Impact Assessment of Infrastructure Development on Poverty Alleviation
Case Studies on Irrigation Projects

Final Report

Sri Lanka Component

Intizar Hussain
Fuard Marikar, and
Sunil Thrikawala

International Water Management Institute
Colombo, Sri Lanka
February 2002

IWMI International Water Management Institute

JBIC JAPAN BANK FOR INTERNATIONAL COOPERATION

Executive Summary

The JBIC Institute, the Japan Bank for International Cooperation, invited the International Water Management Institute (IWMI) in late March 2001 to submit a proposal for a study on the "Impact Assessment of Infrastructure Development on Poverty: Case Studies on Irrigation Projects". The detailed proposal, including scope and coverage and general approach of the study was submitted to the JBIC Institute in early April 2001. Case studies were proposed to be carried out in Sri Lanka and Pakistan in irrigation systems where JBIC has funded the developments/ improvements/rehabilitation of irrigation systems. After some deliberation, discussion and general agreement about the study components, scope and coverage, general approach and methodologies, and sequencing of activities, inception activities for the study were initiated in late April/early May 2001. Main activities of the study consisted of (1) selecting suitable study areas and specific study sites, (2) developing a detailed sampling framework, (3) developing a panel data base by undertaking household level surveys during the year (2001) to cover 'before', 'during', and 'after' situations both for the wet and dry seasons of the year, and (4) undertaking econometric analyses of the impacts of irrigation infrastructure on poverty. The overall goal of the study is to develop an in-depth understanding of income dynamics in relation to access to irrigation water and to comprehensively evaluate the impact of irrigation infrastructure on poverty. The study is of a highly intensive nature in terms of both time and scope. This report provides output of the Sri Lankan component of the study.

The study uses primary data collected through household surveys conducted three times during the year 2000-2001, from a sample of 858 households, using a detailed multi-topic questionnaire. The study was undertaken in IWMI's Benchmark Basin - Uda Walawe Left Bank Irrigation System (WLB) in Uda Walawe area (Ruhuna Basin) in Sri Lanka. The study area exhibits considerable variability in cropping patterns. Main crops grown in the area include paddy, sugarcane, banana and other upland crops. Type of farming in the study area varies from irrigated to rain-fed to Chena cultivation. Demographically, there is a mix of government allottees, encroachers and non-farm households in the area. Since the entire irrigation infrastructure in the WLB irrigation system has already been rehabilitated/upgraded/improved, adjacent rainfed area and an irrigation system with the same source of water but without infrastructure upgrading/improvement were selected as control sites for comparison purposes.

The study area was divided into six strata based on criteria including: availability or non-availability of irrigation infrastructure, improved or unimproved irrigation infrastructure; cropping pattern, and availability or non-availability of water for irrigation in Maha 2000. A multistage sampling procedure was adopted for selecting the sample households in each stratum. The study employs a 'with' and 'without' approach by comparing sample areas with well developed/improved, less developed/unimproved and with no infrastructure and without irrigation to establish irrigation accessibility.

The overall approach to comprehensively assess the impacts of irrigation infrastructure on poverty, covering its both spatial and temporal aspects, consists of (1) comparing various strata representing the state of infrastructure development – quantifying the differences in the

value of relevant variables by developing a socio-economic profile for each strata. (2) developing and quantifying key indicators of poverty – covering both monetary and non-monetary dimensions of poverty. (3) estimating household income/ consumption smoothing effects of irrigation infrastructure development through econometric analysis, and (4) identifying and quantifying key determinants of household incomes/expenditures/poverty including quantifying the impact of irrigation infrastructure development on these variables through econometric analysis. [It should be clear at the outset that the study is based on inter-household analysis and does not look into intra-household poverty structures].

The results of this study provide strong empirical evidence on the role of irrigation infrastructure development on poverty alleviation, particularly on dynamic aspects of poverty. The findings suggest that the incidence, depth and severity of poverty, as measured by monetary indicators, are the highest in areas without irrigation infrastructure and lowest in areas with access to established irrigation infrastructure and with adequate water supplies. The study provides quantitative estimates of both transient and chronic poverty. In addition, the study quantifies and compares non-monetary indicators of poverty and shows how access to irrigation infrastructure development contributes to poverty reduction and raises overall welfare standards. Further, the study econometrically estimates expenditure smoothing effects of access to irrigation infrastructure. Finally, the study develops a multivariate econometric model to quantitatively assess the impact of various factors, including household access to irrigation infrastructure, endowment of land resources, land productivity, household human resources, household non-land productive assets and so on and so forth, on household incomes/expenditures. The model provides quantitative estimates of the potential increases in incomes and expenditures through development of infrastructure and improved access to adequate water supplies.

Summary of Findings

- Irrigation infrastructure has a beneficial impact, in terms of reducing poverty, particularly in reducing the incidence of chronic poverty, provided adequate supplies of water are available.
- The benefits of upgraded irrigation infrastructure over non-upgraded systems are less apparent. The availability of water appears to be more important as a factor in reducing poverty, and upgraded infrastructure becomes important insofar as it contributes to increased water supplies (both upstream and downstream).
- The dependency ratio and under five mortality rates are relatively higher in areas without access to irrigation infrastructure compared to areas with access to irrigation infrastructure.
- A comparison of Body Mass Index (MBI) across strata indicates no significant differences. There are only few instances of underweight children. In general, BMI for households in irrigated areas shows an increase from survey one (June) to survey three (October). However, in rainfed areas, BMI for all age groups declines in t he second period (August) and increases during the third period (October) but does not reach the level of the first period (June) values. BMI for non-farm households is generally lower than that for farm households.

- A larger proportion of the school-aged population not in school is in areas without access to irrigation infrastructure compared to areas with access to irrigation infrastructure.
- The cropping intensity is low in the typical rainfed areas. However it is high in rainfed areas with good moisture retaining soils, systematic cropping and marketing facilities.
- Although farm sizes are larger in rainfed areas, there appears to be a relationship between poverty and land size. The chronically poor population had smaller land holdings than either the transient poor or the non-poor.
- Income levels are lower in rainfed areas. Income peaks during the year coincide with availability of water for cultivation. In double-cropped areas there are two peaks in income and in single cropped areas, a single peak in income.
- Labor use per hectare and wage rates are lower in areas without access to irrigation infrastructure (Extension/rainfed -Rs. 173/day) compared to areas with access to irrigation infrastructure. (above Rs.194/day)
- Incomes and expenditures are higher in areas with access to irrigation infrastructure compared to areas with access to irrigation infrastructure, but the pattern of monthly incomes and expenditures are similar in both areas.
- Non-crop income makes up to 75 percent of total income in areas without access to irrigation infrastructure compared 50 percent in areas with access to irrigation infrastructure.
- Income inequality is only moderate in both with and without access to irrigation infrastructure. In areas where average incomes are high, income distribution is relatively more skewed. Differences in income inequality across strata are mainly due to variation in size of holdings, availability of irrigation water, opportunities for diversified cropping and availability of non-agricultural sources of income.
- The welfare cost of income and expenditure fluctuations is only marginally lower in areas with access to irrigation infrastructure compared to areas without access to irrigation infrastructure.
- Using monthly income data, 12 percent of the sample population is under chronic poverty, 69 percent is transient poor and the remaining 19 percent are non-poor. The depth and severity of poverty are higher for the chronically poor than the transient poor households.
- Using quarterly income data, 16 percent of the sample population is classified as chronically poor, 59 percent as transient poor and 25 percent as non-poor.
- Using annual data, 35 percent of the sample population is classified as poor (including and transient poor).
- Incidence of chronic poverty is highest in areas without access to irrigation infrastructure (typical rainfed areas) compared to areas with access to irrigation infrastructure. However, the incidence of transient poverty is high in both areas.
- Overall, highest chronic poverty is found among non-farm households, and in areas with no access to irrigation infrastructure and lowest in areas with access to irrigation infrastructure and adequate water supplies. This is regardless of whether monthly or quarterly data are used.
- The typical rainfed area as characterized by the Extension area had a high proportion of its population earning monthly incomes less than 50 percent of the poverty line.

- Household monthly expenditures in areas with access to irrigation infrastructure are, on average, are 24 percent higher than in areas with no access to irrigation infrastructure.
- Production activities in areas with access to irrigation infrastructure also provide livelihood support to households in areas with no irrigation infrastructure.
- There are both month, and average monthly income effects in monthly expenditures. The month effects are higher in the typical rainfed areas. Prices and preferences, in addition to monthly incomes, play a bigger role in determining monthly expenditures in the typical rainfed areas.
- Variations in monthly household expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income share/timing of income flows. The results indicate that monthly variations in consumption expenditures, that is, month effects in expenditures, are higher for households in irrigated areas compared to rainfed areas, and higher for farm households compared to non-farm households. Expenditures in August and September (Yala season) are much higher for households in strata with irrigation infrastructure compared to those households in strata without irrigation infrastructure, and it is this difference that influences the pattern of expenditures across months. These results are more clearer in comparison of households in irrigated (all) with those in rainfed areas, where month effects in expenditures for households in irrigated areas are higher and significant for all months, and patterns of monthly expenditures are different, especially during August and September. The results from these comparisons imply that household groups who have different income patterns, also have different expenditure patterns (although not in all months), suggesting that in addition to average monthly incomes and pure month effects (preferences, prices), timing of income receipts do influence monthly expenditures (the case of imperfect smoothing). Household access to infrastructure helps in improving average incomes, and increasing monthly incomes during the dry season period. Therefore, households with access to irrigation infrastructure are in better position to smooth their expenditures compared to those without it. It is concluded that variations in monthly expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income share/timing of income flows. Overall, the results of the study imply that irrigation infrastructure helps to reduce income fluctuations and enable households to smooth their consumption.
- Education level of households' heads, number of family earners, landholdings, gross value of product, household assets and access to irrigation infrastructure with adequate water supplies are the key determinants of household expenditure/income levels.
- Majority of the sample households believe that upgrading of the system/canal lining saved water and reduced labor requirement for irrigating their fields. A few believed that upgrading increased cropped areas, crop yields, and reduced water logging. On the other hand, many households indicated that infrastructure upgrading by lining of canals reduced seepage to their home gardens.

The study provides strong empirical evidence that irrigation infrastructure does have positive impact on poverty alleviation. Areas without access to irrigation infrastructure and adequate water supplies have the highest incidence, depth and severity of poverty. Areas with access to irrigation infrastructure generally have lower levels of chronic poverty and a higher

proportion of non-poor. However, these areas also have significant incidence of transient poverty.

The analysis of non-monetary indicators of poverty such as dependency ratio, mortality rate of children below five years, housing, education and other facilities, clearly demonstrates that households with access to irrigation infrastructure are socio-economically better off than households without access to irrigation infrastructure. The availability of water is critical to obtaining regular incomes and even in irrigated areas with access to irrigation infrastructure, the lack of water could result in lower incomes. Factors such as adequate water, marketing facilities, and systematic cropping can help to reinforce and boost the benefits from irrigation infrastructure.

Based on the analysis and evidence presented, one may conclude that access to irrigation infrastructure has significant impacts on poverty alleviation. Irrigation infrastructure can help lift both farm and non-farm households out of permanent or chronic poverty, by increasing productivity, employment, incomes, expenditures and indirectly by enhancing related economic activities. Along with infrastructure development, availability of water is critical to the achievement of the stated benefits. Inadequate water supplies will reduce the impact of infrastructure on poverty, even if the infrastructure is well developed. Poor maintenance can lead to reduced water supplies and negate any positive impact on poverty alleviation. Similarly, even if water supply is adequate and the infrastructure well maintained, the cultivation of low value crops or the absence of marketing facilities can reduce the impact of infrastructure on poverty.

For any questions, clarifications, comments and suggestions on the contents of this report, please contact the project leaders at the following addresses:

IWMI Team
Intizar Hussain, Ph.D.
Senior Economist
International Water Management Institute (IWMI
P.O.Box 2075, Colombo, Sri Lanka
Email: i.hussain@cgiar.org
Phone: 94-1-787404 (Extension 2204)
Fax: 94-1-786854

JBIC Team

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Part 1

Chapter 1

Study Background

Introduction

Over the last decade the focus of major development lending and aid agencies has gradually shifted towards the alleviation of poverty in developing countries. Poverty alleviation has now become one of the most important goals of development assistance. The perception of poverty, too, has changed in recent years, from the popular static concept of poverty to a dynamic one such as chronic and stochastic or transient poverty. Recent studies show that transient poverty accounts for a major part of overall poverty in developing countries. Since the poor are vulnerable and susceptible to exogenous negative shocks due to natural disasters such as drought, flood, typhoon, etc, providing households with coping strategies against the emergence of such temporary poverty becomes an important policy target.

It is generally believed that irrigation infrastructure development provides large benefits to the production activities in agriculture. The development of irrigation infrastructure contributes to increased productivity, and raises long-term production and income levels. It is generally recognized that irrigation infrastructure, by providing access to irrigation water, enables small and poor households to better manage risks and reduce income fluctuations caused by drought or other seasonal climatic fluctuations. This income stabilization and smoothing effect of infrastructure is assumed to contribute to transient poverty reduction by helping consumption smoothing. There is a large body of research showing that irrigation infrastructure contributes to socio-economic uplift and overall economic development. However, as Lipton and Ravallion (1995) and Jimenez (1995) indicate that research clearly analyzing the direct influence of infrastructure development on poverty alleviation is very limited. A recent review, by Sawada (2000), on the role of infrastructure in reducing chronic and transient poverty clearly indicates the need for empirical research in understanding the dynamics of poverty in irrigated agriculture and the role of infrastructure development in reducing chronic and transient poverty.

Irrigated agriculture provides the bulk of food and food security in the Asian region. At present, 40 percent of the cropland in Asia is irrigated and accounts for 70 percent of total cereal production. The population of Asia, already the most populous region in the world, is expected to grow to over 4.2 billion by 2025. Poor people are the most vulnerable to variability in the supply and quality of water available for agricultural uses. Irrigation sector interventions, therefore, must consider programs that contribute most effectively to poverty reduction. This requires a proper analysis of the various dimensions of poverty in diverse socioeconomic conditions, and a better understanding of the dynamics of poverty in irrigated agriculture and the role played by irrigation infrastructure development in poverty alleviation.

Goal and Objectives

The goal of the study is to evaluate the efficacy of using irrigation infrastructure development as a policy instrument for poverty alleviation in developing countries. The objective is to make an assessment of infrastructure development by using the concepts of transient and chronic poverty, taking irrigation project as a case study.

The study aims to fill a major gap in the literature on the role of irrigation infrastructure in poverty reduction. This study formally investigates the dynamic poverty reduction effects of irrigation infrastructure development by integrating field observations, economic theory, and econometric analysis. By using the quantitative evaluation results, the study also derives in a rigorous manner the policy implications for future infrastructure development.

Specific objectives of the study are:

1. To assess the impacts of irrigation infrastructure development on poverty alleviation taking JBIC financed irrigation projects as case studies.
2. To develop a set of indicators and an analytical method by which to measure the impact of irrigation infrastructure development on poverty alleviation.
3. To establish a panel database for impact assessment and to understand the dynamics of poverty in the selected study areas.

Scope and coverage

The scope and coverage of a study such as this is quite extensive in the sense that it is attempting to evaluate both the static as well as the dynamic aspects of poverty in relation to irrigation infrastructure development. The scope and coverage of the study include the following:

1. Undertake assessments of the impacts of irrigation infrastructure development on poverty taking selected JBIC funded projects as case studies – the Uda Walawe area in Sri Lanka (Uda Walawe Left Bank Irrigation System)

2. Establish a detailed methodology including all inputs, outputs and data requirements for the study. Develop an analytical framework, including indicators of poverty, to analyze inter-temporal changes in income and consumption.

3. Develop a sampling framework for the study based on several criteria including access to irrigation water, cropping patterns and stage of development of irrigation infrastructure and select representative sample areas. Identify specific locations within the selected areas, which represent various states of irrigation infrastructure development: well established/developed/improved, partially developed/improved, unimproved and with no infrastructure.

4. Carryout household level surveys three times over a period of 10 months beginning May 2001, of a representative sample of over 850 households in order to establish the panel database.

5. Evaluate the impact of irrigation infrastructure on poverty reduction using a "with and without" approach, comparing sample areas of varying degrees of irrigation infrastructure development: improved, unimproved, no infrastructure and without irrigation to construct the optimal mix of irrigation accessibility in each of the selected areas.

6. Compare the inter-temporal movements of income and consumption (e.g., variance and means) of household income and consumption in the surveyed areas. Through this quantitative evaluation, assess the impact of the irrigation infrastructure on dynamics of poverty in selected locations, assuming that other conditions such as climate, soil, and access to the market is more or less similar across the selected areas and locations in order to control those external factors in the analysis.

7. Carry out econometric analysis of household level panel data to investigate the dynamic poverty reduction impacts of irrigation infrastructure development.

Organization of the Report

This report is organized into three parts consisting of 11 chapters. Part 1 (chapters 1, 2, and 3) provides background material for the study. Chapter 2 provides a brief review of literature on the impact of irrigation infrastructure development on poverty. Chapter 3 gives an overview of key developments and trends in Sri Lankan economy, its agricultural sector, and poverty situation and trends in the country. Part 2 (chapters 4, 5 and 6) provides details on study methodology. Overall study design, approach and sampling framework are discussed in chapter 4, with details on household level survey administration and data collection procedures in chapter 5. Chapter 6 develops an analytical framework of the study. Part 3 (chapters 7, 8, 9, 10, and 11) reports results of the study. Basic socio-economic profile of sample households is given in chapter 7, followed by analyses of household income and expenditures and distribution patterns in chapter 8. Chapter 9 provides detailed estimates of chronic and transient poverty. Econometric analysis of seasonality in incomes and expenditures, and quantitative estimates of impact of infrastructure development on poverty are provided in chapter 10. Summary of study findings, conclusions and policy implications are provided in the final chapter. Other information, including detailed descriptive statistics are given in the appendix of the report.

Chapter 2

A Brief Review of Literature on Irrigation Infrastructure Development and Poverty

Poverty is usually defined as a state in which a household or individual's living standard is below the poverty line. If a household's living standard is always below the poverty line, that household is considered to be in a state of chronic poverty. If the household's living standard is usually above the poverty line, but falls below it at times, or has the potential to fall below the poverty line, such a state is defined as transient poverty or short-term or temporary poverty. Much effort has been made in the past to study the various aspects of poverty, including its the measurement, causes and determinants. The role of infrastructure in alleviating poverty is an area of study that is currently receiving much attention. It has been argued that most of the poor are concentrated in rural areas and depend heavily on agriculture. Therefore rural infrastructure development, and irrigation development, in particular, is believed to increase returns from agriculture, thereby reducing poverty.

Results of the studies undertaken on the impact of infrastructure on poverty suggest that infrastructure development can have a beneficial impact on the poor. There is some evidence to suggest that infrastructure does play an important role in reducing both chronic as well as transient poverty. Raising the productivity of the poor requires a sustained investment in infrastructure development, particularly rural infrastructure, which raises agricultural production and thus permanent incomes of the poor, which reduces chronic poverty in the long-run (Lipton & Ravallion, 1995).

A study on infrastructure and poverty in Vietnam (van de Walle, 1996) simulated the benefits from irrigation, using certain assumptions on how the benefits would be distributed. The study showed that the gains to the poor from irrigation infrastructure development would be higher than the gains to the non-poor, and therefore the benefits would be re-distributive in nature. The greatest gains to the poor would be from the expansion of irrigation to households with small landholdings. The rate of return from irrigation would be in the region of 20 percent. However, constraints other than those due to lack of irrigation would equally reduce the benefits of irrigation to both the poor and non-poor. One should keep in mind that Vietnam is a country with high levels of income poverty, and where every type of infrastructure is in poor shape. Under the circumstances, benefits from expanding a particular infrastructure would be reduced. Net marginal benefits from irrigation increases with education, therefore, the gains to the poor who are usually less educated, would be less than the gains to more educated non-poor.

A recent review of the literature on the role of infrastructure by Sawada (2000) highlights the importance of the dynamic aspects of poverty, specifically chronic and transient poverty aspects, in relation to the role of infrastructure in poverty reduction and the associated policy interventions. Conventional static indicators such as the Foster-Greer-Thorbeeke (FGT) indicators are useful in determining poverty targets, particularly in determining public

allocation between regions at different poverty levels according to the index. However, Sawada argues that conventional static indicators of poverty are unable to capture the differences between transient and chronic poverty effectively. These indicators use static information on average income and consumption levels, and social indicators over a period or a particular point in time and therefore cannot grasp the problem of dynamic poverty or changes in the state of poverty over time. This could result in advocacy of inappropriate measures/policies for poverty alleviation.

Recent research by Jalan and Ravallion (2001) raises an important question: Are the determinants of chronic and transient poverty different? and do policies that reduce transient poverty also reduce chronic poverty? Their studies in China suggest that some of the factors determining transient poverty do not matter to chronic poverty. They found that while a household's average wealth holding is an important determinant for both transient and chronic poverty, household demographics (such as education levels and health status), while important for chronic poverty, are not significant determinants of transient poverty. Results of their studies suggest that different types of policies will be needed to address the two types of poverty. They conclude that while China's poor area development program may well be an appropriate policy response to reduce chronic poverty, it is unlikely to reduce consumption variability and transient poverty. Additionally, policy instruments such as seasonal public works, credit schemes and insurance options for the poor may be needed to smooth consumption and to reduce transient poverty.

Transient poverty is most common in agriculture. Since agricultural production involves high risk and is seasonal by nature, the income of farmers tends to vary according to the season, while net income changes according to the level and use of inputs and variability of output. Farmers face a variety of risks, including output and input price fluctuations, that tend to have a negative influence on the household welfare. Tropical diseases can cause a severe reduction in household income. The basic problem faced by a developing country household is how to reconcile variable income flow with a stable consumption pattern. Farmers manage agricultural production risks through various means, including, crop diversification, use of low risk technologies, business relationship through kinship and ethnicity, and other traditional ways. Studies using Pakistani household data (Kurosaki, 1998) show that reduction of risks resulted in a 20 percent drop in the welfare of the small farmers. Risk coping strategies for avoiding temporary poverty (as summarized by Sawada, 2000), include, " self insurance" or consumption smoothing to adjust their resources inter-temporarily and "mutual insurance" or informal risk sharing arrangements among family members, relatives, neighbors and friends. Sawada describes five strategies for self-insurance. The first strategy for consumption smoothing adopted by the poor is to lower the quality of consumption (substitution of cheaper food with the same nutritional value, e.g. soybean instead of meat or fish) and reduce expenditures on health, education and other 'luxury' goods. Other strategies for self-insurance include, borrowing, selling of own physical assets or drawing on savings; greater use of own human assets like joining the labor market, and obtaining gifts/money from relations and friends.

Mutual insurance or risk sharing refers to the informal reciprocal transfers that take place among family members, relatives, friends, and neighbors in times of need. This coping

strategy has evolved through years of developing relationships based on trust, reciprocity and mutual assistance within rural communities in developing countries, arising from the need to find alternatives to the less accessible commercial insurance and credit markets. Studies done by several researchers (Townsend 1994, 1995, Deaton 1997, Jalan and Ravallion 1996, Gillani 1996, Kurosaki and Sawada 1999) showed that, although a perfect risk sharing hypothesis was rejected statistically, about 60 to 70 percent of income fluctuations were absorbed by some form of risk sharing or mutual insurance. When an entire village is affected by a flood or drought, transfers from family members living elsewhere serve as insurance for smoothing the household's consumption.

Paxson (1993), using data from Thailand, investigated whether seasonal variations in incomes, as opposed to variations in preferences or prices, determines seasonal consumption patterns. It is generally assumed that the consumption patterns of poor rural households, with restricted access to credit, follow the pattern of seasonal incomes, implying that these households are unable to smooth consumption levels across seasons. However, Paxson suggests that there may be reasons, apart from borrowing constraints that may cause this seasonality in consumption. First, taste variations due to festivals, holidays and weather patterns may be an important determinant of seasonal consumption. Second, seasonal price variation may also cause fluctuation in consumption. The results of her study suggest that seasonal variations in consumption are not clearly or consistently related to the timing of income receipts. Her findings suggest that, seasonal consumption patterns are due to the seasonal variation in prices or preferences, common to all households and not due to an inability of the household to dis-save or use savings to smooth consumption.

Canning (1999) estimated production functions using human assets and physical infrastructure as factors of production, with data covering 57 countries. Empirical results from this study suggests that the development of physical infrastructure will raise long-term production and income levels by externalities, thus making a large contribution to the reduction of chronic poverty.

Jimenez (1995) demonstrated that improvement to irrigation, paved roads, or an increase in the density of regional roads, had a direct impact on poverty reduction by generating an increase in agricultural productivity, the highest impact coming from irrigation development. Lipton and Ravallion (1995) suggested that infrastructure development increases the mobility of information, goods and services and employment, thereby indirectly helping to reduce chronic poverty. Sen (1981) suggests that improved access to infrastructure increases access to markets, including non-farm labor markets; reduces the cost of exchange or sale of goods and services; and raises farm and non farm incomes. Thus infrastructure development, both directly and indirectly, raises the welfare standards of the poor and reduces chronic poverty by increasing agricultural production, raising non-farm incomes, bringing smooth transition to the market economy, and reducing the transaction costs of accessing education and medical services. Datt and Ravallion (1997) show that agricultural productivity and rural poverty in India has moved together, and that irrigation and other infrastructure development has played an important role. States with better initial stock of human resources and physical infrastructure and irrigation intensity achieved higher growth in agricultural productivity which in turn helped to reduce rural poverty.

Infrastructure development also helps to reduce transient poverty through preventing or reducing the risks of natural disasters. It also reduces transaction costs of marketing goods and services, and increasing non-farm employment opportunities, thereby, reducing transient poverty. Risk sharing and mutual insurance strategies adopted by the transient poor could be complemented by the development of infrastructure that aims to integrate markets by increasing the mobility of goods, services and information, and promote consumption smoothing.

A study by IFPRI (Fan, Hazell and Thorat, 1999) analyzes the linkages between government spending, growth and poverty in rural India, using state level data from 1970 to 1993. The results of the study show that government spending on productivity enhancing investments, such as irrigation, research and development in agriculture, rural infrastructure (including roads and electricity), and rural development and welfare programs which target the rural poor directly have all contributed to reductions in rural poverty. Most of these investments have also contributed to growth in agricultural productivity, but their impacts on poverty and productivity show large variations. For example, expenditure on roads has the largest impact on both poverty reduction and productivity growth. Targeted spending on welfare for scheduled castes, tribes and other backward classes has been very effective and has had a large impact on rural poverty reduction, but it has had a negligible impact on productivity. On the other hand, expenditure on health reduced rural poverty significantly, but had little impact on productivity. Government spending on agricultural research and extension has had the largest impact on agricultural productivity growth, and it has also led to large benefits for the rural poor. Additional investments in irrigation had the third largest impact on growth in agricultural productivity, but a smaller impact on rural poverty (it should be noted here that the impact is determined based on marginal returns of each additional unit of investment, over and above the past investment in irrigation development), while the study acknowledges that irrigation development played a large role in production growth during the Green Revolution. The study appears to have some methodological problems in quantifying the impacts of various investments).

Chapter 3

Economy, Agriculture and Poverty in Sri Lanka
An Overview of Key Developments and Trends

Characteristics of Sri Lankan Economy

Sri Lanka's economy was largely based on agriculture during the early 1950's and 1960's. Agriculture contributed between 60 and 70 percent to the GDP[1], with export agriculture comprising mainly plantation crops such as Tea, Rubber, Coconut and Spices, accounting for over 70 percent of the income generated by agricultural sector. Much of the labor force (over 60 percent) was employed in the agricultural sector. More importantly, the bulk of foreign exchange earnings (over 70 percent)[1] was earned from export agriculture. With very little industrial development, almost all consumption goods and more than 60 percent of domestic rice requirement were met with imports. Thus, the economy was largely trade dependent, with a highly productive plantation agriculture sector in the hands of large foreign companies co-existing with an inefficient local agricultural sector, based on irrigated and rainfed rice cultivation, and underutilized labor force, providing only subsistence level income to farmers.

During the 1970's and 1980's, the contribution of the agriculture sector to GDP declined steadily, while that of other sectors increased. In the last two decades, the economy has undergone further transformation from agriculture to a predominantly services based economy, with a slight increase in the level of industrialization. The contribution made to the GDP by agriculture declined from 30 percent to 20 percent[1] over the last two decades. The share of the industrial sector remained stagnant at around 17 to18 percent, while that of the services sector increased from 44 to 55 percent and that of the construction sector from 4 to 7 percent[1]. Although the labor force in the agriculture sector declined marginally, this sector still retained the bulk of the labor force. The last two decades also witnessed a phenomenal increase in foreign employment, particularly in the Middle Eastern countries, thus somewhat easing the high level of under employment observed in the rural sector.

In 1990, agricultural exports made up 36 percent of total exports, industrial exports accounted for 53 percent[1]. In the year 2000, the value of industrial exports has increased to 78 percent of the total compared to 18 percent[1] for agricultural exports. The highest amount of foreign exchange earnings is from the export of garments and textiles (50 percent of total value of exports), followed by earnings from private transfers (20 percent)[1] from foreign

[1] Central Bank Reports for various years.

employment. Agricultural exports, which provided the largest source of foreign exchange prior to the 1970's, is now the third largest source of foreign exchange (18 percent of total earnings), with tea exports providing 12 percent[1] of total earnings. Thus, we can observe a gradual decline in importance of the role of the export agricultural sector in the Sri Lankan economy. At the same time, industrial exports, particularly garments and private transfers from foreign employment have substantially increased their contribution to the economy. The domestic agricultural sector, comprising paddy and other crops, have slightly increased their share in GDP over the last two decades. However, incomes from paddy farming have remained stagnant or have declined in real terms. Contribution to the GDP from other crops has also increased marginally, and generates incomes higher than those in paddy.

Although Sri Lanka was the first South Asian country to adopt liberal open market policies two decades ago, it lags behind in development when compared with several other Asian countries that adopted these policies much later. This is due to various internal as well as external factors[2]. Various political parties have supported reforms despite their political differences. Consequently, the direction of the policy changes has remained unaltered. The overall results of these reforms in terms of macro economic indicators have been positive, although the implementation has been slow or ineffective. Several reasons have been put forward to explain the slow or ineffective implementation of these reforms and the declining rate of growth. These include internal factors, such as ethnic and political conflicts, the diversion of large amounts of financial resources for the war effort aimed at resolving the ethnic conflict; and external factors such, as sharp increases in the price of imports, low export prices, rapid increase in energy costs, inflation, and labor unrest. Several issues require the immediate attention of policy makers in order to shore up the economy. These include the problems of inadequate investment and saving levels, high rates of inflation, unemployment and poverty, high crime rate, stagnant agricultural productivity, inadequate demand for industrial goods and other serious macro economic imbalances. Some of these problems have further deteriorated in recent years, posing greater risks of marginalization when compared to the outside world.

Characteristics of Agriculture in Sri Lanka – Rainfed and Irrigated

About 30 percent of Sri Lanka's total land cover of 6.3 million ha (excluding area under inland waters) is under permanent cultivation and a further 16 percent under shifting or "Chena"[3] cultivation. Thus, about 3.0 million ha, or nearly 50 percent of Sri Lanka'a land surface is under some form of agricultural enterprise, of which 1.8 million ha is under permanent cultivation and 1.0 million ha under Chena cultivation. About a third of the area under permanent cultivation, or 0.6 million ha has been provided with irrigation facilities and is mainly cultivated with paddy. The total extent of land under paddy cultivation is estimated at 0.9 million ha, over 70 percent of which has irrigation facilities, while the rest is rainfed.

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[2] Central Bank Report, 2000.

[3] Chena – Slash and burn agriculture, where forests are cleared and cultivated for one to two years and then allowed to regenerate. The cycle, which usually lasted 10-15 years earlier, has been reduced to 3-5 years due to unavailability of land and due to restrictions on Chena cultivation and the reduction in forest cover.

Of the land with irrigation facilities two thirds, or 0.43 million ha, is under major irrigation schemes and the balance 0.23 million ha under minor irrigation schemes. The Mahaweli irrigation system provides irrigation facilities to almost 0.1 million ha of land under major schemes. The three main plantation crops of Tea, Rubber, and Coconut and other minor export crops occupy 0.8 million ha of rainfed land, mainly in the wet zone of Sri Lanka. Other permanent highland or annual crops occupy 0.2 million ha. The rest of the land area comprises forest, grassland and non- agricultural land (buildings, homes, rock outcrop, etc.). Details of land use are given in Table 3.1.

Table 3.1 Land Use in Sri Lanka

Land Use Category	Area in Million Ha	Percentage of Total	Area Irrigated in Million Ha
Total Area	6.57	100	
Inland waters	0.29	4.4	
Buildings, Non-agricultural land, and Homes	0.80	12.2	
Tea	0.18	2.7	0
Rubber	0.16	2.4	0
Coconut	0.44	6.7	0
Paddy	0.90	13.7	0.58
Chena lands	1.00	15.2	0
Other permanent / annual crops	0.20	3.0	0.02
Forest cover	2.10	32.0	
Grassland and shrub	0.50	7.6	

Sources: Statistical Abstract 2000, Census and Statistics Dept., Central Bank Reports, Mahaweli Authority Reports.

The bulk (97 percent) of irrigated land is cultivated with paddy, and the rest with other permanent and semi permanent crops or seasonal crops such as, chillies, onions, pulses, yams, groundnut, potato, maize and other grains, sugarcane, vegetables, coconut, papaya, banana, melon and other fruits. The rainfed area can be categorized into Chena lands and other permanent highlands or lowlands. Due to restrictions imposed on Chena cultivation, by legal and other means, the area under Chena cultivation has not increased in recent years. The existing Chena areas are now being re-used, with a shorter interval for recovery. It is likely that in the future, Chena lands will be converted to permanent rainfed farms. Other permanent highlands and lowlands under rainfed cropping can again, be classified into lands in the wet zone and lands in the dry zone. In the dry zone, permanent rainfed farming is restricted by seasonality of rainfall. A successful cultivation is possible only in the wet season. In the dry season, the rainfall is much less and is insufficient for a complete and successful cultivation, unless supplementary sources of water are available. Thus, rainfed farming in the dry zone is mostly restricted to seasonal crops in uplands and permanent crops, particularly fruit crops such as bananas, papaya, citrus, mango, pomegranate, coconut

and timber trees. Permanent crops are usually grown in home gardens and rarely in highland plots outside of home gardens. Crops grown in home gardens do receive some supplementary irrigation from wells, or from adjacent streams and canals. Seasonal crops are also grown in home gardens as well as in highland plots outside of home gardens. But more often seasonal crops, including paddy, are grown during the rainy or Maha[4] season in the highlands. If paddy is not cultivated in the dry or Yala[5] season, due to lack of water, a few drought tolerant annual crops may be grown on paddy fields to make use of the left over moisture in the paddy fields, supplemented by whatever rain that may fall during this season.

In the wet zone, the rainfall pattern is bi-modal, with high intensity rainfall occurring during both the Maha and Yala seasons. Thus the climatic pattern is ideally suited for permanent or seasonal rainfed farming. This region has specialized in export oriented plantation agriculture, with the bulk of the area covered by the three major crops of Tea, Rubber and Coconut. Rice is grown in valley bottoms and on terraced fields in hilly slopes. Some paddy is irrigated using the run of the river irrigation systems, but much of the paddy is rainfed. Other crops grown in this region include vegetables, potatoes, fruit and spice crops, tobacco, timber and medicinal plants.

Irrigated farming has been practiced for centuries in Sri Lanka and dates back more than two thousand years. The ancient kings, who had developed highly advanced irrigation technological skills, constructed large numbers of irrigation systems to cultivate rice. In fact, ancient Sri Lanka was once known as the rice bowl of Asia, and was famed for its exports of rice to many parts of the world. These irrigation systems usually consisted of a reservoir to store and regulate water, and a canal system to convey water for irrigation in both seasons. In some cases, the system comprised of a large reservoir that served as both storage and regulating facility connected via a well-developed canal system to many small reservoirs for the irrigation of fields commanded by these small reservoirs. Under this system, the large storage reservoir did not usually irrigate fields directly. The Yoda Wewa irrigation scheme in the North West coastal area of Mannar in the Northern Province is an example of such a system that is currently operational. Similarly, structures that have survived up to the present include very long canals (some more than 50 miles long), with gradients of one inch to a mile. It is noteworthy that such feats of irrigation engineering have not been emulated even with present day technology.

After thousands of years of use, around 12th Century BC, the highly developed hydraulic civilization started to disintegrate, many of these systems went into disrepair, and farmers abandoned these schemes and moved south. Several theories exist as to the reasons for the apparent decay of the hydraulic civilization that prevailed during this period. These include war between the local kings and invading forces from South India, loss of experienced water

[4] Maha is the rainy cultivation season in Sri Lanka, which receives rainfall mainly from the North East Monsoon and lasts from October to March (The monsoon proper is from December to February and the inter monsoonal period from March to April)

[5] Yala season is the dry cultivation season, which receives rainfall mainly from the South West Monsoon and lasts from April to September. (The monsoon proper is from May to September and the inter monsoonal period from October to November)

management personnel due to war, soil impoverishment, climatic change, famine and diseases such as Malaria, and attraction towards the wetter areas of the country.

Modern irrigation began in the last century during which period a large number of these ancient systems were restored by the British Colonial rulers, and are operational at present. Restoration of these ancient systems continued even after independence by the Government of Sri Lanka. A concerted effort was made to develop the water resources of the country, including the restoration of the ancient schemes, as well the construction of new ones. Major river basin development initiated in the 1950's and includes the Gal Oya, followed by Uda Walawe, Rajangane, and culminated in the Mahaweli program which aimed to develop the largest river basin in Sri Lanka. One of the objectives of developing these irrigation systems was to resettle the population from the land scarce Wet Zone[6] to the sparsely populated Dry Zone[7] of the country. Irrigated area increased from about 200,000 ha in 1950 to about 400,000 ha in 1970, and 500,000 ha in 1990 to about 650,000 ha in the year 2000. Over eighty percent of the irrigated land lies in the Dry Zone.

As in ancient times the bulk of the irrigated area is cultivated with rice. A small proportion of the irrigated command areas is cultivated with high value crops such as chillies, onions, pulses, sugar cane, tobacco, fruits and vegetables. The irrigated area can be categorized by the size of the irrigation system into areas irrigated by major schemes and areas irrigated by minor schemes. All schemes with a command area of less than 80 hectares are considered to be minor schemes. It is estimated that the area currently irrigated by major schemes, including Mahaweli schemes, is over 400,000 ha and that by minor schemes over 200,000 ha. The minor schemes are under the administration of the Department of Agrarian Services and operated by farmers. Typically, minor schemes impound run-off from local catchments, using earth dams, to provide supplementary irrigation for a full Maha crop and a restricted Yala cultivation. The Mahaweli Authority is responsible for 100,000 ha of irrigated lands under major schemes, while the Irrigation Department is responsible for the balance 300,000 ha, of lands under major schemes. The Irrigation Department, further classifies the schemes under its control into medium schemes (command area between 80 ha and 400 ha) and major schemes (command area above 400 ha). The management of most major schemes is in the process of being transferred to the farmers. Major schemes provide sufficient water for a full Maha crop and a full or partial Yala crop. Average cropping intensity in major schemes is about 165 percent per annum and in the minor schemes, about 120 percent. The majority of the irrigation systems in the Wet Zone, divert water from perennial streams or rivers using

[6] The Wet Zone is classified as areas receiving more than 2500 mm of rainfall per annum at 75 percent expectancy of annual rainfall. The Wet Zone comprises the following districts: Colombo, Gampaha, Kalutara, Kandy, Nuwara-Eliya, Galle, Matara, Ratnapura and Kegalle (About 20% of the land area and 9 of the 25 districts fall within the Wet Zone)

[7] The Dry Zone is classified as areas receiving less than 2500 mm of rainfall per annum at 75 percent expectancy of annual rainfall. Within the Dry Zone is included the Intermediate Zone with mean annual rainfall between 1900-2500mm. The Dry Zone included the following districts, Jaffna, Mannar, Vavuniya, Mullaitivu, Batticaloa, Amparai, Trincomalee, Puttalam, Chilaw, Anuradhapura, Polonnaruwa, Hambantota, Moneragala, Badulla, Matale and Kurunegala. Parts of the latter three districts fall within the Intermediate Zone. (About 80% of the land area and 16 of the 25 districts fall within the Dry Zone)

anicuts (weirs) for irrigation. Anicut schemes are also found in a few major Dry Zone perennial river systems.

Labor force in agriculture

The total employed labor force, which was 2.9 million in 1953, increased to 3.4 million in 1963, 4.5 million in 1971, 5.0 million in 1981, 6.0 million in 1990 and to 6.9 million in the year 2000[8]. The rate of unemployment, which was 16.6 percent in 1963, rose to18.7 percent in 1971, and declined marginally to 17.9 percent in 1981. Since then, the rate of unemployment has declined, to 15.8 percent in 1990, and reached to its lowest rate of 7.7 percent in the year 2000. The labor force participation rate has increased from 37 percent of the total household population (population aged 10 years and above) in 1953 to 50 percent in 1990 and has remained at this level over the last ten-year period. The above shows that, over the last five decades or so, the labor participation rate has improved considerably, while the rate of unemployment has also fallen drastically.

The share of agriculture in total employment, which was 53 percent in 1953, declined to 45 percent in 1981 and reached its lowest level of 36 percent of total employment in the year 2000, with the total number employed in this sector (agriculture, hunting, forestry, and fisheries) remaining at around 2.3 million. While the total number employed in agriculture has remained more or less static, the absolute number employed in industry has doubled, while that in the services sector has increased by over 50 percent, since the 1980's. The share of the labor force employed in industry rose from 10 percent in 1981 to 16.5 percent in the year 2000. The share of the labor force employed in the services and construction sectors rose from 40.1 percent and 3 percent to 41.3 percent and 5.5 percent respectively (Central Bank Report, 2000), over the same period. This indicates that a structural transformation of the economy has been taking place, with a gradual transfer of the agricultural labor force to other sectors.

Census data for 1981 (latest available) shows that, 25 percent (about 1 million persons) of those employed were farmers or cultivators, and about 18 percent (0.75 million persons) were agricultural or animal husbandry workers. A further 2.5 percent (0.1 million persons) were in other employment within agriculture. The share of employment in paddy cultivation in total employment in agriculture was 24 percent in 1953. This share increased to 37 percent in 1963, 44 percent in 1971 and declined slightly to 42 percent in 1981. Thus paddy cultivation was a major source of employment within the agriculture sector in the 1980's. Although the share of agriculture in total employment has declined to 36 percent in the year 2000, it is likely that paddy cultivation still provides a major share of the employment within this sector.

[8] Data on labor force, participation rate, employment and unemployment by sector were obtained from the four Censuses of Population conducted in 1953, 1963, 1971 and 1981 and from quarterly labor force surveys conducted by the Census and Statistics Department, from 1990 onwards.

Poverty in Sri Lanka

Although much work has been done to conceptualize, define and measure poverty, there is no official definition of poverty or a designated poverty line in Sri Lanka. Conclusions made in various studies undertaken on poverty in Sri Lanka are not strictly comparable, since different definitions of poverty have been used in determining the poverty line. The Department of Census and Statistics and the Central Bank are the two main sources of data for poverty analysis. Data from periodic Censuses, Socio-economic and Labor Force Surveys, Annual Food Balance Sheets, and Household Income and Expenditure Surveys, of the Census and Statistics Department and Annual Reports, and Consumer Finances and Socio-economic Surveys of the Central Bank provide the basis for inter-temporal analysis of poverty. A generally accepted conclusion of studies based on such data is that about 25 percent of the population lives in poverty, and that abject poverty or destitution does exist in Sri Lanka, but in small pockets.

Poverty in general terms can be defined as an inability to maintain a minimal standard of living. Others[9] have defined the poor as "those who do not have adequate resources to meet their basic needs". Researchers in Sri Lanka have used household income/expenditure as well as dietary intake data to determine poverty lines. Consumption poverty has been defined as those consuming less than a recommended minimal daily dietary intake of calories. In Sri Lanka, most studies have been based either on consumption poverty, or consumption poverty adjusted for basic non-food expenditure, but excluding consumer durable goods. Poverty, defined using household income/expenditure is more complicated as the values have to be adjusted for inflation in order to be comparable over time.

Some general characteristics of the poor can be derived from different studies on poverty undertaken in Sri Lanka. For example, poor households are larger in size and have a high dependency ratio. They have limited access to outside resources and little or no productive assets. There is a higher incidence of female-headed households among the poor. Members of poor households have lower levels of educational attainment and a greater proportion of unskilled labor. The level of underemployment, seasonal employment and unemployment is higher among the poor. There is no relationship between poverty and ethnicity and the type of occupation. The poor can be found among many occupations, including semi-subsistence farmers, low income market oriented farmers, self-employed individuals, urban workers and self employed in tradable and non-tradable sectors (Tudawe, 2000)

The population of Sri Lanka is largely rural with about 85.3 percent[10] living in rural areas (80 percent in rural villages, 5.3 percent in estates in the plantation sector) (World Bank, Recapturing Missed Opportunities, 2000). Thus poverty is largely a rural phenomenon (those in the estate sector are also considered as rural). As there is no official definition of a poverty line in Sri Lanka, different researchers have used different reference values in estimating

[9] Theoretical basis developed by Harberger (1978; 1983) and Scandizzo and Knudsen (1980). The problem here is to identify core basic versus non-basic consumption goods. The basket comprising basic goods may vary in different communities, countries or over time.

