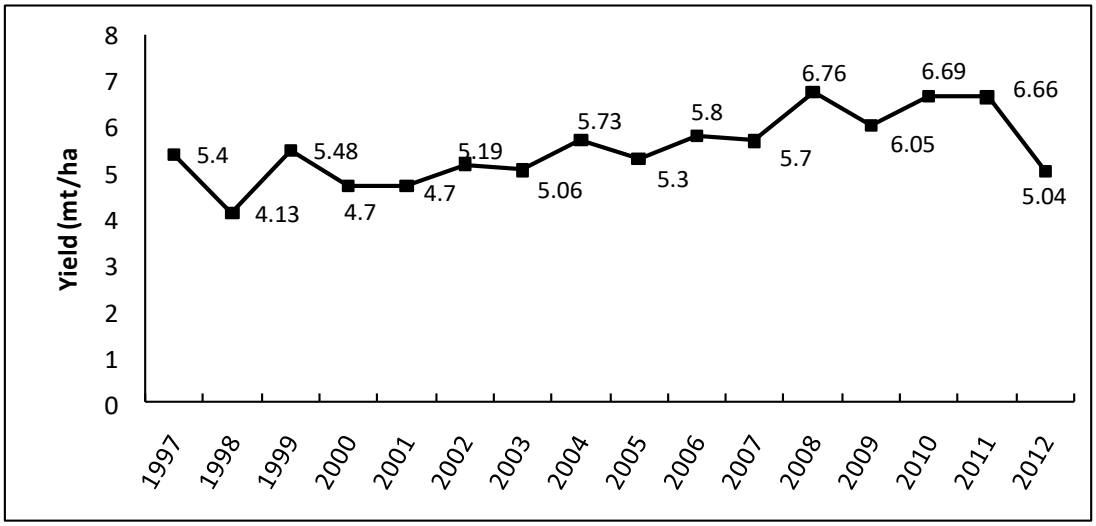
4.2.2 Changes in Paddy Yield

As paddy is the major crop cultivated under irrigation in the area, the trend of paddy yield was analyzed to identify the trend with regulated water supply. Figure 4.11 and 4.12 illustrate that, there is an increase in yield, despite the reduction in water issue, both in *maha* and *yala* seasons.



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.11: Changes in Paddy Yield (*Maha* Seasons)



Source: Resident Project Managers' Office, MASL, Uda Walawe (2012)

Figure 4.12: Changes in Paddy Yield (*Yala* Seasons)

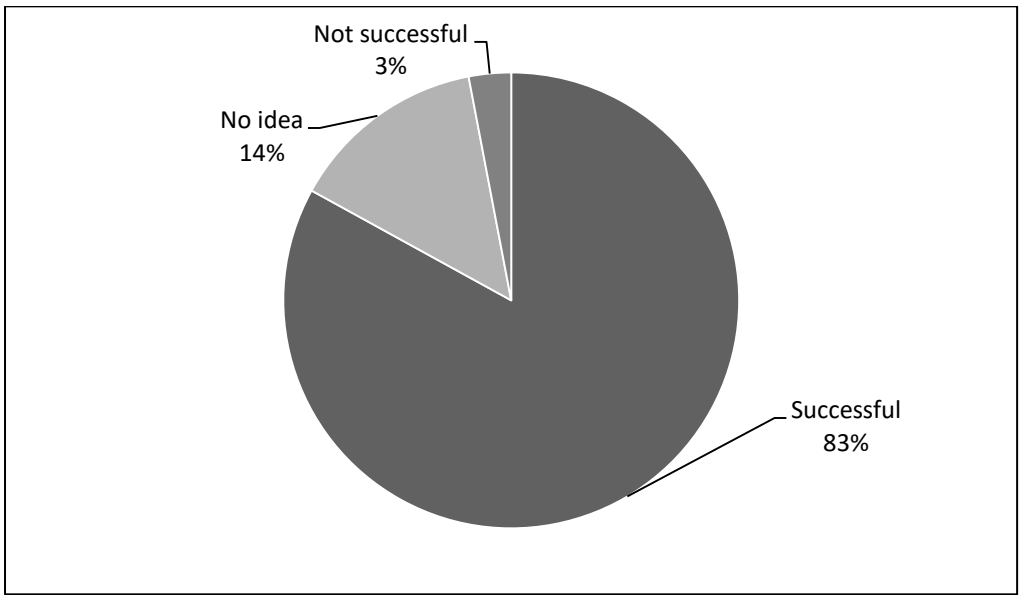
CHAPTER FIVE

Performance of Innovative Components and Techniques

5.1 New Components Adopted

5.1.1 High Tank and Low Tank System

Construction of high tank and improvement/augmentation of existing low tank systems is one of the key innovative interventions made by the project to improve the storage capacity, water use efficiency, crop diversification and expansion of irrigation extent. High tanks are novel infrastructure constructed in highland areas. Those are mainly consisted of soil with high permeability and suitable to cultivate NPCs. According to the findings, 83% of the beneficiaries expressed that the intervention was a success, while only three percent were of the view that the adopted system was not successful (Figure 5.1).