[10] Source: Extract from report of Census of Sri Lanka, 2001, Department of Census and Statistics.

poverty. The following Tables 3.2, 3.3, and 3.4 provide a measure of poverty in three sectors, estimated by different researchers using various reference poverty lines (Gunetilleke, 2000)

Table 3.2 Incidence, Depth and Severity of Poverty in Sri Lanka by Sector: 1985/86, 1990/91, and 1995/96 – Reference Poverty Line

Sector	Reference Poverty Line : Rs 792 per person per month at 1995/1996 prices								
	1985/1986			1990/1991			1995/1996		
	IOP	DOP	SOP	IOP	DOP	SOP	IOP	DOP	SOP
Urban	18.4	4.4	1.6	15.0	3.4	1.2	14.7	3.0	0.9
Rural	35.6	8.9	3.2	22.0	4.5	1.4	27.1	5.8	1.9
Estate	20.5	3.9	1.3	12.4	2.1	0.6	24.9	4.9	1.6
Sri Lanka	30.9	7.6	2.8	19.9	4.1	1.3	25.2	5.4	1.7

Source: Department of Census and Statistics; and World Bank Sri Lanka Poverty Assessment 1995 (as reported in Gunetilleke, 2000).
IOP - Incidence of Poverty (Head Count), DOP – Depth of Poverty (Poverty Gap), SOP – Severity of Poverty (Squared Poverty Gap) .

Table 3.2, which shows the poverty level using a lower reference poverty line, indicates that the incidence, depth and severity of poverty are high in rural areas. Poverty in rural villages and estates declined between 1986 and 1991, and increased between 1991 and 1996. Poverty in urban areas has declined continually between 1985 and 1996. For the whole of Sri Lanka, poverty declined up to 1990 and then increased substantially in 1996, but was still below the level of 1986.

Table 3.3 Incidence, Depth and Severity of Poverty in Sri Lanka by Sector: 1985/86, 1990/91, and 1995/96 – Higher Poverty Line

Sector	Higher Poverty Line : Rs 950 per person per month at 1995/1996 prices								
	1985/1986			1990/1991			1995/1996		
	IOP	DOP	SOP	IOP	DOP	SOP	IOP	DOP	SOP
Urban	28.1	7.5	2.9	24.5	6.1	2.2	24.9	5.8	2.0
Rural	50.2	14.6	5.9	36.0	8.6	3.0	41.3	10.5	3.8
Estate	20.5	3.9	1.3	12.4	2.1	0.6	24.9	10.1	3.3
Sri Lanka	44.5	12.6	5.0	33.0	7.8	2.7	39.2	9.9	3.5

Source: Department of Census and Statistics; and World Bank Sri Lanka Poverty Assessment 1995 (as reported in Gunetilleke, 2000).
IOP - Incidence of Poverty (Head Count), DOP – Depth of Poverty (Poverty Gap), SOP – Severity of Poverty (Squared Poverty Gap)

Table 3.3, which uses a higher poverty line, indicates a similar trend as the lower reference poverty line, in case of all sectors. The magnitude of poverty is obviously higher because of the high poverty line. Urban poverty shows decline between 1986 and 1990 and a marginal rise in 1996. In the estate sector, poverty declines substantially and between 1986 and 1991, but increases above the 1986 level in 1996. The increase in poverty in rural areas between 1991 and 1996, is attributed to the drought that prevailed during this period (World Bank, 2000).

Table 3.4 Incidence, Depth and Severity of Poverty in Sri Lanka by Sector: 1996/97 – By Reference Poverty Line

Sector	Reference Poverty Line at 1996/97 prices					
	Rs 1032 per person per month			Rs 860 per person per month		
	IOP	DOP	SOP	IOP	DOP	SOP
Urban	17.3	4.1	1.5	10.9	2.2	0.7
Rural	33.3	8.8	2.8	20.3	4.3	1.4
Estate	33.7	6.5	1..8	17.5	2.6	0.7
Sri Lanka	31.2	7.4	2.6	18.9	3.9	1.3
	Contribution to Poverty (Percent)					
	IOP	DOP	SOP	IOP	DOP	SOP
Urban	7.2	7.2	7.3	7.5	7.2	7.5
Rural	86.8	87.9	88.8	87.4	89.0	89.6
Estate	6.0	4.9	3.9	5.2	3.8	2.9
Sri Lanka	100.0	100.0	100.0	100.0	100.0	100.0

Primary Source: Consumer Finances & Socio-economic Survey 1996/97 Central Bank of Sri Lanka.
Secondary Source: Framework for Poverty Reduction in Sri Lanka Draft, Jan. 2000, Department of External Resources, Sri Lanka. IOP - Incidence of Poverty (Head Count), DOP – Depth of Poverty (Poverty Gap), SOP – Severity of Poverty (Squared Poverty Gap)

Table 3.4 provides poverty estimates for 1996/97, using data from the Consumer Finances & Socio-economic Survey 1996/97 of the Central Bank. Although not strictly comparable to the earlier data, all sectors show a reduction in poverty when compared to the 1995/96 data at the lower poverty line, with the estate sector showing the greatest improvement. When both 1995/96 and 1996/97 values are compared at the higher poverty line, both urban and rural poverty appeared to have declined, but estate sector poverty had increased substantially. This result is probably due to the large number of non-poor households clustered slightly above the poverty line, sensitive to economic fluctuations such as prices, droughts etc. particularly in the estate sector, which is vulnerable to external factors and natural conditions such as climate and rainfall. For Sri Lanka as a whole, poverty declined both at the lower and higher poverty lines. Thus we can observe a cyclic pattern of decline, increase and decline in poverty for Sri Lanka as a whole. The current declining trend in poverty in Sri Lanka is continuing after 1997.

Income poverty is high in Sri Lanka, with as much as 25 percent of the population below the poverty line (excluding the North and East, where poverty may have worsened because of the conflict). Poverty is high in rural areas, which has 85 percent of the population and 85 percent of the poor. The declining trend in poverty is probably the result of structural changes and opening of the economy, which has sustained a reasonably high rate of economic growth over the last 15 years. However, there is still a large proportion of the population, who remain susceptible and vulnerable to economic changes and income fluctuations because they are clustered at the borderline of the poverty line. Poverty levels are particularly high among landless laborers, and among casual laborers employed in agriculture, mining, construction and the informal sector. Greater vulnerability and insecurity of the poor and those clustered above the poverty line, may be due to poor targeting of poverty alleviation programs, large increases in temporary and casual employment, and insufficient attention to risk management in agriculture.

There is evidence to suggest that high agricultural growth can reduce poverty significantly, since a large proportion of the population live in rural areas. The highest incidence of poverty was recorded (1995/96 data) among households deriving their income from agriculture. Thus, slow per capita growth in agriculture (only 1 percent during 1990-96), major droughts, contraction in the paddy sector; slow growth in rubber and mining sub-sectors may have contributed to the high poverty levels in these sectors. Another factor that may be contributing to the high level of poverty in rural areas is lack of or inadequacy of infrastructure facilities. For example electricity reaches only 55-60 percent of the population, rural-urban road linkages are weak, transport facilities are poor and road networks are not maintained and of poor quality. Distortions in land and labor markets have reduced mobility, and created a large number of low quality, casual and temporary employment contributing to the perpetuation of poverty

A World Bank Report (1990), which analyzed the links between poverty and unemployment in Sri Lanka, suggests that, there is no conclusive evidence of poverty being related to unemployment, although many believe that unemployment may be a major cause of poverty. Such views have been reinforced by nutrition studies carried out in 1987, which showed that over 25 percent of pre-school children were malnourished and 20 percent of all babies delivered were of low birth weight due to maternal malnutrition. Most of the poor are found in households with a large number of dependents, with a high share of children and pregnant mothers among the poor. The World Bank report argues that unemployment may not be the main cause of poverty since as much as 75 percent of the unemployed came from non-poor households and less than ten percent of the poor were unemployed. The report further states that half of the unemployed are well educated women, who are being supported by their parents while awaiting high-paying jobs in the formal sector. A subsequent World Bank study on poverty (Recapturing Missed Opportunities, 2000) has not dealt specifically with the relationship between poverty and unemployment, but suggests that poverty levels are high among casually employed persons in agriculture, mining, and construction sectors. The report also indicates that there is evidence to suggest that fluctuation in economic performance leads to large increases in poverty.

Sri Lanka has been committed to a well-established social welfare program, providing free health and educational services, since the early 1900s. Public expenditures in health and education grew to 6 percent of the GDP in 1948-52 and remained at this level up to the 1970s (World Bank, 1990). As a result of improved health care and education, mortality rates declined rapidly and population increased at rates close to 3 percent, resulting in a large population increase in the 1950s. However, improved education and other social welfare programs began to have an opposite impact on population growth rates, which started to decline by the early 1980s and has been declining ever since. Apart from education and health services, the Government introduced a food subsidy program to reduce the impacts of World War II. This program, which was initiated in the 1940s and continued up to 1977, provided a fixed amount of rice and wheat flour at a subsidized price to all households in Sri Lanka (World Bank 1990).

With the opening up of the economy in 1977, an attempt was made by the government to target food subsidy programs to the actual poor and needy population. In 1978, the food

subsidy program was restructured and redirected to the poorest of the population. Consequently, food subsidies were issued only to households with a monthly income of Rs 300 or less for five or more persons. The number of people receiving food subsidies was halved as a result. Toward the end of 1979, food subsidies in the form of a rationed quantity of food was eliminated and replaced by a food stamp program (FSP), for those earning below Rs 300 per month. An evaluation of the FSP showed that only 38 percent of the total food stamp payments reached the intended poorest 20 percent of the population (World Bank, 1990). The remainder of the subsidy went to higher income groups. The FSP is undergoing restructuring to increase the proportion of the subsidy actually reaching the poor from 38 to 80 percent. This would eliminate about half of the number of current beneficiaries of the subsidy scheme.

The opening up of the economy provided an impetus to growth, and the economy grew at 6 percent per annum during the five-year period 1978-82. However, growth slowed down to around 3 percent over the next seven-year period. Further structural reforms in the economy were needed to accelerate growth. An economic reform program was instituted in 1989, whereby adjustment measures were introduced in order to institute a sustainable macroeconomic framework to accelerate growth, provide an enabling environment for private sector investment and employment. In the long-run, these reforms would facilitate greater participation of the poor in the economy and overall growth process, expand access to resources for economic activity and self employment, eliminate the biases against labor intensive enterprises and reduce unemployment. Some of the reform measures introduced, such as the removal of subsidies, restoration of macroeconomic imbalances, and exchange rate re-adjustment, would adversely affect the poor in the short-run. It was estimated that the overall consumption levels of the poorest 20 percent of the population would fall by 20 percent or more by the removal of subsidies on wheat flour, rice, bus fares, and sugar, and the devaluation of the rupee (World Bank, 1990). To address this problem, the government decided to set aside 3.0 – 3.5 percent of the GDP every year for programs to increase the living standards of the poorest 20 percent of the population.

The food subsidy program provided free or subsidized food to all households, but the first real attempt at poverty alleviation was the Janasaviya Program (JP) initiated by the Government in 1989. The program intended to transfer Rs 2500 per month to each poor household for a period of two years. In addition, JP included components for credit based entrepreneurial development, and free mid-day meals, uniforms, and text books for school children. An evaluation of the Janasaviya Program (World Bank, 1990) identified its many shortcomings. In addition to the program being too costly to be sustainable, the selection criteria were not defined precisely and the benefits not related to incomes, leading to inequities and the inclusion of non-poor within the program. The benefits were high compared to prevailing income levels, leading to disincentives to work. Poverty, being a long-term problem, cannot be resolved within the two-year limitation of the JP. There was no provision for the inclusion of families falling into poverty after the selection process was completed.

In addition to the JP, another program, the Mid Day Meal Program (MDMP) targeted towards children was started in 1989. A total of US$ 50 million was spent annually in

providing one meal a day to all children in primary and secondary schools under the Mid-Day Meal Program. This program failed because it was too costly to sustain and did not reach the group which was nutritionally most at risk, i.e. the pre-school children. The Janasaviya Program was scrapped, after the formation of the new Government in 1994.

After the scrapping of the JP, a more ambitious poverty alleviation program "Samurdhi" program, was put into operation by the new government in 1995[2]. This program, which is basically an income transfer program, provides direct cash grants to more than 2 million poor families (55 percent of the population). In addition to cash grants, several other subsidiary activities were being implemented through this program to alleviate poverty. These included community and infrastructure development projects, savings programs, banking and credit programs, social insurance programs, training and entrepreneur programs, and self-employment schemes. About 80 percent of the funds allocated to the program were utilized for income transfers, intended to provide as a consumption supplement. In this case, the amount of transfer was related to the income of the household and ranged from Rs 100 to Rs 1000 per month per family, depending on the household size. The other components of the program were intended to expand the productive asset base of the poor and to create employment and income through community infrastructure development (S. Kelegama, 2001).

Both the design and implementation of the Janasaviya and Samurdhi programs have been flawed and their effectiveness in creating opportunities or empowering the poor to overcome economic and social barriers minimized as a result (World Bank, 2000). The major reasons for their ineffectiveness according to the World Bank are:

(1) Political bias of administrators/mobilizers of poverty programs, with party affiliation and voting patterns influencing the allocation of income transfers, which made the poor vulnerable to changes in political climate;

(2) Both programs covered up to 50 percent of the population, or twice the actual percentage living in poverty. The transfers from the poverty programs reached only between 55-65 percent of those in the lowest income groups. Poor targeting resulted in thin spread of income transfers, diverting funds away from the most needy.

[2] Although the "Samurdhi" program was a targeted poverty alleviation program, many flaws in the procedures adopted in estimating income and eligibility, resulted in the targeted group not receiving adequate allocations. An assessment of the income of poor households is made by Government appointed officials (Samurdhi Development Officers). This assessment is made on the basis of a visit to the household and interview with household members, as w ell as an examination of any documentary evidence of income or lack of income. The Grama Niladhari's (the lowest level government administrative official) assistance is also obtained in the certification and evaluation of household income. Families owning or cultivating irrigated land are not eligible for Samurdhi payments. Because of the paucity of evidence on income, particularly agricultural income and biases of officers evaluating income (Samurdhi Officers are mostly political appointees of the then Government in power), deserving cases are sometimes left out while those ineligible may be brought within the program. Furthermore, the actual amount of allocation also depends on the number in the household and amount of income earned per month. The maximum number of household members taken into account in the estimation include the parents and up to four children below 18 years of age. Although certain criteria for eligibility for Samurdhi payments have been established, these are often difficult to verify. A family of six earning less than (Rs 1000 ? or Rs 3000? per month) is eligible for Samurdhi payment. Consumption of home grown produce is not taken into account in estimating income. About 2 million households (55% of the population) was brought under the Samurdhi program, with each family receiving between Rs 100 to 1000 per month as grants, under the program.

(3) Central control of poverty programs has hindered the development of communal social capital, and collaborative social relations, reducing the participation of the poor in development.

(4) The costly poverty programs (up to 1 percent of GDP) have not created sufficient opportunities for the poor. Large expenditures on poorly targeted transfers, lack of sustained rural works programs, long-term administrative costs of hiring poverty workers (over 30,000 workers in the Samudhri Program), and weak exit mechanisms are some of the issues that have to be addressed.

Part 2

Chapter 4

Study Design, Approach and Sampling Framework

Study inception activities

Selection of study areas

A number of factors were considered in selecting suitable study areas. One such factor was that the selected infrastructure development projects should be the ones financed by JBIC. Another major consideration was that the selected areas should reflect sufficient variability in terms of irrigation infrastructure and related aspects. Other considerations, such as availability and ease of obtaining secondary data, transportation and logistical support, were also taken into account in the selection process.

Based on the above considerations, the Walawe Left Bank (WLB) irrigation system in Sri Lanka was selected as a case study. The WLB system can be divided into areas with adequate access to irrigation water and into areas that are presently rain-fed but where irrigation is planned to be provided in the future. The area exhibits considerable variability in cropping patterns. Main crops grown in the area include paddy, sugarcane, banana and other upland crops. The type of farming in the study area varies from irrigated to rain-fed to Chena cultivation. Demographically, there is a mix of government allottees, encroachers and non-farm households in the area. Since the entire irrigation infrastructure in the WLB irrigation system has already been rehabilitated/upgraded/improved, an adjacent rainfed area and irrigation system with the same source of water but without any upgrading/improvement were selected as control sites for comparison purposes.

Field visits by team of economists

Prior to the onset of the surveys, a team of economists undertook a field-visit to the selected study area to make a visual assessment of field conditions in the area. This visit also involved collection of more information on the study area, particularly information on the major characteristics of the study area needed to develop sampling framework and to identify specific study sites. Additionally, the team was able to meet with relevant officials to apprise them of this study and to obtain their consent and cooperation for the study. The team was also able to make most of the logistical arrangements for undertaking the household level surveys.

The team met with the Resident Project Manager (Uda Walawe) of the Mahaweli Authority (MA), and Plantation Manager of the Sevanagala Sugar Industries Ltd, who agreed to provide all the necessary assistance for the study. The team also met with other field officers of the MA and the Sevanagala Sugar Industries Ltd, who provided information on the

rehabilitation status of the WLB area as well as maps of the Issue Tree for the WLB area and other relevant information required for sampling and surveys. Mahaweli Authority informed the team that several WLB areas did not receive irrigation water during the last Maha season due to water shortage in the reservoir and also due to infrastructure rehabilitation (construction) activities (in Sooriyaweva area).

The team members visited the entire left bank area, starting from the head of the left bank main canal (LBMC) of the system and proceeded to the end of the 31 km long canal on the canal bund-road. The team visited all the proposed sites (strata), starting with Sevanagala, and proceeding up to Kiri-ibbanwewa and Sooriyawewa blocks and lastly, the Extension Area. The team observed the main characteristics of the WLB area, noting the cropping patterns, current status of cultivation, type and condition of the structures and canals taking off from the LBMC, and the number and characteristics of other smaller tanks within the system supplied by the Udawalawe reservoir. In the Extension Area, the team met with some villagers cultivating under rain-fed conditions or under minor tanks.

The team also met with households and farm leaders to verify the status and quality of rehabilitation or upgrading currently under implementation. Discussions with farm leaders indicated that household lists were available with the Chairmen or Secretaries of Household Organizations. The household leaders were willing to provide the necessary household lists and were also willing to assist in locating selected households during the surveys. The team was able to make some logistical arrangements regarding accommodation for enumerators at the Mahaweli Development Center at Sooriyawewa in the study area.

Based on observations and information gathered during field visits, it was decided to consider the following factors when selecting the specific study sites for comparison purposes.

1. Irrigation infrastructure and its rehabilitation status
2. Availability of irrigation water during last Maha season; and
3. Cropping patterns

Using the above criteria, the study area was classified into five strata, with each stratum representing a site of different characteristics. Before we go into details of the specific study site, let us discuss general characteristics of the study area.

Characteristics of study areas- General

The study sites are located in the command area of Uda Walawe reservoir. This reservoir is built across the Walawe Ganga, which is the fifth largest river in Sri Lanka. The river is 136 Km long and has a catchment area of 1200 square kilometers. It is located at a distance of about 200 km south east of Colombo. The Uda Walawe reservoir was constructed during the period 1963 – 1967, as part of a plan to develop irrigation infrastructure in 32,000 ha of land in the dry zone of southern Sri Lanka. It is an earth fill dam, with a live storage capacity of 240 MCM and a power generating capacity of 6 MW. There are two main canals, the Right Bank Main Canal (RBMC), which is 42 km long and the Left Bank Main Canal (LBMC),

which is 31 km in length. The original plan was to develop 20,000 hectares of land for irrigation, under the project. The total area actually developed up to the end of 1997 was about 12,900 ha, comprising 8,500 ha under RBMC and 4,400 ha under LBMC. At present, the area irrigated has increased to 11,000 ha in the RBMC and 6400 ha in the LBMC.

Agro-climatics of Uda Walawe

The Uda Walawe reservoir is located on the boundary of the Wet and Dry Zones of Sri Lanka. Annual rainfall is around 1500 mm in the Uda Walawe dam area and 1000 mm near the coastal area. The Dry Zone is defined as an area receiving below 1900 mm of rainfall per annum or less than 500 mm of rainfall during the southwest monsoon season. The location of Uda Walawe basin is such that, the rainfall pattern is more influenced by the northeast monsoon, than the southwest monsoon. Evaporation is 6 mm per day during the dry season and 4 mm per day in the wet season. The average relative humidity varies between 70 and 82, while the annual average temperature ranges between 27-28 °C. The annual and diurnal variations in temperature are small in the basin. Ten-year averages of annual rainfall in the Uda Walawe area, between 1960 and 2000 are provided in Table 4.1. The table shows that average rainfall has been declining over the last four decades.

Table 4.1 Total annual rainfall in Uda Walawe – ten year averages (mm / year)

Area/Year	1960-70	1970-80	1980-90	1990-2000
Right Bank	1560	1513	1289	1262
Left Bank	1518	1414	1344	1022
Catchment	2504	2410	2110	2033

Monthly rainfall varies, with the highest rainfall in the months of October to January and again from March to May. The monthly rainfall figures for the Uda Walawe Reservoir area for some selected years are shown in Table 4.2.

Table 4.2 Monthly rainfall in Uda Walawe reservoir area (mm)

Month	1994	1995	1996	1997	1998	1999	Avg.
January	78	206	47	45	67	137	96.7
February	127	49	101	54	38	72	73.5
March	198	36	6	86	25	170	86.8
April	257	307	409	297	176	195	273.5
May	67	162	8	223	197	79	122.6
June	7	50	40	7	49	44	32.83
July	28	38	35	26	87	1	35.8
August	77	30	53	17	119	41	56.2
September	88	34	103	231	23	97	96.0
October	340	201	201	444	57	137	230.0
November	262	255	376	511	219	287	318.3
December	71	45	220	134	298	138	151.0
Total	1600	1413	1599	2075	1355	1398	1573.2

The Uda Walawe reservoir currently irrigates about 17,400 ha land in the left and right banks of the system. The major soil type in the area is the well drained Reddish Brown Earth (RBE), which make up 47 percent of the total area in the system, including the extension area. The poorly drained Low Humic Gley (LHG) soils in the valley bottoms is the next largest type, covering 34 percent of the total area. The remaining 19 percent are the moderately drained soils which are a mix of both RBE and LHG soils. Table 4.3 provides details of soil types of the different areas within the system.

Table 4.3 Soil type by area in the Uda Walawe System

Area	Area under RBE soils in ha	Area under LHG soils in ha	Area under a mix of RBE & LHG soils in ha	Total Area
RB area	4470(39)	4057(35)	3045(26)	11572
LB area	3236(50)	2657(41)	552(9)	6444
Extension area	3148(61)	1114(22)	889(17)	5142
Total	10854(47)	7828(34)	4486(19)	23168

Figures in parenthesis show the percentage of total in each area

Data on cropping patterns in the irrigated areas in Uda Walawe over the last few years shows that about 52 percent of the land is under paddy cultivation, another 24 percent under bananas, 12 percent under sugarcane and remaining 12 percent of the area under OFC's. The total area cultivated under irrigated paddy ranged between 8000-10000 ha per season. Banana is cultivated on 3500-4500 ha of irrigated land annually. Sugar cane is cultivated on 1500 ha of irrigated land and 2100 ha of rainfed land. Cropping intensity in the system ranged between 174 percent to 192 percent during the years 1993-1998. In the irrigated areas, the average yield of paddy ranged between 4.5 to 5.5 metric tons per hectare, and that of sugarcane between 100-120 metric tons per hectare. Average yield of banana ranged between 15-20 metric tons per hectare per annum and that of OFC's about 1-1.5 metric tons per hectare.

A project titled, "Walawe Left Bank Upgrading and Extension Project" was launched in 1997 with assistance from JBIC, to further expand and upgrade the irrigation infrastructure in this area. The areas included for upgrading of existing irrigated areas were Kiri-ibbanwewa and Sooriyawewa blocks with a total irrigated area of 2400 ha, occupying the northern half of the WLB and the Extension Area in the southern half of the WLB area. The existing irrigated sugarcane area of 2000 ha in Sevanagala was not taken up for rehabilitation under this project. Phase I of this project has been completed recently, providing new irrigation facilities to an additional 1600 ha of land and improved irrigation facilities (concrete lining of all canals) to about 2400 ha of existing irrigated areas in the Kri-ibbanwewa and Sooriyawewa blocks under the LBMC. At present, LBMC irrigates 6,000 ha of land (2000 ha in Sevanagala and 4000 ha in Kri-ibbanwewa and Sooriyawewa blocks).

Further development of the left bank is envisaged in Phase II of the project under which an additional 5200 ha would be provided with irrigation facilities in an "Extension Area". This area, which is presently rainfed or under chena cultivation, occupying the southern half of the

left bank, has similar climatic conditions as the irrigated areas in the northern half of the LBMC of the Udawalawe system. This area was chosen as a control site for comparison purposes in this study. With the completion of the WLB extension project in 2004, the total area under irrigation would increase to 11,200 ha in the WLB

In addition, an area located downstream of the Uda Walawe reservoir, called Ridiyagama, was selected as an additional site for the study to represent an area where the irrigation infrastructure had not been upgraded/improved with concrete lining. This became necessary, since almost the entirety of the left bank irrigated area of the Uda Walawe system had already been upgraded with concrete lined canals. Such a site was needed as a second control site in order to assess the impact of infrastructure improved through concrete lining of canals. The Ridiyagama reservoir receives water via an anicut (Liyanagastota Anicut), across the Walawe river. The anicut diverts most of the drainage flows from the left bank irrigated areas of the Uda Walawe system for reuse in the Ridiyagama system.

Socio-economics of Uda Walawe

There are about 38,000 households (farm and non-farm) in the Uda Walawe area, of which slightly less than half are non-farm households. About 40 percent of the households are in the left bank. The population of the area is largely rural. The total estimated population of the area is 170,000. The total population of the selected study area in the WLB is estimated at 75,000 persons. There are three major urban centers close to the study area, namely Hambantota, Ambalantota and Embilipitiya. Embilipitiya is the closest town/city to the study area, with the right bank main canal of the reservoir passing through the city. Other infrastructure such as electricity, roads, schools and hospitals are reasonably well developed in parts of the area. There are 53 schools, 51 health centers, 27 post offices, and 46 cooperative societies in the Uda Walawe area. Piped water supply for drinking is generally limited to the urban centers or to adjacent areas. There are 25,000 houses, 21,000 latrines and 4500 wells in the area. Transport facilities in the study area are generally adequate. The annual average gross income is estimated at Rs 105,000 per household. Real household gross income is estimated at Rs 30,000 per annum. Income from OFC cultivation accounts for over half of the total household gross income.

Characteristics of specific study sites

The entire area was divided into five strata and five locations were selected for this study in the WLB area. About 11,400 farm households and about 5,200 non-farm households are settled in the WLB area. The total population of the area, based on an average household size of 4.5 persons per household, is estimated to be 75,000. In the Ridiyagama system, there are about 1800 farm households and 400 non farm households with a total population of about 10,000 persons. Table 4.4 provides the breakdown of the number of households and population.

Table 4.4 Farm and non-farm households in the selected study sites

Study site Households	No.of farm households	No.of non farm households	Total no. of Population	Total
Sevanagala	3,520	900	4,420	19,890
Kiri-ibbanwewa	2,084	1,420	3,504	15,770
Sooriyawewa	3,983	2,860	6,843	30,794
Extension Area	1,800		1,800	8,100
Ridiyagama	1,800	400	2,200	9,900
Total	13,187	5,580	18,767	84,454

For administrative purposes, the entire WLB is divided into 4 main blocks namely;

1. Sevanagala
2. Kiri-ibbanwewa
3. Sooriyawewa
4. Mayurapura (Extension Area)

The following are the main characteristics of these areas

Sevanagala:

The Sevanagala block is located upstream of the WLB canal. There are both rainfed and irrigated settlements in this block. The gross area under irrigated agricultural settlements is 2600 ha, of which 600 ha are allocated for homesteads. In the irrigated area, a total of approximately 2300 farm households have been settled on 2000 ha of irrigated land, with each household receiving an allotment of 0.75 ha for sugarcane and 0.25 ha for paddy. The settlements are concentrated in three villages, Sevanagala, Ginigalpelassa and Kowularagama. The total area under irrigated sugar cane and paddy is 1495 ha and 505 ha, respectively. In the rainfed area about 1200 farm households are settled on 2100 ha of land. Each settler has been provided with 1.75 ha of land for the cultivation of sugar cane under rainfed conditions. In the Sevanagala block, canals were lined in the early 1980's in some distributaries and during the early 1990's in recently settled areas. No upgrading was undertaken in this area under the new rehabilitation project. Overall, the irrigation infrastructure in Sevanagala is well established, although the condition of infrastructure at some sites is poor.

Kiriibbanwewa and Sooriyawewa

The second block is Kiriibbanwewa , which is located in the middle of the WLB. About 2000 farm households are settled in the block, occupying 1700 ha of irrigated land. Since it is a settlement system, all households received an allotment equal to 1 ha of irrigated land and 0.25 ha of highland for homesteads. Some of the settlers have not received irrigated land, but only highland for homesteads. These settlers are encroachers, second-generation household members of settlers or part time households. Therefore the number of settler households

exceeds the number of allotments provided on the basis of one ha of irrigated land per allotment. The main crop is paddy, followed by bananas and other OFC's

A similar situation prevails in the third block, namely Sooriyawewa, located downstream of the WLB, where there are more farm households than allotments. There are 3800 farm households resident in the Sooriyawewa block, having over 2300 ha of irrigated land. Some of the households may be provided irrigated allotments when the Extension Area is provided with irrigation facilities under the Walawe Upgrading and Extension project, now under implementation. Non-farm households have also been settled in the WLB area. These households have been provided with small plots of land for housing or business activities and are engaged in trading, or other service providing activities. Here too the main crop is paddy but relatively more bananas are grown here than in Kiri-ibbanwewa.

Upgrading was completed in all of the old existing irrigated areas in the Kir-ibbanwewa and Sooriyawewa Blocks, over a period of four years between 1998 and 2001. New irrigation facilities have been provided to about 300 ha of land in Kiri-ibbanwewa and 1300 ha of land in Sooriyawewa. Some of the new areas have started cultivation in Yala 2001. Although upgrading work has been completed, there appear to be many deficiencies in construction, as indicated by households. Most of the complaints relate to technical faults/problems i.e. poor levels in field canals, resulting in water not reaching households fields. These deficiencies need to be corrected if the full area is to be cultivated in the future.

Control sites

(i) Mayurapura (Extension Area)

An Extension Area located further downstream of the WLB was chosen as a control site for comparison purposes. In this area, infrastructure development has not yet taken place. Residents are mostly encroachers from surrounding villages or permanent residents of small ancient villages that have evolved around small tanks. They either cultivate land under the command of existing small tanks in the area, or undertake rainfed cultivation in the Maha season. Many of those cultivating under small tanks do not reside there permanently. They migrate to the area during the cultivation season, living in temporarily built small huts till the end of the season. Those residing permanently in the area are clustered in eight villages, scattered across the Extension Area. Some have been resident in these villages for over 20 years. Currently, Land Kachcheris (process of allocating land to eligible persons for settlement in irrigation systems, including the regularisation of encroachers) are being held to select eligible persons to be settled in the Extension Area.

Table 4.5 provides information on number of villages and farming households in the Mayurapura Block (Extension Area).

Table 4.5 Villages in Mayurapura (Extension Area)

Name of Village		No. of Households
1.	Mahawelikada	260
2.	Summodaraya	380
3.	Nabodagaswewa	360
4.	Andarawewa	280
5.	Mahara	200
6.	Wediwewa	200
7.	Bolhinda	48
8.	Bellagaswewa	46
	Total	1774

(ii) Ridiyagama

Ridiyagama reservoir receives irrigation water via the Liyanagastota anicut across the Walawe river downstream of the Udawalawe reservoir. A single main canal branches into five branch canals, from which several distributary canals provide water to field canals. Distributary and field canals also take off from the main canal. There are a total of 30 distributary canals in this system, irrigating an area of approximately 3000 ha. Available information suggests that there are about 1800 farm households settled in 3000 ha of irrigated land in the Ridiyagama system. Since it is an old settlement with private lands, the size of holdings is not uniform. The majority of households cultivate private lands. The size of holding of private lands is usually higher than government allotments and may go up to 10 ha. Many owners have leased out their lands to Ande households on long-term lease contracts. Ridiyagama irrigation system is planned to be rehabilitated under Kuwait government funding.

Sampling procedures

A multistage sampling procedure was adopted in selecting the sample for the study. Given the differences across various areas of the WLB, the study area was initially stratified based on the following criteria;

- availability or non-availability of irrigation infrastructure,
- improved or unimproved irrigation infrastructure,
- cropping pattern, and
- availability or non-availability of water for irrigation in Maha 2000.

At the second stage, one to two clusters representing each of the strata were selected. For the purpose of this study, a cluster is defined as a distributary canal in the case of irrigated areas and a village or division in the case of rainfed areas. While the clusters within a stratum may be more or less homogeneous in terms of the above criteria/characteristics, there could be variations in clusters within a stratum in terms of access to water (locational differences).

These clusters were chosen to represent potential differential access to water within a stratum, if any. For example, in irrigated areas, a head, middle or tail end canal was selected to represent the variations due to the differences in access to irrigation water across locations within a stratum. In rainfed areas, criteria such as size of village or division, access to markets, period of residence of settlers, were used for the selection of representative clusters.

At the third stage, systematic random sampling procedure was adopted to select the sample within each selected cluster. The systematic random sample was drawn from a sampling frame of a complete list of all households within a cluster. The number of households selected within each cluster was based on the sample size adopted for the survey. It was decided to use a sample size of around 4.5 percent of total households for the study. Factors such as, adequate representation of the variations within the study area, adequacy of sample for statistical validity, cost and time frame for completion of surveys, were considered in selecting an appropriate sample size.

After visiting the field sites and discussing the characteristics of these sites it was decided to divide the sample into six strata as follows: Sevanagala Irrigated; Sevanagala Rainfed; Kiriibbanwewa; Sooriyawewa; Extension Area and Ridiyagama. These areas were different in the following characteristics;

- availability of irrigation infrastructure,
- level and timing of infrastructure development,
- cropping pattern and type of farming, and
- issue of water for cultivation in Maha 2000-2001.

Detailed characteristics of the selected strata or sub strata are described below.

Strata 1 and 2 - Sevanagala

Sevanagala area is located at the head end of the WLB main canal. This area can be demarcated into two distinct areas, according to the availability of irrigation infrastructure. The first area, which has a well established irrigation infrastructure including lined canals, is under irrigated sugar cane and paddy and has been selected as Stratum 1 for the purposes of this study. The second area, which has no irrigation infrastructure, is under rainfed sugar cane and has been selected as Stratum 2. Thus the two strata in this area can be named as Sevanagala Irrigated (Stratum 1) and Sevanagala Rainfed (Stratum 2). Settlers in Stratum 1, or the irrigated area of Sevanagala are provided with 0.75 ha for sugar cane and 0.25 ha for paddy cultivation. Settlers in Stratum 2 or the rainfed area are provided with 1.75 ha for sugar cane cultivation, to compensate for lower yields obtained under rainfed conditions. Canal lining of 75 percent of the irrigated areas in Stratum 1 was completed in the early 1980s while the remaining areas were lined in the early 1990's. Cultivation of sugar cane commenced in the early 1980's in the irrigated area and in the early 1990's in the rainfed area. Unlike other irrigated areas in WLB, the irrigated area in Sevanagala received water for sugar cane and paddy cultivation in Maha 2000/2001.

Stratum 3 – Kiri-ibbanwewa

Stratum 3, comprises of the Kiri-ibbanwewa area located immediately adjacent to the Sevanagala area. The cropping pattern is largely paddy and irrigated bananas with a small extent under other field crops (OFC's). During the field visit to Kiri-ibbanwewa, we were able to confirm that most work on irrigation infrastructure improvement was completed by May 1999. It was possible to identify clusters or areas within the block by date of completion of upgrading. Some of the distributaries received water for paddy cultivation in Maha 2000/2001, while others received water for bananas and OFC's only. This block is located midway of the WLB main canal and two medium sized reservoirs, Kiri-ibbanwewa and Mahagama, are located in this block. Both reservoirs receive water from the Walawe reservoir via the WLB main canal. The main characteristics of this block are, completion of upgrading / improvement of irrigation infrastructure two years prior to our study, water issue for paddy cultivation in some areas and for OFC's in the other areas, paddy cultivation more prevalent and located in the middle of the LBMC.

Stratum 4 - Sooriyawewa

Stratum 4 comprises the Sooriyawewa area, which is the last block irrigated by the WLB main canal. The cropping pattern is similar to the Kiri-ibbanwewa block, but a larger extent of bananas and OFC's are grown in this block. Demographically, this block has a larger number of households both farm and non-farm (landless households) in the WLB area. There was a larger number of both farm and non-farm households than the number of allotments. Upgrading of the infrastructure was undertaken over a period of two years between 1999 and 2001, with most work on irrigation infrastructure improvement / upgrading completed by Mid 2001. It was possible to identify clusters or areas within the block by date of completion of upgrading. No water was issued for paddy cultivation in Maha 2000/2001 in this block. However, most distributaries received water for banana and OFC cultivation in this season. In this stratum, there are a much larger number of non-farm (landless) residents than in Kiri-ibbanwewa.

Stratum 5 – Extension Area

Stratum 5 comprises of the Extension area which is currently under chena/rainfed cultivation. This area is to be provided with irrigation facilities in the near future. The existing settlers in the area are mostly encroachers, who have settled in this area over the last 20-30 years. They cultivate mostly upland crops under rainfed conditions. Some undertake paddy cultivation under small tanks that are scattered in the area. It was decided to include this area as another stratum for the study to compare the differences between irrigated and rainfed farming.

Stratum 6 - Ridiyagama

Since the entire irrigated area in the WLB has already been rehabilitated / upgraded, no area within the WLB could be located with unimproved infrastructure. In order to assess the impact of irrigation infrastructure upgrading, it was necessary to include a sample from an

area where no such infrastructure improvement/upgrading had taken place, and also where cultivation had taken place in the last season, since most areas did not receive water during last Maha due to water shortage. Having discussed the various options available, it was decided to include the adjacent system, Ridiyagama, within our study area. The Ridiyagama and the Udawalawe systems have many similarities. For example, the water source for both systems is the Walawe river and both systems are located on the left bank of the river. The main differences are that, Ridiyagama is a much older system being in existence for about 100 years, and about 50 percent of the irrigated lands are privately owned. The management system operated by the Irrigation Department, in Ridiyagama is different to that operated by the Mahaweli Authority. The cropping system in Ridiyagama is largely paddy with little diversification to upland crops. The irrigation infrastructure had not been upgraded in Ridiyagama, and there was a full cultivation of paddy in Maha 2000/2001. A new irrigation rehabilitation project funded by Kuwait government funds has been initiated in this system and is currently underway. It was felt that the differences between these two systems were minor, excepting that irrigation infrastructure in Ridiyagama was unimproved and the impact study would benefit by including a sample from Ridiyagama. It was decided to select samples for the study from the non- rehabilitated areas of the Ridiyagama system in order to utilize this as a control stratum for poverty analysis with and without improved infrastructure.

Sample Size

It was decided to select a sample around 4.5 percent of the total households in the selected study area. On this basis, the required sample size was 870 households. However, the sample actually selected was 858. Table 4.6 provides information on selected strata and planned and actual sample size.

Table 4.6 Selected strata and sample size

Study site	Total No.of Households	Planned Sample	Percentage of total	Actual Sample	Percentage of total
Sevanagala					
(a) Irrigated	3202	160	5.0	167	5.2
(b) Rainfed	1218	62	5.1	60	5.0
Kiri-ibbanwewa	3504	154	5.5	151	4.3
Sooriyawewa	6843	240	4.4	229	3.3
Extension Area	1800	100	3.5	105	5.8
Ridiyagama	2200	154	7.0	146	6.6
Total	18767	870	4.6	858	4.6

Table 4.7 provides a breakdown of the planned sample by stratum and by type of household i.e. farm or non-farm. Field level information and ground realities suggest that, most households categorized as non-farm, were in fact engaged in some form of agricultural activity. A large majority of these households were engaged in Chena cultivation, upland or home garden cultivation or were cultivating lands leased in from settlers who had been allotted land in the system. Only very few households were engaged purely in non-farm activities such as trading, small enterprise, or skilled work. A large number of the non-farm

households were the second-generation of original settlers, who did not legally own land or had not been allotted any land within the system. A better classification of these households would be landless households rather than non-farm households.

Table 4.7 Selected strata and planned sample size (farm / non- farm households)

Study site	Total No.of FHH	Sample Size FHH	Percentage FHH	Total No.of NFHH	Sample Size NFHH	Percentage NFHH
Sevanagala						
(c) Irrigated	2392	120	5.0	810	40	5.0
(d) Rainfed	1128	54	5.0	90	6	6.6
Kiri-ibban wewa	2084	104	5.0	1420	50	3.5
Sooriyawewa	3983	140	3.7	2860	100	3.4
Extension Area	1800	100	5.0			
Ridiyagama	1800	126	7.0	400	28	7.0
Total	13187	646	5.0	5580	224	4.0

FHH – Farm Household: NFHH – Non Farm Household

A breakdown of actual sample size by stratum and by type of household i.e. farm or non-farm shows that the sample planned originally was 646 farm households and 224 non-farm households. The total sample actually selected was 660 farm households and 198 non-farm households/landless. The details of actual sample selected are given in Table 4.8.

Table 4.8 Selected strata and actual sample size (farm / non- farm households)

Study site	Total No.of FHH	Sample Size FHH	Percentage FHH	Total No. of NFHH	Sample Size NFHH	Percentage NFHH
Sevanagala						
(a) Irrigated	2392	126	5.3	810	41	5.4
(b) Rainfed	1128	54	4.8	90	6	6.7
Kiri-ibbanwewa	2084	114	5.5	1420	37	2.6
Sooriyawewa	3983	149	3.7	2860	80	2.8
Extension Area	1800	105	5.8			
Ridiyagama	1800	112	6.2	400	34	8.5
Total	13187	660	5.0	5580	198	3.5

FHH – Farm Household: NFHH – Non Farm Household

Sample selection within strata

Strata 1 and 2 - Sevanagala

Within the Sevanagala block, two distributaries in the irrigated sub-stratum (C 2 and C 8) and two divisions in the rainfed sub-stratum (D 1 and D 3) were selected as sample clusters. Irrigation facilities for the C 2 distributary, which is located at the head end of the stratum, was provided in 1995. Irrigation facilities for the C 8 distributary, which is located at the tail end of the stratum, was provided in 1983/84. It should be noted that the entire stratum is located at the head of the LBMC canal. Households were settled in these two clusters at the time of development of irrigation facilities. It is assumed that by selecting the C 2 and C 8 distributaries, the head-tail differences and variations due to the length of the period of establishment of settlements would be accounted for in the analysis. In the rainfed area too, settlements were established at different times. Households in division D 1 were settled in 1990, while those in D 3 were settled a few years later in 1993/94. By selecting these two divisions the variations due to the timing of settlements would be accounted for in the analysis. Details of clusters and sample selected within individual clusters in Sevanagala are provided in Table 4.9.

Table 4.9 Selected sample in Sevanagala (farm/non- farm households)

Cluster/ Distributary	Total No.of FHH	Sample Size FHH	Total No. of NFHH	Sample Size NFHH	Sample Size Total
C 2 (Head)	226	37		26	63
C 8 (Tail)	470	89		15	104
Sub-total	696	126	363	41	167
Rainfed Div 1	266	28		3	31
Rainfed Div 3	399	26		3	29
Sub-total	665	54	40	6	60
Total	1361	180	403	47	227

FHH – Farm Household: NFHH – Non Farm Household

Stratum 3 - Kiri-ibbanwewa

In Stratum 3, the Kiri-ibbanwewa block, only part of the total area was cultivated under Paddy in Maha 2000-2001, due to shortage of water in the reservoir. The following distributaries were issued water for paddy and OFC cultivation in Maha 2000/2001; KRB, KLB, MD11 to MD14, and Mahagama Branch Canal. All the other distributaries received water only for OFC cultivation in Maha 2000/2001. In this block, clusters were chosen on the basis of head-tail differences, availability of water for paddy cultivation in Maha 2000/2001, and the date of completion of irrigation upgrading. A total of seven clusters (distributary canals) was selected in this block. Two distributaries in this block, MD3 and MD 10 were selected, from those that were issued water for OFC cultivation only and not for paddy cultivation in Maha 2000/2001. The MD 3 is at the head end while MD 10 is at the tail end of the section of LBMC passing through this block. . Upgrading was completed in both canals

in May 1998. The other five distributaries were selected from those that received water for both paddy and OFC cultivation in Maha 2000/2001. The upgrading of infrastructure of these distributaries was completed in May 1999. Distributaries selected from the latter category included MD11 from the head end and MD14 from the tail end of the section of LBMC passing through this block. MBD 2 from the head end and MBD 11 from the tail end of the Mahagama branch canal, and KLB, which is the left bank main canal of the Kiri-ibbanwewa reservoir. Table 13 shows details of sample selected in the Kiri-ibbanwewa Stratum. It can be seen that there is a mix of large, medium and small sized distributaries among those selected for the survey.

Table 4.10 Selected sample in Kiri-ibbanwewa (farm / non- farm households)

Cluster/ Distributary	Total No.of FHH	Sample Size FHH	Total No. of NFHH	Sample Size NFHH	Sample Size Total
KWLB	116	25	79	10	35
MBD 11	63	7	12	3	10
MBD 2	20	4	14	2	6
MD 11	34	12	3	2	14
MD 14	185	33	31	9	42
MD 3	82	15	21	5	20
MD 10	105	18	22	6	24
Total	605	114	182	37	151

FHH – Farm Household: NFHH – Non Farm Household

Stratum 4 - Sooriyawewa

In this Stratum, upgrading of the irrigation infrastructure of the existing irrigated area of approximately 1400 ha, was completed during the period between May 1999 and May 2001. Additionally, 1025 hectares of new lands in the Sooriyawewa block, were provided with new irrigation facilities under Phase I of the upgrading project. In the entire block, no water was issued for paddy cultivation in Maha 2000/2001. However water was issued once every 10 days for OFC and banana cultivation in Maha 2000/2001, to all except the following distributaries; BBD 9, BBSB1, BBSB2/D2, BBSB2/D3, BBD 12, BBD 14, and BBD 15. The usual cropping pattern in this block is paddy, bananas and OFC's. There is a greater area under bananas in this block than in Kiri-ibbanwewa. In the Sooriyawewa block, a total of six distributaries (clusters) were selected for the survey. Two of the selected distributaries, MD15 (head end) and MD 18 (tail end) are off-takes from the head and tail ends of the LB main canal respectively. Three other selected distributaries BBD2, BBD5 and BBD7, arise from the head, middle and tail ends of the Beddewewa Branch Canal, which is the extension of the LB main canal. The last selected distributary, BBSB2 D2 is fed by BBSB2, one of the main sub branches of the Beddewewa Branch canal. This provides water to Tank 2, which is part of the new Extension Area, provided with water by the upgrading project. The left bank of this tank was selected, to represent an area, where there was no irrigated cultivation prior to this. Those currently settled in this area were undertaking rainfed upland cultivation, or

chena cultivation prior to receiving irrigation water. In terms of size a mix of large, medium and small distributaries were selected as a representative sample of the block. Details of sample selected in this stratum are provided in Table 4.11.

Table 4.12 Selected sample in Sooriyawewa (farm / non- farm households)

Cluster/ Distributary	Total No.of FHH	Sample Size FHH	Total No. of NFHH	Sample Size NFHH	Sample Size Total
MD 15	45	12	5	3	15
MD 18	99	25	60	13	38
BBD 2	85	21	33	11	32
BBD 5	246	52			52
BBD 7	149	39	26	9	48
BBSB2 D2			166	44	44
Total	790	149	124	80	229

FHH – Farm Household: NFHH – Non Farm Household

Stratum 5 – Extension Area

There were a total of eight villages in the Extension Area. The cropping system was similar in all of these villages. In some villages, where there were small village tanks, paddy is cultivated under partially irrigated conditions. Villages closer to the nearest town had greater access to facilities such as roads and markets. Table 4.13 provides details of the sample selected in the Extension Area.

Table 4.13 Selected sample in Extension Area (farm / non-farm households)

Name of Cluster/Village	Total No. of FHH	Sample Size FHH	Sample Size Total
Andarawewa	248	47	47
Maha-ara	137	24	24
Wediwewa	79	19	19
Bolhinda	17	4	4
Bellagaswewa	37	11	11
Total	518	105	105

FHH – Farm Household: NFHH – Non Farm Household

Five villages were selected as clusters for the survey. These villages were selected on the basis of size and other differences, such as cropping pattern, availability of village tanks, access to towns and other services. Two large villages, two small villages and a medium sized village were selected for the study. Three of the villages selected, Maha-ara, Bolhinda, and Wediwewa, are situated close to the main road and have easy access to transport and markets. In four villages, Andarawewa, Wediwewa, Bolhinda and Bellagaswewa, paddy is cultivated under small tanks during Maha season. There are no small tanks in village of Mahaara, and cropping is limited to chena and rainfed crops.

Stratum 6 – Ridiyagama

The Ridiyagama system consists of two units, the Ridiyagama unit and the Bolana unit. The Ridiyagama unit has a command area of 760 ha and the Bolana unit a command area of 1800 ha. In this system, there is a single main canal – the left bank (LB) main canal, which divides into two branch canals North Central Branch (NCB) and North Right Branch (NRB) canals. All three canals feed the Ridiyagama unit. Further down the LB main canal, it branches into the (South Right Branch) SRB, South Central Branch (SCB) and South Left Branch (SLB) canals, which feed the Bolana unit. Table 4.14 provides details of the sample selected in Ridiyagama.

Table 4.14 Selected sample in Ridiyagama (farm / non- farm households)

Name of Cluster/ Distributary	Total No.of FHH	Sample Size FHH	Total No. of NFHH	Sample Size NFHH	Sample Size Total
LBMain Canal	72	12	26	8	20
RB 1	72	12	26	8	20
SRB Canal	149	25	44	9	34
LB 1	60				
LB 2	40				
LB 3	49				
SRB Canal	169	29	34	7	36
RB 5	57				
Basnawa	74				
Mahawewa	38				
SCB Canal	257	46	40	10	56
Canal 19	72				
Canal 11	50				
Canal 18	82				
SCB 2	20				
SCB 3	33				
Total	647	112	144	34	146

FHH – Farm Household: NFHH – Non Farm Household

The clusters were chosen on the basis of access to irrigation water- one cluster at the head end, one at the middle and two clusters at the tail end. The first cluster, the RB 1 distributary canal, is at the head end of the system and takes off from the LB main canal itself. The second cluster comprises of distributaries LB 1, LB 2, and LB3, which are at the middle of the system and take off from the SRB canal. The third cluster, which comprises RB 5 and drainage canals Basnawa, and Mahawewa, are at the tail end of the system, and arise from the tail end of the SRB canal. The fourth cluster comprises canals 19, 18, 11, SCB 2 and SCB 3, which is also at the tail end of the system and take off from the tail end of the SCB canal.

The tail end clusters receive relatively less water, and have poorer soils, while the head and middle end clusters receive relatively adequate water and have good soils. Paddy is the main crop in all four clusters, very little OFC's are grown in this system. Households in all clusters cultivated paddy during the Maha 2000/2001 season.

Chapter 5

Survey Administration and Data Collection

Questionnaire development and pre-testing

A common questionnaire was developed for both Pakistan and Sri Lanka. The questionnaire consisted of six modules arranged as follows; Basic information, Infrastructure, Agricultural production, Expenditure, Credit and Retrospective questions.

- Basic Information Module:
  This module is designed to gather basic information about the household, such as household members, their ages, schooling, employment, non-farm income, housing, land ownership, and housing characteristics.

- Infrastructure Module:
  This module gathers information on the operating environment of the household, including information on sources of water, irrigation infrastructure, cultivated area, operation and maintenance of infrastructure and health facilities.

- Agricultural Production Module:
  This module attempts to obtain information on the farming situation, farm assets, cost and value of agricultural production, household organizations, and marketing of inputs and produce.

- Expenditure Module:
  This module gathers information on household expenditure, including food, clothing, medical care, transportation, education and other living expenses.

- Credit Module:
  This module obtains information on loans obtained, sources, repayment and problems in obtaining credit.

- Retrospective Questions Module:
  This module is designed to obtain historical information over the last ten years on crop yields, and production of the main crops and related problems.

The questionnaire was carefully edited to frame the questions to suit the local context, in so far as units of measurement, local connotations, or other common usage of phrases or words etc., was concerned. This made the questionnaire easier to understand by both the enumerators and the respondents as well as easier to administer and process. All local team members, as well as mission members of JBIC, took part in the revision process. The enumerators also participated in the process as a part of their training program. The revision

of the questionnaire continued after pre-testing of the questionnaire and feedback from such pre-testing.

Pre-testing was undertaken in each stratum, but avoiding the selected clusters within each strata. Information such as the clarity of the questions, length of time required to complete a questionnaire, quality of the answers, relevancy of the questions, logistical requirements, etc. was gathered during the pre-test. Such information was reviewed and discussed in detail with the participation of the enumerators, and if deemed necessary, the questionnaire revised appropriately to incorporate the information gathered. This procedure was applied after each pre-test and a final revised questionnaire developed. This was then translated into the local language (Sinhala) prior to final administration. Details of the schedule of pre-testing, including the number of sample pre-tests and other information is provided below The questionnaire was pre-tested during the training program. The enumerators were divided into two groups for pre-testing and covered all the selected strata, except some clusters, as follows.

May 29 –	Group A – Nebadagaswewa (Extension Area)
	Group B – Sooriyawewa
May 30 -	Group A – Kiriibbanwewa
	Group B – Ridiyagama
May 31 -	Group A – Sevanagala (Rainfed)
	Group B – Sevanagala (Irrigated)

Enumerators training

The enumerators' training was designed to provide an overview of the study including its background and objectives. The ethics and code of conduct of surveys was dealt with in some detail in order to inculcate a sense of discipline among the enumerators and to stress the importance of upholding the standards of the institution. A general review of the questionnaire was conducted in order to introduce the contents of the questionnaire, to discuss the methods or processes to be adopted in filling the questionnaire, and what was expected of the enumerators in this information collection process. This was followed by a detailed review of the questionnaire in both languages (English & Sinhala). Each question in the questionnaire was discussed and explained in detail to the enumerators and any doubts cleared. A further period was set aside to allow the enumerators to discuss their individual problems in relation to the questionnaire.

This training session was followed by a field visit by the enumerators and a subsequent one to one discussion between pairs of enumerators. This included a hypothetical role-play among the enumerators to fill up the questionnaires. This was followed by several pre-tests and if needed, further revisions to the questionnaire, based on field observations. The enumerators were requested to carefully go through the revised questionnaire and bring up any problems or clarifications before going to the field. The training program, including the pre-testing and review of questionnaires was conducted over a period of six days prior to the start of the surveys.

A short training was provided to the enumerators and data entry operators to familiarize them with the requirements of the second and third surveys. The revised questionnaires for the second and third surveys were discussed in detail, and any doubts, problems or ambiguities arising from the questionnaires cleared by the supervisors. Problems that were encountered in the first survey were also discussed and suggestions were made to resolve such problems, taking into account the views of the enumerators, in order to improve the quality of the data collected. The need for adhering to the ethics and code of conduct of the Surveys was repeatedly emphasized in order to inculcate a sense of discipline among the enumerators. A procedure for evaluating the performance of enumerators, data entry operators, those assigned to check filled questionnaires and supervisors was established for both the second and third surveys. Details of this evaluation procedure are provided below.

Those assigned for checking the questionnaires were required to evaluate the quality of data gathered by the enumerators, using a grading system. The checkers were required to look for errors in the filling out of questionnaires such as missing or illegibly entered values or responses, very high, low or improbable values, faulty coding or numbering, not entering the responses logically or in the proper sequence. The checkers were trained to discuss these types of possible errors with the enumerators and give an initial warning not to repeat such errors. Those enumerators who repeatedly made such errors were given black stars, with penalties imposed. The performance of those checking the questionnaires was evaluated by the data entry persons and given black stars according to the number of mistakes made. The performance of data entry persons was evaluated in turn by the supervisors using criteria such as accuracy, completeness and reliability of data entry. Log books were maintained and daily records kept of attendance of all staff, the number of questionnaires completed, number of questionnaires checked, the number of questionnaires entered in the data base, and the performance evaluation and grading of enumerators, checkers, data entry persons and supervisors. With all of these measures put in place by the project leader, the quality of data collection was maintained at high levels in all the three surveys.

Planning and implementation of first survey

Table 5.1 provides a summary of implementation schedule of the three surveys. A total of 25 enumerators were recruited to conduct the field survey. They were given a week's training prior to the beginning of the survey. The first field survey was conducted during the period 2 to 27 June, 2001. The study area was divided into five strata and surveys were conducted stratum by stratum. In each stratum, except Sevanagala, a farm leader from the selected distributary or cluster (chairman, secretary, any current or former office bearer of the relevant household organization) was recruited as a field-guide, for the surveys. The field guides were recruited to assist the supervisors in locating the residences of selected households (based on household lists) and to make prior appointments with the respondents. In the case of Sevanagala, officers of the Sevanagala Sugar Industries Ltd. assisted the supervisors in locating the farm households and in making appointments. The sampling was completed prior to the start of the survey, using household lists obtained either from the farm leader or in the case of Sevanagala, from officials. A list of the names of selected households in each stratum was prepared and a copy was handed over to the field guide or official. One or two

days prior to the date of survey of a particular cluster or distributary area, the supervisors along with the field guide or official, visited the selected farm households and made an appointment with the respondents for the survey. On the date of the survey, the field guide or official accompanied the supervisor and enumerators to show the location of the selected farm households. The enumerators were dropped off one by one in each selected household and picked up upon completion of the survey questionnaire. The procedure followed in implementation of the survey was to complete one stratum before moving into the next one. The survey was completed in the following order; Extension Area, Sevanagala, Kiri-ibbanwewa, Sooriyawewa, and Ridiyagama. There were a few cases in some strata, where the questionnaires could not be completed. These were completed on a subsequent day and towards the end of the survey.

Each enumerator was required to fill at least two questionnaires per day. This target was achieved in most cases, with only a few exceptions. On an average, about 35 questionnaires were competed per day. At the beginning, all 25 enumerators were sent to the field to administer the questionnaires. From the second day of the survey onwards, two to four of the enumerators were assigned the job of checking the completed questionnaires in the field. In order to increase the accuracy of the data gathered and enhance the quality of the survey, it was decided that all questionnaires should be checked for minor errors, missing information or other shortcomings. This was done immediately after filling out the questionnaires, while the data gathered was still fresh in the minds of the enumerators. All errors were corrected in the field itself or immediately afterwards. If necessary, the enumerators were required to go back to the household to correct any shortcomings in the collected information. Six to seven of the enumerators were identified for this work and rotated for administering and checking of the questionnaires. Checking of the questionnaires was slow at the start, with only 3-4 questionnaires completed per person per day. Since there was a backlog of unchecked questionnaires building up, it was decided to eliminate the backlog by putting all the enumerators on the job of checking for one day. Subsequently, it was decided to assign an adequate number of persons for checking (varying from two to six per day) depending on the number of questionnaires filled on the previous day, in order to complete all checking by the following day. However, those assigned for checking had to work late hours in order to complete all questionnaires filled on the previous day.

There were four supervisors assigned for the survey and at least two of them were in the field throughout. Supervisors took turns accompanying the enumerators, and observing how they were conducting the surveys. They corrected any errors that they observed during the interview process and advised the enumerators on the correct procedures to be adopted in the conduct of the survey. As far as possible, a few of the completed questionnaires were randomly checked by the supervisors while in the field and during lunch breaks. If errors were noticed, the enumerators were sent back to the households for correcting such errors or missing information. Supervisors also spent some time with those assigned for checking to discuss any problems that they faced in reviewing the questionnaires. While in the field, the supervisors also gathered information about the specific sites selected for the survey, by talking to the people of the area and to local officials. At the end of each day, discussions were held after dinner, to discuss the problems in questionnaire filling, checking of questionnaires, and any other problems encountered during the day. These problems were

usually resolved satisfactorily during these sessions. Data entry of corrected questionnaires started on 07 June, and continued until the end of the surveys. Initially two persons were assigned for data entry. Subsequently more enumerators were assigned to this task. Prior to this, the questionnaire was coded and variable names assigned.

Table: 5.1 Summary of Survey Implementation Schedule

Stratum	**Extension area**	Sevanagala Irrigated	Sevanagala Rainfed	Kiriibban wewa	Sooriya wewa	Ridiyagama	Total*
No of samples	105	167	60	151	229	146	858
Dates of first survey	Jun 2,3,4,18	Jun. 6,7,8,10.11	Jun 9, 10	Jun 11,12,13,14 ,20,25	Jun 15,16,17, 18,19, 20,26,27	Jun 21,22, 23, 24	25 days
Number interviewed	105	167	60	151	229	146	858
Dates of second survey	Aug 24, 25	Aug 26, 27	Aug 28	Aug 29, 30	Aug 31, Sept 01	Sept 02, 03	11 days
Number interviewed	102	165	53	146	217	142	825
Dates of third survey	Oct 11, 12, 13	Oct 18, 19, 20	Oct 21, 22	Oct 23, 24, 25, 26	Oct. 27, 28 28,29,30, 31	Oct 14,15,16, 17	22 days
Number interviewed	104	163	59	145	221	145	839

* Total number of days for surveys does not include the additional days in the field for undertaking interviews and measuring heights and weights of those households that were not available during the first visits by enumerators.

Planning and implementation of second and third surveys

Although the common questionnaire for the second and third surveys remained basically the same as the first survey, some modifications were made to incorporate the changes in the calendar months (March to mid August for second survey and mid August to September for the third survey). For the second survey, the questionnaire was considerably shortened, as sections relating to infrastructure, agriculture, and retrospective information, and part of the section on basic information were not included. The basic module was adjusted to obtain only the weights and heights of household members, and labor utilization during the period of March to mid-August of each household member. The expenditure and credit modules were adjusted only to obtain information during March to mid August. For the third survey, the questionnaire was almost same as that for first survey, except that sections on housing, electricity, and retrospective information were not included.

Thus the initial period of preparation for the surveys involved making the required changes to the questionnaire and translating the modified questionnaire to Sinhala. The templates in the computer program (Excel) were adjusted to accommodate data entry for the second and third surveys. In order to facilitate data entry, all questions in the questionnaire were serially numbered, and the numbers incorporated in the templates of the second, as well as the third, survey. The first two pages of the filled questionnaire from the first survey were photocopied and attached to the questionnaire of the second and third survey, to avoid re-entering of previously obtained basic data, and to reduce the chances of errors in filling out the

questionnaires. The respondent ID and code number of each respondent was written on every page of the questionnaire so as to reduce errors resulting from torn pages, mix-up or faulty entering.

The enumerator assigned for checking the completed questionnaires was expected to check all the questionnaires completed the previous day. He was also required to maintain a log-book to keep track of the number of questionnaires filled daily by each enumerator. One of the supervisors would cross check a random sample of about 10-15 percent of the checked questionnaires to ensure that the checking was being done properly. Three persons were assigned for data entry. They were required to complete data entry of all the questionnaires completed and checked on the previous day. Log-books were also required to be maintained by the data entry persons as well as the supervisors, to monitor the progress and quality of the survey.

A total of 23 enumerators were hired for the second survey. Three of the enumerators were assigned to data entry, after a few days in the field. The actual field time taken for completion of the second survey was 18 days compared to the planned 11 days. For the first eleven days all 20 enumerators undertook field interviews, using two vehicles. During the last seven days of the second survey, only seven enumerators were utilized for the survey, using one vehicle for field travel. This was mainly to complete the interviews with respondents not available at the time of the visit of the enumerators earlier and to enter the weights and heights of household members not present at the time of interview.

A total of 23 enumerators were recruited for the third survey. The three enumerators who undertook data entry for the second survey were assigned for data entry for the third survey as well, because of their previous experience in data entry and familiarity with the questionnaire. However, for the first seven days, the data entry persons were engaged in field interviews in order to complete a sufficient number of filled and checked questionnaires to begin data entry at IWMI head office in Colombo. The actual field time taken to complete the survey was 29 days, as compared to the planned 22 days. As for the second survey the extra time was required to complete the interviews of respondents not available during the first visit and to complete the weights and heights of householders not present at the time of interview. The last eight days of the field survey were utilized for the above, using only 8 enumerators and one vehicle.

Logistical arrangements for surveys

Considerable effort went into planning the logistics of the study in order to keep to the deadlines specified by the terms of reference. A major problem of finding suitable accommodation for the field enumerators and supervisors was resolved prior to the surveys. The Mahaweli Authority agreed to provide accommodation in their newly constructed Mahaweli Development Centre, located within the project area. The survey team was also able to make use of copying, computer, training and other facilities available at the center during the enumerators' training program as well as during pre-testing and revision of the questionnaire, although some problems were encountered in operating some of the equipment. Two vehicles (vans) were hired to take the enumerators and supervisors to the

field during data collection. Four computers were set up in the Development Centre (DC) to begin data entry as soon as the questionnaires had been filled and checked. Four persons were assigned for data entry work a week after the start of the surveys. Two additional data entry persons were hired from outside to speed up the data entry process.

Logistical arrangements for the second survey were similar to the arrangements made for the first survey. Accommodation for the enumerators, date entry persons and supervisors was provided at the Mahaweli Development Center in Sooriyawewa. Two vans were hired for field travel and three desk-top computers provided for data entry at the site. At least one supervisor accompanied the enumerators in the vans to locate farmers, and to ensure the proper conduct of the survey. The second supervisor accompanied the enumerators to the field when possible, while supervising data checking and entry in the Mahaweli Center. The enumerators were requested to report for work on the evening of the day prior to the start of the survey to enable them to participate in the refresher training program in the morning and to begin the surveys in the afternoon on the following day. The required number of questionnaires was copied and the ID and code numbers entered on every page of the questionnaire by the enumerators, to ensure that there were no mix-ups.

The logistical arrangements for the third survey differed somewhat due to the unavailability of the Mahaweli Center during the third survey. Although it was indicated by the Mahaweli officials that the Center would be available for the latter half of the third survey period, the lack of water facilities at the Center precluded the use of this Center for the survey. Accommodation for the enumerators and supervisors for the first eight days of the third survey (Oct 10 to Oct.18) was provided at the Vihara Maha Devi Women's Development Center at Mirijjawela. The enumerators were accommodated in a rented house in Sooriyawewa for the rest of the 22 days survey period (Oct. 19 to Nov. 8). The full complement of 20 enumerators and checkers worked up to the end of October, while only 8 enumerators were hired for the balance period of 9 days to complete the surveys of those respondents not available earlier and to measure weights and heights of household members not present at the time of interview. Here too, two vans were hired for field travel within the project area. For the third survey it was decided to undertake data entry at the IWMI Head office in Colombo, as there were better facilities in Colombo, and data entry could be closely supervised. Prior to starting data entry work in Colombo, the data entry operators undertook household interviews along with the other enumerators. Data entry started a week after the beginning of the surveys with an initial lot of completed questionnaires. From time to time, completed questionnaires were brought to Colombo for data entry.

Survey team

The survey team for the three surveys comprised the following members:

Dr. Intizar Hussain	-	Project Team Leader
Dr. Fuard Marikar	-	Supervisor
Mr. Sunil Thrikawala	-	Supervisor
Mr. J.K. Somasiri	-	Field Supervisor

Enumerators	-	20
Data entry persons	-	03

While Dr Hussain and Dr. Marikar were present during the start up of the surveys and made visits to the field during the surveys, Mr. Thrikawala and Mr. Somasiri, remained with the enumerators throughout the field surveys. Field problems were referred to the supervisors, who discussed these problems and tried to resolve them as quickly as possible.

Data Collection Procedures

Primary data collection was undertaken by a formal one to one interview process, using a structured questionnaire. A sample 4.5 percent of the population (858 households) was selected for the interviews. The weights and heights of all household members were also measured and recorded during the interview. The enumerators were provided with a weighing scale and a tape measure to obtain the weights and heights of all household members. The problem faced in taking weights and heights was that not all members of the household were present at the time of interview. The weights and heights of those members not present at the time of the interview were obtained subsequently. A small team of enumerators, together with a supervisor, visited all of the incompletely measured households in the weeks following completion of the main survey to complete these measurements. Primary data was also collected through discussions with household leaders, and local officials. Additionally, secondary data from published and unpublished literature was collected by the supervisors. Other data relating to the project area, available in government and other offices, was also collected. In addition to household level surveys, participatory poverty assessments (PPAs) were done in each of the selected blocks, as a separate activity (see chapter 11 for more details on PPAs) .

The first survey was completed by the end of June 2001. As per schedule, the second of the series of three surveys commenced during the third week of August 2001. The first survey was designed to obtain data for the previous Maha cultivation season beginning October 2000, up to the end of May 2001.The second survey was expected to obtain data from June to August, 2001. Since the second cultivation season, Yala (Apr.-Sept.), would not be completed during this period, it was decided to exclude the section relating to agricultural production from this survey. Other basic data gathered during the first survey was also excluded from this survey. Therefore the questionnaire was shortened considerably, and limited to income and expenditure data, heights and weights, time spent on household and other income generating activities as well as credit data. The third survey was a complete survey, designed to obtain data on Yala cultivation, as well as on expenditures, incomes, weights and heights, infrastructure and credit. The sections left out of the third survey were information pertaining to family details, housing and retrospective information. The second survey was conducted over a period of two and a half weeks beginning August 23, 2001. The third survey began on October 10, 2001 and was completed on November 8, 2001. Details of the process and conduct of the second and third surveys are provided in the sections below.

Twenty-three out of 25 enumerators recruited for the first survey participated in the second and third surveys. Three of the enumerators, who were computer literate, and considered above average in terms of their knowledge and understanding of the surveys and familiarity with the questionnaire, were assigned for data entry work. The first two pages of the completed questionnaire of the first survey was photocopied and attached to the new questionnaires for the second and third surveys, to prevent mix-ups of family members as well as to avoid entering the same information again. All questionnaires were then arranged according to the strata and by DC canal or village. Enumerators were advised to write down the sample and identification numbers and the names of the household members in the same order as in the first survey. They were also advised to check whether the ID number marked in each of the sample household premises during the first survey coincided with the sample ID number in the questionnaire, prior to commencing the interviews for the second and third surveys.

The same procedure adopted in the first survey of completing one stratum before moving to the next stratum was followed in the second and third surveys. For the second survey, each enumerator was required to fill at least four questionnaires per day. The enumerators were assigned at least two nearby households for completion in the morning session and two more in the afternoon session. However, if no one was available in one of the assigned households at the time of interview, the enumerator was usually reassigned to another household after completion of one interview. The supervisor would try to reassign the missed households to one of the other days that the survey team planned to be in the area or stratum. If such reassignment was not feasible, the household that was missed would be taken up later by a smaller team of enumerators, after completing the survey in all the strata. A similar procedure was adopted for the third survey, excepting that the enumerators were expected to complete at least two interviews per day.

Initially, all 23 enumerators were sent to the field for the second and third surveys. From the second day onwards, one enumerator was assigned for checking questionnaires. Although working longer hours, only 30-40 questionnaires on average could be checked per day, per person. From time to time, an additional person was assigned for checking to reduce the backlog. Since data entry for the second survey was undertaken in the field office, the three data entry operators started entering data within two days of the start of the survey, when a sufficient number of questionnaires had been filled and checked. In the case of the third survey, data entry started a week after the beginning of the survey, since a sufficient number of questionnaires had to be filled, checked and brought to Colombo, prior to entry. There were three supervisors assigned for the surveys and at least two of them were in the field throughout the survey period. As in the previous survey, supervisors took turns accompanying the enumerators, to observe and advise the enumerators on the correct procedures to be adopted in conducting the survey. The supervisors also made a random assessment of the quality of the checking and data entry process by reviewing checked questionnaires and examining the data entry files.

Household income and expenditure diaries

In addition to questionnaire survey, the households were provided with a diary (notebook) to record their daily expenditures and income for the three months following the survey. The premise was that data from daily records of income and expenditure would be more reliable than recall data obtained from the questionnaire survey. Furthermore, such data would help in assessing the quality of the data gathered using the structured questionnaire. Information on all expenditures, including expenditure on agricultural production activities was requested to be recorded by a literate person in the household. The households were also requested to include the quantity of produce consumed from home garden or from their agricultural lands. This diary was developed from the expenditure module of the questionnaire. The households were requested to list all income received and expenditure incurred on each day on a page in the diary or notebook. The enumerator selected a suitable person in the household to keep the diary. He would then instruct the selected person, on how to fill up the diary, including examples of what should be included. For example, expenses on food, such as vegetables, fish, milk powder, etc. were included in this category. Other expenses such as, for health, education, transport, entertainment, payment of bills, hiring of labor, agricultural inputs were also included. All income, including salaries from permanent employment, wage labor, sale of produce, gifts, subsidies, interest payment etc were included in the income category. Thirdly, the quantity of produce used for home consumption was also included in the diary. This included such items as rice, bananas, vegetables and fruits, and livestock products.

Although most households had made an honest attempt to fill out the diaries as requested by the enumerators, there were some shortcomings that we observed. Some households had filled out the diaries for a month or so and then stopped, for various reasons such as an impending examination in the case of a student, no time to fill out in the case of a female or male spouse, due to field or household work commitments. Most households appear to have filled up the diaries on a daily basis at the beginning, but had then progressively increased the interval between filling up, to a week, fortnight or month, due to lack of motivation or other causes. The accuracy and reliability of the information would decline in such cases. There were some who, filled up the diaries initially and then stopped, and restarted at the time of the second and third surveys, when the enumerators went back to the households for interviews. A few households had lost the notebooks, but at least 80 percent of the diaries have been returned. Overall, at least one month of income and expenditure data entered on a daily basis could be gleaned from the notebooks, from a majority of the households.

Field Problems

The survey team faced several problems during the field surveys. Some of the problems faced during the second surveys include the following:

1. Events such as weekly markets (*pola*) and farmer organization meetings caused some delays in the survey schedules on several occasions.
2. Due to severe drought in the area, individual household members in several households or in some cases entire households, in some cases, had temporarily moved out of the area.

Consequently, it was not possible to make appointments for interviews for all of the selected households. Some households were re-visited several times, before an interview was possible, while few could not be interviewed at all.

3. Due to school vacations, some families had left their residence to visit their home-towns or relatives, gone on a pilgrimage, excursion or similar activity. Whenever possible, interviews of such cases were completed on a later date.
4. In a few cases, encroachers who were part of the sample, had been evicted from their residences by the Authorities, and hence could not be contacted.

As for the second survey, field problems faced during the third survey include the following

1. In the Sevanagala area, there were delays in contacting some respondents as they were involved in sugarcane harvesting, either in their own fields or in other farmers' fields.

2. Delays were also encountered due to roads being affected by the heavy rains, particularly in Sevanagala, where many of the dirt roads became slippery after rains, thus hindering travel in the area.

3. Many of the respondents were involved in chena cultivation, particularly in the Extension, Sooriyawewa and Kiriibbanwewa areas. These farmers were sometimes not available for days if the chena plot was located at some distance to their homes. This also caused delays in contacting the farmers.

4. In the third survey, too, we encountered the problem of not being able to contact some of the sample encroachers who had been evicted from their homes by the Authorities. Some could not be contacted at all, because they had moved out of the area, while a few others who were residing elsewhere in the area were contacted and interviewed.

5. A few respondents had begun preparatory work for Maha cultivation and were in the field. Enumerators had to make several visits before they were able to interview these farmers.

6. Due to prevailing drought in most of the areas covered by the survey, several farmer associations had called frequent meetings to distribute drought relief to residents of the area. Thus it was difficult to contact some of the residents who were actively involved in such activities, and repeated visits had to be made.

The above problems were resolved to a large extent by retaining a smaller team of enumerators in the field for extended period of time to undertake a second round of surveys for interviews as well as for measuring heights and weights of those households that were not available during the first round of surveys.

Data entry

The procedure followed in data entry required each data entry operator to complete all modules of the filled questionnaire, before moving on to the next questionnaire. Individual data entry operators divided the completed questionnaires equally among them, and entered all data from the questionnaire. They were also required to convert data recorded in different units in the questionnaire to standard units, prior to entering in the database. The templates used in the first survey were adjusted to facilitate data entry for the shortened second survey data, while retaining the framework for comprehensive analysis of all three surveys. Initially, operators were able to enter only 21 - 27 questionnaires per day, but this eventually increased to 35 questionnaires per day. The Excel program was used for data entry. After initial cleaning, data were transferred to the SPSS program for further cleaning and analysis

The data entry process was modified in the third survey to improve efficiency. Each data entry operator was required to specialize in data entry from a particular section or module of the questionnaire, rather than complete the entire questionnaire, as was done previously. The questionnaire was broken up into three sections with approximately equal work load as follows: modules 1 & 2, module 3 and modules 4 & 5, and distributed among the three data entry operators, with each entering one section only. This reduced errors in the entering process, facilitated and improved accuracy when data conversion was required prior to entry, increased familiarity with the data so that obvious errors, outliers or unusually large or small figures could be detected. The data entry operators were also required to double check the entered data after completing each page or section

Data cleaning process and quality control

The primary data collected through the surveys was subject to a five-stage process for quality improvement. At the first stage, the enumerators who filled the questionnaires were required to carefully go through their own questionnaires to check for errors, missing values or other problems and correct such problems before handing it over for checking. At the second stage, those assigned for checking questionnaires are required to carefully check all the filled questionnaires for accuracy, clarity, completion of entries, and other errors and correct these errors in consultation with the enumerator who filled the questionnaire. At the third stage, a random sample of the checked questionnaires, were again checked by one of the supervisors. At the fourth stage, the date entry person was required to look for errors, mistakes or missing values and correct the errors, prior to data entry. Conversions to standard units were also undertaken by the data entry person prior to entering the data. At the fifth stage, the supervisor responsible for cleaning the data prior to analysis, also examined the data for errors or bad entry, missing values, etc. and corrected any mistakes in consultation with the data entry person or the enumerator, if necessary.

The supervisors also randomly checked completed questionnaires in the field, immediately after it had been filled. At the initial stages, the supervisors accompanied the enumerators to the household, to determine how the enumerators were performing with respect to the interviewing procedure adopted, the framing of the questions to the household, coverage of entire questionnaire, and proper filling of the questionnaire. Errors identified by the

supervisor were immediately corrected in the field itself. Apart from this, the supervisors held discussions with the enumerators almost on a daily basis after dinner, to sort out any problems relating to the questionnaire or to the conduct of field surveys. Thus a fairly rigorous procedure for quality control was implemented to improve the quality as well as the reliability of data collected.

The data cleaning process for the surveys began even prior to the interviews, through an exhaustive and thorough training program offered to the enumerators and supervisors, in order to minimize the errors that could be potentially made during the survey. The second step began upon completion of the interviews, when a thorough check of the completed questionnaires was undertaken by a group of trained enumerators and supervisors. Checks were made for errors in recording data, outliers, conversion errors, missing values or other obvious mistakes. Errors detected during this initial screening process were corrected in consultation with the enumerator concerned. If these errors could not be corrected in consultation with the enumerator, the enumerator was sent back to verify the data.

Similar procedures were used for data cleaning for all three surveys. After data entry, the data was cleaned first in the Excel Program, into which the data was initially entered. Specifically, the missing values, zeros, and not applicable values were identified and classified. The minimum and maximum values were determined and outliers identified for verification or correction. The coding was completed for open ended questions and appropriate codes entered. The data was also examined cell by cell to detect any errors. The data base in Excel was converted into SPSS format and further cleaning undertaken. Frequency tables were generated for all variables and these tables examined for outliers, errors in coding, as well as other errors. Variables with such errors were sorted and the case number identified and doubtful cases were verified by checking back with the questionnaire. Subsequently, the each data file was examined by individual row or column to detect any errors across variables or within a variable.

Chapter 6

Analytical Framework

The major objective of this study is to assess the impact of irrigation infrastructure development on poverty. The study employs a 'with' and 'without' approach by comparing sample areas representing various states of infrastructure development: well developed/improved, less developed/unimproved, with no infrastructure, and without irrigation in order to establish irrigation accessibility. Like other types of infrastructure, development of irrigation infrastructure can be expected to generate positive outcomes for the poor in terms of overall increased productivity and production, improved incomes, increased consumption and employment, reduced vulnerability and food in-security, and enhanced overall welfare through both direct and indirect positive impacts. All these factors can be assumed to reduce not only the incidence of chronic poverty but also to positively influence temporary poverty. The overall framework for this study is based on three key hypotheses as stated below.

1.The incidence, depth and severity of poverty is lower in agricultural areas with irrigation infrastructure than in areas without infrastructure.

The dynamic aspect of poverty to be examined in this study is to determine whether irrigation infrastructure can reduce the variability in incomes and expenditures in rural households. The second hypothesis to be tested can be stated as follows:

2. The variability in incomes and expenditures is less in agricultural areas with irrigation infrastructure than in areas without infrastructure or in other words irrigation infrastructure help smoothens incomes and expenditures.

The relationship between consumption smoothing and irrigation infrastructure, specifically the question of whether households with access to irrigation infrastructure receive higher incomes and thus able to smooth consumption, is another dynamic poverty aspect that will be addressed in this study. The third hypothesis can be stated as follows;

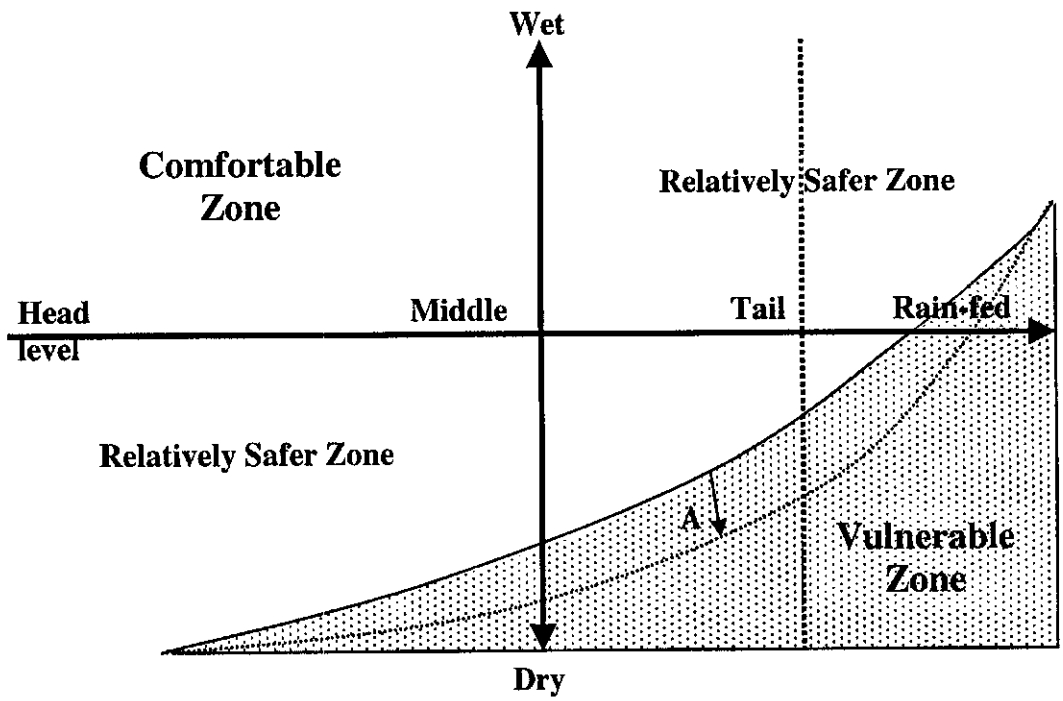
3. If incomes in agricultural areas with irrigation infrastructure are higher (than in areas without infrastructure), consumption expenditure may not track incomes during the year. Or if incomes in agricultural areas without irrigation infrastructure are lower (than in areas with infrastructure), consumption expenditure may track incomes during the year.

In assessing the impact of irrigation infrastructure on poverty, it is important to understand that irrigation water and infrastructure are complementary to each other. Access to irrigation water becomes possible only if infrastructure for conveyance and distribution of water is available. However, while availability of physical irrigation infrastructure alone may not be a sufficient condition for access to water, it is surely a necessary condition. Adequate water may be available, but without infrastructure, people may not be able to access it. The access

to water depends upon availability of both water and infrastructure. However, there may be variations in availability of water and the degree of infrastructure development, with varying impacts on poverty.

The hypothesized spatial and temporal relationships between infrastructure development and poverty are depicted in Figure 1. The horizontal axis represents the irrigation system with the arrow illustrating the flow of water from the head down to the tail reach. The rainfed area relies on rain as its primary source of water. The vertical axis represents the time dimension and is characterized as either the wet or dry season. Based on the location and season/ timing each area is classified by the state of infrastructure development and relative security of access to adequate irrigation water supplies.

Figure A1: Spatial and Temporal Dimensions of Irrigation and Poverty



Near the head of the irrigation system, where infrastructure is most likely to be well developed (compared to, for example, tail reaches, a farmer is most likely to be guaranteed an adequate supply of water during the rainy season. This is because during the wet season surface water flows will be at their highest and because head-end farmers will have first opportunity to take water. Farms located further down the irrigation system will experience diminished relative security of their access to irrigation water. The diagram presented illustrates that there are seasonal vulnerability patterns for access to irrigation water, as well

as distinct spatial patterns. Policy interventions to alleviate the vulnerability, should attempt to reduce the vulnerability zone both in time and location, illustrated by the lower dashed curve.

Analytical Methods

There is no single indicator or method for testing the above hypotheses. In this study, we use the following approach to comprehensively assess the impacts of irrigation infrastructure on poverty covering both its spatial and temporal aspects.

1. Compare various strata representing the state of infrastructure development – quantify the difference in the value of relevant variables by developing a socio-economic profile for each stratum.

2. Develop and quantify key indicators of poverty – covering both monetary and non-monetary dimensions of poverty.

3. Estimate household income/ consumption smoothing effects of irrigation infrastructure development through econometric analysis, and

4. Identify and quantify key determinants of household incomes/expenditures/poverty including quantifying the impact of irrigation infrastructure development on these variables through econometric analysis.

Details on indicators of poverty and econometric framework are provided in the following section.

Defining the Poor and Measuring Poverty

A basic problem in any work on poverty is how to define the poor and how to measure poverty. There could be as many definitions of poverty as the number of poor themselves, or at least as many as the number of people who have attempted to define poverty. Traditional approaches to measure poverty have centered around the concepts of incomes and consumption levels, with poverty generally perceived in two distinct ways: absolute poverty and relative poverty. Absolute poverty is defined in terms of minimum consumption needs without reference to income or consumption levels of the general population. A relative poverty situation, on the other hand, is generally defined in relation to mean income or consumption of a population as a whole. A person is considered poor, in absolute terms, if his/her income or consumption level falls below some minimum level necessary to meet basic needs – this minimum level is called the poverty line.

However, it has been argued that income is a narrow concept and is not an adequate measure of poverty and well-being. In recent years, it is has been increasingly recognized that poverty is a multidimensional concept, extending from low levels of incomes and consumption to lack of education and poor health, and includes other social dimensions such as powerlessness, insecurity, vulnerability, isolation, social exclusion and gender disparities.

Similarly, the concepts of livelihoods, basic capabilities and entitlements have broadened the concepts of poverty. While looking at poverty from both economic and non-economic dimensions provide a comprehensive and holistic approach for understanding poverty, analytical and measurement problems pose difficulties in the application of most of the above concepts. Consequently much of the empirical work in poverty relies on traditional income and consumption measures – estimating poverty lines using a basic needs approach. As the basic needs vary across time and space, poverty lines also vary over time and across societies – depending upon the level of socio-economic development, social norms and values within regions in a country or across countries.

For the purpose of this study, we will measure poverty in terms of the following two major dimensions:

1. Monetary Dimensions of Poverty – Income Poverty
2. Non-monetary Dimensions of Poverty

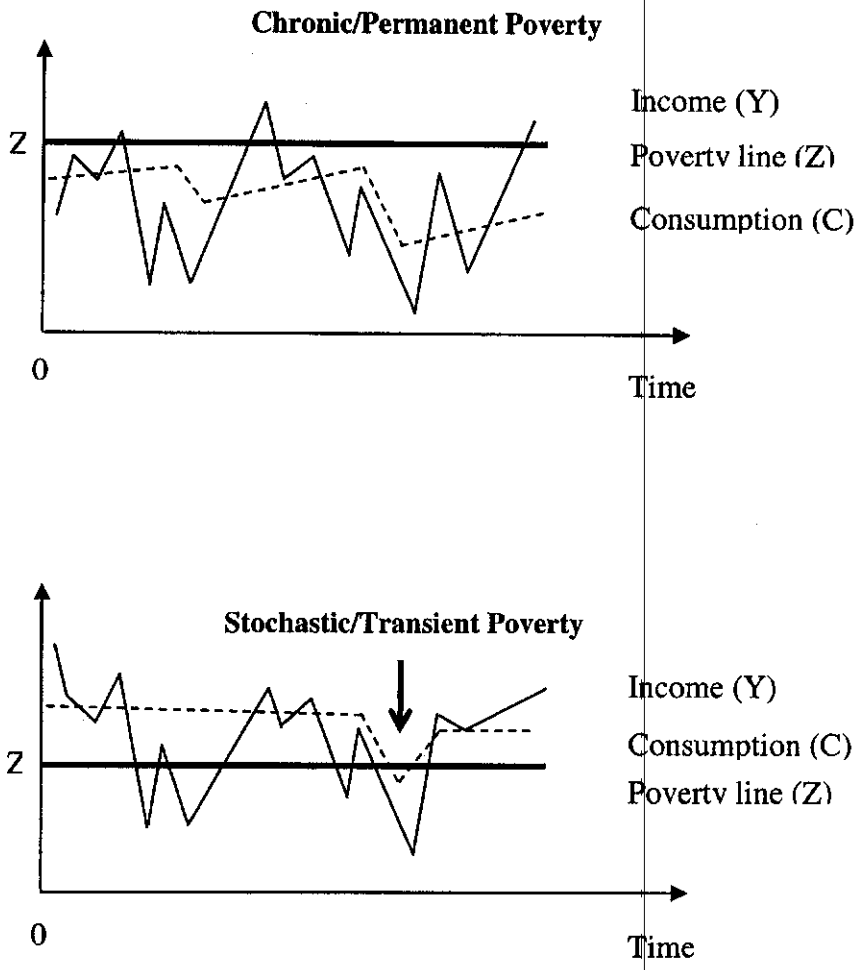
Monetary Measures of Poverty

Income Poverty – Concepts of Chronic and Transient Poverty

There are two basic concepts of income poverty, static and dynamic. Static concepts relate to measurement of poverty at a point in time. Dynamic poverty relates to changes in poverty over time. The concept of dynamic poverty is further analyzed as chronic poverty and transient poverty. Chronic poverty is defined as a state where a household's income (consumption) is constantly below the poverty line. Transient poverty, on the other hand, is a state where a household's average income (consumption) is above the poverty line, but the household is confronted with the possibility of temporarily falling below the poverty line. Transient poverty is also called stochastic poverty.