Source: Authors' Survey Data (2012)

Figure 5.1: Level of Farmer Acceptance on the Success of Low Tank and High Tank Systems (% of Farmer Responses)

The major reasons for the success in the introduction of high and low tank systems as perceived by the farmers were, increased capacity of water storage structures and reduction in water wastage due to re-use of water under the new cascade system of tanks (Table 5.1).

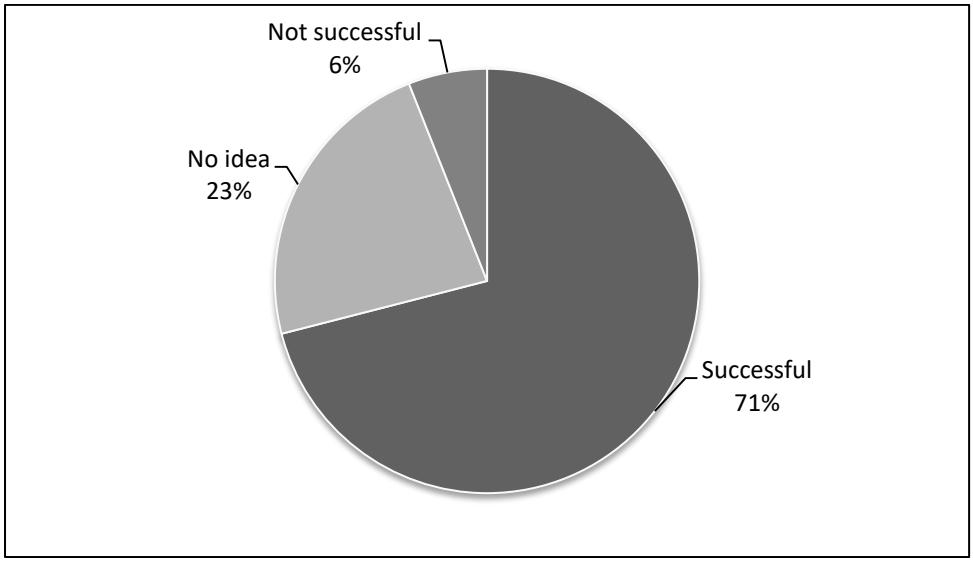
Table 5.1: Reasons for the Success of High and Low Tank System

Reasons	No. (N=99)	%
Increased water storage capacity	53	54
Reduction in water wastage	41	41
Increased extent in cultivation	7	7
Other	2	2

Source: Authors' Survey Data (2013)

5.1.2 Dual Canal System

The project completion report of WLBP (MASL, 2009) stated that, 93% of farmers had responded that the dual canal system has improved the water use efficiency. According to the present research, construction of the dual canal system to increase the water use efficiency at field level was declared as a success by 72% of farmers, while 6% of the farmers said it was a failure (Figure 5.2). The major reasons for the success are reduction in water wastage and availability of dedicated channel for the cultivation of NPCs (Table 5.2)



Source: Authors' Survey Data (2013)

Figure 5.2: Level of Farmer Acceptance of Dual Canal System as a Successful Intervention (% of farmer responses)