Chronic poverty = a situation where $Y^P < Z$
Transient poverty = a state where $C < Z < Y^P$,

where Y^P= a household's permanent income
C = a household's current consumption level
Z = poverty line



In the figures above, solid and dotted lines indicate income and consumption respectively.

There are distinct policy implications underlying the two dynamic concepts of poverty. For example, when chronic poverty is dominant, continuous long-term policy interventions are necessary. Such policies may include agricultural research and extension, land reforms, income re-distribution and price support policies. When transient poverty is more prevalent, some form of insurance provision policies are more appropriate. For example, policies such as as micro-credit, crop insurance, employment guarantee, or price stabilization policies may be needed. Recent literature from the Asian region suggests that transient poverty is more prevalent, with 50-70 percent of the population identified as living in transient poverty (Sawada, 2000).

Some of the monetary indicators of income poverty include:

1) Average income per month
2) Average farm income per month
3) Average non-farm income per month

4) Average expenditure per month
5) Ratio of food expenditure to total expenditure

The relationship between income and consumption is embodied in the Engel's law, put forward by a German statistician Ernst Engel, who concluded that as incomes increase a smaller and smaller proportion of income is spent on food. In general, the function denoting the relationship between income and consumption, keeping prices constant is called the Engel curve. As incomes increase, the quantity demanded increases for a normal good, like food, a necessity. As incomes increase further, the quantity of necessities consumed does not increase in proportion to income increases. Consumption does not cease altogether, because they are necessities. For luxury goods, there is little or no consumption at low levels of income, but consumption increases as income increases. For inferior goods, consumption declines with increases in incomes. A good cannot be inferior at all levels of income, at zero income there are no purchases, as income increases a little, consumption increases a little, and eventually as income gets high enough, the consumer ceases to purchase it altogether. Thus at high poverty levels one may observe a high proportion of income being spent on food, and as poverty levels decline, the proportion spent on food declines while the proportion spent on luxury and other normal goods increases.

Monetary Measures of Poverty

The measurement of income poverty involves: 1) specification of an indicator of well-being such as income or expenditure, 2) specification of an income level or threshold below which a person or household is considered poor – the poverty line, and 3) construction of poverty measures. Foster-Greer-Thorbecke (FGT) class of measures is the most commonly used measure of poverty, which captures three aspects of poverty: incidence, depth/intensity and severity of poverty. These measures are the Headcount Index, the Poverty Gap Index and the Squared Poverty Gap Index.

1. Headcount Index is defined as the share or proportion of the population which is poor or whose income is below the specified poverty line. This is a measure of incidence of poverty. Suppose in a population of size n, there are q number of poor people whose income y is less than the poverty line z, then head count index can be defined as:

$$\text{Head Count Index } HC = q/n \quad \ldots\ldots (6.1)$$

2. Poverty Gap Index is defined as the mean distance separating the population from the poverty line. This can be interpreted as a measure of depth of poverty. Non-poor are given a distance of zero. This measure can be mathematically represented as follows:

$$\textbf{Poverty Gap } PG = 1/n \sum_{i=1}^{n} \left[\frac{z - y_i}{z}\right] \quad \ldots\ldots (6.2)$$

where z is the poverty line, y_i is the income of the individual i or household i, and the sum is taken only on those individuals who are considered poor (below poverty line).

The poverty gap can also be defined as the product of the income gap and the Head Count Index ratio, represented as follows:

PG = I*HC, where I is the income gap

Where $I = \frac{z - y_q}{z}$ and $y_q = 1/q \sum_{i=1}^{q} y_i$ is the average income of the poor.

Squared Poverty Gap Index is a measure of the severity of poverty. The poverty gap takes into account the distance separating the poor from the poverty line, while the squared poverty gap $[PG]^2$ takes into account the square of the distance. The squared poverty gap index gives more weight to the poor, by taking into account the inequality among the poor—greater weights are given to larger gaps and the weights are simply the poverty gaps. It is represented as follows:

$$\text{Squared Poverty Gap} \qquad [PG]^2 = 1/n \sum_{i=1}^{n} \left[\frac{z - y_i}{z}\right]^2 \qquad \text{.....(6.3)}$$

Both Poverty Gap Index and the Sqaured Poverty Gap Index put more emphasis on those who are further away from the poverty line. The general formula for all three measures is given below, which depends on parameter α which takes a value of zero for the Head Count Index, one for the Poverty Gap Index and two for the Squared Poverty Gap Index

$$P(\alpha) = 1/n \sum_{i=1}^{q} \left|\frac{z - yi}{z}\right|^{\alpha} \qquad \text{.....(6.4)}$$

The above measures can be analyzed for various socio-economic groups and for different geographic locations (within irrigation systems).

The above general income/consumption measures of poverty can be used to estimate the incidence of chronic poverty and transient poverty. The households can be divided into three groups: a. non-poor b. chronic poor, and c. transient poor.

a. households that never experienced income at levels below the poverty line
b. households whose income sometimes fell below the poverty line during the study period
c. households with income levels that are always below the poverty line

$$I_t = \frac{1}{n} \sum_{i=1}^{Pt} \left(\frac{Z - y_{it}}{Z}\right)^{\alpha} \qquad \text{.....(6.5)}$$

$$C_t = \frac{1}{n}\sum_{i=1}^{P^*}\left(\frac{Z-\overline{y_i}}{Z}\right)^{\alpha} \quad \text{.....(6.6)}$$

$$T_t = I_t - C_t \quad \text{.....(6.7)}$$

I_t	poverty index
C_t	chronic poverty index
T_t	transient poverty index
Z	poverty line
$\underline{y}$	monthly income of household
$\overline{y}$	average monthly income of household
n	population

In this report, poverty indices are calculated as per the following categories, with $\alpha = 0 or 2$.

First category

1. both average monthly income and highest monthly income are less than the poverty line (i.e. chronic poverty)
3. average monthly income>poverty line, lowest monthly income<poverty line (i.e. transient poverty)
4. average monthly income>poverty line, lowest monthly income>poverty line (i.e. the case of non-poor)

Second category

1. average monthly income<0.5*poverty line
2. 0.5*poverty line<average monthly income<0.75*poverty line
3. 0.75*poverty line<average monthly income<poverty line
4. poverty line<average monthly income<1.25*poverty line
5. 1.25*poverty line<average income

In addition to the above measures, we also undertake income distribution analysis both spatially and temporally and estimate welfare impact of income/expenditure fluctuations/variability using the following measures.

1. Gini-coefficient and Lorenz Curve
2. Cofficient of Variation
3. Standard Certainty Equivalence Measure—measure of welfare impact of income variability

The first two measures are self-explanatory. The third measure is described below.

Standard Certainty Equivalence Measure

Suppose a household's expected income and expected utility are denoted as follows:

$$E(y) = Y,$$
$$U(Y-m) = E[U(y)], \quad \text{.....6.8)}$$

where y is stochastic income, Y is the expected value of income, and m is the certainty equivalent compensation of income risks. Then, the fraction of income which households would be willing to give up to eliminate risks will be approximately:[11]

$$\frac{m}{Y} = \frac{RRA(\sigma/Y)^2}{2} \quad \text{..... (6.9)}$$

where *RRA* is the degree of relative risk aversion and σ is the standard deviation of household income. Note that m/Y represents the negative welfare effects of the existence of income fluctuations. When there is no income risk, i.e., $\sigma = 0$, then there is no negative welfare impact. The certainty equivalent measure quantifies the amount that household would be willing to give-up to achieve perfect smoothing in incomes/expenditures, and measures the welfare cost of income/expenditure fluctuations (for more details see Morduch, 1995).

Empirically, the value of the standard deviation σ and the average monthly income Y are easily obtained from the data set. However, *RRA* is more difficult to estimate. Estimates obtained from South Asian data sets suggest that a value of R = 2 to 4 can be used to calculate the welfare impact, m/Y of each household.

Defining the poverty line

As mentioned above, specification of a poverty line is an important step in estimating the above measures. There are three commonly used approaches used for estimating poverty line: a) based on calories intake, b) income /expenditure needed for required food energy intake (only food) and c) cost of basic needs (food and non-food). For the purpose of this study, we use secondary estimates of national/regional poverty line available from the national statistical agencies for that country/region.

As stated earlier, there is no official definition of poverty line in Sri Lanka. Several studies have used a poverty line that has been estimated based on the value of a food basket that provides the required minimum calorie and protein intake, and allows for a certain empirically determined proportion of expenditure on non-food items. Nanayakkara and Premaratne (1987) estimated a poverty line using the 1985/86 Labor Force and Socio-Economic Survey (LFSS) data of the Department of Census and Statistics, at a monthly per capita food expenditure of Rs 202 at 1985/86 prices. This corresponded to the expenditure required for a daily calorific intake of 2500 calories and 53 grams of protein per adult male

[11] We can employ a second-order Taylor expansion around Y.

(age 20-39) equivalent. An additional amount of Rs 40 was allowed for basic non-food expenditure estimated from national Engel functions for 1985/86, bringing the total poverty line to Rs 242 per capita per month (excluding consumer durables) at 1985/86 prices. This was updated to Rs 471 at 1990/91 prices using the Greater Colombo Consumer Price Index (GCCPI) to adjust for price inflation (World Bank, Poverty assessment Study, 1995). A higher poverty line of Rs 565 was also estimated on the basis of expenditures of 20 percent above the reference poverty line. The reference and higher poverty lines are used as the basis for this study, updating the figures at 2000 prices using the same GCCPI to account for inflation. This works out to Rs 952[11] per person per month for the reference poverty line and Rs 1142 for the higher poverty line. The poverty line of US$1 per day used by the World Bank (1990), estimated at Rs 252 per person per month, adjusted for purchasing power parity at 1985 prices, can also be used for comparison purposes. This poverty line works out to Rs 991 per person per month at 2000 prices, when adjusted for domestic price inflation using the GCCPI.

Defining household income —sources of rural income

The concept of rural income, as used in methodological discussions above, is defined as the total income received in both cash and kind in a given season/year. Income received in kind is imputed in monetary value using the prevailing prices. The total income used is net of all cash expenses but exclude the imputed value of all resources owned by the household (family labor, draft animals etc)

Total income may be disaggregated by its source of origin as follows.

1. Income from crop production – includes incomes from the sale of all crop outputs (including grains, vegetables and fruits), imputed value of all crop outputs retained for household consumption, and imputed value of crop by-products. The income is calculated net of all cash expenditures on material inputs (seeds, fertilizers, chemicals), hired labor, rental payments for farm machinery.
2. Income from non-crop agriculture – includes incomes from livestock, fisheries and forest products and their by-products. This includes the imputed value of the produce retained for household consumption.
3. Income from agricultural wages – includes incomes from working in agricultural activities on others' farms.

[11] The Greater Colombo Consumer Price Index has a base January to June 1989=100, and weights for different components of expenditure are based on the Labor Force and Socio Economic Survey 1985/86 of the Department of census and Statistics, revalued at January to June 1989 prices. This index measures consumer price inflation in the Greater Colombo area based on the expenditure on a typical basket of goods and services of an average urban family (Statistical Abstracts, Department of Census and Statistics, 2000). The basic poverty line of Rs. 242 at 1985/86 prices was updated using the GCCPI to Rs 471 at 1990/1991 prices. For our study, we have updated the poverty line based on 1991 prices and estimated a new poverty line based on 2000 prices using the GCCPI. Therefore, the basis for the poverty line (estimated by Nanayakkara and Premaratne , 1987 as consumption of 2500 Kcals of energy and 53 grams of protein and an additional amount for basic needs) remains the same for this poverty line except that it is now valued at 2000 prices. {GCCPI for 1990 = 124.6 and for 2000 = 252.0 Poverty Line 2000 = (471/124.6)*252=952.6}. The international poverty line of US$ 1 per day (at 1985 purchasing power parity) works out to Rs 252 per capita per month expenditure at 1985/86 prices (Datt G. & Gunawardena D, 1997). This value of prices works out to Rs 490 per capita per month updated at 1990/91 prices and Rs 991 per capita per month updated at 2000 prices, on the basis of the GCCPI.

4. Incomes from trade, services and other non-agricultural sources – includes incomes from shop-keeping, petty trade, business and market intermediation, self-employment, salaried services, earnings from manual labor employed in rural processing and industrial activities, transport operations, housing and road construction and other similar activities.

Definition Household Expenditures and Assets.

Household expenditure is first divided into durable and non-durable expenditures. Non-durable expenditure is divided into three categories. Category I comprised rice, both purchased and consumed from own farm, cereals other than rice, pulses, cassava and sweet potato, vegetables, fruits, sea fish, tank fish, canned fish, dried fish, meat, flour, bread, eggs and milk. Category II comprised tea, coffee, milk powder, yoghurt, soft drinks, liquor, cooking oil, coconut, sugar, salt, and spices. Category III comprised, of tobacco, cigarettes, soap, shampoo, electricity charges, expenses for firewood, cooking fuel, LP gas, and lighting fuel. Other category of expenditure included expenses for house repairs and maintenance, clothing and shoes, medical care, education, recreation, ceremonies, transport and communication, remittances for family/relatives, rent, loan repayment, taxes, bank deposits, weddings, and other miscellaneous expenditures. Non-durable expenditures included food expenditure, which included all items in Categories I and II and non food expenditure, which included all other expenditure included in Category III and Other Category (i.e. non-durable expenditures other than those in the above three categories). Since wedding expenditure, was considered to be one time expense it was excluded from the non-food category of expenditure. Household expenditure data was obtained on a monthly basis from October 2000 to September 2001.

Durable expenditure included expenditure on agricultural assets and household assets. Agricultural assets included two and four wheel tractors, plow and harrow, water pump, sprinkler systems, motorized and hand threshers, winnows, rice mills, mechanized livestock feed processors, hand and mechanized sprayers, ox and hand carts, and other farm equipment. Other items included in agricultural assets are the ownership and amount spent on purchases of livestock such as cattle, buffalo, milk cows, pigs, goats, chicken and other animals on a seasonal basis. Household assets include assets such as bicycles, motor cycles, television, radio, cassette recorder, sewing machine, refrigerator, petromax lamps, electric fans, telephone, clocks, gas cookers, electric cookers, trucks and pick up trucks, cars, land and buildings, and any other assets.

In the case of agricultural assets, data were obtained on the ownership of assets and the market value of such assets and not on expenditure or the date of purchase of such assets. Data on the value of sales of assets such as livestock during the season was also obtained. Household assets included the number owned, and if purchased, the price and the year of acquisition of such assets. Since monthly data on expenditure on assets was not obtained, it was not possible to analyze monthly movements on such expenditure. The only durable item for which monthly data were collected was the expenditure on repairs and maintenance of house. This was included under the other category expenditure in the analysis. Data on durable expenditure was obtained on a yearly basis.

Non – Monetary indicators of poverty

Frequently used non-monetary indicators of poverty can be grouped into the following categories.

1) Health related indicators: under 5 mortality rate, life expectancy, number of days absent from work due to illness, prevalence of child malnutrition, access to sanitation, access to hospitals, access to drinking water, type/housing condition, per capita calorie intake;
2) Education related indicators: Adult literacy rates, number of years of schooling, school drop out rate, distance to school;
3) Infrastructure indicators: Distance to nearest bus station, market, post office, telephone, availability of electricity, access to gas cooking, access to irrigation, access to upgraded lined irrigation;
4) Asset ownership: per capita land, per capita irrigated land, ownership of houses, household assets;
5) Household, Labor and Employment: Primary and secondary occupation, percent unemployed, dependency ratio, labor force participation rate.

For this study the following key non-monetary indicators have been selected, on the basis of information collected in the survey. These indicators will be estimated for each stratum.

1. *Dependency ratio:* This is defined as the ratio of the number of children and elderly persons to total potentially employable persons. This indicator can be calculated on the basis of a household, stratum, group or sector of the population. One would expect the dependency ratio to decline with the decline in poverty.

2. *Educational level:* The rationale for this indicator is that, higher levels of educational attainments opens up economic opportunities, including ability to absorb new technology, make better use of available services such as extension, credit, marketing and venture into new enterprises or self-employment. The indicator is measured as the number of years of schooling of household head. It is assumed that higher levels educational attainments would reduce poverty.

3. *School drop out rate:* Traditionally, it has been assumed that high drop out rates of children of school going age was mainly due to the household not being able to afford schooling due to poverty. It could also be a result of schools being far away, and/or lack of transport facilities. On the other hand, high drop out rates may be due to the availability of employment opportunities for children within the locality. The parents may prefer to send their children to work than to school in order to earn an additional income.

4. *Under-five mortality rate:* Poverty can result in higher mortality of children under five years old, as they are the most vulnerable group. Thus, one would expect a higher mortality rate of this group within poor households. A measure of mortality of children under five would be a good indicator of poverty.

5. *Housing Index:* This index evaluates the quality of housing based on the materials used for the walls, roof and floor, the number of rooms in the house and the type of toilet. The maximum points for each component of housing is three points as follows; wall (palm-1, mud-2, brick-3, other-2); roof (palm leaf-1, tin-2, tile-3, other-2) and floor (mud-1, cement-2, tile-3, other-2) and maximum points for the number of rooms is four, estimated as the average number of rooms per household. The water seal type of toilet was allocated 2 points and all other types 1 point. The maximum score possible is 15 points, which translates to an index of 100 percent.

6. *Ownership of household assets:* One would expect households owning greater amounts of assets to be less poor than those having little or no such assets. Data has been collected on the current value of household assets owned by households. Value of household assets per household or per capita, would be good indicators of poverty (household assets here include only non-agricultural assets).

7. *Average land holding – irrigated and non irrigated:* This estimates the average land holding ownership by type of water source. It is assumed that households owning larger irrigated holdings are less poor than those not having irrigation facilities.

8. *Access to irrigation water:* This is similar to the indicator on irrigated land holding described earlier. The difference here is that lands, officially classified as rainfed or un-irrigable, may be receiving irrigation water from some source, such as agrowell, illegal diversion of canal, seepage water, tube well, drainage water, etc. and would fall into this category. This indicator and would capture the true irrigated extent and provide a more precise categorization of land by irrigation.

9. *Cropping intensity:* This is the ratio of the area cropped to the area actually owned, per season. The higher the cropping intensity the less poor the household.

10. *Agricultural productivity per hectare:* The average productivity per unit of land (total output / total land owned) and average productivity per unit of land cropped (total output / total area cropped) will provide a measure of the potential versus actual productivity. The difference may be due to various causes such as lack of irrigation facilities, poor water management, climate, input supply problems, lack of credit or finances, marketing problems, poor soils, drainage problems or other problems.

11. *Total agricultural assets:* Agricultural asset ownership provides a measure of wealth and would be a good indicator of poverty in rural areas. Data has been collected on the current value of agricultural assets owned by the household. Thus the value of agricultural assets per household or per capita would be a good indicator of the level of poverty of the household. Agricultural assets would include, all equipment used in agricultural production, e.g. tractors, plows, threshers, trailers, sprayers etc.

12. *Access to electricity:* The proportion of households with access to electricity is another indicator of poverty. However, it is also possible that the household does not have electricity because of non-availability of electricity supply to the locality by the

authorities and not due to poverty. These factors should be considered when interpreting the results of this indicator.

13. *Access to piped water supply:* This indicator can be estimated as the proportion of households having access to piped supplies of water, which can be used as a measure of poverty.

14. *Access to credit:* The assumption here is that the poor have less access to credit than non-poor households.

Econometric Analysis

a). Seasonality in Incomes and Expenditures

The third hypothesis on the issue of income and expenditure smoothing is tested using the model developed by Paxson (1983). Paxson suggests that in addition to constraints to borrowing there are other reasons that can cause consumption fluctuations. She tested the hypothesis that seasonal taste and price variations, as opposed to variations in incomes, is a major determinant of observed consumption variation in Thailand. Assuming two seasons, she develops a model of perfect smoothing, i.e. individuals do not have credit market constraints. It implies that seasonal consumption patterns are unaffected by the timing of income inflows. The model is extended to allow for imperfect smoothing, and actual expenditure in any season, which is a weighted average of income in that season and desired expenditure given a perfect ability to smooth. This is expressed as follows:

$$E_{ji} = E_{ji}^{*}(1-\pi) + Y_{ji}\pi,\ j = 0,1 \quad \text{.....(6.10)}$$

Where $0 \leq \pi \leq 1$. This yields the following equation for expenditure in each period.

$$E_{ji} = Y_i [\beta_j (1 - \pi) + A_{ji}\pi] , j = 0,1 \quad \text{.....(6.11)}$$

Where A_{ji} is the fraction of annual income earned by individual i, in season j (so that A_{ji} sums to one across seasons for any individual). As π increases, the effects of prices and preferences (measured by β_j) receive less weight in determining seasonal expenditure, and seasonal incomes receive more weight. If $\pi = 1$, then seasonal expenditure tracks seasonal income. Y_i is defined as total annual income divided by the number of seasons (12 months), or the average monthly income level of person i. The above equation yields the following log expenditure equation:

$$\ln (E_{ji}) = \ln (Y_i) + (1 - \pi)\beta_j + \pi A_{ji} - 1$$

where E_{ji} is the expenditure of individual i, for season j.
Y_i is the total annual income divided by the number of seasons.
A_{ji} is the fraction of annual income earned by individual i, for season j.
β_j is the effect of prices and preferences and
π is the smoothing coefficient

In the above equation, perfect smoothing ($\pi = 0$), implies seasonal expenditure is determined only by income, preferences and prices. Imperfect smoothing ($\pi>0$), implies that the timing of income flows A_{ji} is also a determinant of seasonal expenditure. The above equation can be estimated using OLS. For more details on the framework see Paxon (1993).

Separate OLS estimates for the six strata can be obtained for each season, in order to test the hypothesis that seasonal expenditure is dependant only on permanent income, prices and preferences and not on timing of income flows. A regression analysis based on the above framework using consumption as the dependent variable and dummy variables for seasons/months as independent variables is undertaken. Regional differences and the differences in irrigation infrastructure development are also taken into account in this analysis. A graphical analysis of the outcome is produced to illustrate the differences (see chapter 10).

b) Estimation of the determinants of incomes/expenditures – Quantification of Impacts

Quantification of key determinants of household incomes and expenditures is undertaken by estimating a multivariate econometric model with annual household level data. It is hypothesized that household incomes/expenditures depend upon:

a) Household endowment of natural resources, particularly land;
b) Household productivity of natural resources, such as land productivity;
c) Household human resources and their characteristics, such as number of non-dependent working family members, education levels of family members, occupation;
d) Household capital resources, such as household non-land productive assets such as agricultural machinery, livestock;
e) Household access to irrigation/infrastructure.

Irrigation infrastructure and its state of development can be expected to contribute positively to household incomes through increased overall productivity and production, through enhanced employment and income earning opportunities associated with infrastructure induced improved economic activities in both farm and non-farm rural sectors.

Chapter 7

Basic Socio-economic Profile of Sample Households Asset Base and Livelihood Systems

This chapter provides a basic socio-economic profile of the study area and characteristics of sample households with a view to set a stage for discussions and analyses in the subsequent chapters. As explained in the previous chapters, the selected study area was divided into six strata based on the state of irrigation infrastructure development and other related characteristics. Table 7.1 provides a summary description of the strata and sample areas. In the Sevanagala irrigated area, sugarcane is the main crop but paddy is also grown on a smaller extent under irrigation. The irrigation infrastructure in the Sevanagala area is well developed but it is beginning to show a certain amount of disrepair due to inadequate maintenance. In the Sevanagala rainfed area, farmers have been provided with a relatively larger extent of land (compared to Sevanagala irrigated area) for rainfed sugar cultivation to compensate for the lack of irrigation infrastructure. No other crop is grown in the rainfed allotments but homesteads are cultivated with some annual and a few seasonal crops, with varying degree of success, depending on the rainfall.

Table 7.1 Summary description of sample areas

Stratum	Irrigation Infrastructure	Agro-ecosystems/ Cropping Pattern	Distributary Canal /Village	Cultivated/Water Issued in Maha 2000/1	Sample Size
Sevanagala	Upgraded/lined	Irrigated Sugarcane/Paddy	C_2, C_8,	Yes	167
Sevanagala	No Irrigation infrastructure	Rainfed sugarcane	Div. 1 and Div. 2	Yes	60
Kiriibbanwewa	Upgraded/ lined in May 1999	Irrigated paddy/OFC	KLB,MD11,MD14 , MBD2/MBD11 MMD11/MMD12	Yes	109
Kiriibbanwewa	Upgraded/lined in May 1998	Irrigated paddy/OFC	MD3, MD10	No	42
Sooriyawewa	Upgraded/lined in May 1999	Irrigated banana/paddy/ /OFC	BBD2, BBD 5, BBD7, MD 15, MD 18	Yes for OFC's only	184
Sooriyawewa	Upgraded/lined in 2001	Paddy/OFC	BBSB2 D2	No	43
Extension area	No infrastructure	Rainfed/ Chena	Mahara Andarawewa Wediwewa Bolhinda Ballegaswewa	No	26 46 18 4 11
Ridiyagama	Infrastructure not upgraded/lined	Irrigated paddy/OFC	LB,SRB Head, SCB, SRB Tail	Yes	146

Irrigation infrastructure was rehabilitated/upgraded in the two irrigated blocks of Kiriibbanwewa and Sooriyawewa over the period 1999 to 2001. The channels are now fully lined both at the distributary and field levels. These areas are cultivated mainly with paddy and bananas in addition to small areas allocated to other food crops such as chillies, onions, pulses and vegetables. Irrigation infrastructure has not been developed in the Extension/rainfed area as yet. However, there are several small village tanks spreading across the Extension area, which are utilized for paddy cultivation in the Maha season and for the cultivation of OFCs during Yala season. The Ridiyagama is a well-established old irrigated scheme, receiving the drainage flows from the cultivated areas in the Uda Walawe system. The irrigation infrastructure in this system has not been upgraded/lined, but irrigation water supplies are adequate for cultivating two crops per year.

Table 7.2 provides a summary of the basic characteristics of the sample households by strata. The irrigated areas have relatively larger households compared to the rainfed areas. Also a larger number of dependents (family members between the ages 5-20) were found in the rainfed areas. Ridiyagama has the lowest number of dependents, highest age of the household head, and the highest number of schooling years, reflecting the fact that it is a more established old system. The average age of the household head and the number of schooling years is higher in irrigated areas compared to rainfed areas.

Table 7.2 Selected basic characteristics of sample households

Basic Characteristics	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All
Number of observations	167	60	151	229	105	146	693	165
Household size (number)	5.17	4.78	5.01	5.18	4.98	5.25	5.16	4.91
Average number of family members between 5-20 years (number)	1.8	2.0	1.8	2.1	2.0	1.4	1.8	2.0
Age of household head	47.7	42.4	52.6	48.8	43.3	53.3	50.3	42.9
Average years of schooling of household head (no. of years)	6.1	7.1	6.8	6.5	5.5	7.5	6.7	6.0
Average number of family members not attending school who are between 5-20 years per household (number)	0.8	1.5	0.6	0.5	0.4	0.4	0.6	0.8
Average number of workers per household (number)	3.1	2.3	2.7	2.7	2.5	3.2	2.9	2.5
Average farm size (ha)	0.98	1.59	1.21	0.83	1.38	1.31	1.05	1.46

The rainfed settlements in Sevanagala and the Extension area are newer than the irrigated settlements and therefore the families are younger, with a smaller family size but having more dependents and fewer number of workers/earners per household. The number of household members of school age not attending school is also higher in rainfed areas. The average farm size of rainfed areas (1.46 ha) is relatively higher than irrigated areas (1.05).

This is due to encroachments in the Extension Area and larger sized allotments in the Sevanagala rainfed area (to compensate for lower yields). The largest farm size among irrigated strata was in Ridiyagama. This is because households in this system received relatively larger allocations of land when they were first settled.

While there are no landless households in the area, overall land endowments are quite small. Table 7.3 presents information on land distribution pattern across strata. Nearly 49 percent of the sample households owned less than 1 hectare of land and 45 percent owned between 1 - 2 hectares and only 6 percent owned more than 2 hectares.

Table 7.3 Land distribution pattern

Block / Stratum	Land category	Less than and up to 1 ha	1.01 to 2.-0 ha	2.01 to 3 ha	over 3 ha	Total
Sevanagala-Irrigated	Percent Households (N=167)	47.9	50.3	1.8	0.0	100
	Average Land size (ha)	0.57	1.24	2.28	0.0	
Sevanagala-Rainfed	Percent Hpuseholds (N=60)	11.7	86.7	1.7	0.0	100
	Average Land size (ha)	0.22	1.71	2.12	0.0	
Kiriibbanwewa	Percent Households (N= 151)	41.1	49.0	9.9	0.0	100
	Average Land size (ha)	0.56	1.36	2.03	0.0	
Sooriyawewa	Percent households(N= 229)	79.9	19.2	0.9	0.0	100
	Average Land size (ha)	0.63	1.20	2.41	0.0	
Extension Area	Percent Households (N= 105)	19.0	64.8	16.2	0.0	100
	Average Land size (ha)	0.64	1.35	2.31	0.0	
Ridiyagama	Percent Households (N= 146)	47.9	42.5	7.5	2.1	100
	Average Land size (ha)	0.52	1.38	2.51	3.4	
Irrigated-All	Percent Households (N=693)	57.0	38.1	4.5	0.4	100
	Average Land size (ha)	0.59	1.30	2.25	3.4	
Rainfed-All	Percent Households (N= 165)	16.4	72.7	10.9	0.0	100
	Average Land size (ha)	0.53	1.51	2.30	0.0	
Farmers	Percent Households (N= 724)	41.7	51.1	6.8	0.4	100
	Average Land size (ha)	0.68	1.37	2.27	3.4	
Non-Farmers	Percent Households (N= 134)	89.6	10.4	0.0	0.0	100
	Average Land size (ha)	0.34	1.34	0.00	0.0	
All	Percent Households (N = 858)	49.2	44.8	5.7	0.3	100
	Average Land size (ha)	0.49	0.45	0.06	0.003	

Is land a good indicator of poverty? A comparison of land size by poverty category shows the following:
Average land size: Chronic poor =0.95 ha; Transient poor = 1.05 ha; Non poor = 1.07 ha:
The above results indicate that the chronic poor have the smallest land holding and the non-poor the largest land holding, suggesting that size of land holding may have influence on the level of poverty. However, other factors such as, the proportion of irrigated land, quality of land, and water availability in irrigated and rainfed lands may also be important poverty influencing factors.

About two percent of the households in Ridiyagama owned more than 3 hectares and a further 7.5 percent owned between 2 and 3 hectares. Ridiyagama was the only system where

there were households owning more than 3 hectares. About 80 percent of households in Sooriyawewa owned less than 1 hectare of land and the remaining 20 percent owned between 1-2 hectares. In this area, a large number of new settlers have been allocated smaller plots of land. They are mostly second generation of earlier settlers (sons and daughters) who have occupied their parents' lands and were later allocated smaller plots of land. Under the rehabilitation program, new lands have been brought under irrigation in Sooriyawewa and thus more farmers have been settled in this stratum recently. In the other three irrigated areas of Kiriibbanwewa, Sevanagala Irrigated and Ridiyagama, between 40-50 percent of the households owned less than 1 hectare and between 40 –50 percent owned between 1-2 hectares of land. Households in these strata are equally divided into these two groups. In these areas, no new lands have been brought under irrigation and therefore very few or no new households have been settled in these areas. In the Sevanagala rainfed area, only 12 percent of households owned less than 1 hectare, about 88 percent owned between 1-2 hectares. This is because these settlers were given larger allotments for rainfed sugarcane cultivation to compensate for the lack of irrigation infrastructure. In the Extension area, about 19 percent of the farmers owned less than 1 hectare, 65 percent owned between 1-2 hectares and 16 percent owned between 2-3 hectares. In the Extension area, most farmers have encroached on state land in the hope of receiving irrigation facilities in the future. Thus, the land sizes are relatively larger. A comparison of rainfed and irrigated areas shows that about 90 percent of the farmers own more than 1 ha of land in the rainfed areas, while only 43 percent of the farmers owned more than 1 hectare of land in the irrigated areas.

In sum, average farm size was the highest in the Sevanagala rainfed area, followed by the Extension area and Ridiyagama. Households that were settled in Sevanagala rainfed areas were allocated relatively larger plots of land to compensate for the lack of irrigation. In the Extension area, most households had encroached on state lands and therefore owned larger plots of land. In Ridiyagama, the original settlers were allocated larger sized allotments. Thus in these three strata, land holding size was about 40-50 percent higher than in the other strata.

Table 7.4 provides information on the basic characteristics of agriculture and crop production across strata. The highest cropping intensity was observed in the Sevanagala rainfed, Ridiyagama, and Sevanagala irrigated areas. In the other irrigated areas, it was about one third less. As expected, the lowest cropping intensity was in the Extension area. The highest area under irrigation was in the Sevanagala irrigated, followed by Sooriyawewa and Ridiyagama. Sugarcane productivity was higher in irrigated than in rainfed areas. In the two major banana growing areas of Sooriyawewa and Kiriibbanwewa, the higher productivity was found in Sooriyawewa. The highest gross value of production (GVP) was estimated for Ridiyagama, followed by Sevanagala irrigated and Sooriyawewa. The lowest GVP was found in the Extension area.

Table 7.4 Basic characteristics of agriculture and profitability of crop production

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All
Average Farm Size (ha)	0.98	1.59	1.21	0.83	1.38	1.31	1.05	1.46
Percentage Area irrigated	77.0	1.3	53.0	67.0	12.0	60.0	65.0	7.9
Cropping Intensity (percent)	137	152	89	90	77	148	113	104
Land productivity of major crops (kg/ha)								
- Rice	5876	-	4445	5210	4091	4880	5103	4091
- Sugarcane	72224	54138	-				72224	54138
- Banana	8284	-	4717	5164	-	8264	5406	-
Gross value of production per hectare	59480	44049	45213	54593	34713	60304	55078	38184
Four major problems in agriculture (% reporting)								
1. Shortage of water	53	63	44	61	61	8	44	62
2. Marketing problems	22	22	38	22	32	51	32	28
3. Pest & disease damage	24	3	30	17	29	45	27	19
4. Wild animal damage.	38	62	3	10	69	0.7	13	66

Shortage of water is the major problem in all strata except Ridiyagama, reflecting the current situation in the area. The ongoing rehabilitation activity, together with the drought experienced in the Uda Walawe area in 2000-2001, has resulted in water shortages in all areas, particularly in the Sooriyawewa area. Marketing was the second most prevalent problem, the most affected being Ridiyagama, where more than 50 percent of the households reported this problem. The third most commonly reported problem was pest and disease damage and this problem was most reported in Ridiyagama and Kiriibbanwewa. The fourth most commonly reported problem was damage by wild life. This problem was prevalent in the rainfed areas, particularly in the Extension and Sevanagala rainfed areas and to some extent in the Sevanagala irrigated areas. Most damage is done by wild elephants, which prefer sugarcane and other field crops grown in the rainfed areas to paddy.

Table 7.4 presents estimates of cost of crop production in the two seasons. The highest cost of production in Maha was in Sevanagala irrigated and the lowest in Sevanagala rainfed area. The major cost components are chemicals, fertilizer and labor. In Yala, the lowest cost of production was in the Extension area, and the next lowest in Ridiyagama. The highest cost of production was in Sevanagala irrigated area followed by Sooriyawewa.

Table 7.5 Cost of Crop Production

Cost of production – Maha and Yala	Sevanagala Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	All
Maha									
Total cost of Production / ha	22626	12388	17171	16222	21425	19007	18556	18137	18476
Yala									
Total cost of Production / ha	30663	12638	15317	16209	1418	10658	18331	5522	15872

Note: Cost of production includes only cash costs incurred, and excludes imputed value of costs incurred in kind.

Family labor forms a major component of labor use in the area. Generally, about half to two thirds of the labor used is family labor. The total labor use in the Extension area was the highest in Maha and the lowest in Yala. In addition, family labor accounted for over 85 percent of labor used in the Maha season and 64 percent in the Yala season in the Extension area. These farmers thus exhibit risk averse behavior, attempting to maximize production by making full use of the wet season, and avoid or reduce investments in the dry season, where the chances of success are less. In irrigated areas, during the Maha season, about 30 percent of the labor used (68 person days/ha) is hired but in rainfed areas only 10-12 percent of the labor (40 person days/ha) is hired. In the Yala season, although the proportion of labor hired is higher in rainfed areas, as compared to irrigated areas, the absolute numbers are higher in irrigated areas (42 person days/ha) than rainfed areas (16 person days/ha). Total labor use in irrigated areas is much higher than in rainfed areas. This suggests that irrigated cultivation provides more employment opportunities and therefore provides beneficial externalities to the population in the area. In Maha season, male hired labor accounted for more than 60 percent of total labor hired. The highest was 80 percent in the Sevanagala area and the lowest 61 percent in the Extension area. In the Yala season, male hired labor accounted for over 80 percent of total labor in all strata except Kiriibbanwewa. A similar situation can be seen in the case of family labor as well. Thus hired labor is predominantly male in all strata. Child labor use is negligible in all strata.

Table 7.6 Employment status of sample households

	Sevanagala Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension	Ridiyagama	Irrigated	Rainfed	Farm	Non farm	All
Total hired male labor-Maha (days/ha)	49.8	29.0	58.2	52.5	25.3	38.5	50.1	26.7	49.7	23.4	45.6
Total hired female labor-Maha (days/ha)	11.7	6.4	32.5	14.0	16.2	15.8	17.9	12.6	17.9	11.4	16.9
Total hired child labor-Maha (days/ha)	0.47	0.70	0.27	0.70	0.33	0.00	0.40	0.45	0.48	0.07	0.41
Total family male labor-Maha (days/ha)	113.9	40.0	147.2	135.1	250.4	93.2	123.8	173.9	139.4	101.0	133.4
Total family female labor-Maha (days/ha)	31.2	14.8	67.0	52.4	135.8	41.9	48.3	91.8	55.2	64.6	56.6
Total family child labor-Maha (days/ha)	0.45	0.62	2.03	4.12	7.74	0.48	0.01	5.15	3.09	0.06	2.62
Total	207.52	91.52	307.2	258.82	435.77	189.88	240.51	310.6	265.77	200.53	255.53
Total hired male labor-Yala (days/ha)	58.1	31.3	24.3	28.5	3.9	18.2	32.7	13.8	32.5	10.3	29.0
Total hired female labor-Yala (days/ha)	10.6	4.1	9.1	12.0	1.2	6.4	9.8	2.3	9.2	3.7	8.3
Total hired child labor-Yala (days/ha)	0.12	0.0	0.03	0.13	1.22	0.13	0.11	0.00	0.07	0.18	0.09
Total family male labor-Yala (days/ha)	130.2	35.6	136.1	221.3	16.1	60.2	146.2	23.2	133.5	62.2	122.3
Total family female labor-Yala (days/ha)	10.8	3.1	33.1	75.4	2.5	12.6	37.1	2.7	31.9	22.1	30.4
Total family child labor-Yala (days/ha)	0.48	0.05	1.22	2.47	0.14	0.61	1.32	0.11	1.12	0.85	1.08
Total	210.3	74.15	203.85	339.8	25.06	98.14	227.23	42.11	208.29	99.33	191.17

Labor use was the lowest in Sevangala rainfed area in Maha and was quite low in Yala season. This is probably because rainfed sugarcane cultivation requires little attention once the crop is planted. The highest labor requirement in this area is during the harvesting period. During the rest of the period, the requirements are relatively low. In the Sevangala irrigated area where sugarcane as well as paddy and some banana are grown under irrigation, the labor requirements are considerably higher than the Sevanagala rainfed areas. The labor use in Ridiyagama is relatively lower than Sooriyawewa and Kiriibbanwewa. This may be because of the higher labor requirement for mixed type of cropping in the latter two strata, and relatively lower requirement for labor for paddy which is the main crop in Ridiyagama. Annual labor use in the irrigated areas was about 30 percent higher than in the rainfed areas. It should be noted that a large number of people from the Extension area go for labor work, especially during harvesting periods, to the neighboring irrigated areas such as Sooriyawewa.

Average wage rates in the study area are provided in Table 7.7. The highest wage rates are found in the both Sevanagala irrigated and rainfed areas, reflecting the high demand for labor for sugarcane harvesting. However, the wage rate differentials across strata are not large. The difference between the highest and lowest wage rates was below Rs 50. The wage rates in the Extension area are the lowest. Overall, the wage rates in irrigated areas are higher than in rainfed (Extension) areas.

Table:7.7 Average wage rates by strata (Rs/day)

	Average wage rate per day (Rs.)
Sevanagala-Irrigated	202
Sevanagala-Rainfed	220
Kiriibbanwewa	195
Sooriyawewa	186
Extension Area	173
Ridiyagama	196
Irrigated all	194
Rainfed all	190
Farmers	191
Non-farmers	204
All	193

The structure of household income shows that in the Sevanagala irrigated area, the bulk of the income is obtained from non-rice crops, other non-agricultural income and from paddy. In the Sevanagala rainfed areas, about 70 percent of the income is derived from non-rice crops, showing a high dependence on sugarcane. In Kiriibbanwewa, the bulk of the income is obtained from rice, non rice crops and other non agricultural income. In Sooriyawewa, the largest proportion of income is derived from non-agricultural income, followed by non rice crops, mostly banana and rice. In the Extension area, the bulk of the income (51 percent) is from other non-agricultural income activities, followed by non rice crops. In Ridiyagama, the major share of income is from rice (54 percent), followed by other non agricultural income (23 percent), and non-rice crops (10 percent). The pattern of income share reflects the cropping patterns and pattern of wage employment as well as income from non-agricultural sources, which provides a substantial part of the income in all cases. Thus, the majority of households supplement their agricultural incomes with incomes earned from non-agricultural sources.

Table 7.8 Structure of household income

	Rice	Non-Rice crops	Non crop farm	Wage agriculture	Wage non agriculture	Other
Sevanagala-Irrigated						
Proportion of households receiving income from	0.37	0.66	0.12	0.07	0.17	0.57
Share of income (%)	8.09	55.0	2.47	2.0	6.14	20.35
Income in US$ per HH	49	722	15	12	26	47
Sevanagala-Rainfed						
Proportion of households receiving income from	0.01	0.72	0.15	0.08	0.17	0.37
Share of income (%)	1.67	70.0	4.59	1.25	5.32	8.55
Income in US$ per HH	0.5	1148	10	8	25	45
Kiriibbanwewa						
Proportion of households receiving income from	0.56	0.42	0.06	0.04	0.06	0.57
Share of income (%)	37.75	23.55	1.86	1.13	2.24	25.52
Income in US$ per HH	131	107	7	7	9	38
Soorivawewa						
Proportion of households receiving income from	0.45	0.62	0.11	0.04	0.09	0.83
Share of income (%)	23.22	30.43	2.61	1.32	4.54	33.94
Income in US$ per HH	96	178	11	7	17	62
Extension Area						
Proportion of households receiving income from	0.10	0.61	0.26	0.02	0.08	0.95
Share of income (%)	4.35	32.35	7.32	0.65	2.84	50.58
Income in US$ per HH	19	143	28	3	12	97
Ridiyagama						
Proportion of households receiving income from	0.79	0.25	0.10	0.04	0.29	0.74
Share of income (%)	53.68	9.49	2.34	0.60	8.85	23.0
Income in US$ per HH	561	167	29	5	36	86
Irrigated - all						
Proportion of households receiving income from	0.53	0.51	0.10	0.05	0.14	0.69
Share of income (%)	29.16	30.43	2.36	1.29	5.33	26.52
Income in US$ per HH	190	291	15	8	22	58
Rainfed - all						
Proportion of households receiving income from	0.07	0.65	0.22	0.04	0.12	0.74
Share of income (%)	3.37	45.0	6.33	0.87	3.74	35.30
Income in US$ per HH	12	509	22	5	17	78
All						
Proportion of households receiving income from	0.44	0.53	0.12	0.05	0.13	0.70
Share of income (%)	24.20	33.22	3.12	1.21	5.03	28.21
Income in US$ per HH	156	333	16	7	21	62

Chapter 8

Estimates of Household Incomes and Expenditures: Distribution Patterns and Inequality

This chapter provides estimates of incomes and expenditures, inequality and distribution patterns, and information on household borrowings across strata. Incomes and expenditures were estimated from primary data obtained through the household level surveys. In arriving at total household incomes, the following income components were estimated: crop income, non-crop farm income, wage income from primary and secondary occupations of all working members of the household, and income from other sources.

Crop income comprises of net income from all crop production activities. In deriving gross crop income, entire farm production (including amounts kept for home consumption) was valued at prices at which produce was sold by the household. If the produce was not sold or kept for home consumption, average prices estimated using prices reported by the respondents, were used in valuing the produce. Total cost was deducted from the gross value of output to determine net incomes from crop production. Cost of inputs not purchased by the farmer (particularly family labor) was excluded in calculating total cost of production. Net income from all crops cultivated (paddy, sugarcane, banana, chillies and onions and five other crops) were included in the crop income. Non-crop farm income included income from livestock and livestock products (gross income) and income from rental of agricultural assets. Wage income included income from wage earnings obtained from primary and secondary occupations of all working members of the household who worked outside of their own farms. Other income includes income from self employment activities (gross income), income transfers from government and private sector, relatives, and friends, income from interest, lotteries, and gifts, etc.