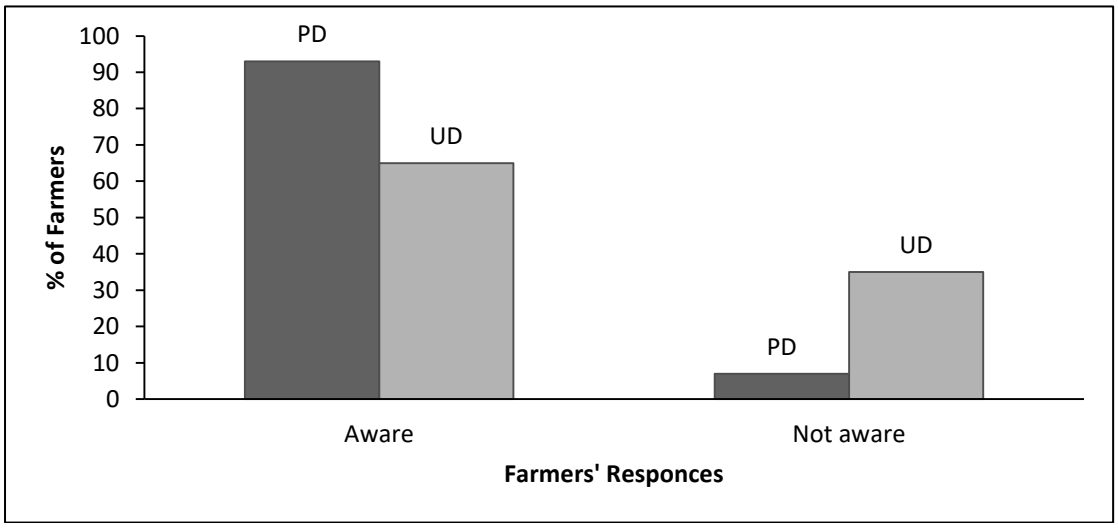
Table 5.2: Reasons for the Success of Dual Canal System

Reasons	No (N=85)	%
Low water wastage	44	52
Availability of dedicated channel for NPC	38	45
Other	3	3

Source: Authors' Survey Data (2013)

5.1.3 'Parachute" Method of Paddy Cultivation

The project identified from the past water delivery and cost of cultivation data that, paddy farming consumes a high amount of water and farmers were mostly practising broadcasting of seeds with a higher seed rate than actually required. This hinders the tillering of paddy crop and consequently returning a low yield. The water duty for paddy cultivation was over 10 ac ft in some of the seasons in the past. Therefore, the project promoted the parachute method of paddy cultivation as a method to overcome the problems of water scarcity and land productivity while motivating farmers to reduce the seed rate and water wastage. The research findings show that, 93% of PD farmers and 65% UD farmers are aware about the parachute technique (Figure 5.3). However, only around 32% and 33% of currently paddy cultivating PD farmers and UD farmers respectively had ever practised this technique.



Source: Authors' Survey Data (2013)

Figure 5.3: Awareness of the Availability of a Technique Called 'Parachute" Method of Paddy Cultivation (% of Farmers' Responses)

Table 5.3: Practice of 'Parachute' Method of Paddy Cultivation

	PD Farmers		UD Farmers	
	No. (N = 56)	**%**	**No. (N = 39)**	**%**
Practised in the past	17	30	6	15
Currently practised	1	2	7	18
Never Practised	38	68	26	67

Source: Authors' Survey Data (2013)

Farmer perceptions were obtained to identify the reasons behind the non practice of the techniques. The major reasons were a high labour requirement with the required skills to practise the technique. The reasons for the discontinuation of the system are also related to labour requirement and failure to obtain substantial benefits (Table 5.5).

Table 5.4: Reasons for Non-practice of 'Parachute' Method of Paddy Cultivation (% of responses of never cultivated farmers)

Reason	PD Farmers		UD Farmers	
	No. (N = 38)	%	No. (N = 26)	%
High labour requirements	19	50	7	27
Lack of sufficient knowledge and skills	17	45	10	38
Difficulties in obtaining 'parachute' tray	9	24	-	-
No substantial benefits	5	13	6	23
Not used to cultivate	3	8	7	27
Other	4	10	1	4

Source: Authors' Survey Data (2013)

Table 5.5: Reasons for Discontinuation of 'Parachute' Method of Paddy Cultivation

Reason	PD Farmers		UD Farmers	
	No (N = 17)	%	No (N = 6)	%
High labour requirements	8	47	2	33
No substantial benefits	6	35	3	50
Difficulties in obtaining 'Parachute' trays	5	29	-	-
Lack of sufficient knowledge and skills	4	24	-	-
Other	2	12	1	17

Source: Authors' Survey Data (2013)

However, the majority of the farmers who practise the technique have accepted that the method needs less water, and provided a higher yield. The cost of production was also reduced due to requirement of less amount of seed paddy.

5.1.4 Crop Diversification

Diversifying the crops from water intensive paddy mono crop to less water consuming non paddy crops was one of the key strategies adopted by the project to improve the performance of both irrigation systems and the well-being of the farming community. The project attempted to develop separate areas for the cultivation of NPCs in the newly developed areas (UD lands) considering the soil type and development of separate irrigation canal for NPC cultivation.

The level of crop diversification by both PD & UD farmers are described in Table5.6. According to the Table, 37% and 82% of PD and UD farmers respectively have diversity in their cropping system. It is interesting to note that, 12% and 62% of PD and UD farmers have been convinced to cultivate NPCs in their entire land areas in the year 2012/13.

Table 5.6: Degree of Crop Diversification

Cropping Pattern	PD Lands		UD Lands	
	No	%	No	%
Paddy only	38	63	05	08
NPCs only	07	12	37	62
Paddy and NPCs	15	25	14	23
No cultivation	-	-	04	07

Source: Authors' Survey Data (2013)

However, a considerable number of farmers settled under the UD are still cultivating paddy crop and vice versa in PD lands. Farmers were inquired about the suitability of the land given for the cultivation of paddy under the given PD lands and NPCs in UD lands. About 92% of PD farmers declared that, allocated land is suitable for paddy cultivation. In the meantime, 67% of the UD farmers perceived that, the provided land is suitable for NPCs, while 22% said that only part of the given land is suitable for NPC cultivation.

Table 5.7 provides the reasons for non cultivation of paddy in the given PD lands which are suitable for cultivation of paddy, in at least one of the past two seasons. The major reason for not cultivating paddy is the high income earning opportunity by cultivating of NPCs. However, the major reason for non cultivation of NPCs in the UD lands is the non suitability of given land for NPC cultivation due to poor soil drainage (Table 5.8).

Table 5.7: Reasons for Not Cultivating Paddy in PD Lands

Reasons	No. of Farmers Responded (N= 19)	% of Responded Farmers
High income from NPCs	14	74
High water requirement for paddy cultivation	03	16
NPC cultivation was promoted by officers	01	05
Soil salinity condition	01	05

Table 5.8: Reasons for Not Cultivating NPCs in UD Lands

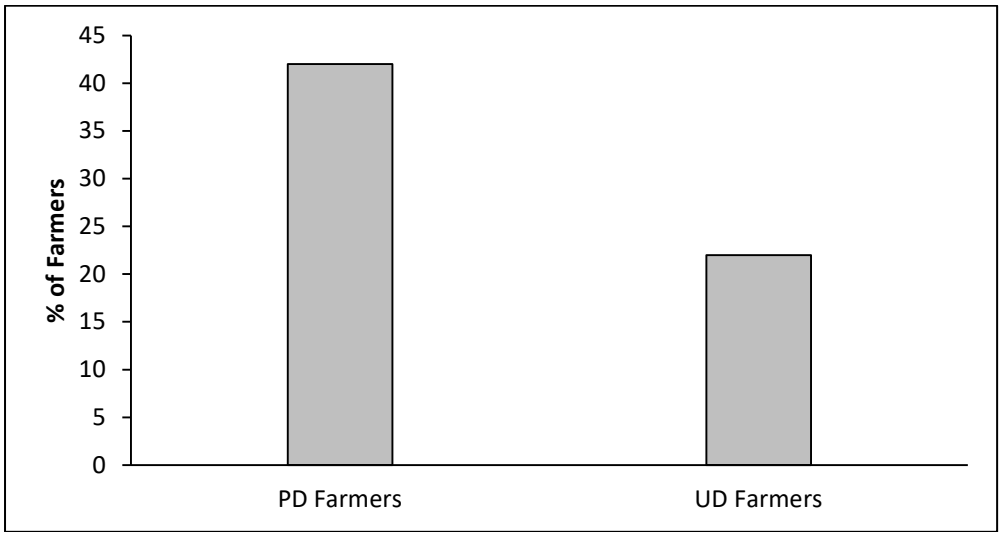
Reasons	No. of Farmers Responded (N= 24)	% of Responded Farmers
Poor drainage	16	67
Cultivation of paddy ensured household food security	06	25
More damages for NPCs from wild elephants	03	12
Water delivery is not suitable for NPC	02	08
Other	02	08

* Two farmers had not cultivated any crops

Source: Authors' Survey Data (2013)

5.1.5 Cultivation of Perennial Fruit Crops

The project implemented a programme to distribute perennial fruit crops to be cultivated under irrigation to increase nutritional security and household income. The program mainly targeted the UD farmers. The findings show that, 42% and 22% of UD and PD farmers respectively had received perennial crops (Figure 5.4). The details of the crops received by the farmers are listed in Table 5.9. Mango, coconut and citrus plants account for the major share of the perennial crops distributed.