These four components comprised the total income. In determining income for each month, the following procedure was adopted. Income from paddy and other field crops was allocated as follows: Net crop income from paddy and other field crops in Maha cultivation season was divided equally among the months of March, April and May. Net income from the same crops in the Yala season was divided equally between the months of August and September. Net crop income from banana and sugarcane in Maha season was divided equally among the six months October to March and that from Yala divided equally among the four months from June to September. Data on income from agricultural assets and livestock, wage and other income was gathered on a monthly/seasonal basis. For the first survey, data were gathered for eight months preceding the survey, for the second survey data were gathered for the preceding five months, and for the third survey data were gathered for the preceding six months. Consequently there was double counting of income from sources other than crops. Thus it was decided to divide the total non-crop income from the first survey by eight to obtain monthly values and allocate these monthly income values for six months from October to March. For the second survey, for which data were collected for five months, total non crop incomes was divided by five and the monthly values allocated for the two months of April and May. Total non-crop income data from the third survey, which were collected

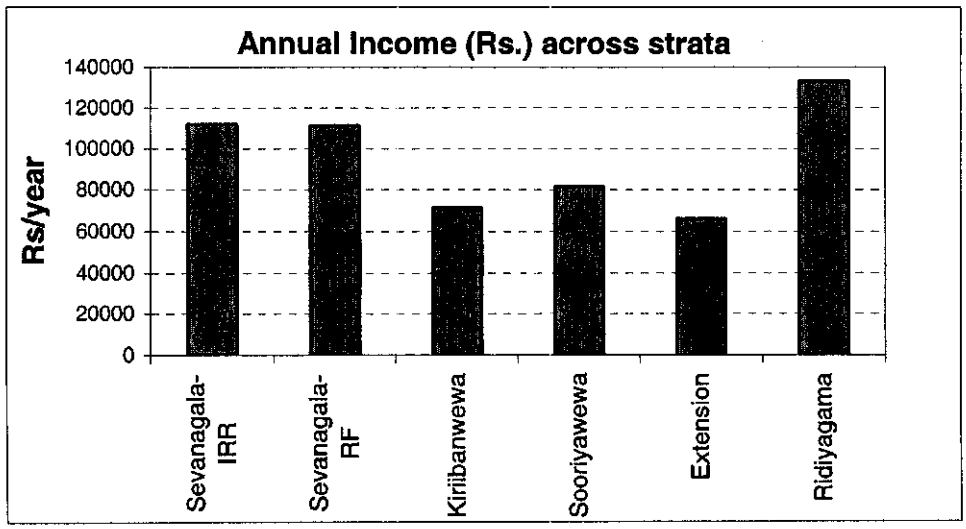
for a six-month period, were divided by six and the monthly value allocated to the four months of June to September. By adopting this procedure, double counting of income was avoided. In the case of expenditure, data were gathered on a monthly basis for each category of expenditure (food, non-food and other). In the first survey, expenditure data were obtained for each of the months from October to March separately, in the second survey for the months of May and June and in the third survey from July to September, thus avoiding any double counting.

Table 8.1 provides estimates of average annual and monthly incomes by strata. Average annual incomes are highest for Ridiyagama (Rs. 132945), followed by Sevanagala irrigated and rainfed, and the lowest for Extension area (Rs. 66080). While the levels of incomes vary significantly across strata, patterns of income distribution across months is fairly similar. Except in Sevanagala area, income levels are lower from October through to February, increasing in March and April (Maha harvesting months), decreasing during May and June, and increasing again in August and September (Yala harvesting months).

Table 8.1 Estimates of average monthly incomes across strata.

Monthly Income (Rs.)	Sevanagala Irrigated	Sevanagala Rainfed	Kiribban Wewa	Sooriya Wewa	Extension	Ridiyagama	Irrigated	Rainfed	Farmers	Non-farmers	All
No of Obs	167	60	151	229	105	146	693	165	724	134	858
October	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
November	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
December	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
January	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
February	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
March	8061	6753	6625	6628	9090	15965	8940	8240	9268	6308	8805
April	6583	3958	6167	5680	9597	16669	8319	7546	8551	6110	8170
May	6583	3958	6167	5680	9597	16669	8319	7546	8551	6110	8170
June	11737	15504	4660	4715	3847	7262	6932	8086	7597	4761	7154
July	11737	15504	4660	4715	3847	7262	6932	8086	7597	4761	7154
August	15622	16043	11124	12926	4713	19957	14664	8833	14621	7716	13543
September	15622	16043	11124	12926	4713	19957	14664	8833	14621	7716	13543
Ave monthly income	9338	9273	5934	6794	5507	11079	8122	6876	8318	5531	7883
Annual income	112062	111281	71202	81523	66080	132945	97467	82517	99814	66377	94592

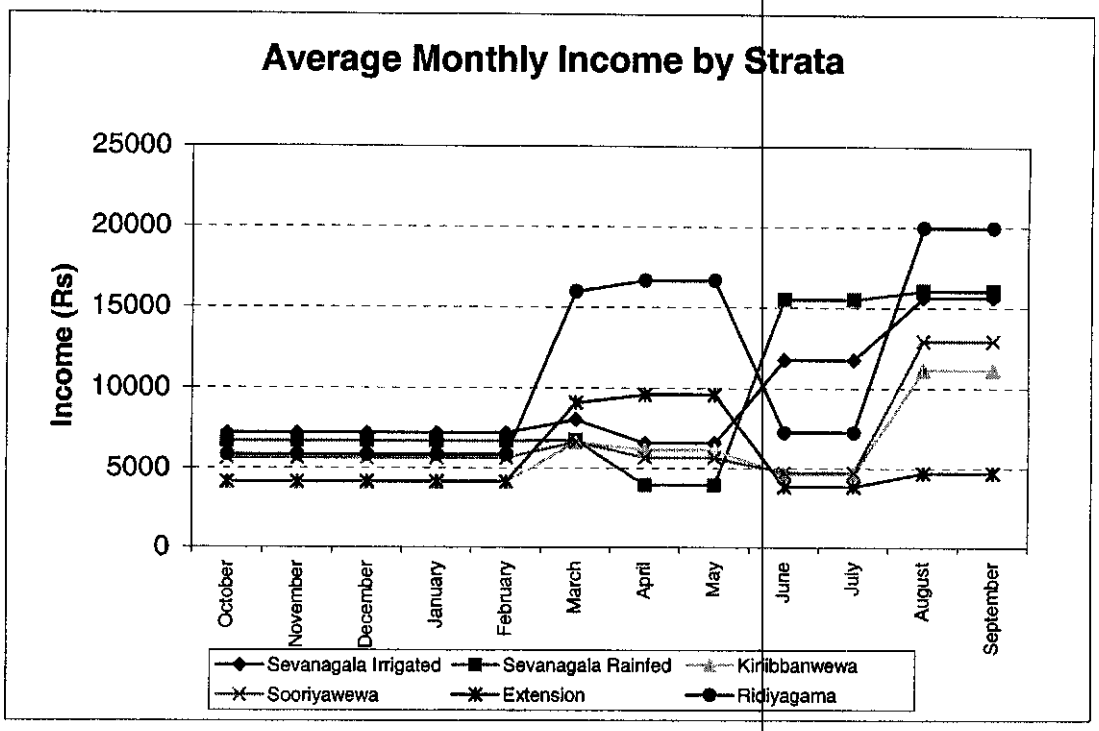
Figure 8.0. Household annual income across strata



Monthly income patterns are different in the Sevanagala areas because of differences in cropping patterns. For households in the Extension area, and for non-farm households, June and July are the most difficult months in terms of lowest incomes. The highest monthly average incomes are received in Ridiyagama followed by the two strata in Sevanagala, in August and September. Relatively lower incomes during Maha months is due to drought conditions experienced during this season.

The monthly income patterns shown in Figure 8.1 are similar across strata, except Ridiyagama and Extension area. Income peaks are observed in August and September and in June and July for Sevanagala (both rainfed and irrigated). However, income in other months from October to May is steady and at a reasonably high level, indicating income from harvest of sugarcane, which is not seasonal. In the Extension area income peaks are observed in March, April and May. In Ridiyagama, income peaks are observed in March, April and May and again in August and September, when the highest levels are reached, coinciding with the harvest from Maha and Yala seasons. In Sooriyawewa and Kiriibbanwewa on the other hand, peaks are observed only in August and September, coinciding with Yala harvest, suggesting that low incomes were obtained during Maha season. This is peculiar to the year in which the survey was done, when water shortages were observed in Maha in these two strata and there was restricted cultivation due to the ongoing rehabilitation in these two areas.

Figure 8.1 Average Monthly Income Patterns by Strata



Decomposition of average monthly income into various components suggest that, on overall bases, monthly farm income contributes around 48 percent of the total income, which is almost equal to the income contribution from non-farm sources. Transfer income (assistance from government, relatives etc) contributes around 4 percent to the household average monthly income. However, there are significant differences across various strata, particularly between irrigated strata and the extension area. In the extension strata, household farm income and non-farm income contribute 34 percent and 55 percent, respectively, with transfer income contributing 11 percent. Similarly, for non-farmers, non-farm income constitute a large part of the total income (around 70 percent).

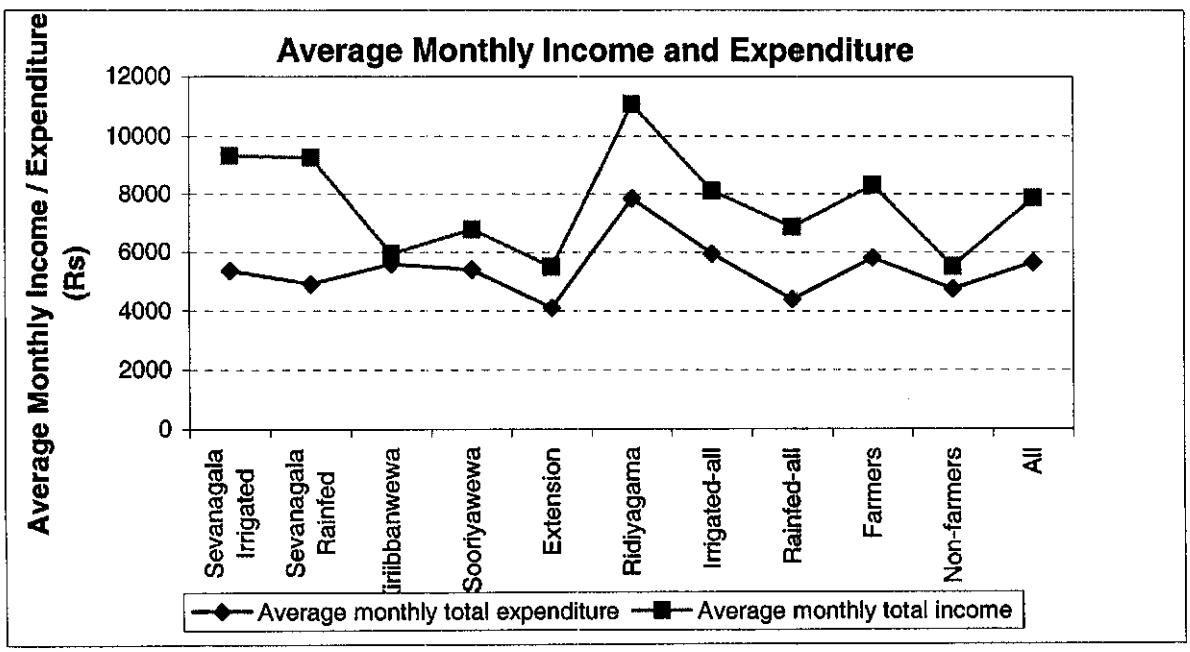
Farm income was low between October and February and increased sharply in March and remained more or less at this or a slightly lower level between March and May in all except the Sevanagala rainfed and irrigated strata. In the latter two strata, farm income remained high between October and March and fell considerably in April and May and increased sharply in June and July and increased even further in August and September. This was probably due to regular income being received from the regular harvesting of sugar cane throughout most of the year and the harvesting of paddy during this period in the case of Sevanagala irrigated area.

In the Extension area, farm incomes were low between October and February, but increased sharply between March and May, dropped sharply in June and July and improved slightly

over the next two months. High farm incomes were obtained in this area only between March and April. This was probably due to high reliance on the Maha season for any farm income in this area as mostly there is no Yala cultivation in this area. Thus the bulk of the farm income was obtained during the period from March to May, soon after the Maha season harvest (for more details, see income decomposition in Appendix A of this report).

Average monthly income and expenditure patterns are shown in Figure 8.2. The graph illustrates the differing patterns of average monthly income and expenditure in the various strata. Relatively larger surpluses of income over expenditure can be observed in the Sevanagala and in Ridiyagama. Surplus can also be observed in the irrigated and rainfed strata. A comparison between farm and non-farm households shows that surplus of income over expenditure is higher for farm than for non-farm households. Overall, monthly average incomes are higher than monthly average expenditures in all strata. The levels of incomes are also high in the Sevanagala, irrigated and rainfed strata, Ridiyagama and in the irrigated and Farm categories. Irrigated and farm households have higher incomes and larger surpluses over expenditure compared to the Extension area and compared to non-farm households, suggesting greater benefits from irrigation infrastructure and from farming activities.

Figure 8.2 Average Monthly Income and Expenditure Patterns



In the Sevanagala areas, income is always above expenditure in all months except in April for Sevanagala irrigated and April and May in the case of Sevanagala rainfed. From June to September, the income is very much above expenditure in both cases. In Kiribbanwewa and Sooriyawewa the income and expenditure patterns are similar to Sevanagala (See Appendix).The monthly income and expenditure patterns differ somewhat in the case of the Extension area and Ridiyagama. In the Extension area, the incomes are above expenditure in

the months of March, April and May and slightly above expenditure in August and September. In the other months, income and expenditure more or less coincide with each other. In Ridiyagama, the pattern is similar to the Extension area except that incomes are substantially higher than expenditures both during the period March to May and August to September. In the rest of the months income and expenditure coincide. Figures 8.3 and 8.4 show monthly income and expenditure patterns in irrigated and rainfed areas. In the irrigated areas income is higher than expenditure in March and substantially higher in August and September. In the other months expenditure and income more or less coincide. In the rainfed area, income is higher in March and from May to September. In the other months income is marginally above or equal to expenditure.

Figure 8.3 Monthly Income and Expenditure – Irrigated areas

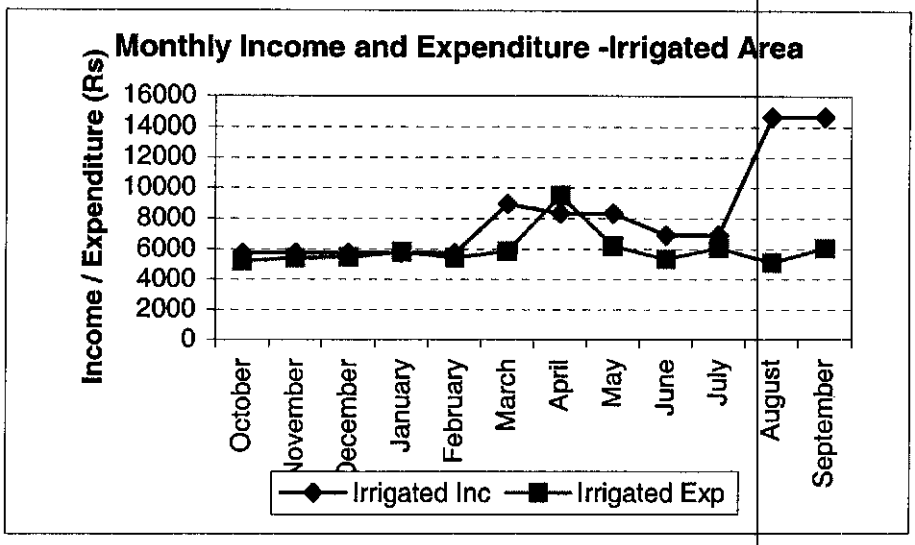
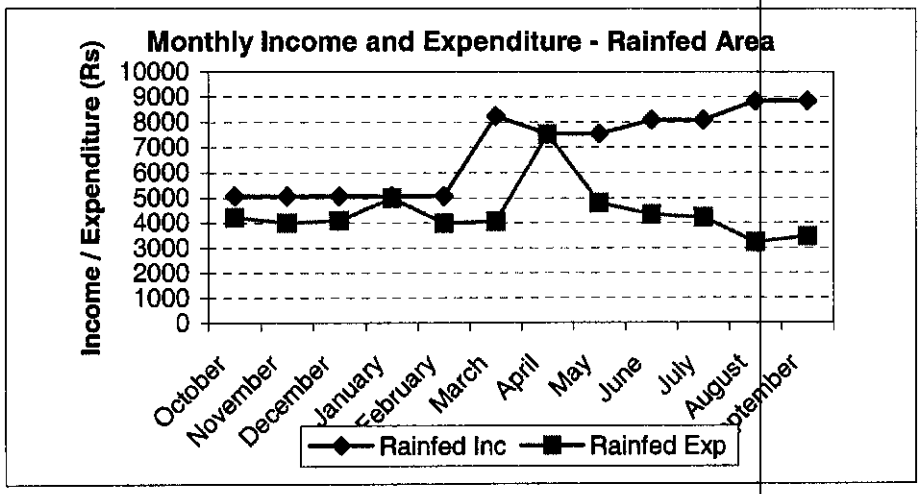


Figure 8.4 Monthly Income and Expenditure - Rainfed



However, the income levels are higher in the irrigated areas compared to the rainfed areas. The maximum monthly income is around Rs. 15000 in the irrigated area and Rs. 8500 in the rainfed areas. The above implies that in irrigated areas, surpluses of income over expenditure coincided with the Yala harvest months. In the rainfed areas, surpluses of income over expenditure were observed in most months, indicating that households in rainfed areas were more dependent on non-crop and wage incomes for their livelihoods. Figures 8.5 and 8.6 depict monthly incomes and expenditures for farm and non-farm households. For farm households, surpluses of income over expenditure can be observed in March and from May to September. In non-farm households income was above expenditure only in March, August and September i.e. crop harvesting months. In other months income and expenditure were more or less equal. However, the highest levels of income for non-farm households was almost half that of farm households.

Figure 8.5 Monthly Income and Expenditure - Farm

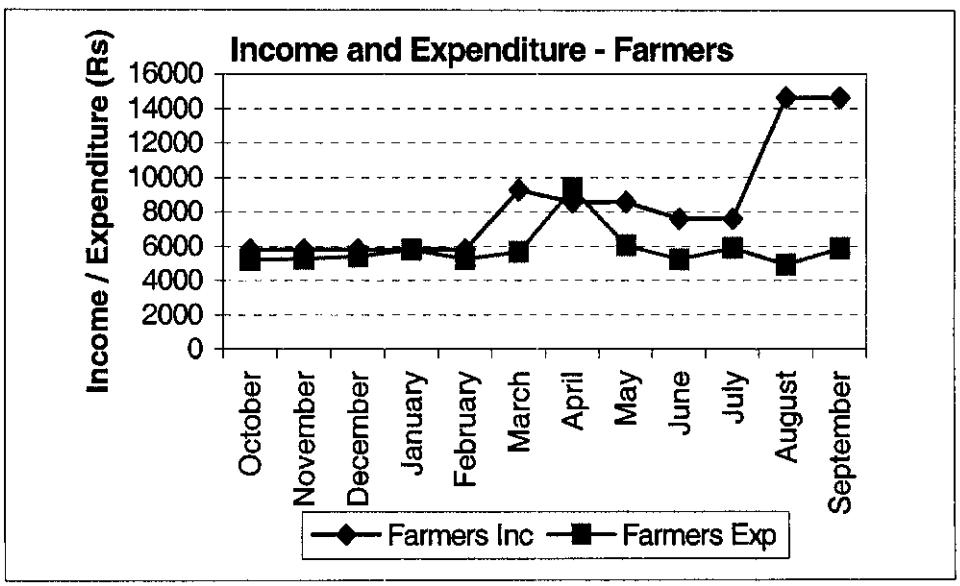


Figure 8.6 Monthly Income and Expenditure – Non Farm

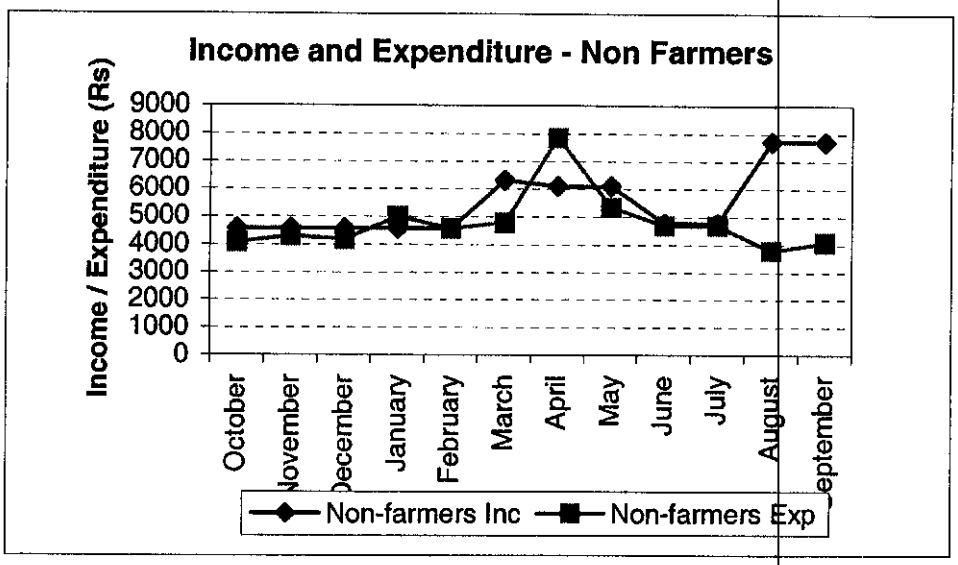


Table 8.2 Monthly expenditure patterns by strata.

Monthly Expenditure (Rs)	Sevanagala Irrigated	Sevanagala Rainfed	Kiriibban Wewa	Sooriya Wewa	Extension	Ridiyagama	Irrigated	Rainfed	Farmers	Non-farmers	All
No. of obs	167	60	151	229	105	146	693	165	724	134	858
October	4599	5039	4752	4653	3743	7292	5218	4214	5202	4066	5025
November	4656	4522	4958	4950	3712	7420	5401	4006	5286	4308	5133
December	5039	4536	5404	4717	3855	7267	5481	4103	5409	4175	5216
January	5107	5014	5339	5549	4990	7511	5810	4999	5776	4997	5654
February	4534	4173	4971	4863	3883	7764	5418	3988	5250	4567	5143
March	4830	4555	5616	4962	3766	8718	5864	4053	5650	4789	5516
April	8641	8349	9151	8455	7023	12504	9505	7505	9355	7851	9120
May	5482	5534	5838	5874	4366	7892	6197	4791	6036	5334	5927
June	5030	3995	4817	4745	4527	7186	5344	4334	5235	4691	5150
July	5673	4111	5993	5390	4277	7605	6057	4217	5891	4687	5703
August	4968	4208	4585	5063	2664	5851	5102	3225	4917	3792	4741
September	5801	4987	5820	5685	2592	7272	6077	3463	5850	4085	5574
Annual expenditure	64360	59024	67243	64907	49398	94283	71473	52898	69856	57341	67901

Figure 8.7a Monthly expenditure patterns

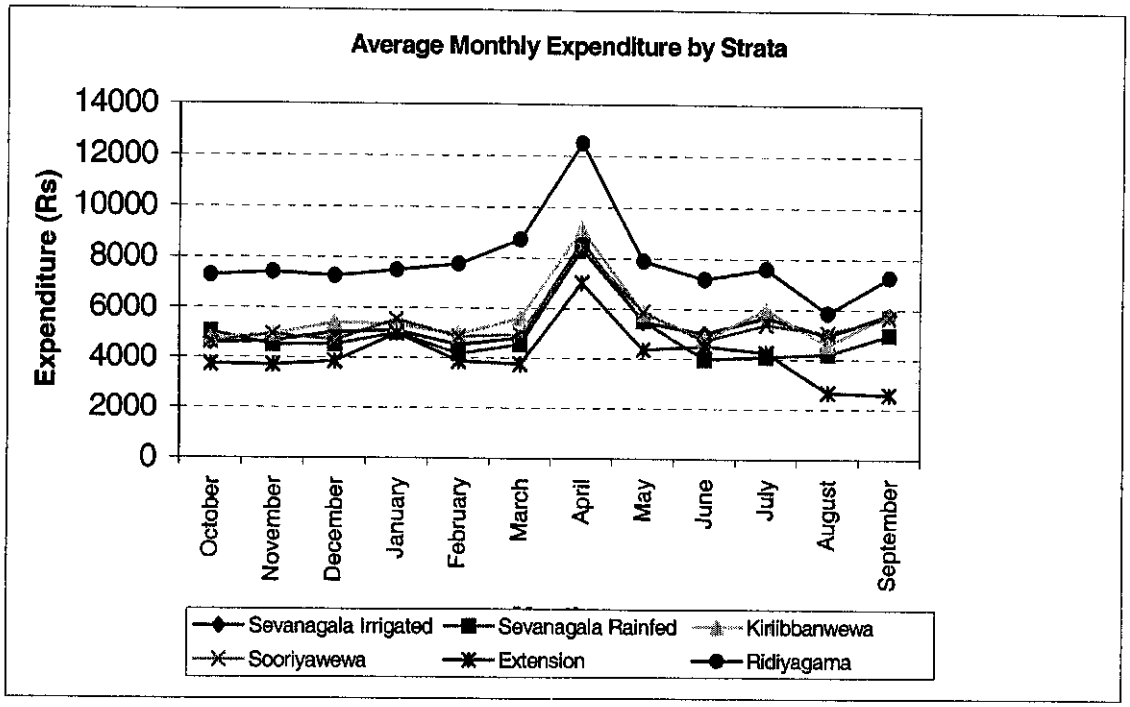
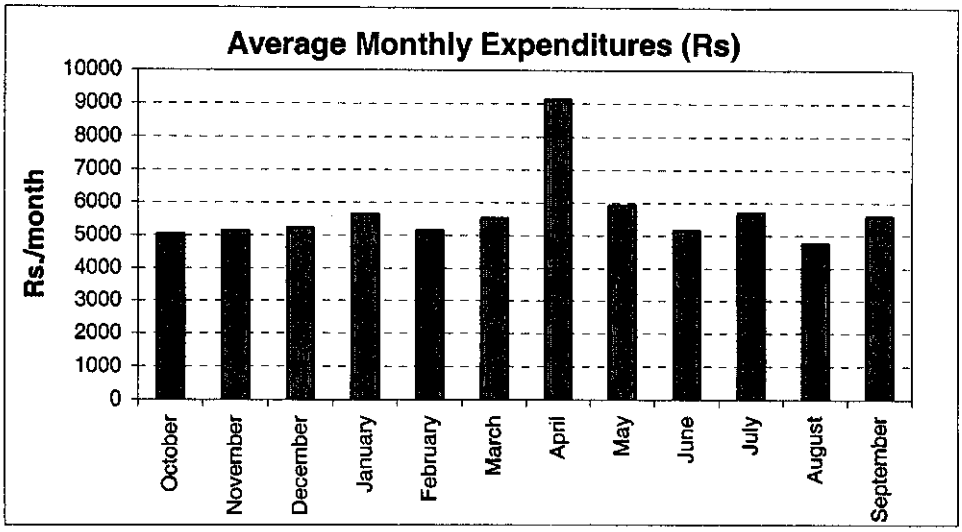


Figure 8.7b Monthly expenditures by strata (Rs.)



Data in table 8.2 and figure 8.7a show that monthly expenditure patterns are similar across strata. However, the level of expenditures varies significantly, with highest level of expenditures found in Ridiyagama, and the lowest in Extension area. Average annual expenditures in Ridiyagama and Extension are estimated at Rs 94283 and Rs. 49398 respectively. In general, annual expenditures are higher for households in irrigated areas (Rs

71473) compared to rainfed areas (Rs 52898), higher for farm households (Rs69856) compared to non-farm households (57341). It is clear from figure 7.8b that average monthly household expenditures are fairly similar across households for all months except, April. The high expenditure in April is due to the Sinhala New Year which is also month after Maha harvest.

Figure 8.8: Average Monthly Expenditure by Category of Expenditure

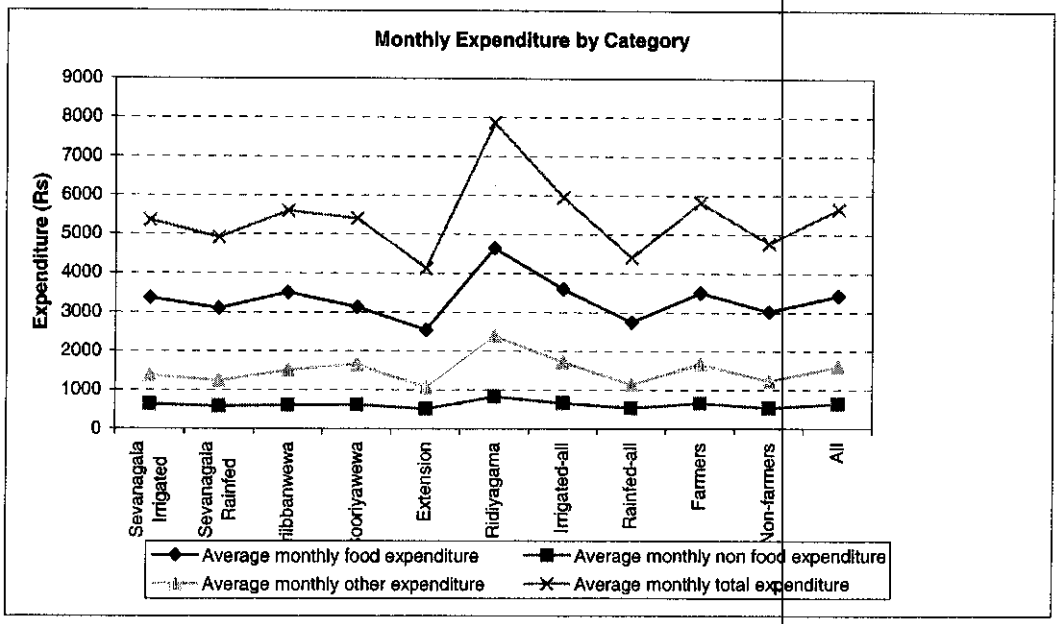


Figure 8.8 shows average monthly expenditures by major expenditure categories: Food expenditure, non-food expenditure, other expenditure and total expenditure. As is clear from the figure, food expenditure forms the major component of total expenditure in all strata, followed by other expenditure category which includes expenditures on clothing and shoes, health, recreation and so on. Expenditure on non-food items (such as Tobacco and cigarettes, soap and shampoo, electric charge, expense for firewood, cooking fuel and LP gas, lighting fuel) is fairly similar across all strata, and constitute a relatively smaller part of the total household expenditure. Overall, monthly expenditures are highest in Ridiyagama and lowest in Extension area.

Regarding monthly distribution of expenditure, the highest expenditure on food was in April for all strata and the lowest was in September for all strata, except for Sevanagala rainfed area. The highest expenditure in April coincides with the New Year celebrations. The lower expenditures on food in August and September is probably due to lower incomes during this period. The Yala harvest comes in September, and a rise in food expenditure is observed in October in all cases. The pattern of food expenditure is the same for rainfed and irrigated farms as well as farm and non farm households. The food expenditure remains more or less constant from October up to March and then rises sharply in April and drops down to previous levels in May and June and drops further down in August and September. The

patterns of monthly non food expenditure shows three peaks, in January, April and September. The highest peak being in April followed by September and January. This pattern was observed in the case of all strata and categories. The highest expenditure level for all months was observed in Ridiyagama. In the case of all other strata, the levels were very similar except in August and September. The higher non-food expenditure in January, April and September is due to additional expenses related to start of school year (January), new year holidays and beginning of Yala cultivation (April) and beginning of Maha cultivation (September).

Estimates of annual and monthly food expenditures are presented in Table 8.3. An analysis of annual food expenditure shows that farm households and those in irrigated areas have the highest food expenditures. On an average farm households spent 15 percent more than non-farm households and irrigated area households spent 25 percent more than rainfed area households. Across strata, the highest amount of food expenditure was in Ridiyagama followed by Kiriibbanwewa, and Sevangala irrigated area. Annual food expenditure was the lowest in the Extension area, and was only 55 percent of that in Ridiyagama. Highest expenditure on food was estimated in the month of April in all strata, coinciding with the local Sinhala New Year festivities. The lowest expenditure on food was estimated in the months of August and September in strata.

Table 8.3 Monthly food expenditure patterns

Monthly Food Expenditure (Rs)	Sevanagala Irrigated	Sevanagala Rainfed	Kiriibban Wewa	Sooriya Wewa	Extension	Ridiyagama	Irrigated	Rainfed	Farmers	Non-farmers	All
No. of observations	167	60	151	229	105	146	693	165	724	134	858
October	3345	3264	3404	3149	2696	5195	3683	2903	3637	2974	3533
November	3260	3190	3618	3141	2625	5270	3722	2830	3630	3126	3551
December	3271	3188	3585	3145	2635	4833	3627	2836	3550	3066	3475
January	3165	2953	3457	3065	2726	4684	3516	2809	3445	3029	3380
February	3182	2913	3378	3019	2647	5074	3570	2744	3471	3088	3411
March	3386	3070	3648	3131	2645	5207	3743	2799	3643	3119	3561
April	4638	4165	4990	4227	3712	6429	4956	3876	4859	4151	4749
May	3681	3596	3629	3416	2795	4808	3820	3086	3758	3252	3679
June	3428	2466	3434	3098	2784	4067	3455	2668	3370	2945	3304
July	3583	2620	3622	3304	2755	4299	3650	2706	3561	2969	3468
August	2798	2912	2596	2571	1391	3033	2728	1944	2633	2279	2578
September	2563	2835	2584	2350	1167	2855	2559	1773	2442	2219	2408
Annual Food Expenditure	40299	37172	41946	37616	30577	55756	43028	32975	41997	36217	41094

The estimates of annual expenditure by category are presented in Table 8.4. The highest annual expenditure was found in Ridiyagama and the lowest in the Extension area. The next highest expenditure, estimated for Kiriibbanwewa, was about 70 percent of that in

Ridiyagama. Since Ridiyagama is a well established and old system, households have better employment opportunities in non agricultural sectors and relatively better access to credit. Expenditure on Category 1 items was about three times that of Category 2 items. Food expenditure made up over 60 percent of the total expenditure in all strata. The highest proportion of food to total expenditure was observed in the Sevanagala area and the lowest in Sooriyawewa and Ridiyagama.

Table 8.4 Average annual expenditure of sample households by category

Average annual expenditure (Rs)	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
Category 1 items[1]	29919	26347	31771	28423	22545	42695	32520	23928	31425	27859	30868
Category 2 items[2]	10380	10824	10175	9192	8031	13060	10507	9047	10572	8358	10226
Category 3 items[3]	7622	6967	7223	7453	6038	9884	7956	6376	7888	6380	7652
Other items[4]	16439	14885	18073	19838	12783	28642	20489	13548	19971	14744	19154
Average expenditure –total	64360	59024	67243	64907	49398	94283	71473	52898	69856	57341	67901
Ratio of food expenditure to total expenditure	0.63	0.63	0.62	0.58	0.62	0.59	0.60	0.62	0.60	0.63	0.61

[1] Category 1 = value of rice purchased and value of rice consumed from own farm, cereals other than rice, cassava and sweet potato, fish, meat, vegetables, flour, eggs, milk, fruits, bread.
[2] Category 2 = Tea, coffee, milk powder, yogurt, soft drinks, liquor, cooking oil and coconut, sugar, salt, spices
[3] Category 3 = Tobacco and cigarettes, soap and shampoo, electric charge, expense for firewood, cooking fuel and LP gas, lighting fuel

[4]Expenditure on other items include expenditures on clothing and shoes, health, house repairs, recreation etc (details are given in appendix tables).

Income Distribution and Inequality

Estimates of incomes by source are presented in Table 8.5. In all strata except the Sevangala irrigated and Sevanagala rainfed areas, non crop incomes were higher than crop incomes. This was true for the irrigated as well as for the rainfed areas. The highest crop income was recorded in Sevanagala rainfed followed by Sevanagala irrigated and Ridiyagama and the lowest in the Extension area. Non crop income was two and a half times that of crop income in the Extension area, about twice that of crop income in Sooriyawewa, and about one and half times crop income in Kiriibbanwewa and Ridiyagama.

Table 8.5 Source of income of sample households

Income (Rs)	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All
No. of observations	167	60	151	229	105	146	693	165
Average crop income	60085	76791	28251	28502	18245	56850	42031	39534
Average non-crop income	51976	34489	42950	53020	47834	76094	55435	42981
Income from livestock	1038	272	968	1164	3570	7421	2409	2371
Income from Agri-assets	1141	544	1939	774	828	3166	1620	470
Income from wages								
-Wages – agri.work	1084	760	608	658	249	488	714	435
-Wages – non-agri.work	2363	2285	842	1562	1126	3303	1965	1547
Income from other sources	4372	4061	3496	5820	10141	9238	5685	7930
Total Income	112061	111281	71202	81523	66079	132944	97467	82516

The sample households were ranked on the basis of average household income, and income shares of successive groups were estimated in order to see the pattern of income distribution across strata. Furthermore, the Gini coefficients were estimated, and Lorenz curves were developed to understand the extent of household level income inequality across various strata and for farm and non-farm households.

The estimates are presented in Table 8.6. The proportion of income received by the bottom 40 percent, middle 40 percent, top 10 percent and top 5 percent of the households do not vary significantly across strata. For example, the bottom 40 percent of the sample households received between 15-20 percent of the total income. Households in Sooriyawewa, and in Sevanagala rainfed area and non-farm households received a slightly higher proportion of total income. The middle 40 percent of the households received about one third of the total income. It is slightly higher in the Sevanagala rainfed, Sevanagala irrigated and the Extension area. The top 10 percent of the households received between 20 – 29 percent of the total income. The households in the Extension area received the lowest proportion (20 percent) of the total income, suggesting that income distribution may be relatively skewed in rainfed areas. The top 5 percent of the households received between 14-19 percent of the total income. The highest proportion (19 percent) was for Kiriibbanwewa, followed by Ridiyagama (18 percent). Overall, income distribution is only moderately unequal in the area, and there are not significant inter-group differences across various strata.

The estimated value of Gini Coefficient varies from 0.30 to 0.42, with an average value of 0.38, reflecting moderate level of inequality. The lowest estimated Gini coefficient value of 0.30 is for Sevanagala irrigated and the highest value of 0.41 for Sevanagala rainfed, followed by 0.40 for Ridiyagama and 0.39 for Kiriibbanwewa. The high value in Sevanagala rainfed is probably due to variations in income resulting from irregular harvest in the rainfed area. The high value in Ridiyagama, where the highest incomes are received is probably due

to income differences resulting from productivity differences among the farmers and disparities in size of land holdings (land distribution is not uniform in this old scheme). The higher values of 0.42 in rainfed areas and 0.39 in farm households are probably due to variations in income from irregular harvests, and income and productivity differences as well as differences in size of land holdings.

Table 8.6 Income distribution by strata and occupation

Strata	Bottom 40%	Middle 40%	Top10%	Top 5%	Gini Coefficient
Sevanagala-Irrigated	0.16	0.37	0.23	0.14	0.30
Sevanagala-Rainfed	0.17	0.38	0.24	0.13	0.41
Kiriibbanwewa	0.15	0.33	0.29	0.19	0.39
Sooriyawewa	0.18	0.33	0.27	0.16	0.35
Extension Area	0.15	0.36	0.20	0.14	0.37
Ridiyagama	0.17	0.33	0.29	0.18	0.40
Irrigated-All	0.15	0.32	0.27	0.17	0.37
Rainfed-All	0.15	0.33	0.27	0.16	0.42
Farmers	0.15	0.33	0.27	0.16	0.39
Non-Farmers	0.20	0.34	0.26	0.17	0.31
All	0.15	0.32	0.28	0.17	0.38

Income distribution patterns are also compared using Lorenz curves in Figures 8.8 to 8.11. For the entire sample, it is observed that 25 percent of the income is received by 50 percent of the sample population and the remaining 50 percent of the income is received by 75 percent of the population. Thus the top 25 percent of population received the balance 50 percent of the income. A comparison of the Lorenz curves for irrigated and rainfed areas shows only slightly higher inequality levels for rainfed areas. As mentioned earlier, households in the rainfed areas depend mostly on the neighboring irrigated areas for their livelihoods. Fairly similar levels of inequality across the two areas implies that irrigation infrastructure helps in keeping the level of income inequality at moderate levels in rainfed areas as well.