Source: Authors' Survey Data (2013)

Figure 5.4: Percentage of Farmers who Received Perennial Crops by the Project

Table 5.9: Supply of Perennial Crops by the Project

Perennial Crops	PD Farmers (N = 13)		UD Farmers (N = 39)	
	No	%	No	%
Mango	9	69	28	67
Coconut	9	69	36	86
Lemon	6	46	25	60
Lime	3	23	8	19
Jamba Narang	2	15	5	12
Pomegranate	3	23	10	24
Guava	1	8	7	17
Ambarella	-	-	3	7
Jak	-	-	2	5
Kathurumurunga/Drumstick	-	-	2	5

Source: Authors' Survey Data (2013)

Farmer perceptions were obtained about the current status of perennial crops supplied. According to the findings, the majority of plants distributed had survived at the time of the survey (Table 5.10). The main reasons for the loss of perennial plants are damages caused by wild elephants and stray cattle, poor extension

services, and inability to attend proper care and maintenance by the farmers since they are living away from the irrigated area.

Table 5.10: Present Situations of Perennial Crops under Irrigation (% of farmer responses)

Crop	100% Survived	Over 50% Survived	Less than 50% survived	All crops lost
Mango (N = 37)	63	24	5	8
Coconut (N = 45)	47	38	6	9
Pomegranate (N = 13)	69	15	-	16
Lemon (N = 31)	58	10	6	26
Lime (N = 11)	54	-	15	31
Jamba Narang (N = 7)	43	14	-	43
Guava (N = 8)	62	13	-	25

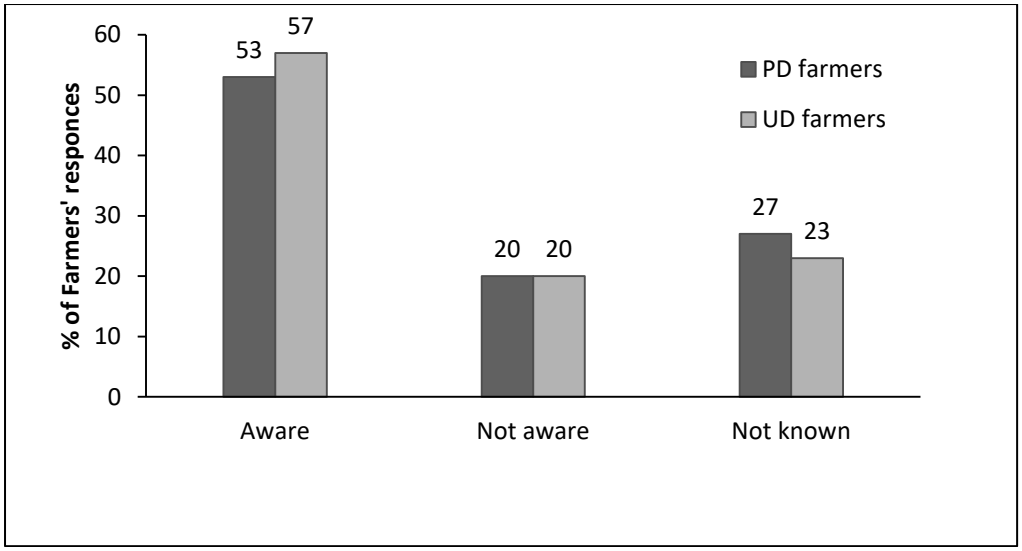
Source: Authors' Survey Data (2013)

5.1.6 Livestock Enterprise

The project had made some efforts to introduce livestock into the Walawe farming system under the intensive management system instead of the traditional free range management system. However, only four PD farmers and one UD farmer of the sample had received support from the project. Three farmers had received cattle and two farmers had received goats under this programme. All farmers except one cattle farmer had lost their animals in the UD area at the time of survey. The main reason for the failure of livestock intervention is the farmers' reluctance to undertake small scale livestock enterprise under intensive rearing system which demanded extra labour and commitments.

5.1.7 Establishment of Agricultural Produce Marketing Centres

According to the past experiences in the area, one of the major problems in cultivation of NPCs was difficulties in marketing and receiving a reasonable price. Therefore the project made interventions to construct a few centres to sell the agricultural products within the area with the participation of the private sector. These centres were aimed at purchasing non-paddy crop products directly from the farmers without intermediaries. The level of awareness about the existence of marketing centres is illustrated in Figure 5.5. About 25% of farmers had no idea about the existence of the centers, while another 20% of the farmers said the centres are currently not functioning, though were actually operating at the moment.