Figure 8.8 Per capita income distribution in all strata

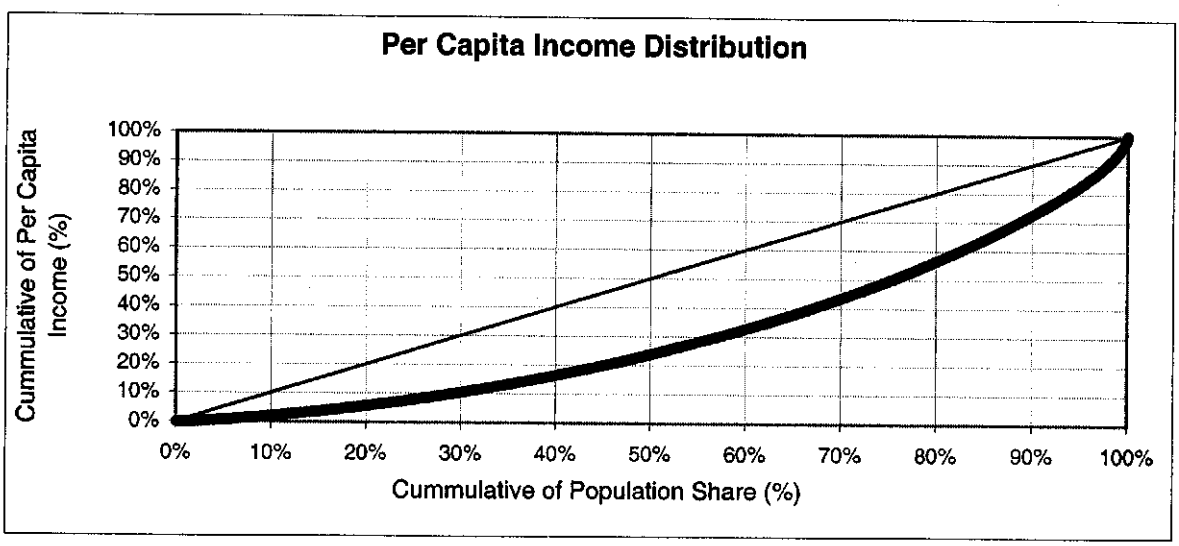


Figure 8.9 Per capita income distribution in irrigated and rainfed areas

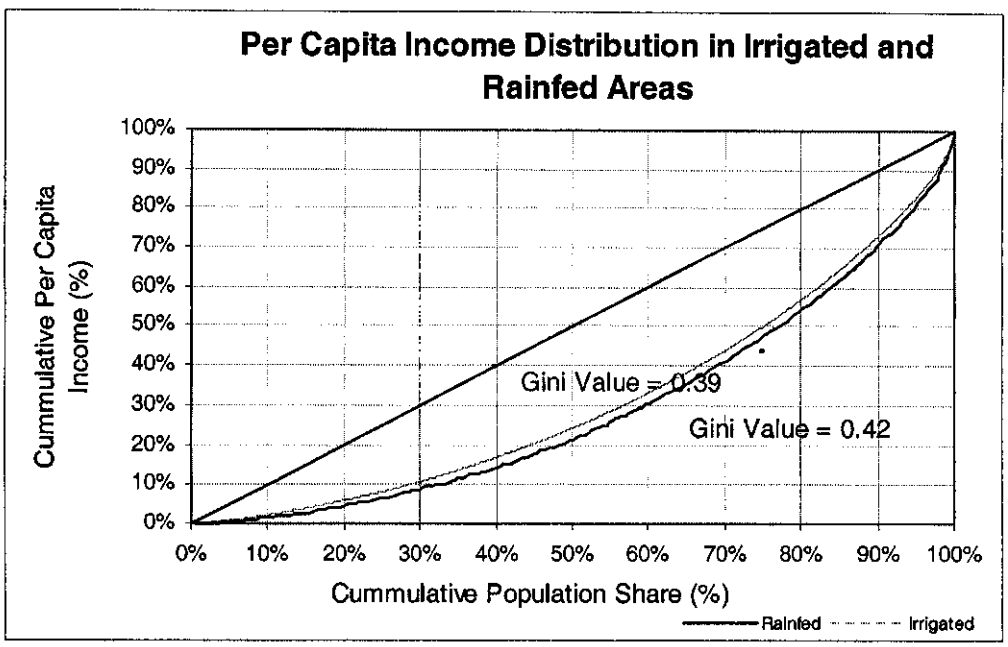
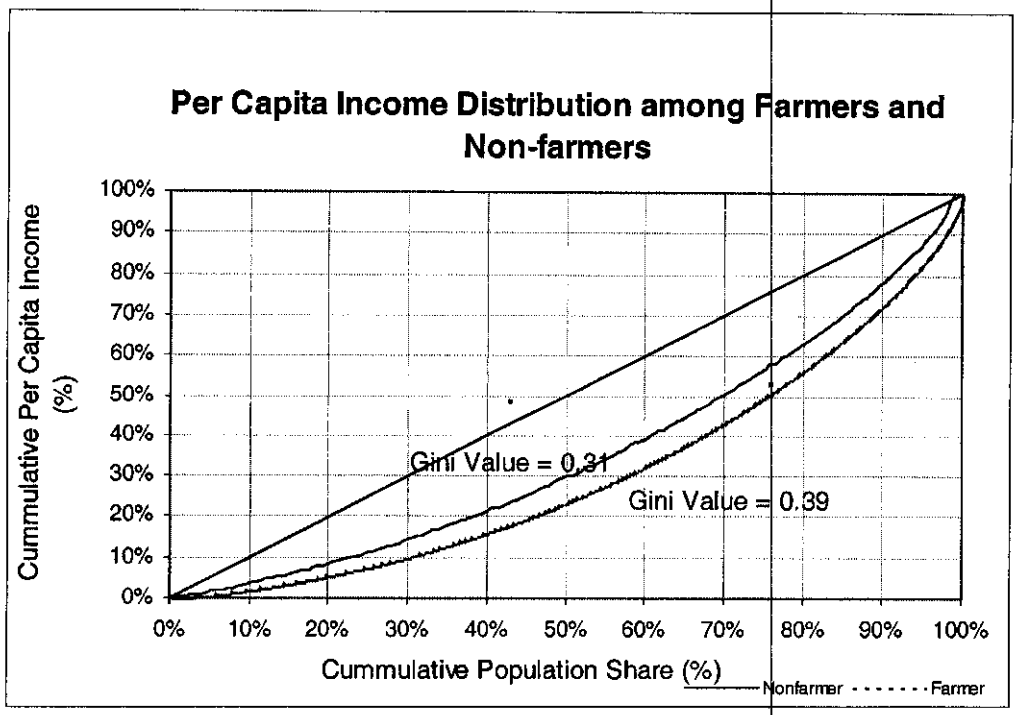


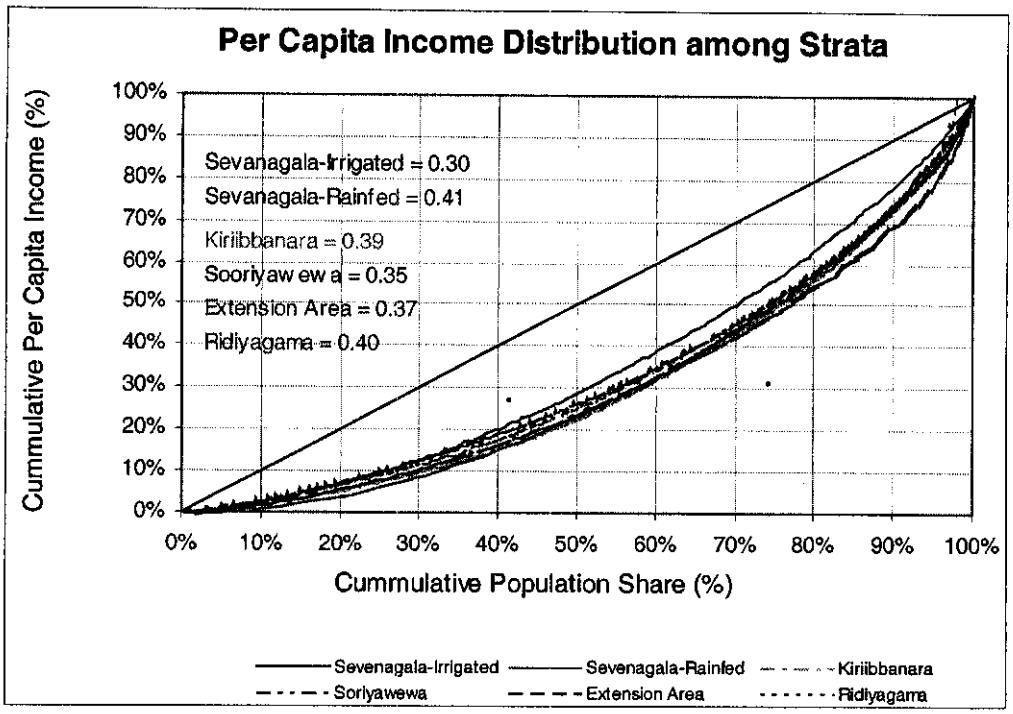
Figure 8.10 Per capita income distribution among farmers and non-farmers



The level of inequality is found to be higher among farm households compared to non-farm households. This appears to be reasonable since farm households receiving higher incomes, compared to non-farm households, also have significant inter-household variations in incomes due to variations in size of landholdings and proportion of land irrigated.

The Lorenz curves for the six strata are depicted in Figure 8.11. Kiriibbanwewa, Sevanagala rainfed and Ridiyagama have relatively higher levels of inequality than the other three strata. Income distribution in Sevanagala irrigated was much more equal than in all other strata. This may be due to uniform land sizes, availability of irrigation water for both Sugarcane and Paddy cultivation, and favorable location of the area at the head end of the reservoir, which has helped to reduce inequality in this area. Although land holdings are uniform in Sevanagala rainfed area, inequality is high. This may be due to productivity differences and irregular harvesting, and the non-availability of land for growing other crops under rainfed conditions. In the Extension area, where inequality is moderate, incomes are lower than other strata and only some households have access to irrigation water (from small tanks). One may conclude that the inequality patterns among the different strata are fairly similar, with differences that exist attributed to land holding, availability of irrigation, and opportunities for diversified cropping.

Figure 8.11 Per capita income distribution among strata



Chapter 9

Dynamics of Poverty

Estimating Chronic and Transient Poverty

Estimates of monetary measures of poverty

Monetary measures of poverty were estimated for each of the strata demarcated in the surveys, and separately for the irrigated and rainfed areas as well as for farm and non-farm households. The head-count index provides an estimate of the number of people living below the poverty line and measures the incidence of poverty. The poverty gap index provides an estimate of the average gap between the income of poor households and the poverty line, and measures the depth of poverty. The poverty gap squared provides estimates of the severity of poverty. Table 9.1 presents estimates of the poverty indices for each strata based on household incomes.

The head count index shows that 12 percent of all the sample households are chronically poor, 69 percent are transient poor and 19 percent are non-poor. Overall, 81 percent of the sample households are found to be poor, with transient poverty being the major contributor to the total poverty in the area.

Table 9.1 Poverty Head Count - Income

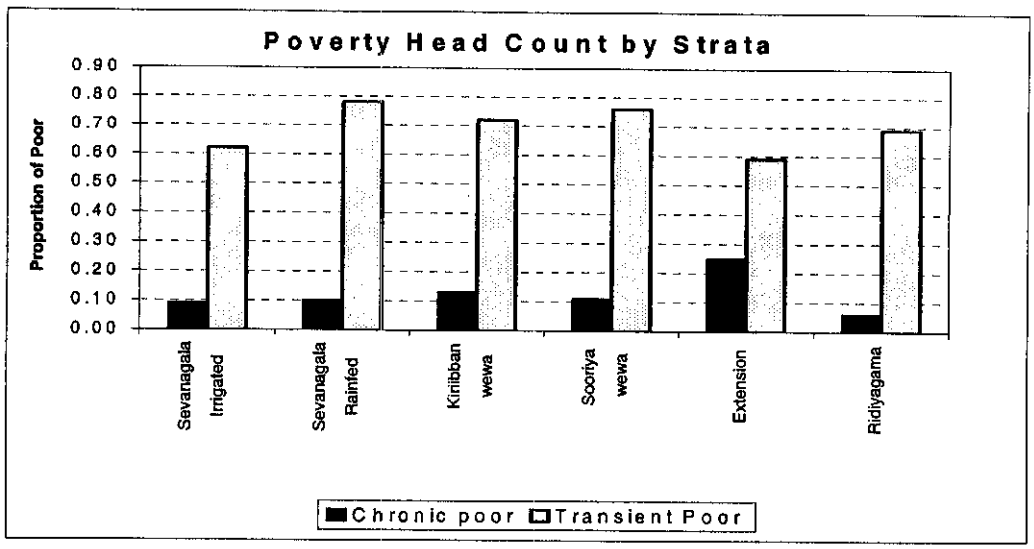
Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	**Extension Area**	Ridiyagama	Irrigated all	Rainfed All	Farm	**Non farm**	All
Head Count (No. of Observations)	167	60	151	229	**105**	146	693	165	724	**134**	858
Total Poverty	0.71	0.88	0.85	0.87	**0.84**	0.75	0.80	0.85	0.82	**0.77**	0.81
- Chronic Poverty	0.09	0.10	0.13	0.11	**0.25**	0.06	0.10	0.19	0.11	**0.16**	0.12
- Transient Poverty	0.62	0.78	0.72	0.76	**0.59**	0.69	0.70	0.66	0.71	**0.61**	0.69
- Non-poor	0.29	0.12	0.15	0.13	**0.16**	0.25	0.20	0.15	0.18	**0.23**	0.19
Poverty Gap											
- Chronic Poverty	0.58	0.58	0.67	0.51	**0.59**	0.50	0.57	0.59	0.61	**0.45**	0.58
- Transient Poverty	0.26	0.35	0.36	0.30	**0.29**	0.29	0.30	0.32	0.31	**0.25**	0.31
Poverty Squared Gap											
- Chronic Poverty	0.45	0.40	0.54	0.36	**0.42**	0.40	0.44	0.41	0.47	**0.30**	0.43
- Transient Poverty	0.19	0.47	0.29	0.21	**0.18**	0.22	0.23	0.31	0.25	**0.17**	0.24

The rainfed Extension area had the highest level of chronic poverty, with a one-fourth of households living below the poverty line throughout the year, and the lowest level of transient poverty, compared to the other strata. On the other hand, the rainfed Sevangala area had a low level of chronic poverty and the highest level of transient poverty. These differences may be due to the differences in the cropping patterns and income sources of the two areas. In the Extension area, the households are more dependent on sources of income other than crops, because of the unreliability of rainfed farming. A significant number of the residents in the Extension area come from outside of the area and are temporarily encroaching on land in the hope of legalizing the encroached plots of land in the area. They do have some other sources of income i.e. they have land and other resources somewhere else.

But there are others who are permanent encroachers, who have no other income opportunities or land elsewhere. They, too, have encroached on these lands in the hope of obtaining legal allotments. Mainly these are the households that form the chronically poor group, that have only limited opportunities for obtaining wage or other employment. The transient poor in this area are those who have lands under small tanks, which can be irrigated at least in one season if the rains do not fail. These households depend on crop incomes that are seasonal and are therefore subject to transient poverty. Thus in the Extension area, we find both the highest level of chronic poverty as well as high levels of non-poor. The provision of irrigation infrastructure may provide the necessary impetus and additional income to lift the chronically poor group out of poverty.

In the Sevanagala rainfed area, the households are mostly dependent on rainfed sugarcane farming for their income. They have less opportunities and time (they have to spend more time in their sugarcane fields) for securing steady wage incomes. However they do have limited work opportunities in harvesting sugarcane both in the rainfed and the adjacent irrigated sugarcane areas. Consequently, the households in Sevanagala rainfed area exhibit high transient poverty but low levels of chronic poverty, compared to the households in the Extension area. In the Sevangala irrigated area, chronic poverty is low, while transient poverty is much less than in the Sooriyawewa and Kiriibbanwewa irrigated areas and the proportion of non-poor the highest among all the strata. This may be reflection of the availability of adequate water for irrigation, being at the head end of the system and assured supply of water over both seasons. Also most farmers in the Sevanagala irrigated area grow both paddy and sugarcane under irrigated conditions and are able to obtain seasonal income from paddy and a regular income from sugarcane and some banana cultivation. In the other irrigated areas, except Ridiyagama, the pattern of chronic and transient poverty is similar. In these areas, about 75 percent of the households are affected by transient poverty and the balance population is divided equally between chronically poor and non-poor households. Sooriyawewa and Kiriibanwewa areas can be considered to be in a transient phase of development. The irrigation infrastructure in the two strata was upgraded with lined canals recently, and the operational systems have yet to be established and run successfully. Thus one can observe greater transient poverty, but lower levels of chronic poverty when compared to the Extension area.

Figure 9,1 Poverty head count by Strata – based on monthly income data



Ridiyagama, which is irrigated but with irrigation infrastructure not upgraded/improved/lined, has a lower proportion of poor households, compared to the other irrigated areas, except Sevanagala irrigated area. This area has also the lowest level of chronic poverty and the second highest number of non-poor households. Transient poverty affects two thirds of the households and is similar to other irrigated areas. Despite unimproved infrastructure, this area shows lower poverty levels. The reason may be the availability of adequate supplies of water to enable cultivation in both seasons. The system is also an old and well established system over 100 years in operation and can be considered to have reached maturity, and therefore able to extract the most benefits from it, despite the fact that irrigation infrastructure has not been upgraded in this system. In comparison, the other three irrigated areas suffered water shortages in the dry season. The two irrigated areas of Kiri-ibbanwewa and Sooriyawewa had also to contend with restricted cropping due to the on-going rehabilitation of irrigation infrastructure. A comparison between irrigated and rainfed areas shows that overall poverty is higher in the rainfed areas. Rainfed areas have greater chronic poverty and irrigated areas have greater transient poverty. Chronic poverty was much higher among non-farm households than farming households. However, transient poverty was higher in farming households than in non-farm households. The non-farm households also had a high proportion of non poor households. This may be due to less dependence on agriculture for an income, compared to farm households.

Poverty gap estimates show that the chronic poverty gap was high and is fairly similar across strata, and farm and non-farm groups. On average, the incomes of the chronically poor households need to be increased by 58 percent in order to lift them above the poverty line. The value of the transient poverty gap was about half that of the chronic poverty gap. On average, the incomes of the transient poor households need to be increased by 31 percent in order to lift them above the poverty line. The transient poverty gap was lower for the non-farm households than for other households. A similar pattern was observed in the case of the

poverty gap squared indicator, except that in the Sevanagala rainfed area, the transient poverty gap squared was higher than the chronic poverty gap squared. In the other groups, transient poverty gap squared was slightly over half that of chronic poverty gap squared. The above estimated poverty indices suggest that the depth of poverty (poverty gap) of the chronically poor households was twice as much as that of the transient poor households.

A similar pattern prevails in the case of the severity of poverty (poverty gap squared) as well, except in the case of households in the Sevenagala rainfed area. This means that the chronically poor households are suffering from greater or more severe poverty, compared to those in transient poverty, although the proportion affected by chronic poverty is around 10 percent compared to 60-70 percent affected by transient poverty. The Extension area suffers most from chronic poverty. The above results suggest that provision of irrigation infrastructure in irrigated areas has helped in reducing chronic poverty, although the majority of the households still remain transient poor. The development of irrigation infrastructure in the Extension area can help to reduce extreme chronic poverty in this area.

It should be noted here that estimating transient poverty using incomes has a methodological problem. By the very definition of transient poverty, a household is considered transient poor if its income is less than the poverty line at least in one of the twelve months. However, in reality if household income is even zero in one or a few months but income in other months is significantly higher (than the poverty line), that household should not be poor (as incomes received in higher income months can be used in lower income months (for example rural households keep a part of own production for family consumption in the months to follow after harvest), and this is very typical in rural settings where the bulk of the incomes are mostly received during a few months of the year. There are two alternative approaches to avoid this problem. One is to allocate income (particularly agricultural income received in cash) over several months (i.e. over the months during which that is spent), and the second is to use expenditures to measure poverty. While expenditures may vary significantly from month to months (not necessarily due to fluctuations in incomes but may be due to month specific factors such as preferences as will be shown in the next Chapter), expenditures falling below the poverty line in one or more than one month may indicate household income levels are not sufficient to main the household monthly expenditures. While the expenditure approach has its own problem, it may be better than income approach in estimating transient poverty, in particular.

Considering the above limitation of using incomes as a basis for measuring transient poverty, we estimate poverty indices using expenditures. The estimated values of poverty indices are presented in Appendix B. Values of indices estimated using monthly expenditures generally correspond to the values estimated using monthly incomes. For example, overall poverty head count was 88 percent using monthly expenditures as compared to 81 percent using monthly incomes. Overall chronic poverty head count was 6 percent using expenditures as compared to 12 percent using incomes. Transient poverty was estimated at 82 percent using expenditures as compared to 69 percent using incomes. About 12 percent of all households were classified as non-poor using expenditures compared to 19 percent using incomes. The main differences were that the head count of the chronic poor and the non-poor was less using expenditures compared to using incomes. The proportion of non-poor reduced from 26

percent using incomes to only 8 percent using expenditures in the Sevanagala irrigated area. It decreased from 12 percent to 5 percent in Sevanagala rainfed area and from 16 percent to only 4 percent in the Extension area.

In the rainfed area the proportion of non-poor declined from 15 percent to 4 percent. The chronic poverty gap estimated using expenditures remained fairly similar to that estimated using incomes, but the transient poverty gap decreased by almost half. Poverty gap squared estimates of chronic poor, using expenditures was about half that estimated using incomes. However, poverty gap squared measures of transient poverty using expenditures was very much lower - about half to one third - of that estimated using incomes. Poverty indices using expenditures indicate that head count of chronic poor and non-poor has generally decreased, except in the case of Kiriibbanwewa and Ridiyagama where the head count of the non-poor increased. Head count of transient poor estimated using expenditures increased in all strata. Chronic poverty gap remained same, while transient poverty gap decreased substantially using expenditures. A similar pattern emerged for poverty gap squared indicator as well. Decrease in chronic poverty head count, and the substantial decrease in depth and severity of transient poverty is probably due to the more equal spread of expenditures across the months than income.

In sum, transient poverty is a major contributor to total poverty. Chronic poverty is relatively higher among non-farm households, while transient poverty is relatively higher among farm households. Chronic poverty is much higher in rainfed areas/areas without irrigation infrastructure compared to areas with irrigation infrastructure. However, transient poverty is relatively higher in irrigated areas compared to rainfed areas. Incidence and severity of both chronic poverty and transient poverty is relatively lower in areas with infrastructure and with adequate water availability (such as Sevanagala irrigated area and Ridiyagama) regardless of whether infrastructure is upgraded or not.

Poverty indices were also estimated for several categories of households, using both incomes and expenditures. Table 9.2 presents the head count indices for all the categories, estimated using income. Indices have been estimated for three groups under Category I and for five groups under Category II (these categories are defined at the end of table 9.2). Category I (1), is basically the head count of chronically poor households, while Cat I (4) is the same as the Head Count of non-poor households. Category I (3), refers to transient poor households. However, this group does not include all the transient poor, as households with both average monthly income and the lowest monthly income below the poverty line would also fall within the transient poor households. These households are not included in the definition of Category I (3) above. Category II has been subdivided into five groups, starting with those below 50 percent of the poverty line, between 50-75 percent of poverty line, between 75 – 100 percent of poverty line, between 100-125 of poverty line and those above 125 percent of poverty line.

Table 9.2 Poverty Head Count – Income – Categories I & II

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	**Extension Area**	Ridiyagama	Irrigated all	Rainfed All	Farm	**Non farm**	All
Head Count Income	167	60	151	229	**105**	146	693	165	724	**134**	858
- Category I (1)	0.09	0.10	0.13	0.11	**0.25**	0.06	0.10	0.19	0.11	**0.16**	0.12
- Category I (3)	0.52	0.63	0.37	0.44	**0.35**	0.56	0.47	0.46	0.48	**0.38**	0.46
- Category I (4)	0.29	0.12	0.15	0.13	**0.16**	0.25	0.20	0.15	0.18	**0.23**	0.19
- Category II (1)	0.05	0.12	0.18	0.08	**0.16**	0.06	0.09	0.15	0.11	**0.07**	0.10
- Category II (2)	0.08	0.05	0.18	0.18	**0.19**	0.07	0.13	0.14	0.13	**0.16**	0.13
- Category II (3)	0.06	0.08	0.13	0.18	**0.13**	0.07	0.12	0.12	0.11	**0.16**	0.12
- Category II (4)	0.12	0.03	0.09	0.12	**0.11**	0.12	0.11	0.08	0.10	**0.13**	0.11
- Category II (5)	0.68	0.72	0.43	0.45	**0.41**	0.69	0.55	0.52	0.56	**0.48**	0.54

Category I (1) - Both average monthly income and highest monthly income are less than the poverty line
Category I (3) – Average monthly income is greater than poverty line, and the lowest monthly income is less than the poverty line.
Category I (4) – Both average monthly income and the lowest monthly income is greater than the poverty line.
Category II (1) – Average monthly income is less than 50% of the poverty line
Category II (2) – Average monthly income is both greater than 50% of the poverty line and less than 75% of the poverty line.
Category II (3) - Average monthly income is both above 75% of the poverty line and below the poverty line
Category II (4) – Average monthly income is both above the poverty line and below 125% the poverty line.
Category II (5) – Average income above 125% of poverty line

Category II (1), head count of those falling below 50 percent of the poverty line is shown in Table 9.2. The highest proportion of poor households under this category was in the Kiriibbanwewa area, where 18 percent received incomes below 50 percent of the poverty line and the lowest proportion in Sevanagala irrigated (5 percent) and Ridiyagama (6 percent). In the Extension area, 16 percent of households were below 50 percent of the poverty line. In other areas, it ranged from 7 percent to 12 percent of the households. This proportion was about one third higher in rainfed (15 percent) as compared to irrigated areas (9 percent). The proportion was higher in farm households (11 percent) compared to non-farm households (7 percent). The above results suggest that there is greater proportion of the households in extreme poverty in rainfed areas as compared to irrigated areas and extreme poverty is most prevalent in the Extension areas and Kiriibbanwewa. Although Sevanagala rainfed area also falls within the definition of rainfed, the pattern of income generation is different, with a permanent crop being gown with assured output markets and assistance in input use and technical advice. Therefore, extreme poverty is less when compared to the Extension area. In other Category II groups (2,3 and 4), the pattern was similar with the Extension area and the irrigated areas showing between 10 percent and 19 percent of the households falling within each of the groups within Category II, with income above 50 percent and below 125 percent

of the poverty line. The lowest proportion of households receiving incomes above 125 percent of the poverty line was in the Extension area (41 percent), compared to 68 percent in Sevanagala irrigated and 72 percent in Sevanagala rainfed areas and 69 percent in Ridiyagama. This reinforces the view that extreme poverty is more prevalent in rainfed areas as characterized by the Extension area, and that irrigation infrastructure could play an important role in reducing extreme chronic poverty. Poverty Gap and Poverty Gap Squared indices for these Categories follow a similar pattern with progressive decline in the value of the indices from Category II, groups 1-5, with the lowest indices in Category II (5), which includes households receiving incomes over 125 percent of the poverty line and the highest indices in Category II (1), which includes households receiving income less than 50 percent of the poverty line. Poverty head count by category are depicted in graphs in Figures 9.2 and 9.3, illustrating the differences between the categories.

Figure 9.2 Poverty Head Count Category I

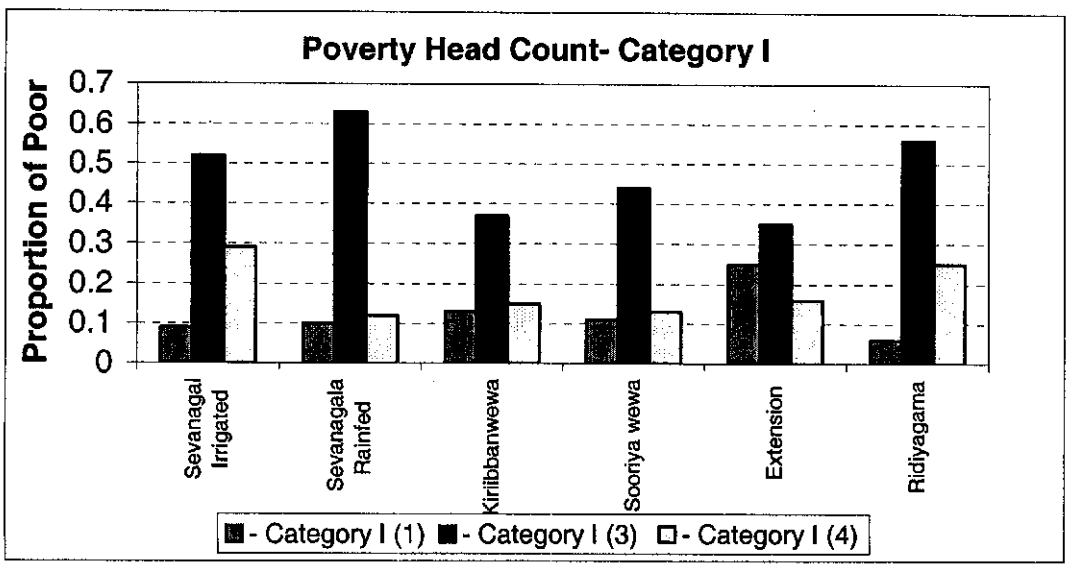


Figure 9.3 Poverty Head Count Category II

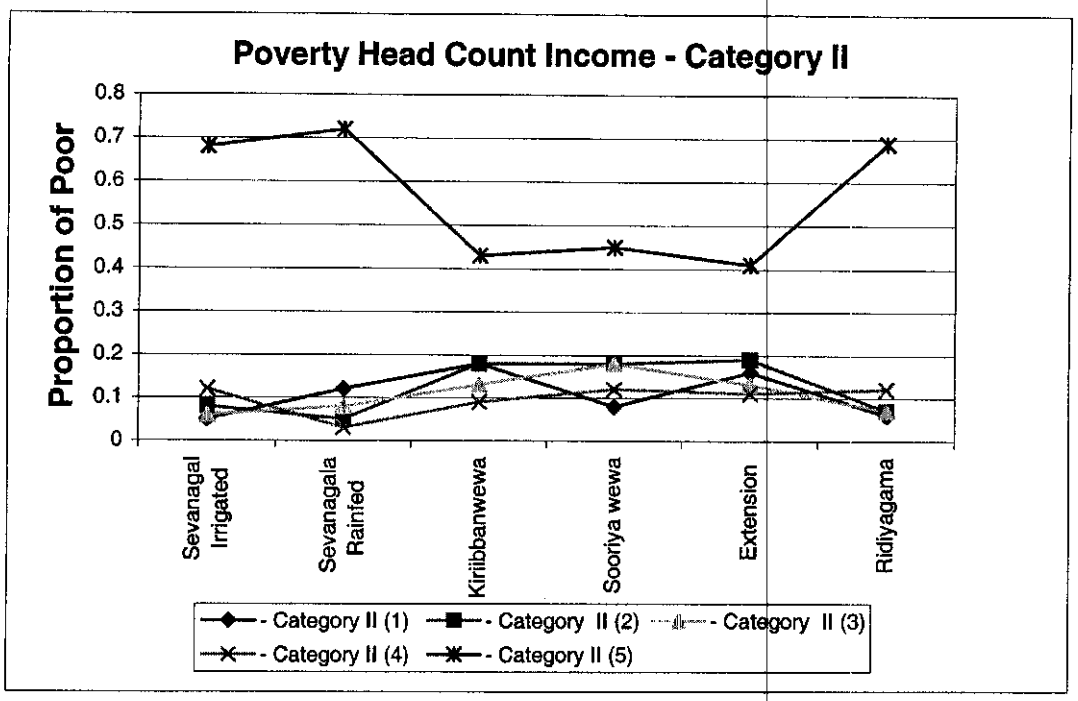


Table 9.3 Poverty Gap – Income – Categories I & II

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
Poverty Gap Income	167	60	151	229	**105**	146	693	165	724	**134**	858
- Category I (1)	0.58	0.58	0.66	0.51	0.59	0.50	0.57	0.59	0.61	0.45	0.58
- Category I (3)	0.23	0.30	0.22	0.21	0.22	0.26	0.23	0.26	0.24	0.19	0.23
- Category I (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Category II (1)	0.74	0.92	0.74	0.68	0.71	0.57	0.70	0.77	0.73	0.62	0.72
- Category II (2)	0.43	0.46	0.51	0.44	0.40	0.50	0.47	0.41	0.47	0.41	0.46
- Category II (3)	0.27	0.12	0.35	0.34	0.37	0.35	0.33	0.31	0.34	0.29	0.33
- Category II (4)	0.26	0.31	0.31	0.23	0.28	0.26	0.25	0.28	0.27	0.19	0.26
- Category II (5)	0.22	0.30	0.19	0.20	0.20	0.26	0.22	0.26	0.23	0.19	0.23

The poverty indices were also estimated using expenditure, and the results are presented in Appendix B. The main differences are that the values of the indices are equally spread between the five groups in Category II. Here again the largest proportion of households were in Category II (5), with the lowest in the Extension area (20 percent) and the highest in Ridiyagama (69 percent). Category I (1), (households receiving incomes below 50 percent of poverty line) had the lowest proportion in all strata ranging from 0 percent in Ridiyagama and 11 percent in the Extension area. In the middle groups, the proportion ranged from 6 percent in Ridiyagama to 29 percent in the Extension area. The poverty gap and poverty gap squared indices estimated using expenditures, behaved in a similar manner to those estimated using incomes. There was a progressive decrease in the value of the indices down the group in Category II. The lowest indices were in Category II (5) and the highest in Category II (1) group. The exception being Ridiyagama, where there were no households in Category II (1), i.e. expenditures below 50 percent of poverty line. With expenditure being more evenly spread across the months, the values of the indices using expenditures are lower than indices estimated with incomes. Here again, the Extension area had higher values for Category II (1) index and lower values for Category II (5) index than the other areas. These results suggest that greater and more severe poverty exists in the Extension and rainfed areas, when compared to irrigated areas. These results are similar to ones obtained using incomes.

Table 9.4 Poverty Gap Squared – Income – Categories I & II

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
Poverty Gap Squared Income	167	60	151	229	**105**	146	693	165	724	**134**	858
- Category I (1)	0.45	0.40	0.54	0.36	0.42	0.40	0.44	0.41	0.47	0.30	0.43
- Category I (3)	0.17	0.23	0.16	0.14	0.14	0.19	0.16	0.18	0.17	0.13	0.17
- Category I (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Category II (1)	0.67	2.11	0.68	0.57	0.54	0.49	0.62	1.00	0.76	0.52	0.73
- Category II (2)	0.28	0.30	0.40	0.29	0.22	0.37	0.33	0.23	0.32	0.26	0.31
- Category II (3)	0.18	0.04	0.25	0.22	0.24	0.24	0.23	0.19	0.23	0.21	0.22
- Category II (4)	0.18	0.25	0.22	0.15	0.17	0.17	0.18	0.19	0.19	0.12	0.18
- Category II (5)	0.17	0.23	0.14	0.14	0.12	0.19	0.16	0.18	0.17	0.13	0.16

Monthly head count, poverty gap and poverty gap squared indices follow similar patterns. The indices are equal from October to February and again from April to May, June to July and August to September for all strata and categories. In all strata except Extension, and rainfed areas the values are low in August and September. In the Extension area, poverty indices are lower from March to May and high in the other months (twice as high). In

Ridiyagama, low values are estimated for March to May and again for August and September, reflecting the effect of incomes resulting from double cropping of Paddy. In the two irrigated strata of Kiriibbanwewa and Sooriyawewa, the poverty indices are low in August and September, and high in the rest of the months. This may be due to the fact that these two strata had only one full crop in Yala and a partial cultivation in Maha (peculiar to the year studied). A comparison of Sevanagala irrigated and rainfed areas show that poverty indices were low from June to September and high in the other months except in March in Sevanagala irrigated when the value was low. The poverty indices in Sevanagala rainfed were generally higher than in the Sevanagala irrigated block. This is probably due to the differing cropping patterns in the two areas. Both paddy and sugarcane are grown in the Sevanagala irrigated area, whereas only sugarcane is grown under rainfed conditions in the Sevanagala rainfed area. Figure 9.4 shows poverty head count indices on a monthly basis for the six strata.

Table 9.5 Poverty Head Count – Income (Monthly Indices)

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Head Count – Income	167	60	151	229	**105**	146	693	165	724	**134**	858
- October	0.42	0.60	0.68	0.60	0.69	0.58	0.57	0.66	0.59	0.55	0.59
- November	0.42	0.60	0.68	0.60	0.69	0.58	0.57	0.66	0.59	0.55	0.59
- December	0.42	0.60	0.68	0.60	0.69	0.58	0.57	0.66	0.59	0.55	0.59
- January	0.42	0.60	0.68	0.60	0.69	0.58	0.57	0.66	0.59	0.55	0.59
- February	0.42	0.60	0.68	0.60	0.69	0.58	0.57	0.66	0.59	0.55	0.59
- March	0.37	0.60	0.47	0.52	0.37	0.20	0.40	0.46	0.41	0.40	0.41
- April	0.45	0.68	0.46	0.58	0.32	0.18	0.44	0.46	0.44	0.43	0.44
- May	0.45	0.68	0.46	0.58	0.32	0.18	0.44	0.46	0.44	0.43	0.44
- June	0.34	0.30	0.62	0.66	0.72	0.56	0.55	0.57	0.56	0.55	0.56
- July	0.34	0.30	0.62	0.66	0.72	0.56	0.55	0.57	0.56	0.55	0.56
- August	0.23	0.27	0.32	0.24	0.70	0.29	0.26	0.54	0.30	0.40	0.32
- September	0.23	0.27	0.32	0.24	0.70	0.29	0.26	0.54	0.30	0.40	0.32

Figure 9.4 Monthly Poverty Head Count Indices by Strata

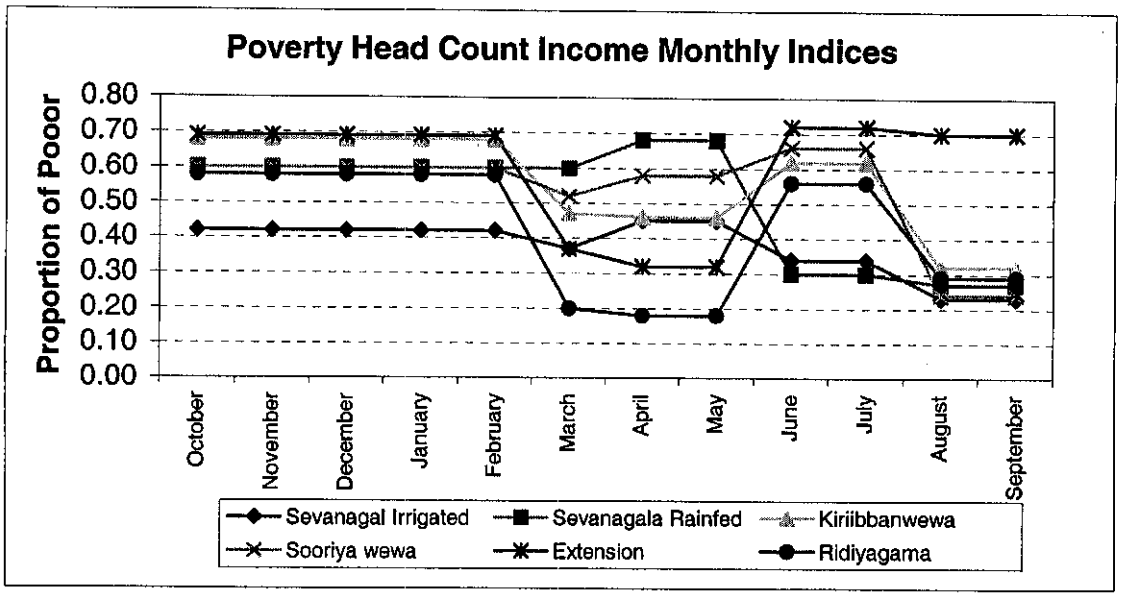


Table 9. 6 Poverty Gap – Income (Monthly Indices)

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Gap – Income	167	60	151	229	**105**	146	693	165	724	**134**	858
- October	0.60	0.71	0.66	0.46	0.51	0.58	0.56	0.58	0.58	0.46	0.57
- November	0.60	0.71	0.66	0.46	0.51	0.58	0.56	0.58	0.58	0.46	0.57
- December	0.60	0.71	0.66	0.46	0.51	0.58	0.56	0.58	0.58	0.46	0.57
- January	0.60	0.71	0.66	0.46	0.51	0.58	0.56	0.58	0.58	0.46	0.57
- February	0.60	0.71	0.66	0.46	0.51	0.58	0.56	0.58	0.58	0.46	0.57
- March	0.53	0.70	0.54	0.43	0.47	0.37	0.48	0.58	0.52	0.40	0.50
- April	0.53	0.61	0.53	0.62	0.53	0.48	0.56	0.58	0.59	0.44	0.57
- May	0.53	0.61	0.53	0.62	0.53	0.48	0.56	0.58	0.59	0.44	0.57
- June	0.56	0.52	0.65	0.60	0.56	0.52	0.59	0.55	0.59	0.51	0.58
- July	0.56	0.52	0.65	0.60	0.56	0.52	0.59	0.55	0.59	0.51	0.58
- August	0.45	0.49	0.68	0.54	0.54	0.45	0.54	0.53	0.55	0.46	0.54
- September	0.45	0.49	0.68	0.54	0.54	0.45	0.54	0.53	0.55	0.46	0.54

Figure 9.5 Poverty head count monthly indices – irrigated and rainfed

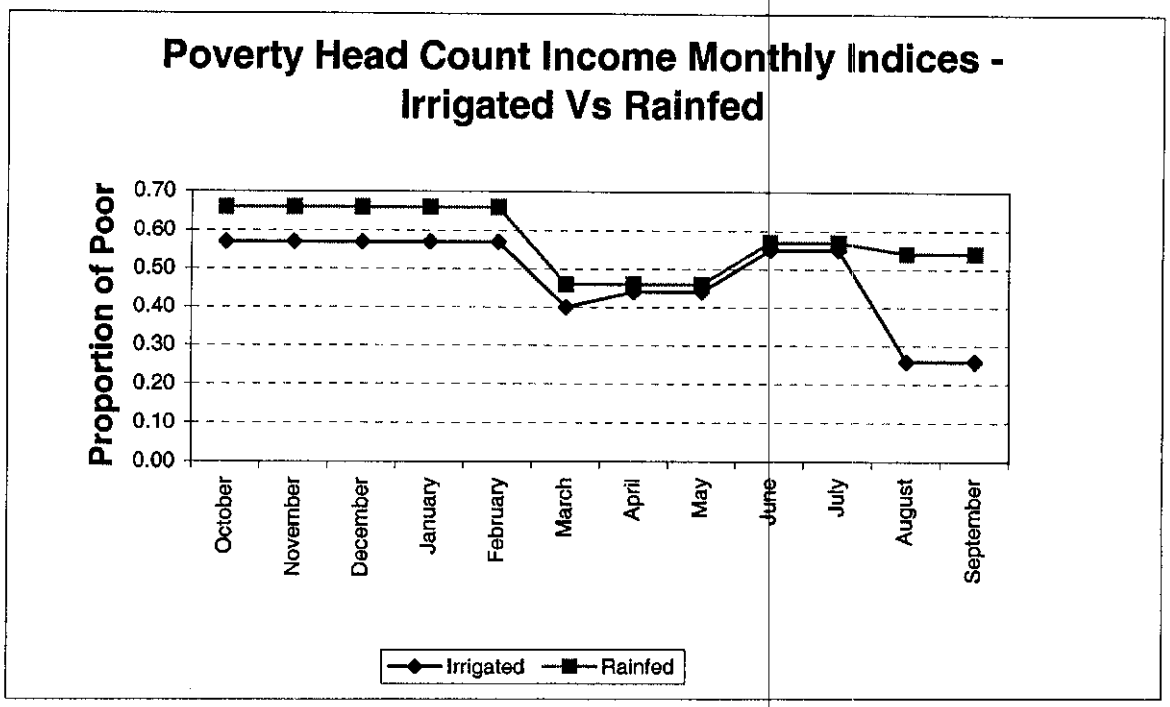


Figure 9.5 compares monthly poverty head count indices between irrigated and rainfed areas. The monthly patterns are similar but the poverty indices are lower in irrigated areas. It should be noted that, while estimates of chronic poverty appear reasonable, the estimates of transient poverty look a bit higher. However, these estimates are consistent with most previous studies estimating transient poverty in developing countries. Gaiha (1989), using national level data from India, found that three-quarters of the households were temporarily poor i.e. they were poor at least one year during the three year period. Walker and Ryan (1990), using panel data from India, found the incidence of temporary poverty to be very high. Roughly 70 percent of the households in their study moved in and out of poverty in at least one year of the nine year study. Adams and He (1996), using panel data from rural Pakistan, found two thirds of the households to be in transient poverty, that is they were poor in at least one of the three survey years. In China, analysis of data from 39,000 households from Guangxi, Guizhou and Yunnan provinces showed that roughly 50 percent of the households were in transient poverty (Jalan and Ravallion, 1998a, 1998b). Analysis of another panel data from Pakistan suggest that the "sometimes poor" group is generally much larger that the "always poor" group and that " in Pakistan 55.3 percent of the households fell below the poverty line at some point between 1886 and 1991" (World bank 2000-2001). Overall, the results of this study seem to be in line with earlier studies on transient poverty.

Table 9.7 Poverty Gap Squared – Income (Monthly Indices)

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Gap Squared – Income	167	60	151	229	**105**	146	693	165	724	**134**	858
- October	0.46	1.09	0.52	0.28	0.32	0.43	0.41	0.58	0.47	0.30	0.45
- November	0.46	1.09	0.52	0.28	0.32	0.43	0.41	0.58	0.47	0.30	0.45
- December	0.46	1.09	0.52	0.28	0.32	0.43	0.41	0.58	0.47	0.30	0.45
-January	0.46	1.09	0.52	0.28	0.32	0.43	0.41	0.58	0.47	0.30	0.45
-February	0.46	1.09	0.52	0.28	0.32	0.43	0.41	0.58	0.47	0.30	0.45
- March	0.39	1.09	0.43	0.26	0.33	0.21	0.33	0.68	0.44	0.23	0.40
- April	0.40	0.47	0.42	0.50	0.35	0.34	0.45	0.42	0.47	0.27	0.44
- May	0.40	0.47	0.42	0.50	0.35	0.34	0.45	0.42	0.47	0.27	0.44
- June	0.42	0.33	0.53	0.45	0.39	0.37	0.45	0.37	0.45	0.35	0.43
- July	0.42	0.33	0.53	0.45	0.39	0.37	0.45	0.37	0.45	0.35	0.43
- August	0.32	0.29	0.59	0.43	0.36	0.40	0.44	0.35	0.42	0.39	0.41
- September	0.32	0.29	0.59	0.43	0.36	0.40	0.44	0.35	0.42	0.39	0.41

Again, it should be noted that estimates of poverty indices reported in the previous sections of this report are based on monthly data. However, analysis based on monthly data may not provide realistic estimates of, particularly transient poverty. In general, the shorter the time period, the higher would be the estimates of poverty due to relatively greater income/expenditure fluctuations in short terms; that is, estimates based on weekly data would be higher than those based on monthly data, which in turn would be higher than those using quarterly data. The poverty estimates can be expected to be much lower with yearly data on incomes and expenditures. While estimates based on inter-year comparisons are useful to understand how households move in and out of poverty in the medium and long run, they may mask intra-year poverty dynamics caused by seasonality in agriculture, which may lead to underestimates of transient poverty (on the other hand, estimates based on monthly data may result in overestimates of transient poverty due to greater volatility in incomes and expenditures).

Given the seasonality in agriculture, it can be realistically assumed that households plan their budgets on a quarterly basis during the year instead of on a monthly basis (which is true mostly for households dependent on fixed monthly incomes, such as salaried persons). Considering all these factors, we also estimate poverty indices using quarterly data on incomes and expenditures. The results are presented in Table 9.8 and Appendix C.

Table 9.8 Poverty Head Count – Based on Household Income – Quarterly Data

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	**Extension Area**	Ridiyagama	Irrigated all	Rainfed All	Farm	**Non farm**	All
Head Count (No. of Observations)	167	60	151	229	**105**	146	693	165	724	**134**	858
Total Poverty											
- Chronic Poverty	0.11	0.12	0.22	0.16	**0.31**	0.08	0.14	0.24	0.16	**0.19**	0.16
- Transient Poverty	0.49	0.63	0.58	0.65	**0.51**	0.62	0.59	0.56	0.59	**0.54**	0.59
- Non-poor	0.40	0.25	0.20	0.19	**0.18**	0.30	0.27	0.20	0.25	**0.27**	0.25
Poverty Gap											
- Chronic Poverty	0.52	0.60	0.62	0.49	**0.54**	0.49	0.54	0.55	0.57	**0.43**	0.54
- Transient Poverty	0.25	0.33	0.30	0.26	**0.23**	0.22	0.26	0.27	0.27	**0.22**	0.26
Poverty Squared Gap											
- Chronic Poverty	0.38	0.42	0.48	0.33	**0.36**	0.35	0.39	0.37	0.41	**0.27**	0.39
- Transient Poverty	0.19	0.53	0.25	0.17	**0.15**	0.16	0.19	0.31	0.22	**0.15**	0.21

Using quarterly income data, 16 percent of the sample households are classified as chronically poor, 59 percent as transient poor and 25 percent as non-poor, indicating that the number of chronic poor and non-poor households have increased while the number of transient poor have decreased (when compared to poverty estimates based on monthly income data). The head count poverty indices based on quarterly incomes for various strata followed a similar pattern. In all cases, the incidence of chronic poverty and the proportion of non-poor were higher, while transient poverty was lower for indices based on quarterly incomes. In the case of poverty gap, both chronic poverty gap and transient poverty gap were lower when estimated on the basis of quarterly incomes than on monthly incomes. A similar pattern was observed in all strata except Sevanagala rainfed. In the case of the poverty gap squared index, similar pattern emerged as in the case of poverty gap indices.

Poverty indices estimated on the basis of quarterly expenditures were also lower compared to indices based on monthly expenditures. For the entire sample the proportion of chronic poor and non-poor was relatively higher while the proportion of transient poor was lower. Using quarterly expenditures data, 20 percent of the sample households are classified as chronic poor, 51 percent transient poor and 28 percent non-poor (compared to 6 percent, 12 percent and 82 percent, respectively, using monthly data expenditures). The proportion of chronic poor and non-poor, estimated using quarterly expenditure data, was much higher in all strata, including irrigated, rainfed, farm and non-farm categories. The Extension is found to have the highest chronic poverty, and Ridiyagama the lowest. The highest proportion of non-poor is in Ridiyagama and the lowest in the Extension area. Transient poverty estimated with

quarterly data, declined substantially, in all strata, from about 70-85 percent to 50-55 percent. The highest transient poverty is found in Sooriyawewa and non-farm category, and the lowest in Ridiyagama.

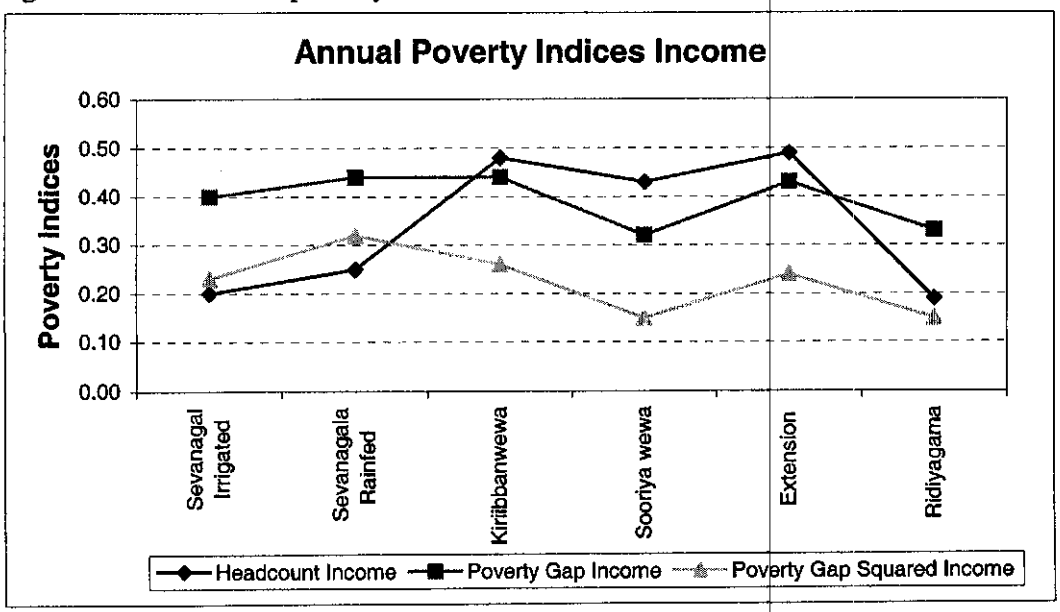
Chronic poverty gap and transient poverty gap estimates using quarterly expenditure data declined from 50 percent to 35 percent and from 16 percent to 12 percent, respectively. This decline was found in all strata and all socioeconomic categories. Using monthly data the lowest chronic poverty gap was 46 percent in Sevanagala irrigated, the highest 57 percent in Extension area and the lowest transient poverty gap 11 percent in Ridiyagama and the highest in Extension area 25 percent. Using quarterly data, the lowest chronic poverty gap was 28 percent in Ridiyagama, the highest in Extension area 42 percent, and the lowest transient poverty gap in Ridiyagama 8 percent and the highest in Extension area of 16 percent. On the other hand, chronic poverty gap squared index increased from 29 percent to 65 percent and transient poverty gap squared index increased from 7 percent to 19 percent. A similar increase is found for all strata. Ridiyagama has the lowest values and Extension area has the highest vales. The methodology adopted for estimating poverty indices does influence the estimates of the poverty indices. Use of quarterly data instead of monthly data results in lower estimates of poverty (especially transient poverty). Therefore, the conclusions drawn from the analysis of poverty indices must be viewed in terms of the influence of the methodology adopted for estimating poverty indices. Overall, it is concluded that, regardless of whether monthly or quarterly data are used, highest chronic poverty is found in areas with no access to irrigation infrastructure and lowest in areas with access to irrigation infrastructure and adequate water supplies.

Further, we estimated poverty indices using annual data on household incomes and expenditures, and the results are presented in Table 9.9. Overall, 35 percent and 44 percent of the sample households were classified as poor using incomes and expenditures respectively. However, poverty gap and poverty gap squared indices are lower when estimated using expenditure than income. What this implies is that poverty depth and severity of poverty are higher probably due to greater fluctuation in incomes than in expenditure. The highest annual income poverty head count was in the Extension area, and the lowest in Ridiyagama. The poverty head count in irrigated areas was lower than rainfed areas, the exception being Sevenagala rainfed area, where it was lower than the Kiriibbanwewa and Sooriyawewa irrigated areas. As explained earlier, Sevanagala rainfed area is a special case, and is not representative of a typically rainfed area like in the case of the Extension area. The poverty gap and poverty gap squared indicators also show higher values in rainfed areas than in irrigated areas, indicating that the depth and severity of poverty are greater in rainfed areas. There is clear evidence that irrigation infrastructure does have a beneficial impact on poverty.

Table 9.9 Annual poverty indices

	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Headcount –Income	0.20	0.25	0.48	0.43	0.49	0.19	0.34	0.40	0.34	0.39	0.35
Poverty Gap- Income	0.40	0.44	0.44	0.32	0.43	0.33	0.37	0.43	0.40	0.30	0.38
Poverty Gap Squared-Income	0.23	0.32	0.26	0.15	0.24	0.15	0.19	0.26	0.22	0.13	0.21
Headcount –Exp	0.44	0.43	0.37	0.43	0.69	0.19	0.37	0.59	0.41	0.40	0.41
Poverty Gap- Exp	0.25	0.23	0.23	0.22	0.30	0.17	0.23	0.28	0.24	0.24	0.24
Poverty Gap Squared-Exp	0.09	0.08	0.08	0.07	0.12	0.05	0.08	0.11	0.09	0.08	0.09

Figure 9.6 Annual poverty indices



Non-monetary Indicators of Poverty

The surveys also collected information on other aspects of household living standards that are indirect /non-monetary indicators of poverty. Table 9.10 gives a summary of indicators that would provide greater insights into the qualitative aspects of poverty in the study area. The dependency ratio, which is the ratio of dependents to non-dependents, could be used as an indicator of poverty. High dependency ratios may indicate greater poverty. The dependency ratio of the entire sample is 60 percent. In the two rainfed Sevanagala and Extension areas, the dependency ratios are 91 percent and 72 percent respectively. This value is quite high compared to the irrigated areas, where the dependency ratio ranges from 51 percent to 62 percent. Overall the irrigated areas have a dependency ratio of 56 percent compared to 79 percent in the rainfed areas. This is suggestive of the fact that in the rain-fed areas greater dependency has caused greater incidence of poverty than in irrigated areas.

The under-five mortality rates provide information on prevalence of malnutrition and other health problems resulting from poverty. Overall the under five mortality rates are quite low indicating that the incidence of health and nutritional problems is low probably due to the easy access to medical care even in rural areas and nutrition programs targeted at children and pregnant mothers. The analysis of data from the survey shows relatively higher under five mortality, in both rainfed and irrigated Sevanagala sugar areas, whereas the rates are considerably lower in the rest of the irrigated strata and in the Extension area. It was observed that the latter areas had easier access to medical facilities, being closer to large hospitals. The access to medical care is more difficult in the Sevanagala area due to long distances to the nearest large hospitals. Thus, this indicator is less useful in determining or assessing poverty in the present context.

The proportion of family members aged between 5 and 20 years not in school over the total number in this age group, is another indicator that can be used to evaluate poverty situation across strata. This proportion was 64 percent in Sevanagala rainfed area, and 39 percent in the Sevanagala irrigated area and ranged between 18 percent and 28 percent in the rest of the areas, the lowest level of 18 percent was in the Extension area. The high proportion not in school in Sevanagala may be because many school going children find work in harvesting sugarcane. Children work in the fields due to heavy demand for labor during harvesting time. As it is necessary to harvest and transport the sugarcane to the factory within a limited period, before a loss in sugar content occurs, all available labor resources within the family are harnessed to meet the demand. This also happens when sugarcane fields catch fire, and the cane or what remains, has to be harvested and delivered to the factory as quickly as possible in order to salvage some income from the burnt fields. The proportion of non-school going members is higher in rainfed areas and farm households as compared to irrigated areas and non-farm households.

The number of years of schooling of the household head may have some relationship to the level of poverty. Results of the study show that household heads in the Extension area had the lowest number of schooling years, and those in Ridiyagama has the highest number of schooling years.

The housing index was the lowest in the Extension area where there were fewer permanent houses, and the quality of housing was poor. This was probably due to the fact that most families were temporary residents and encroachers and did not want to build permanent houses prior to obtaining ownership of the encroached lands. The highest housing index was in Ridiyagama, which is a long established system, where the residents have built permanent housing of good quality. The low housing index also indicates a higher level of poverty in the Extension area and for the non farm households, most of whom were encroachers with only temporary housing.

The value of household assets was also the highest in Ridiyagama and the lowest in the Extension area, reflecting differences in poverty levels in these two areas. The value of agricultural assets was the highest in Ridiyagama and lowest in Rainfed Sevanagala. The value of agricultural assets in irrigated areas was about three times that in the non-irrigated areas, suggesting that poverty levels are lower in irrigated areas.

The cropping intensity was the lowest in the Extension area, while it was comparatively higher in the Sevanagala areas. In this area, the land is permanently under sugarcane, which is not a seasonal crop, and therefore one would expect higher cropping intensity. In the irrigated sugarcane area, farmers are assured of water even during the dry months in order to safeguard the standing crop. Ridiyagama, which has adequate water for both seasons had the highest cropping intensity among the irrigated strata. The low cropping intensity observed in the other two irrigated areas of Kiriibbanwewa and Sooriyawewa may be a temporary phenomenon peculiar to the year when the surveys were conducted when there were water shortages due to the drought prevailing during the period and also due to restricted cultivation as a result of the on-going rehabilitation of the irrigation system. The gross value of production was generally higher in irrigated areas, with the highest value in Ridiyagama and the lowest in Extension area. At the same time the cost of production was the lowest in the Extension area followed by the rainfed Sevanagala area.

Although the extension area is generally poorer than the Ridiyagama area, fewer households have access to electricity in Ridiyagama compared to the Extension area. This was probably due to the lack of distribution lines within the area and not due to poverty. On the other hand, the Extension area is located adjacent to the main highway, with power lines running throughout the length of the highway. Access to power is greater in rainfed Sevanagala and Sooriyawewa as these areas are located adjacent to main highways with power lines.

Access to piped water is relatively low in all areas except in Sooriyawewa, where a public water supply scheme provides piped supply to residents. There are no such schemes in the other areas. Well water is the major source for domestic use in all areas. Access to credit is similar in all areas, with greater number of households reporting borrowing in the Extension area.

Overall, all the non-monetary indicators suggest that incidence of poverty is lower in areas with access to infrastructure and with adequate water supplies compared to areas with no access to irrigation infrastructure. While the development of irrigation infrastructure provides incentives and leads to development of other infrastructure (such as roads), however,

development of other infrastructure may not necessarily reduce poverty. In general, the results using non-monetary indicators are consistent with and confirm the results using monetary indicators of poverty.

Table 9.10 Estimates of Non-monetary Indicators of Poverty

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non Farm	All
No of observations	167	60	151	229	105	146	693	165	134	724	858
Family Size	5.17	4.78	5.01	5.18	4.98	5.25	5.16	4.91	5.24	4.44	5.11
Number of non dependents[1]	3.73	2.75	3.54	3.51	3.17	3.73	3.62	3.01	3.62	2.88	3.50
Number of dependents[2]	1.44	2.03	1.46	1.67	1.81	1.51	1.54	1.89	1.62	1.53	1.60
Dependency ratio[3]	53.6	91.2	51.5	62.3	72.2	55.1	56.4	79.1	60.3	63.5	60.8
Number of deaths < 5 years	0.06	0.07	0.04	0.03	0.04	0.03	0.04	0.05	0.05	0.02	0.04
Mortality rate < 5 years (%)[4]	1.20	1.62	0.69	0.78	0.69	0.54	0.81	1.03	0.88	0.69	0.85
Mortality rate > 5 years (%)	1.61	0.89	0.94	0.62	0.53	1.31	1.07	0.66	1.07	0.57	0.99
Mortality rate total (%)	2.80	2.51	1.62	1.40	1.23	1.85	1.88	1.69	1.95	1.26	1.84
Number of years of schooling of household head	6.13	7.10	6.86	6.53	5.50	7.58	6.73	6.08	6.44	7.48	6.60
Average age of HH head	47.7	42.4	52.6	48.8	43.3	53.3	50.3	42.9	50.6	39.6	48.9
Number of household members between 5-20 years	1.86	2.02	1.89	2.15	2.05	1.42	1.87	2.04	1.95	1.63	1.90
Number not in school	0.84	1.45	0.58	0.54	0.35	0.43	0.60	0.75	0.64	0.57	0.63
Percent of household members between 5-20 years not in school	39.0	64.0	28.6	25.2	17.8	20.2	28.2	34.6	29.0	31.6	29.4
Housing index	74.4	73.6	78.9	73.3	69.2	84.6	77.2	70.8	77.5	67.8	76.0
Average land holding – irrigated ha	0.76	0.02	0.65	0.55	0.18	0.77	0.67	0.12	0.64	0.17	0.56
Average land holding non-irrigated ha	0.18	1.52	0.44	0.21	1.19	0.33	0.28	1.31	0.51	0.28	0.48
Cropping intensity (%)	137	152	89	90	77	148	113	104	116	88	134
Access to electricity (%)	47.9	66.7	39.1	52.0	34.3	24.0	42.3	46.1	43.4	41.0	43.0
Access to piped water (%)	7.8	11.7	11.3	27.5	15.2	17.1	17.0	13.9	17.5	10.4	16.4
Access to credit (%)	41.1	48.9	45.9	49.3	51.4	46.8	46.1	50.5	46.8	47.2	46.9
Gross value of agricultural production per hectare (GVP/ha) (Rs/ha)	59480	44049	45213	54593	34713	60304	55078	38184	51770	50029	51573
Value of household assets (Rs)	18232	13694	17240	19517	8532	32394	21418	10436	20165	14795	19339
Value of agricultural assets (Rs)	17415	1752	21731	18837	10484	27749	21002	7309	19811	10575	18369

[1] Family members >5 and <65 years old

[2] Family members <5 and >65 years old

[3] Number of dependents/Number of non dependents

[4] Number of deaths <5 years/Total number born

Welfare Cost of Income/Expenditure Fluctuations

There is relatively less variation in the welfare cost of fluctuating expenditures among the strata. The highest is about 30 percent and the lowest 24 percent for RRA=2 and 60 percent and 55 percent respectively when RRA = 4. The welfare cost did not vary much between the transient and non-poor households, but it was higher than chronic poor households. The highest welfare cost resulting from expenditure fluctuations was observed in Ridiyagama, followed by Sevanagala rainfed area, and Sooriyawewa. The welfare cost of rainfed households was relatively higher than irrigated farmers and that of farm households higher than non-farm households. The welfare cost of fluctuations in income was also estimated (See Appendix Table D1). The variation in welfare cost of fluctuating income was, however, much higher. Sevanagala rainfed area had the highest welfare cost in the case of income fluctuations, followed by Kiriibbanwewa and Sooriyawewa. The Extension area and Sevanagala irrigated had the lowest welfare cost due to income fluctuations. As in the case of expenditure fluctuations, the welfare cost of income fluctuations of households in irrigated areas was higher than households in rainfed areas and that of farmers higher than non farmers. The chronic poor had the highest welfare cost of income fluctuations followed by transient poor and lastly the non- poor.

The main conclusion here is that the welfare cost of expenditure fluctuations was much less than that of income fluctuations, consequent to the high variations observed in income. Both Sevanagala rainfed and Sooriyawewa were subject to high welfare cost both in income and expenditure. The magnitude of the welfare cost in income was almost four times that of the welfare cost of expenditure, when all the cases are taken into account. The welfare cost to farm households was higher than non-farm households, and that of rainfed stratum higher than the irrigated stratum. The welfare cost to the chronic poor was high compared to the transient poor and as expected the lowest for non-poor households.

In addition, we also estimated welfare cost fluctuations in incomes and expenditures using quarterly data. While welfare cost of income fluctuations is only marginally less when using quarterly data compared to that obtained monthly data, cost of expenditure fluctuations is substantially less with quarterly expenditure data (about 12 percent compared to about 28 percent using monthly expenditure data). The welfare cost estimated based on quarterly data are given in Appendix tables D2 and D3.

Table 9.11 Welfare cost of fluctuations in expenditures

Welfare cost of fluctuations in expenditures based on expenditure	N	STD	CV	m/y (RRA=2)	m/y (RRA=4)
Sevanagala-Irrigated	167	2526	0.440	0.260	0.521
Sevanagala-Rainfed	60	2299	0.470	0.300	0.601
Kiriibbanwewa	151	2614	0.436	0.239	0.479
Sooriyawewa	229	2622	0.481	0.296	0.592
Extension Area	105	2088	0.480	0.268	0.536
Ridiyagama	146	4147	0.499	0.301	0.603
Irrigated all	693	2919	0.465	0.276	0.552
Rainfed all	165	2165	0.477	0.280	0.560
Farmers	724	2880	0.473	0.286	0.571
Non-farmers	134	2198	0.435	0.229	0.459
Chronic Poor	100	1704	0.438	0.236	0.473
Transient poor	597	2799	0.467	0.280	0.559
Non-poor	161	3342	0.487	0.292	0.584
All	858	2774	0.467	0.277	0.554

Formal and Informal Credit Use

Table 9.12 presents data on credit availability and use in the two main cropping seasons. Overall, over 47 percent of the sample households reported borrowing money in Maha and 41 percent in Yala. A higher proportion of farmers in rainfed areas borrowed in Maha compared to irrigated areas. In Yala the situation was opposite, with a higher proportion borrowing in irrigated areas than rainfed areas. Overall, greater number of households borrowed for production as well as for consumption purposes in Maha season than in the Yala season. The largest proportion borrowing in Maha for production purposes was in the Extension area (52 percent) followed by Ridiyagama (50 percent). More households borrowed in rainfed areas than in irrigated areas in Maha. In the Yala season, more farmers borrowed for production in irrigated areas than rainfed areas. Thus availability of water in the wet Maha season motivates farmers to borrow more and to make the most productive use of available water, indicating a risk averse behavior, among rainfed farmers. Generally, more households borrow during the months of August, September, October and to some extent in November. This coincides with the Maha cultivation season. The other months when more farmers take loans are in April and May and to some extent in June, coinciding with the Yala season and the New Year festival period. Here again, it is observed that more rainfed farmers borrow during the wet Maha season period than in the dry Yala season.

Friends and relatives provide the majority of the credit, with over 50 percent of the households reporting borrowing from these sources. Bank is the next important source, with 35 percent of the households reporting, with professional money lenders as the next major source of borrowing for 17 percent of the households. In both the Maha and Yala seasons, the major sources of credit are relatives, friends and banks. Merchants and traders play a more limited role as sources of credit, but are more prevalent in Sevanagala and Kiriibbanwewa area. In Yala, professional money lenders play a greater role as sources of credit in all strata except Ridiyagama. A greater proportion of households in irrigated areas obtain credit from

institutional sources such as banks than rainfed farmers, in both seasons. On the other hand, a greater proportion of rainfed households obtain loans from relatives and friends than irrigated farmers. The results show that irrigated farmers have greater access to institutional sources of credit than rainfed farmers, who depend more on relatives and friends for credit. This suggests that provision of irrigation can increase access to cheaper credit from institutional sources. Overall, households in the study area use credit to reduce income and expenditure fluctuations.

Table 9.12 Formal and Inform Credit Use

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibbanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
1. Percent of households borrowing money											
(a) Maha	37	52	36	48	57	56	45	55	47	46	47
(b) Yala	42	34	46	46	35	35	43	34	41	42	41
2. Purpose of borrowing (percent borrowing)											
- Consumption											
(a) Maha	13	24	10	9	10	4	10	16	10	17	11
(b) Yala	10	17	11	9	8	1	8	12	8	15	9
- Production											
(a) Maha	19	36	24	36	52	50	32	46	36	28	35
(b) Yala	13	11	28	33	6	27	26	8	24	14	23
3. Percentage of household reporting borrowing money in following months *(%)*											
a. October	20	23	13	11	52	22	16	42	23	16	22
b. November	1	23	1	1	15	34	14	18	15	15	15
c. December	12	1	12	1	1	11	1	1	8	7	8
d. January	16	13	18	12	13	1	13	13	12	14	13
e. February	1	1	14	11	1	1	1	0	8	8	8
f. March	1	13	1	12	1	1	1	1	8	6	8
g. April	26	33	25	29	13	11	23	20	22	21	22
h. May	26	23	16	45	12	15	28	16	30	18	28
i. June	19	10	25	18	11	22	20	11	20	15	19
j. July	13	15	21	20	14	22	19	14	19	13	18
k. August	34	45	21	21	25	18	23	32	24	29	25
l. September	31	45	28	14	33	22	23	37	23	35	25

4. Percentage of household reporting borrowing money during the last **Maha Season** from the following sources *(%)*											
a. Bank	22.6	22.6	20	56.4	41.7	73.2	47.6	35.2	45.1	42.6	35.2
b. Cooperative	1.0	1.0	1.0	1.0	1.0	0.0	0.1	0.2	2.1	0	0.02
c. Relative	33.9	21.9	21.8	14.6	30	1.0	12	17.6	21.2	14.7	27.2
d. Friends	32.3	32.3	41.8	28.1	23.3	1.0	18.1	27.2	25.4	31.1	26.4
e. Trader	1.0	1.0	1.0	1.0	1.0	1.0	26.2	26.4	6.2	1.1	0.04
f. Merchant	19.4	1.0	1.0	1.0	1.0	1.0	0.5	0.4	5.2	6.6	0.03
g. Professional money lender	14.5	32.2	14.6	11.0	10	1.0	0.6	0.3	13.6	11.5	17.6
h. Other	17.7	19.4	11	1.0	1.0	1.0	10.0	12.0	11.2	6.6	10.5
5. Percentage of household reporting borrowing money during the last **Yala Season** from the following sources *(%)*	0.8	0.5	16	44	44	63	32	30	33.0	27.3	32.1
i. Bank	0	0	0.1	0.1	0	0.0	0.07	0	6.9	0	0.6
j. Cooperative	28.6	15	18	11	0.8	0.9	16	11	15.1	18.2	15.6
k. Relative	44.3	40	30	18	33	21	28	36	28.9	31.0	29.2
l. Friends	0.6	0	0.5	0.5	0.8	0.2	0.5	0.5	4.8	5.5	4.9
m. Trader	0.8	25	0.5	0.7	0.2	0.4	0.6	11	5.8	14.6	7.2
n. Merchant	12.8	20	24	13	17	0.4	14	18	15.5	9.1	14.5
o. Professional money lender	0.7	10	0.5	1.0	11	14	0.9	11	9.3	9.1	9.2
p. Other											

Chapter 10

Seasonality in Incomes and Expenditure Quantifying the Impacts of Irrigation Infrastructure

This Chapter is divided into two parts. The first part provides an analysis of seasonal variations in household expenditures. The second part provides quantitative assessment of the impacts of irrigation infrastructure development on household incomes/expenditures. It is clear from discussions in the previous chapters that a large majority of rural households in the irrigation system under consideration, infact in the country as whole, depend directly or indirectly on seasonal agriculture for their incomes. The key issue is whether seasonality in household incomes causes seasonal changes in household consumption. Past research on this issue suggests that seasonal changes in consumption expenditure could be due to a number of other non-income factors. These include borrowing constraints that households may face, preferences and seasonal taste variations (due to weather patterns, festivals etc). Since these other non-income factors may affect consumption, seasonality in incomes may not necessarily be the key determinant of seasonal changes in consumption expenditure. However, there is no consensus on this issue in available limited empirical work in this area. Pinstrup-Anderson and Jaramillo's work (1989), using data from India, support the view that seasonal consumption variability and income variability are related. Townsend (1991), using data from South India, finds that while changes in household consumption do move with household incomes, although more changes in household consumption are explained by changes in village level consumption. Research on consumption smoothing by Alderman and Garcia (1996) suggests that consumption does not changes very much when income fluctuates and households protect their consumption levels from short term changes in incomes mainly through household savings. Detailed study by Paxon (1993), using data from Thailand, concludes that seasonal variation in prices or preferences, rather than income flow, is the key determinant of seasonal changes in consumption. However, she acknowledges that income seasonality may cause consumption seasonality in other contexts. Thus, whether household consumption tracks household incomes remains an open empirical question. The key hypothesis to be tested in the first part of this chapter is weather seasonal variations in household incomes, as opposed to seasonal variations in preferences and prices, is a major determinant of observed seasonal variations in consumption expenditures, and whether there is any relationship with household access to irrigation infrastructure.

In this study, the test of the above hypothesis is based on the framework adopted by Paxon (1993). The theoretical development of the model is described in an earlier chapter of this report (Chapter 6). The basic approach adopted in this paper is to compare seasonal consumption patterns of different groups of households that have different seasonal income patterns. To the extent that non-income factors (such as seasonal preferences and prices) are similar across households, seasonal consumption patterns should be similar across households despite differences in seasonal income patterns. In other words, if seasonal variation in incomes is responsible for seasonal variation in consumption, then household groups with different seasonal income patterns will display different consumption patterns.

In this paper, we compare seasonal consumption patterns of different groups of households having different seasonal income patterns – based on a set of household characteristics that determine the timing of income receipts. These include:

(i) occupational status: occupational status of households as whether a household is farmer or non-farmer [a farm household is defined as the one where the primary occupation of the household head is farming or if the major part of the household income is from farming. Note: in the selected study area, there are only few households that do no farming at all]. One can realistically assume that seasonal income patterns will differ for farm and non-farm households. This is because, unlike farm households for whom there are seasonal peaks for work in farming, non-farm households are more likely to work in all months of the year to stabilize their income flows (however, it should be noted that where non farm households depend on farming for employment, their timing of income flows would partly be similar to those of farm households.

(ii) access to irrigation infrastructure: access to irrigation infrastructure enables farm households to increase annual cropping intensity, level of crop diversification and overall productivity through cultivation in both wet (Maha) and dry (Yala) seasons, compared to those without access to irrigation infrastructure, leading to higher incomes from dry season cultivation. As shown in chapter 8 (table 8.1), households in irrigated strata and extension (rainfed) stratum received average monthly incomes of Rs. 14664 and Rs. 4713, respectively, from dry season cultivation. Differences in cropping patterns and the level of crop diversification (due to access or lack of access to irrigation infrastructure) could also affect not only the level of household incomes but also the timing of income flows. Cultivation of other field crops (OFCs), that is crops other than paddy, such as vegetables, banana etc (which are high value crops) may provide incomes for extended period of time during the growing season. For example, household monthly income patterns for Sooriyawewa (where a relatively greater proportion of area is allocated to OFCs including banana) and Sevenagala (where mostly sugarcane is grown) are quite different from those observed in other strata (see chapter 8,table 8.1). Thus, household access to irrigation infrastructure could influence timing of income flows, and comparison of those who do and who do not have access to irrigation infrastructure should provide useful information about the effects of seasonal income patterns on seasonal consumption patterns

Before we discuss these sub-samples, let us specify and estimate the following general model to analyze the seasonal/month effects in expenditures for the entire sample of cases. The null hypothesis tested is Ho: there are no month effects in expenditures across months.

$$\ln(E_{ji}) = \alpha_0 + \alpha_1 \ln(Y_i) + \beta_j M_j + \varepsilon_{ji} \quad \text{..... (10.1)}$$

where

$Ln(E_{ji})$ = log of monthly household expenditures
$Ln\ (Y_i)$ = log of household average monthly income (annual income divided by 12)
M_j = monthly dummies (October though to September). First month is October (October =1, =0 otherwise and so on and so forth). Omitted month is September (to avoid the problem of perfect collinearity in estimations).

j= number of months (=11)

αs, *and* βs, are respective parameters to be estimated

ε is error term

α_0 is a constant terms, which includes the effects of omitted month;

α_1 measures the effects of average monthly incomes on monthly expenditures;

β_j measures the month effects in expenditures of non-income factors (timing of income flows, preferences, prices) (j= 1, 2, 3...11) relative to the omitted month (September);

The Greater Colombo Area Consumer Price Index (GCCPI) was used to deflate monthly income and expenditure, with the month of October 2000 as the base month. In order to obtain deflated values using October 2000 as base month, the monthly expenditure and income is divided by the monthly factor constructed using the monthly GCCPI.

Table 10.0 Deflation factor using Greater Colombo Consumer Price Index

Month	GCCPI	GCCPI Base October 2000
Oct.2000	252.5	1.000
Nov.	254.5	1.008
Dec.	263.4	1.043
Jan.2001	267.5	1.059
Feb.	270.5	1.071
Mar.	266.9	1.057
Apr.	272.9	1.081
May	278.8	1.101
Jun.	282.3	1.118
Jul.	281.8	1.116
Aug.	279.8	1.108
Sep.	284.8	1.128

Regression results are presented in table Table 10.1. The numbers under column Month are estimates of month effects relative to the base/omitted month, that is September). The results of the regression analysis show that non-income month effects in expenditures are significant and negative from October through to December and in August. The month effects are positive and significant in April, May and July. From January through to March and in June the coefficients are not significant. The null hypothesis that there are no month effects is rejected at 1 percent level of significance. The average monthly household income is positive, as expected, and significant at 1 percent level of significance. The coefficient of Ln (Yi) suggests that 1 percent increase in average monthly incomes increases expenditures by 0.28 percent. The following points should be noted: (1) Month effects in expenditures are positive and significant in April and May and could be reflecting the additional expenditures incurred for new-year celebrations (Sinhala new-year is in the month of April and Wesak in

Table 10.1 Regression results – General Model

Dependent Variable: Ln(Eji) Log of average monthly household expenditure

Variable	*Month*	*STE*	*t*
Oct.	-0.149	0.026	-5.69**
Nov.	-0.124	0.026	-4.74**
Dec.	-0.080	0.026	-3.08**
Jan.	0.018	0.026	0.68
Feb.	-0.050	0.026	-1.92
Mar.	-0.019	0.026	-0.72
Apr.	0.534	0.026	20.48**
May	0.095	0.026	3.63**
Jun.	0.032	0.026	1.20
Jul.	0.123	0.026	4.67**
Aug.	-0.102	0.026	-3.90**
Sep.	-	-	-
Constant term	6.091	0.059	103.69**
Ln (Yi)	0.280	0.006	43.49**
N = 10065	R^2 = 0.227	df = 12	F=246.4

* indicated significance at 1 percent level.

Test: H0: 1- No month effects in expenditures Pr = 0.001
Ho is rejected

Note: The month effects in expenditures should be interpreted by taking into account the effect of omitted month i.e. September in this case.

May). April is also a month when households receive incomes from Maha harvest. (2) The reason for significant positive month effects in July is less clear. In general, June and July are critical months in dry/Yala season when incomes drop to lower levels and expenditures tend to decrease. (3) The month effect is negative in August and from October to December. In all other months, month effects are not significant (month effects in expenditures are negative, though insignificant, for February and March. These are the months just before Maha harvest). In general, month effects are more pronounced for months when income levels increase or decrease significantly (e.g. month effects in expenditures are higher for months of crop harvest, and tend to decline thereafter), suggesting that the timing of income flows also has some influence in monthly expenditures[1]. The overall conclusions is that the households in the study area have significant month effects in expenditures, with peaks in expenditures in April and September, and decline in months that follow these months.

[1] We also estimated the above equation by including the variable for monthly income share to capture the monthly income shares effects on expenditures. The coefficient of monthly income share (estimated at 0.006) is found to be positive and significant at 1 percent level. The small coefficient suggests that the effects of monthly income on expenditures are less than that of other factors, confirming that other factors such as prices and preferences also play an important role in determining monthly expenditures. The overall conclusion is that monthly income share does have some influence on monthly expenditures, although the effect is small.

Monthly expenditures are determined by average monthly incomes, non-income month effects (preferences, prices, weather), and timing of income flows. The results suggest that while households tend to generally smooth consumption, timing of income receipts do have some influence on monthly expenditures – the case of imperfect smoothing. We will show, in the remaining part of this chapter, if and how this effect varies across strata and socio-economic groups.

Using the Paxon's framework, we further analyze variations in monthly household expenditures for 10 separate sub-samples based on the above described characteristics to understand any behavioral differences across households. The general regression model for such comparisons is specified as follows:

$$\ln(E_{ji}) = \alpha_0 + \alpha_1 \ln(Y_i) + \beta_j M_j + \theta_j M_j * Z + \varepsilon_{ji} \quad \text{.....(10.2)}$$

where

$Ln(E_{ji})$ = log of monthly household expenditures
$Ln\ (Y_i)$ = log of household average monthly income (annual income divided by 12)
A_{ji} = monthly share of household income (ratio of income earned in a month to average monthly income)
Z = dummy variable for location/strata, access to irrigation, occupation depending on the sample of households
M_j = monthly dummies (October though to September). First month is October (October =1, =0 otherwise and soon and so forth). Omitted month is September (to avoid the problem of perfect collinearity in estimations).
j= number of months (=11)
αs, βs ,*and* θs are respective parameters to be estimated
ε is error term

α_0 is a constant terms, which includes the effects of omitted month and when Z=0 for variables without interaction terms;

α_1 measures the effects of average monthly incomes on monthly expenditures;

β_j measures the month effects in expenditures (j= 1, 2, 3...11) relative to omitted/base month (September) for households when Z=0;

θ_j measures the additional month effects in expenditures relative to base/omitted month for households with when Z= 1

The above equation was estimated using Ordinary Least Squares, and several hypotheses tested to determine the significance of month effects in expenditures for each of the following 11 samples.

1. Z= 1 for stratum1 (with improved infrastructure) and Z= 0 for stratum 5 (rainfed/no infrastructure)
2. Z= 1 for stratum 2 (rainfed/no infrastructure) and Z= 0 for stratum 5 (rainfed/no infrastructure)
3. Z= 1 for stratum 3 (with improved infrastructure) and Z= 0 for stratum 5 (rainfed/no infrastructure)
4. Z= 1 for stratum 4 (with improved infrastructure) and Z= 0 for stratum 5 (rainfed/no infrastructure)
5. Z= 1 for stratum 6 (with un-improved infrastructure) and Z= 0 for stratum 5 (rainfed/no infrastructure)
6. Z=1 for irrigated (with infrastructure) and Z=0 for rainfed/no infrastructure
7. Z=1 for farmers and Z= 0 for non-farmers
8. Z= 1 for stratum 1 (with improved infrastructure) and Z=0 for stratum 6 (with un-improved infrastructure)
9. Z= 1 for stratum 3 (with improved infrastructure) and Z=0 for stratum 6 (with un-improved infrastructure)
10. Z=1 for stratum 4 (with improved infrastructure) and Z=0 for stratum 6 (with un-improved infrastructure)

11. Z=1 for stratum 3 (with improved infrastructure) and Z=0 for stratum 4 (with improved infrastructure)

The following four tests are conducted for testing null and alternative hypotheses.

Test1
Ho: No month effects in household expenditures for those with Z=0;
H1: At least one of the month parameters is not equal to zero

Test2
Ho: No month effects in household expenditures for those with Z=1;
H1: At least one of the month parameters is not equal to zero

Test3
No difference in month effects in household expenditures for Z=0 and Z=1
H1: At least one of the month parameters is not equal to zero

Test4
Ho: The difference in month effects in household expenditures for Z=0 and Z=1 is constant across months.
H1: At least one of the month parameters is not equal.

Tests 1 and 2 are the tests of null hypotheses of no seasonal effects in expenditures across months for those with Z=0 and Z=1, respectively. Hypothesis in test 3 tests whether 12 month * Z interactions are jointly insignificant. Test 4 tests whether the parameters of 12 month * Z interactions are constant across months. This test provides information on whether the patterns of month effects in expenditures are the same for two groups, without requiring that the level of expenditures be the same for the two groups. The joint tests on parameters were performed using F-statistics as follows:

$$F_{calculated} = \frac{(ESS_R - ESS_{UR})/m}{ESS_{UR}/(N-k)}$$

Where
ESS_R = Error sum of squares of the restricted model
ESS_{UR} = Error sum of squares of the unrestricted model
m = number of restrictions (number of coefficients set equal to zero)
k = number of parameters in the unrestricted model
N = number of observations
If the value of $F_{calculated}$ is greater than $F_{critical}$, the null hypothesis is rejected otherwise accepted. $F_{calculated}$ is F [α (k-1, N-k)] at the α level of significance and (k-1) numerator df and (N-k) denominator df. The results for the 11 samples are presented in Tables 10.2 to 10.12, and figures 10.1 to 10.11. Before we discuss results for all samples, we present here a brief summary of results common to all samples.

In all samples, the effect of average monthly income in expenditures is positive and significant as expected. The magnitude of the coefficient of average monthly income varies

from 0.195 to 0.302, indicating that 1 percent increase in average monthly incomes will increase monthly expenditures by 0.195 percent and 0.0302 percent, respectively.

In all the 11 samples, which compare two groups of households with different income patterns due to access to infrastructure, level of infrastructure development and occupations of households, null hypotheses of all the four tests are rejected. The results indicate that (i) there are month effects in expenditures in all strata and for all socio-economic categories considered in this study; (ii) there are differences in month effects in all strata and socio-economic categories, and (iii) differences in month effects between strata and between categories are not constant, indicating that the patterns of expenditures are not the same between the groups of households compared. Comparison of strata with irrigation infrastructure with Extension/rainfed (without infrastructure) indicates that differences in month effects in expenditures are higher for August and September (i.e. dry season months). It is the difference in expenditures in these two months that drives the differences in month effects in expenditures between the two groups of households, resulting in different patterns in expenditures. Expenditures of households in strata with irrigation infrastructure are higher (for all strata) than that in strata without infrastructure, and it is this fact that is influencing the results of test 3 (in all samples). Expenditures in August and September (Yala season) are much higher for households in strata with irrigation infrastructure compared to those households in strata without irrigation infrastructure, and it is this difference that is driving the results of test 4. These results are more clearer in comparison of households in irrigated (all) with those in rainfed areas, where month effects in expenditures for households in irrigated areas are higher and significant for all months, and patterns of monthly expenditures are different, especially during August and September. Comparison of farm (all) and non-farm (all) categories suggest that month effects in expenditures are higher for farmers compared to non-farmers, and the patterns of monthly expenditures are not identical, at least for certain months. The results from these comparisons imply that household groups who have different income patterns, also have different expenditure patterns (although not in all months), suggesting that in addition to average monthly incomes and pure month effects (preferences, prices), timing of income receipts do influence monthly expenditures (the case of imperfect smoothing). Household access to infrastructure helps in improving average incomes, and increasing monthly incomes during the dry season period. Therefore, households with access to irrigation infrastructure are in better position to smooth their expenditures compared to those without it.

Sample –1: *Sevenagala Irrigated and Extension/Rainfed*

Table 10.3 compares the regression results for Sevanagala irrigated area and the Extension area. Month effects for all months except August are positive and significant for the base case (Extension area). The coefficients of month*Z variables are the differences (or the additional effects) that access to infrastructure makes in month effects in expenditures. The additional monthly effects for Sevenagala irrigated area are significant and positive only for the months of August and September (dry season months). The effect of average monthly incomes on monthly expenditures is positive, as expected, and significant.

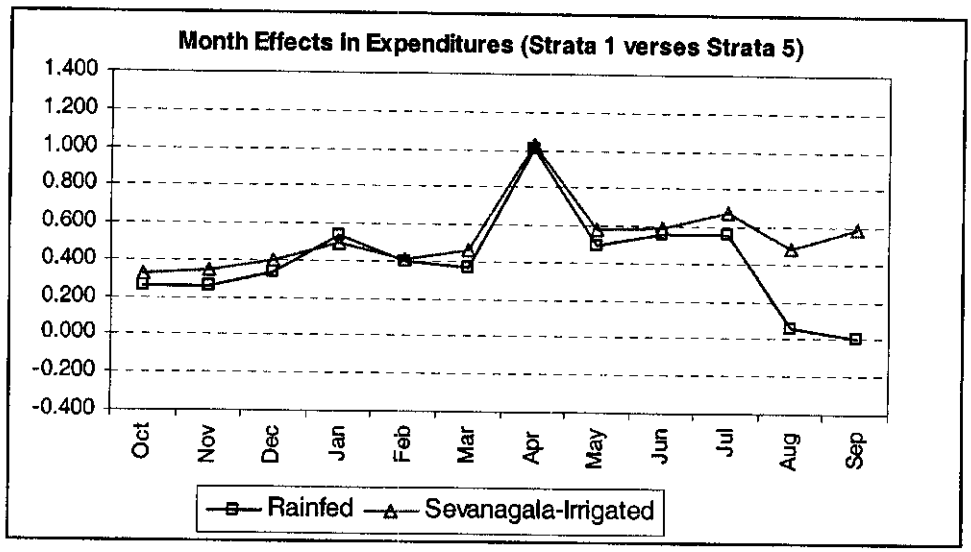
The results suggest that there is a significant effect in expenditures of average monthly income and of months in both strata. The monthly consumption expenditure is dependent on average monthly income, preferences and prices. All four tests of null hypotheses are rejected, which means that, there are month effects in both Sevanagala irrigated and Extension area, there are differences in month effects between the two strata, and that the differences in month effects between the strata are not constant. The graph shows that the monthly variations in consumption expenditures, over the base/omitted month (September in this case) are higher for Sevanagala irrigated area compared to the rainfed Extension area. The pattern is similar in peak in April in both strata (due to new-year and timing of Maha harvest), but it is different for August and September.

Table 10.2: Sample 1: Strata 1 (Sevanagala Irrigated) and Strata 5 (Extension/Rainfed)

Dependent Variable: Ln(Eji)						
Sample 1 : Strata 1 (Sevanagala Irrigated) and Strata 5 (Extension/Rainfed)						
Z=1 Sevanagala Irrigated; Z=0 for Extension/Rainfed						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.261	0.071	3.691**	0.058	0.064	0.912
Nov.	0.259	0.071	3.659**	0.086	0.064	1.338
Dec.	0.332	0.071	4.683**	0.068	0.064	1.068
Jan.	0.540	0.071	7.641**	-0.049	0.064	-0.771
Feb.	0.403	0.071	5.695**	0.008	0.064	0.122
Mar.	0.364	0.071	5.159**	0.097	0.064	1.516
Apr.	1.009	0.071	14.283**	0.022	0.064	0.347
May	0.497	0.071	7.031**	0.081	0.064	1.278
Jun.	0.554	0.071	7.783**	0.039	0.064	0.599
Jul.	0.563	0.071	7.914**	0.115	0.064	1.778
Aug.	0.053	0.071	0.750	0.431	0.064	6.732**
Sep.	0.000			0.588	0.064	9.183**
Constant term	5.456	0.099	54.971			
Ln (Yi)	0.284	0.010	27.564			
Test 1	F=30.47	P=.0001				
Test 2	F=22.35	P=.0001				
Test 3	F=11.41	P=.0001				
Test 4	F=12.73	P=.0001				
N = 3216	df =24	R^2 = 0.324	F=63.74			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.1



Sample-2: *Sevenagala Rainfed and Extension/Rainfed*

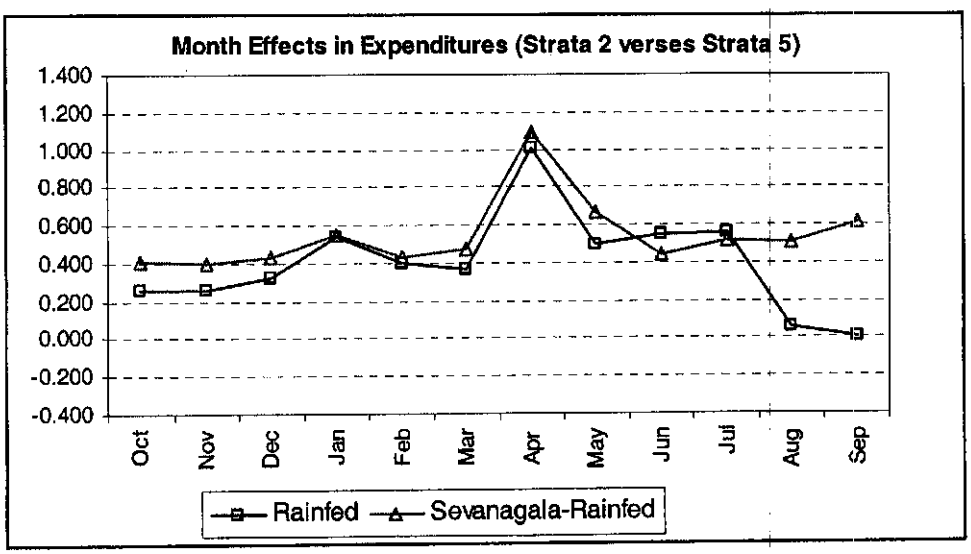
The regression results comparing Sevanagala rainfed and Extension area shows significant positive month effects for the Extension area for all months except for August.
The additional monthly effects for Sevanagala rainfed area are significant and positive only for the months of August and September. The month effects are generally higher for Sevanagala rainfed area compared to Extension area, except in June and July. The effect of average monthly incomes on monthly expenditures is positive, as expected, and significant. All four null hypotheses are rejected, indicating that there are month effects in both Sevanagala rainfed and Extension area, there are differences in month effects between the strata, and that the differences in month effects between the strata are not constant. Figure 10.2 compares graphically the month effects in the two strata. The patterns are similar with peaks in January and April, but the effects are lower in the Extension area. Lower month effects in Extension area in August and September reflect lower or no incomes from dry season cultivation. Differences in month effects in these two strata also reflect differences in cropping patterns , as sugarcane is the major crop grown in Sevanagala rain-fed area.