Source: Authors' Survey Data (2013)

Figure 5.5: Farmer Awareness on the Functioning of Marketing Centres

Out of the farmers who were aware about the functioning of marketing centres, only 15-20% of them had ever used the centres. Altogether, only 10% of the total farmers had utilized the centres at least once. The regular users are limited to four percent of the total farmers (Table 5.11). The major benefit of supplying products to the collection centres (mainly banana) is the farmers' ability to earn almost twice the price compared to traditional markets.

Table 5.11: Utilization of the Services Provided by Collecting Centers (As the % of Farmers who were aware about the centre)

Type of Use	PD Farmers (N = 32)		UD Farmers (N = 34)	
	No. of Aware Farmers	%	No. of Aware Farmers	%
Regular use	3	9	2	6
Frequent use	-	-	3	9
Occasional use	2	6	2	6
Never used	27	85	27	79

Source: Authors' Survey Data (2013)

The aim was to find out the reasons for non-use or irregular use of marketing centre by the farmers despite their awareness on the functioning of centres (Table 5.12). The main hindrance for over 50% of them was purchasing of selected high quality products only (determined by the size and shape) by the buyers of the centres, which prevented them from obtaining a reasonable price for the rest of the products and increased difficulties and extra burden in transporting the remaining goods to other marketing areas. Another major limitation as expressed by the farmers was that the purchase of products in a day is limited, hence the demand was normally fulfilled by the regular suppliers.

Table 5.12: Reasons for Non Use or Irregular Use of Collecting Centre

Reasons (N = 61)	No	%
Purchase of high quality produce only	31	51
Purchase is for limited quantity	15	24
Paddy is not purchased at the centre	12	20
Existing *'pola'* system is convenient	7	11
Incurred additional transportation cost to deliver goods to the centre	5	8
Other	2	3

Source: Authors' Survey Data (2013)

5.2 Benefits and Constraints of the Project

5.2.1 Benefits

Beneficiaries were inquired about the achievements of the project implemented. The major advantage of the project is the increase of farm income as listed in Table 5.13. The findings show that, around 70% of the farmers in the newly developed areas have expressed that their farm income has doubled or more. The farmers who were originally in and around the area were used to depend on low input and low value rain-fed or *chena* cultivation. It was observed that most of the farmers were leading a decent lifestyle with good housing consisting of fairly good furniture and consumer durables. This is a great achievement of the project. The UD farmers who were not cultivating or partially cultivating their lands due to salinity and the farmers experiencing crop damages by wild elephants have reported that there is no change or decrease in income.

Table 5.13: Impact of the Project on Income

Level of change	PD Farmers (N = 60)		UD Farmers (N = 60)	
	No	%	No	%
More than double	36	60	28	47
Double the income	7	12	10	17
Increased by 50 percent	13	22	9	15
Increased by less than 50 percent	1	1.5	4	7
No change	2	3	8	13
Decrease	1	1.5	-	-
New farmers	-		1	01

Source: Authors' Survey Data (2013)

5.2.2 Constraints of the Project

About 50% of the PD farmers were satisfied with the project performance and stated that there were no drawbacks in the project approach and the interventions made. The major drawback expressed by the UD farmers is scarcity of water after the end of the paddy cultivation season to satisfy the water requirement of the NPCs. As Mayurapura is a newly developed area, there is a deficiency in social infrastructure as expressed by 18% and 16% of PD and UD farmers respectively (Table 5.14).

Though the project adopted a comprehensive and integrated approach of development, there is a number of problems hindering the livelihood development of the settlers. The most serious problem affecting the livelihoods and income earning of the people is the damage to crops and livelihood assets and life threats posed by wild elephants, followed by crop damages caused by stray cattle (Table 5.15). The project had allocated about 2000 acre of land to develop pasture land for the livestock in the area, but this area is under the banana cultivation by encroachers who are most influential elite people in the area.

Marketing difficulties of agriculture products, weak extension services and poor soil condition were also reported by a considerable number of UD farmers as barriers in their livelihood development.

Table 5.14: Drawbacks of the Project (% of farmers' responses)

Drawbacks	PD Farmers (N = 60)		UD Farmers (N = 60)	
	No	%	No	%
No drawbacks	28	47	9	15
Insufficient supply of water	01	2	24	40
Non provision of planting materials	10	17	01	2
Poor rural infrastructure and facilities	11	18	10	16
Poor extension services and awareness creation	02	3	04	7
Upland is not regularly demarcated	03	5	02	3
High distance to field from homestead	02	3	02	3
Allocation of unsuitable land	03	5	05	8
Weaknesses in channel system	01	2	-	-
Settlement of outsiders	02	3	06	10
Insufficient water in *yala* and lack of proper water issue plan	01	2	01	2
Capacity of high tank is low	02	3	05	8
Other	08	13		

Source: Authors' Survey Data (2013)

Table 5.15: Major Barriers in Undertaking Livelihood Activities Development in the Area

Drawbacks	PD Farmers (N = 60)		UD Farmers (N = 60)	
	No	%	No	%
Wild elephants problem	43	72	51	85
Stray cattle problem	30	50	19	32
No price for agriculture products	11	18	16	27
Weak extension services	03	5	13	22
Poor soil condition	12	20	11	18
Lack of infrastructure and other facilities	7	12	8	13
Other wild animals/birds problems	-	-	9	15
No issues	2	3	2	3

Source: Authors' Survey Data (2013)

5.2.3 Emerging Environmental Problems

One of the environmental problems arisen in the new settlement area was the development of salinity patches. The problem was high in the newly developed UD lands compared to the already existing PD lands. Some of the land plots were completely abandoned due to salinity, while some were cultivated with the patches while applying some treatments for salinity. For example, about 22 farmers were abandoning their allocated land in UD-74 area due to salinity. Table 5.16 describes the current situation of salinity as expressed by farmers who had been involved in cultivation at the time of the survey.

According to the findings, 67%, and 40% of PD and UD farmers who do not abandon their lands have experienced salinity problems. The majority of them has experienced a decreasing trend of salinity over the years with the treatment measures undertaken.

Table 5.16: Trend of Salt Affected Soil

Type of Trend	PD Lands (N=40)		UD Lands (N=24)	
	No	%	No	%
Salinity continues from the beginning	01	2.5	2	9
Developed a little later and increasing	08	20	7	29
Developed a little later but decreasing	20	50	7	29
Same extent from the beginning	4	10	7	29
High during *yala* and low in *maha*	6	15	1	4
Available in the past, but not now	1	2.5	-	-

Source: Authors' Survey Data (2013)

The major reasons for the salinity development as expressed by the key informants were, re-use of irrigation water, lack of maintenance of drainage channels/insufficient capacity of drainage channels and use of newly asweddumized lands for cultivation. Farmers have adopted several techniques to minimize the

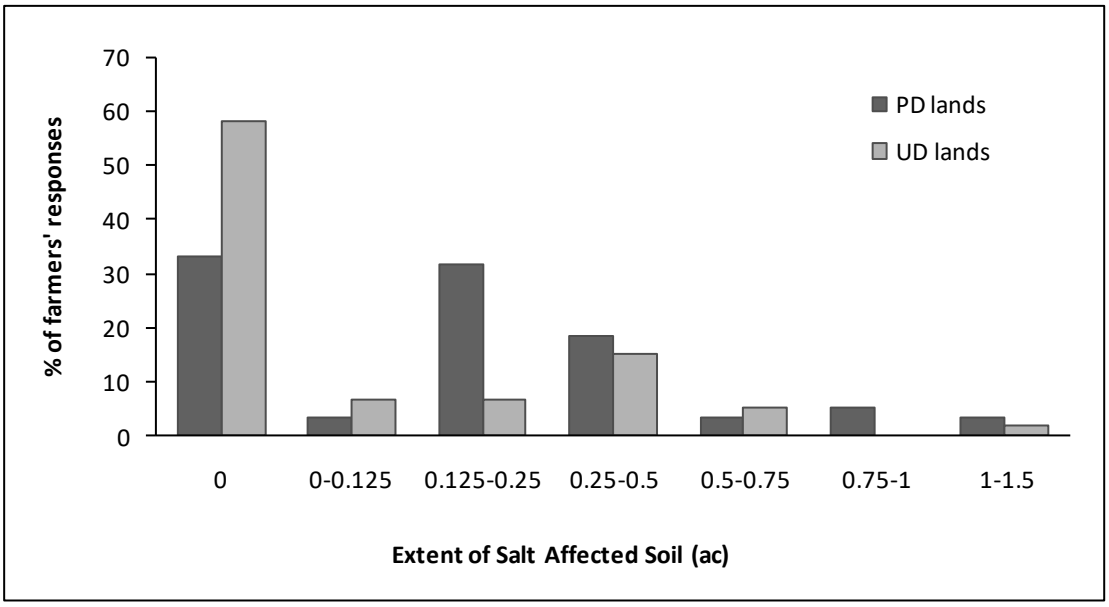
salinity problem. The development of proper drainage channels at on-farm level and application of charcoal made out of partially burnt paddy husk, were most popular techniques adopted (Table 5.17).

Table 5.17: Techniques Adopted to Minimize Salinity Effects

Techniques	PD Lands (N=40)		UD Lands (N=24)	
	No	%	No	%
Development of drainage canal	24	60	17	71
Application of partially burned paddy husk ash	20	50	03	12
Application of Dolomite	02	05	03	12
Use of organic fertilizer	06	15	02	8
Application of Citronella ash	08	20	02	8
No action	01	2.5	02	8
Use of salt resistant varieties	01	2.5	-	-
Application of lime	01	2.5	01	4
Use of poultry litter	01	2.5	-	-
Construction of large wells	-	-	01	4

Source: Authors' Survey Data (2013)

The current extents of salt affected soils (currently not cultivated) among the sample farmers are illustrated in Figure 5.6. According to the findings, about 50% of the currently cultivating PD farmers have salinity affected soil in an extent of 0.125-0.5 ac, while 22% of UD farmers fall into this category excluding the fully abandoned lands due to salinity.



Source: Authors' Survey Data (2013)

Figure 5.6: Extent of Salt Affected Soil in the Selected Areas by 2013 (Excluding completely Abandoned Lands)

CHAPTER SIX

Findings and Recommendations

6.1 Major Findings

1) Construction of high tank and low tank system under the cascade concept and construction of the dual canal system were successful interventions for 70-80 of farmers and have helped to reuse the water within the system and improve the water use efficiency.

2) The project has succeeded in reducing water duty and increasing the extent of cultivation through reduction of water losses, changing farmer attitudes and crop diversification

3) 'Parachute' method of paddy cultivation has helped in improving the yield and reducing the water use, but the majority of the farmers are not willing to practise the technique due to the high labour requirement and need of skilled labour. The findings indicate that, farmers are more interested in labour saving devises than water saving devises in paddy cultivation due to value of labour time for other income earning opportunities. This was proved to be true in the past as well with the less popular labour intensive SRI method of paddy cultivation and quick adoption of labour saving combine harvester.

4) About 40 and 20% of lowland paddy farmers and highland non paddy crop farmers had received perennial fruit crops to cultivate under irrigation. Almost all the plants supplied had survived for 40-70 % of the farmers.

5) Crop diversification has helped increasing the water use efficiency and superior income levels. Banana is the most popular non paddy crop among farmers.

6) Agricultural produce marketing centres were not successful and only 10 % of the farmers had utilized the centres, while regular users were limited to four percent.

7) The project has been able to double the farm income of the 70 % of the farmers in the area

8) The most serious problem affecting the livelihoods and income earning of the people is the damage to crops and livelihood assets caused by wild elephants and stray cattle.

6.2 Recommendations/Policy Implications

1) Reduction of conveyance losses and reuse of water by enhancing the capacity of the storage system, concrete lining of the distributory canal system and introducing field level dual canal system will help improving the irrigation system performance substantially.

2) It is important to provide systematic training and awareness to change the attitude and perceptions of the farmers to shift from paddy mono crop to non paddy crop cultivation by strengthening local level organizations, extension support, demonstration and provision of subsidies to produce better results as achieved in the Walawe scheme.

3) Farmers should be motivated to cultivate different types of high value bananas other than 'Embul' to receive an enhanced income and to capture the market potential.

4) As the soil salinity has been developed in some of the newly developed areas, it is important to provide a systematic drainage system in the new development area and empower and enlighten the farmers on the ways and means to overcome the negative effects of soil salinity.

5) It is important to institutionalize the system for the operation and maintenance at the FO level to ensure the mobilization of sufficient resources from farmers routinely and establish formal procedures to utilize the resources.

6) The project should carry out more advocacies on the lessons and experiences towards commercialization of irrigated agriculture and climate change adaptation.

7) It is not advisable to promote labour intensive technologies in paddy cultivation, without creating an enabling environment for a considerable income gain.

8) More attention should be paid to overcome the possible effects of wild animals by developing new areas for agriculture and human settlement.

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