Table 10.3: Sample 2 : Strata2 (Sevanagala-Rainfed) and Strata 5 (Extension/Rainfed)

Dependent Variable: Ln(Eji)						
Sample 2 : Strata2 (Sevanagala-Rainfed) and Strata 5 (Extension/Rainfed)						
Z=1 Kiriibbanwewa; Z=0 for Extension/Rainfed						
Variable	Month	STE	t	Month X Z	STE	T
Oct.	0.258	0.069	3.755**	0.153	0.083	1.843
Nov.	0.257	0.069	3.732**	0.141	0.083	1.695
Dec.	0.329	0.069	4.784**	0.097	0.083	1.159
Jan.	0.537	0.069	7.817**	0.013	0.083	0.158
Feb.	0.401	0.069	5.825**	0.030	0.083	0.357
Mar.	0.362	0.069	5.265**	0.113	0.083	1.351
Apr.	1.006	0.069	14.645**	0.084	0.083	1.005
May	0.494	0.069	7.189**	0.172	0.083	2.080*
Jun.	0.551	0.069	7.954**	-0.113	0.086	-1.303
Jul.	0.560	0.069	8.089**	-0.045	0.086	-0.523
Aug.	0.053	0.069	0.771	0.453	0.083	5.435**
Sep.	0.000			0.610	0.083	7.311**
Constant term	6.194	0.130	47.826			
Ln (Yi)	0.195	0.014	13.533			
Test 1	F=30.47	P=.0001				
Test 2	F=22.35	P=.0001				
Test 3	F=11.41	P=.0001				
Test 4	F=12.73	P=.0001				
N = 1875	df =24	R^2 = 0.274	F=29.14			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.2



Sample-3: *Kiriibbanwewa and Extension/Rainfed*

Table 10.5 presents the results of the regression analysis comparing Kirribbanweva and Extension area. The results indicate that the month effects in expenditures are positive and significant for all months for the Extension area (except for August) and additional month effects for Kirribbanweva are positive and significant for all months including September.

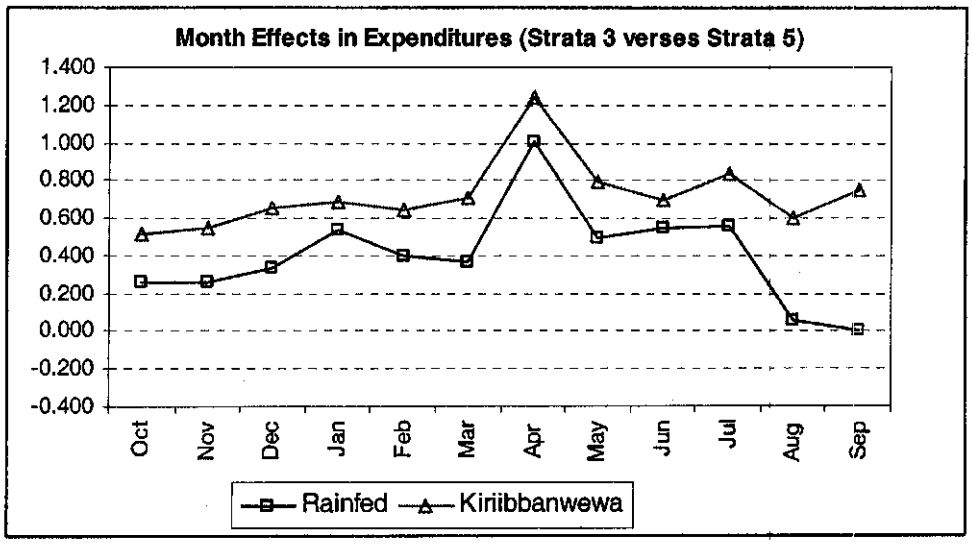
The month effects are generally higher for Kirribbanweva area compared to Extension area. The effect of average monthly incomes on monthly expenditures is positive, as expected, and significant. All four null hypotheses are rejected, indicating that there are month effects in both Kirribbanweva and Extension area, there are differences in month effects between the strata, and that the differences in month effects between the strata are not constant. Figure 10.2 compares graphically the month effects in the two strata. The patterns are similar with a high peak in April, due to the new-year, and smaller peaks in January and July, but the effects are lower in the Extension area. The higher month effects in August and September in Kiriibbanwewa reflect the effects of dry season (Yala) cultivation, suggesting that timing of income flows do influence expenditures.

Table 10.4: Sample3 : Strata3 (Kiriibbanwewa) and Strata 5 (Extension/Rainfed)

Dependent Variable: Ln(Eji)						
Sample3 : Strata3 (Kiriibbanwewa) and Strata 5 (Extension/Rainfed)						
Z=1 Kiriibbanwewa; Z=0 for Extension/Rainfed						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.260	0.070	3.734**	0.260	0.064	4.066**
Nov.	0.258	0.070	3.705**	0.295	0.064	4.601**
Dec.	0.331	0.070	4.744**	0.322	0.064	5.020**
Jan.	0.539	0.070	7.746**	0.152	0.064	2.370**
Feb.	0.402	0.070	5.773**	0.241	0.064	3.760**
Mar.	0.363	0.070	5.225**	0.349	0.064	5.457**
Apr.	1.008	0.070	14.490**	0.229	0.064	3.586**
May	0.496	0.070	7.126**	0.295	0.064	4.606**
Jun.	0.553	0.070	7.887**	0.140	0.065	2.163*
Jul.	0.562	0.070	8.020**	0.273	0.065	4.221**
Aug.	0.053	0.070	0.762	0.550	0.065	8.521**
Sep.	0.000			0.745	0.065	11.533**
Constant term	5.728	0.107	53.677			
Ln (Yi)	0.251	0.011	22.073			
Test 1	F=30.47	P=.0001				
Test 2	F=22.35	P=.0001				
Test 3	F=11.41	P=.0001				
Test 4	F=12.73	P=.0001				
N = 3008	df =24	R^2 = 0.314	F=56.91			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.3



Sample-4: *Sooriyawewa and Extension/Rainfed*

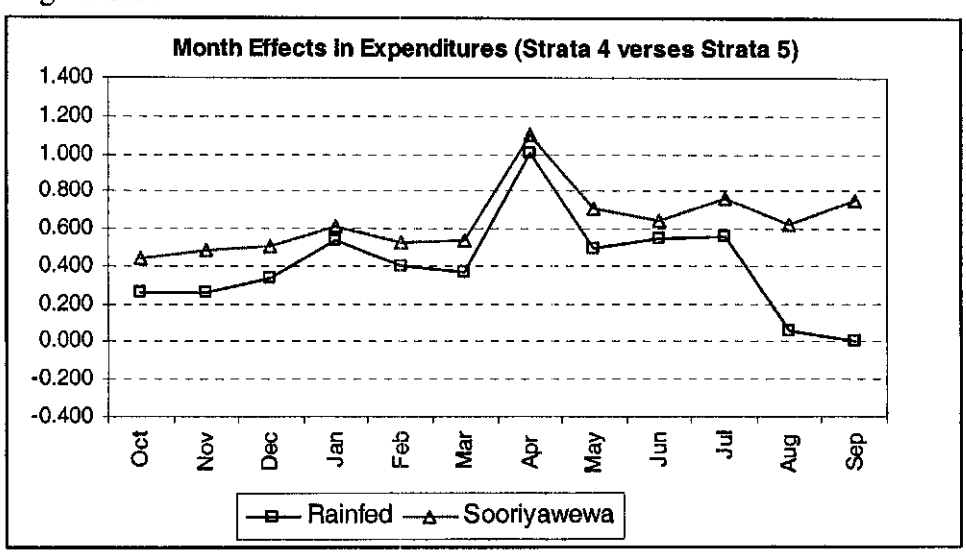
Table 10.6 presents the regression results for comparing Sooriyawewa and Extension area. The month effects in the Extension area are significant and positive for all months except for August. For the Sooriyawewa area, additional month effects are positive and significant for all months, except for December, April and June. The effect on expenditures due to average monthly incomes is positive and significant. In all four tests the null hypothesis is rejected. This means that there are month effects in both strata and the month effects are different and not constant in the two locations. Figure 10.4 compares graphically the month effects of the two strata. The patterns are similar with a high peak in April, due to the new-year, and smaller peaks in January and July, but the effects are lower in the Extension area. As in Kiriibbanwewa, the higher month effects in August and September in Sooriyawewa reflect the effects of dry season (Yala) cultivation, suggesting that timing of income flows do influence expenditures.

Table 10.5 Sample 4 : Strata4 (Sooriyawewa) and Strata 5 (Extension/Rainfed)

Dependent Variable: Ln(E|I)						
Sample 4 : Strata4 (Sooriyawewa) and Strata 5 (Extension/Rainfed)						
Z=1 Sooriyawewa; Z=0 for Extension/Rainfed						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.260	0.070	3.712**	0.186	0.060	3.111**
Nov.	0.259	0.070	3.681**	0.228	0.060	3.801**
Dec.	0.331	0.070	4.712**	0.177	0.060	2.956**
Jan.	0.539	0.070	7.690**	0.069	0.060	1.157
Feb.	0.403	0.070	5.732**	0.127	0.060	2.125*
Mar.	0.364	0.070	5.191**	0.176	0.060	2.942**
Apr.	1.009	0.070	14.378**	0.098	0.060	1.632
May	0.496	0.070	7.076**	0.213	0.060	3.571**
Jun.	0.553	0.071	7.832**	0.090	0.061	1.483
Jul.	0.563	0.071	7.965**	0.202	0.061	3.309**
Aug.	0.053	0.070	0.755	0.572	0.060	9.483**
Sep.	0.000			0.746	0.060	12.366**
Constant term	5.535	0.104	53.166			
Ln (Yi)	0.274	0.011	24.958			
Test 1	F=30.47	P=.0001				
Test 2	F=22.35	P=.0001				
Test 3	F=11.41	P=.0001				
Test 4	F=12.73	P=.0001				
N = 3932	df =24	R^2 = 0.285	F=64.96			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.4



Sample-5: *Ridiyagama and Extension/Rainfed*

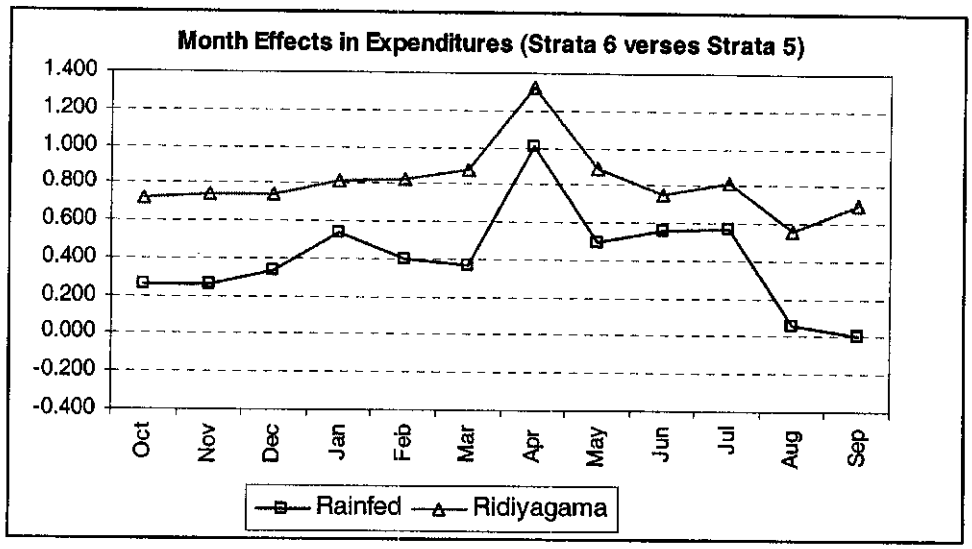
Table 10.7 presents the regression results comparing Ridyagama and the Extension area. Month effects in expenditures for the Extension area are significant and positive for all months except August. In the case of Ridiyagama, the additional month effects are significant and positive for all months including September. Thus overall month effects are higher for Ridiyagama compared to Extension area. The effect of average monthly income is significant and positive. In all four tests the null hypothesis is rejected, indicating there are month effects in both locations. In addition there are differences in month effects and these differences are not constant. Figure 10.5 compares graphically, the month effects of the two strata. The patterns are similar with a high peak in April, due to the new-year, and smaller peaks in January and July, but the effects are lower in the Extension area. As in other irrigated strata, the higher month effects in August and September in Ridyagama reflect the effects of dry season (Yala) cultivation, suggesting that timing of income flows do influence expenditures. In Ridyagama, month effects in expenditure are higher compared to not only Extension, but all other irrigated strata. This is despite that infrastructure in this stratum is unimproved, but overall incomes are higher due to higher productivity resulting from greater availability of water (compared to other strata).

Table 10.6 Sample 5 : Strata 6 (Ridiyagama) and Strata 5 (Extension/Rainfed)

Dependent Variable: Ln(Eji)						
Sample 5 : Strata 6 (Ridiyagama) and Strata 5 (Extension/Rainfed)						
Z=1 Ridiyagama; Z=0 for Extension/Rainfed						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.261	0.072	3.646**	0.460	0.067	6.877**
Nov.	0.260	0.072	3.613**	0.483	0.067	7.203**
Dec.	0.332	0.072	4.622**	0.403	0.067	6.008**
Jan.	0.540	0.072	7.540**	0.273	0.067	4.073**
Feb.	0.404	0.072	5.620**	0.418	0.067	6.226**
Mar.	0.365	0.072	5.093**	0.508	0.067	7.593**
Apr.	1.009	0.072	14.086**	0.317	0.067	4.734**
May	0.497	0.072	6.938**	0.392	0.067	5.861**
Jun.	0.555	0.072	7.681**	0.192	0.068	2.826**
Jul.	0.564	0.072	7.811**	0.247	0.068	3.638**
Aug.	0.053	0.072	0.739	0.506	0.067	7.541**
Sep.	0.000			0.702	0.067	10.454**
Constant	5.302	0.119	44.56			
Ln (Yi)	0.302	0.013	23.374			
Test 1	F=30.47	P=.0001				
Test 2	F=22.35	P=.0001				
Test 3	F=11.41	P=.0001				
Test 4	F=12.73	P=.0001				
N = 2978	df =24	R^2 = 0.424	F=90.43			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.5



Sample-6: *Irrigated (all) and Rainfed (all)*

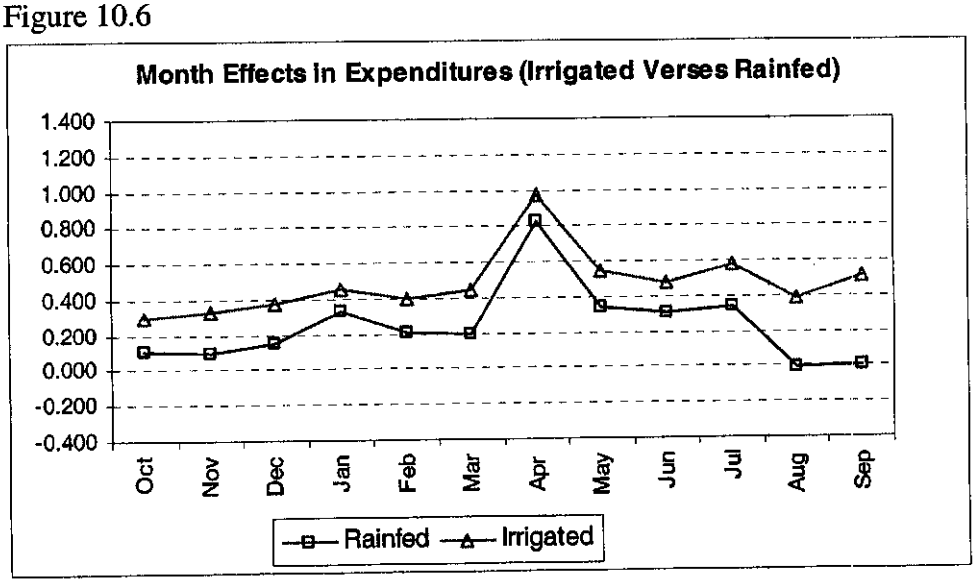
Table 10.8 presents the regression results for Irrigated and Rainfed sample. The coefficients of the month effects are positive and significant for the Rainfed area, except for August, October and December. In the case of the Irrigated area, the additional month effects are also positive and significant for all months including September. The effect of average monthly income is positive and significant. In all four tests, the null hypothesis is rejected. Here too there are month effects in both locations, and there are differences in month effects and these differences are not constant across months. Figure 10.6 compares graphically the month effects in expenditures in irrigated and rainfed areas. The patterns are similar with peaks in January, April and July, but the effects are lower in the Rainfed area. Expenditures in irrigated areas are higher for all months, including for August and September (dry season months) than those in rainfed areas. These differences drive the results of test 3 and 4.

Table 10.7 Sample 6 Irrigated and Rainfed

Dependent Variable: Ln(EJI)						
Sample 6 : Irrigated and Rainfed						
Z=1 if Irrigated, and Z=0 if Rainfed						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.102	0.059	1.730	0.198	0.046	4.275**
Nov.	0.097	0.059	1.650	0.235	0.046	5.054**
Dec.	0.154	0.059	2.610**	0.218	0.046	4.693**
Jan.	0.334	0.059	5.660**	0.118	0.046	2.552**
Feb.	0.203	0.059	3.440**	0.195	0.046	4.204**
Mar.	0.192	0.059	3.250**	0.247	0.046	5.335**
Apr.	0.827	0.059	14.020**	0.147	0.046	3.166**
May	0.346	0.059	5.860**	0.198	0.046	4.291**
Jun.	0.307	0.060	5.120**	0.167	0.047	3.513**
Jul.	0.339	0.060	5.650**	0.240	0.047	5.062**
Aug.	-0.001	0.059	-0.010	0.383	0.047	8.238**
Sep.	0.000			0.508	0.047	10.926**
Constant term	5.7690	0.068	84.393			
Ln (Yi)	0.2700	0.006	42.431			
Test 1	F=127.52	P=.0001				
Test 2	F=75.97	P=.0001				
Test 3	F=31.45	P=.0001				
Test 4	F=35.01	P=.0001				
N 10065	df =24	$R^2 = 0.255$	F=143.01			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.6



Sample-7: *Farmers (all) and non-farmers (all)*

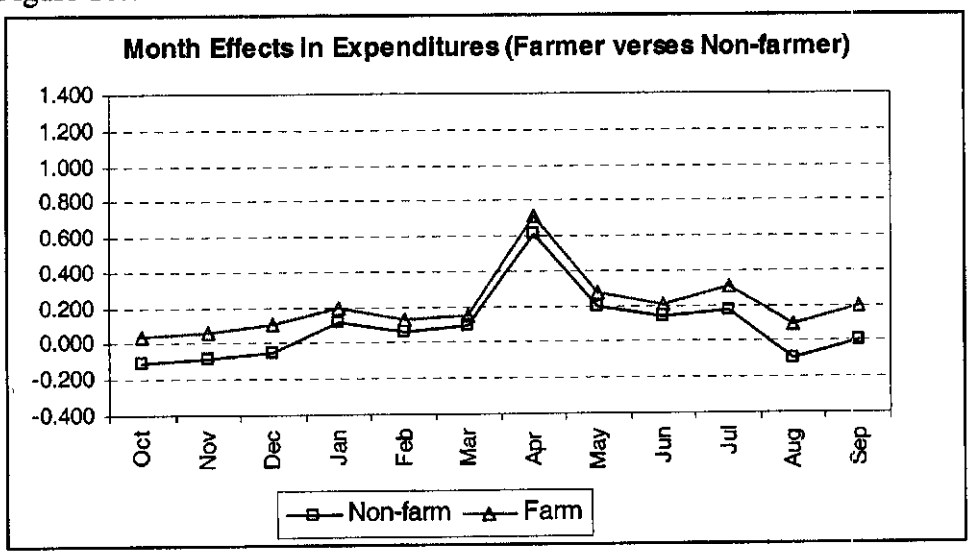
Table 10.9 presents the regression results comparing farm households with non-farm households. For non-farm households, month effects are positive and significant from April to July, and insignificant for other months. The additional effects for farm households are positive and significant for the months of October, November, December, April, July, August and September. This means that Non-Farmers have month effects only for four months as compared to seven months for the farmer group. The effect of average monthly income in monthly expenditures is positive and significant. The hypothesis tests 1, 2, 3 and 4 are rejected at 1 percent level of significance. This means that there are month effects for both Farmers and Non-Farmers, and there are differences in month effects between the two groups and these differences in month effects between the groups are not constant. Figure 10.7 compares graphically the month effects in expenditures for farm and non-farm households.

Table 10.8 Sample 7 Farmer and Non-farmer

Dependent Variable: Ln(Eji)						
Sample 7 : Farmer and Non-farmer						
Z=1 if Farm, and Z=0 if Non-farm						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	-0.113	0.065	-1.721	0.153	0.050	3.033**
Nov.	-0.084	0.065	-1.282	0.148	0.050	2.940**
Dec.	-0.053	0.065	-0.817	0.163	0.050	3.247**
Jan.	0.121	0.065	1.858	0.072	0.050	1.433
Feb.	0.063	0.065	0.973	0.061	0.050	1.208
Mar.	0.091	0.065	1.390	0.065	0.050	1.302
Apr.	0.611	0.065	9.359**	0.104	0.050	2.077*
May	0.197	0.065	3.023**	0.074	0.050	1.467
Jun.	0.139	0.066	2.111*	0.068	0.051	1.337
Jul.	0.177	0.066	2.685**	0.132	0.051	2.588**
Aug.	-0.094	0.066	-1.428	0.186	0.051	3.672**
Sep.	0.000			0.196	0.051	3.874**
Constant term	5.989	0.071	83.872			
Ln (Yi)	0.273	0.006	42.11			
Test 1	F=22.77	P=.0001				
Test 2	F=80.45	P=.0001				
Test 3	F=16.47	P=.0001				
Test 4	F=11.87	P=.0001				
N = 10065	df =24	R^2 = 0.233	F=127.17			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.7



Other Sub-samples

In this sub-set of sub-samples, we compare groups of households, who have fairly similar timing of income receipts. Specifically, we compare irrigated strata with and without improved infrastructure and two strata both with improved infrastructure. Ridyagama has un-improved infrastructure, while all other strata have improved infrastructure. Results are presented in Tables 10.9 to 10.12 and shown in Figures 10.8 to 10.11. In the first three sub-samples (Sevanagala irrigated and Ridyagama, Kiriibbanwewa and Ridyagama, Sooriyawewa and Ridyagama), month effects in expenditures are higher for Ridyagama compared to all other strata, and the patterns in expenditures in most months including August and September are fairly similar, as both groups of households do double cropping (i.e. in both Yala and Maha). In August and September, the difference in month effects is insignificant in the case of Sooriyawewa and Ridyagama and Kiriibbanwewa and Ridyagama (as cropping patterns are fairly similar in these strata). As mentioned earlier, income and expenditure levels in Ridyagama are higher compared to all other strata despite that infrastructure is un-improved. This is because availability of irrigation water in Ridyagama is much higher compared to all other strata, resulting in relatively higher productivity in this stratum.

Comparison of two strata, both with improved infrastructure (Kiriibbanwewa and Sooriyawewa) suggests that effects in expenditures in most months are insignificant, including those in dry season months. Expenditure patterns in both strata are fairly similar. These results suggest that where timing of income flows are fairly similar, consumption patterns also tend to be similar, further supporting that timing of income flows do influence monthly expenditures.

Table 10.9 Sample 8: Sevanagala Irrigated and Ridyagama

Dependent Variable: Ln(Eji)						
Sample 13 : Strata 1 (Sevanagala-Irrigated) and Strata 6 (Ridiyagama)						
Z=1 for Sevanagala Irrigated; Z=0 for Ridiyagama						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.019	0.062	0.316	-0.414	0.060	-6.929**
Nov.	0.041	0.062	0.661	-0.410	0.060	-6.852**
Dec.	0.033	0.062	0.536	-0.347	0.060	-5.801**
Jan.	0.111	0.062	1.800	-0.334	0.060	-5.587**
Feb.	0.119	0.062	1.938	-0.422	0.060	-7.068**
Mar.	0.171	0.062	2.777**	-0.424	0.060	-7.095**
Apr.	0.624	0.062	10.133**	-0.307	0.060	-5.140**
May	0.187	0.062	3.041**	-0.323	0.060	-5.409**
Jun.	0.044	0.062	0.717	-0.166	0.060	-2.748**
Jul.	0.109	0.062	1.755	-0.145	0.060	-2.400**
Aug.	-0.143	0.062	-2.309*	-0.087	0.060	-1.447
Sep.	0.000			-0.125	0.060	-2.091*
Constant term	6.106	0.105	58.203			
Ln (Yi)	0.291	0.011	27.681			
Test 1	F=17.44	P=.0001				
Test 2	F=22.35	P=.0001				
Test 3	F=27.32	P=.0001				
Test 4	F=30.10	P=.0001				
N = 3721	Df =24	R^2 = 0.312	F=69.90			

Figure 10.8

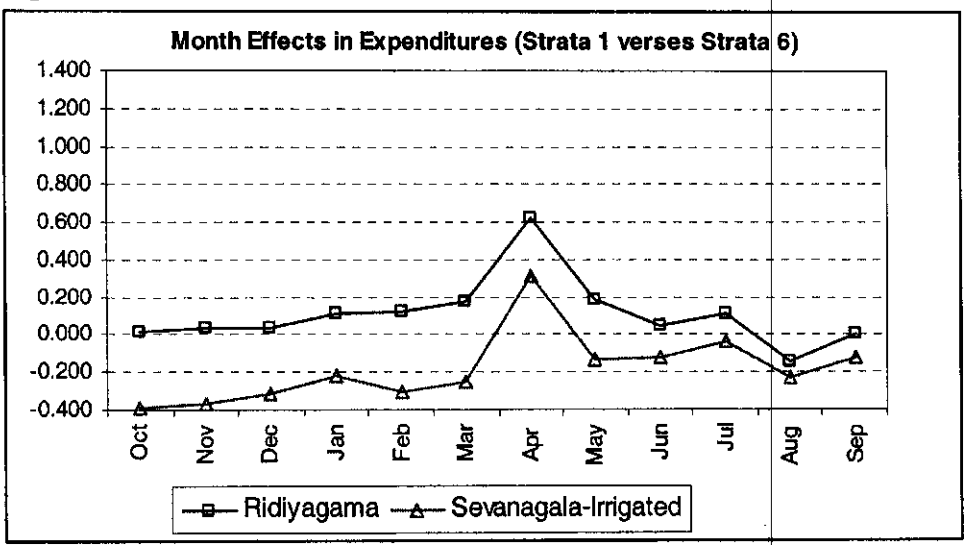


Table 10.10 Sample 9: Kiriibbanwewa and Ridyagama

Dependent Variable: Ln(Eji)						
Sample 14 : Strata 3 (Kirlibbanwewa) and Strata 6 (Ridiyagama)						
Z=1 for Kiriibbanwewa; Z=0 for Ridiyagama						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.019	0.061	0.316	-0.233	0.061	-3.812**
Nov.	0.041	0.061	0.665	-0.221	0.061	-3.609**
Dec.	0.033	0.061	0.539	-0.114	0.061	-1.859
Jan.	0.111	0.061	1.815	-0.154	0.061	-2.517**
Feb.	0.119	0.061	1.954	-0.209	0.061	-3.421**
Mar.	0.171	0.061	2.801**	-0.192	0.061	-3.140**
Apr.	0.624	0.061	10.229**	-0.120	0.061	-1.968*
May	0.187	0.061	3.068**	-0.130	0.061	-2.134*
Jun.	0.045	0.061	0.724	-0.085	0.062	-1.380
Jul.	0.109	0.061	1.773	-0.007	0.062	-0.115
Aug.	-0.143	0.061	-2.332	0.012	0.062	0.201
Sep.	0.000			0.011	0.062	0.183
Constant term	6.378	0.114	55.879			
Ln (Yi)	0.261	0.012	22.426			
Test 1	F=17.44	P=.0001				
Test 2	F=19.89	P=.0001				
Test 3	F=5.09	P=.0001				
Test 4	F=6.96	P=.0001				
N =3513	Df =24	R^2 = 0.257	F=50.28			

Figure 10.9

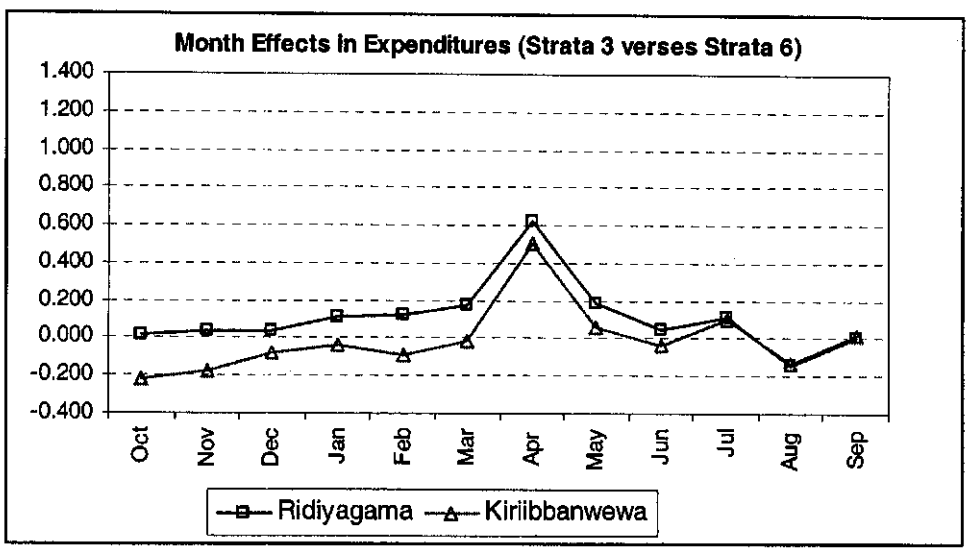


Table 10.11 Sample 10: Sooriyawewa and Ridyagama

Dependent Variable: Ln(Eji)						
Sample 15 : Strata 4 (Sooriyawewa) and Strata 6 (Ridiyagama)						
Z=1 for Sooriyawewa; Z=0 for Ridiyagama						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	0.019	0.061	0.319	-0.291	0.055	-5.257**
Nov.	0.041	0.061	0.668	-0.272	0.055	-4.910**
Dec.	0.033	0.061	0.541	-0.243	0.055	-4.377**
Jan.	0.111	0.061	1.819	-0.220	0.055	-3.977**
Feb.	0.119	0.061	1.959	-0.307	0.055	-5.543**
Mar.	0.171	0.061	2.807**	-0.349	0.055	-6.302**
Apr.	0.624	0.061	10.244**	-0.236	0.055	-4.264**
May	0.187	0.061	3.074**	-0.196	0.055	-3.533**
Jun.	0.044	0.061	0.725	-0.119	0.056	-2.112*
Jul.	0.109	0.061	1.775	-0.063	0.056	-1.117
Aug.	-0.143	0.061	-2.335*	0.049	0.056	0.875
Sep.	0.000			0.027	0.056	0.486
Constant term	6.180	0.110	56.160			
Ln (Yi)	0.283	0.011	25.358			
Test 1	F=17.44	P=.0001				
Test 2	F=27.74	P=.0001				
Test 3	F=14.99	P=.0001				
Test 4	F=16.79	P=.0001				
N = 4437	df =24	R^2 = 0.264	F=66.11			

Figure 10.10

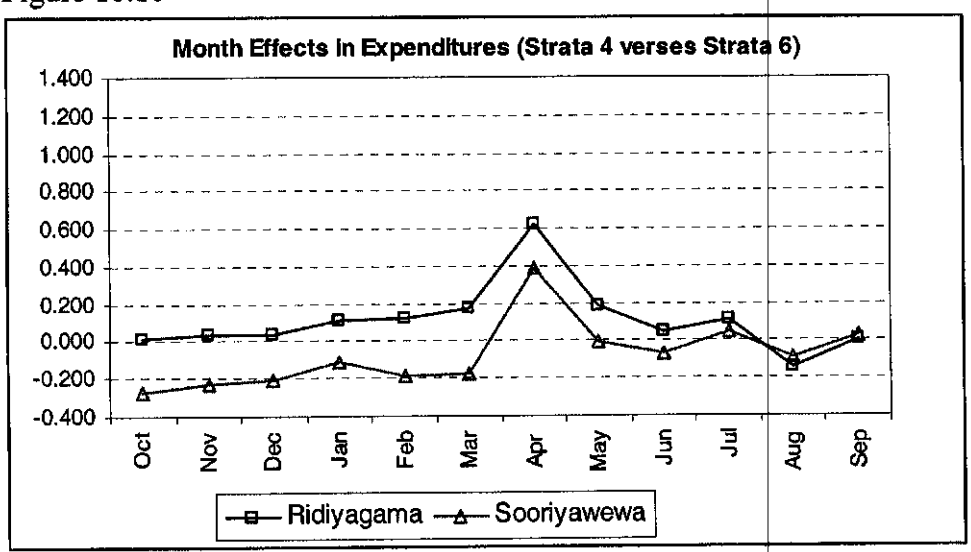
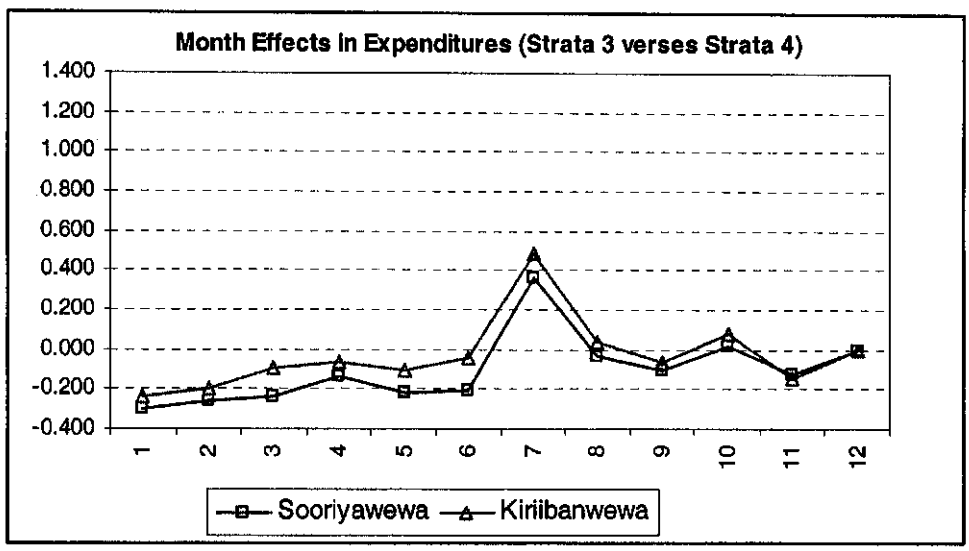


Table 10.12: Sample 11: Kiriibbanwewa and Sooriyawewa

Dependent Variable: Ln(EJI)						
Sample 10 : Strata 3 (Kiriibbanwewa) and Strata 4 (Sooriyawewa)						
Z=1 for Kiriibbanwewa; Z=0 for Sooriyawewa						
Variable	Month	STE	t	Month X Z	STE	t
Oct.	-0.301	0.048	-6.247**	0.068	0.054	1.265
Nov.	-0.260	0.048	-5.406**	0.061	0.054	1.138
Dec.	-0.238	0.048	-4.953**	0.139	0.054	2.582**
Jan.	-0.138	0.048	-2.874**	0.076	0.054	1.419
Feb.	-0.217	0.048	-4.500**	0.108	0.054	2.006*
Mar.	-0.207	0.048	-4.300**	0.167	0.054	3.110**
Apr.	0.359	0.048	7.463**	0.126	0.054	2.340**
May	-0.037	0.048	-0.773	0.075	0.054	1.396
Jun.	-0.102	0.049	-2.099*	0.043	0.055	0.781
Jul.	0.018	0.049	0.373	0.065	0.055	1.186
Aug.	-0.121	0.049	-2.487	-0.028	0.055	-0.520
Sep.	0.000			-0.008	0.055	-0.142
Constant term	6.522	0.094	69.741			
Ln (Yi)	0.246	0.01	24.252			
Test 1	F=27.74	P=.0001				
Test 2	F=19.89	P=.0001				
Test 3	F=3.25	P=.0001				
Test 4	F=3.53	P=.0001				
N = 4467	df =24	R^2 = 0.202	F=46.75			

* indicates significance at 5 percent level
** indicates significance at 1 percent level

Figure 10.11



The results and findings of this section may be summarized as follows:

Household average monthly expenditures depend on average monthly incomes. This is true for all strata and for all socio-economic groups analyzed above. There are month effects in all strata and groups. The results of this study indicate that monthly variations in consumption expenditures, that is month effects in expenditures, are higher for households in irrigated areas compared to rainfed areas, and higher for farm households compared to non farm households. Expenditures in August and September (Yala season) are much higher for households in strata with irrigation infrastructure compared to those households in strata without irrigation infrastructure, and it is this difference that is driving the results of test 4. These results are more clearer in comparison of households in irrigated (all) with those in rainfed areas, where month effects in expenditures for households in irrigated areas are higher and significant for all months, and patterns of monthly expenditures are different, especially during August and September. The results from these comparisons imply that household groups who have different income patterns, also have different expenditure patterns (although not in all months), suggesting that in addition to average monthly incomes and pure month effects (preferences, prices), timing of income receipts do influence monthly expenditures (the case of imperfect smoothing). Household access to infrastructure helps in improving average incomes, and increasing monthly incomes during the dry season period. Therefore, households with access to irrigation infrastructure are in better position to smooth their expenditures compared to those without it. We can conclude that variations in monthly expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income share/timing of income flows. Overall, the results of the study imply that irrigation infrastructure helps to reduce income fluctuations and enable households to smooth their consumption.

Impact of Irrigation Infrastructure

In this section, we quantitatively assess the impacts of irrigation infrastructure development on household incomes/expenditures. We adopt a comprehensive approach for identifying and quantifying key determinants of household incomes and expenditures by estimating a multivariate econometric model with annual household level data. We hypothesize that household incomes/expenditures depend upon:

a).household endowment of natural resources, particularly land;
b).household productivity of natural resources, such as land productivity;
c).household human resources and their characteristics, such number of non-dependent working family members, education levels of family members, occupation;
d).household capital resources, such as household non-land productive assets such as agricultural machinery, livestock;
e).household access to irrigation/infrastructure.

Irrigation infrastructure and its state of development can be expected to contribute positively to household incomes through increased overall productivity and production, through

enhanced employment and income earning opportunities associated with infrastructure induced improved economic activities in both farm and non-farm rural sectors.

The following model was estimated with annual household level data in both linear as well as log linear forms. In the final specification, household annual expenditures instead of annual incomes were used as a dependent variable.

$$\ln(E_i) = \alpha_0 + \alpha_1 HHSY + \alpha_2 ANFM + \alpha_3 GVP + \alpha_4 ALH + \alpha_5 AGA + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_6 D_6 + \varepsilon$$

where

HHSY = Household Head Schooling Years (years)
ANFM = Average Number of Family Workers (number)
GVP = Gross Value of Production
ALH = Average land holding (ha)
AGA = Household Agricultural Assets (Rupees)
D1 = Dummy for strata 1(Strata 1= 1, 0= otherwise)
D2 = Dummy for strata 2 (Strata 2= 1, 0= otherwise)
D3 = Dummy for strata 3 (Strata 3= 1, 0= otherwise)
D4 = Dummy for strata 4(Strata 4=1, 0 otherwise)
D6 = Dummy for strata 6(Strata 6=1, 0 otherwise)

The regression results of the log – linear model using annual expenditures as the dependent variable are presented in Table 10.15. The results show that all coefficients except Dummy 2 (for the Sevanagala Rainfed area) are significant. The average number of family working members has a significant impact on expenditures. Each additional worker increases the average annual expenditures by 11.6 percent. The number of years of schooling of household head has a smaller impact of around 2 percent in annual expenditures. The size of land holding has significant positive impact on annual expenditures, with 1 percent increase in size of holding resulting in about 10 percent increase in average annual expenditures. Value of agricultural assets have significant positive impact in household expenditures. If assets increase by one rupee, average expenditures are estimated to increase by around 10 cents. Similarly, GVP (Gross value of agricultural output) also have significant positive impact on expenditures, with one rupee increase in GVP resulting in 8 percent increase in average expenditures.

The coefficients of dummy variables are all significant and positive, except for strata 2 (Sevenagala rainfed) indicating that households having access to irrigation infrastructure have significantly higher annual expenditures than those with no access to irrigation infrastructure. However, the impact varies across strata. The largest impact is estimated for Ridiyagama, followed by Sooriyaweva and Kirribbanweva and Sevenagala irrigated, with household annual expenditures in these strata, over the Extension area, higher by 55.4 percent, 30.6 percent, 27.4 percent and 13.9 percent respectively. There are no significant differences in average annual expenditures between Sevanagala rainfed and Extension area, where crop production takes place under rainfed conditions. The impact of infrastructure is fairly similar in Sooriyaweva and Kirribbanweva.

The results suggest that irrigated area in general have higher expenditure levels compared to rainfed areas and that higher the number of family workers, land holding and higher the education of the household head the higher the level of annual expenditures. The GVP and the value of agricultural assets owned by the household also contribute significantly to annual expenditures. The implications are that irrigation infrastructure, being an important and significant contributor to annual expenditures can provide considerable benefits to the household and contribute substantially towards poverty reduction. Increasing productivity of agriculture and assistance in acquiring more agricultural assets will contribute to poverty reduction.

The results of annual regression using a linear model with the same set of variables are provided in Appendix G. The results are similar. Regressions using only a single dummy, irrigated/rainfed with the same set of variables also generated similar results. Households in irrigated areas having access to irrigation infrastructure have around 28 percent higher expenditures compared to those in rainfed areas (see Appendix G). [Note: the other variables such as household location on distributary, percent of area irrigated were also included as explanatory variables, however, their impact was found to be insignificant.]

Table 10.15 Regression Results – Determinants of Annual Expenditures/Incomes

Dependent Variable: Log of annual expenditure			
	Coefficient	STE	t
(Constant)	10.19	0.06	185.29
HHSY	0.02	0.00	3.77
ANFM	0.11	0.01	10.50
GVP	0.00000133	0.00	6.82
ALH	0.094	0.02	4.49
AGA	0.00000129	0.000	5.30
D1	0.131	0.048	2.73
D2	0.070	0.061	1.15
D3	0.242	0.047	5.15
D4	0.267	0.045	5.93
D6	0.441	0.050	8.82
N = 857	Adj R = 0.382	df = 10	R = 0.390

STE = Standard Error
HHSY= Household Head Schooling Years
ANFM= Average Number of Family Workers
FNF= Farm-Non-farm (Farm = 1and Non-farm=0)
GVP
ALH = Average land holding (ha)
AGA= Agri Assets
D1= Dummy for stratum 1(Stratum 1= 1, 0= otherwise)
D2= Dummy for stratum 2 (Stratum 2= 1, 0= otherwise)
D3= Dummy for stratum 3 (Stratum 3= 1, 0= otherwise)
D4= Dummy for stratum 4 (Stratum 4=1, otherwise 0)
D6= Dummy for stratum 6 (Stratum 6=1, otherwise 0)

Overall, the results of regressions using annual data imply that household access to irrigation infrastructure have significant impacts on the levels of household incomes/expenditures. However, the magnitude of impact depends upon adequacy/inadequacy of water.

Chapter 11

Impacts of Infrastructure Development on Poverty Conclusions and Policy Implications

This study was undertaken with the overall objective of developing in-depth understanding of income dynamics in relation to access to irrigation water with the aim of assessing the impacts of irrigation infrastructure development on poverty. The sample areas for the study were selected based on several criteria including access to irrigation water, cropping patterns and stage of irrigation infrastructure development. The study uses primary data collected through household surveys conducted three times during the year 2000-2001, from a sample of 858 households, using a detailed multi-topic questionnaire. The study was undertaken in IWMI's Benchmark Basin - Uda Walawe Left Bank Irrigation System in Uda Walawe area (Ruhuna Basin) in Sri Lanka

The results of this study provide strong empirical evidence on the role of irrigation infrastructure development on poverty alleviation, particularly on dynamic aspects of poverty. The findings suggest that the incidence, depth and severity of poverty, as measured by monetary indicators, are the highest in areas without irrigation infrastructure and lowest in areas with access to established irrigation infrastructure and with adequate water supplies. The study provides quantitative estimates of both transient and chronic poverty. In addition, the study quantifies and compares non-monetary indicators of poverty and shows how access to irrigation infrastructure development contributes to reducing poverty and raise overall welfare standards. Further, the study econometrically estimates expenditure smoothing effects of access to irrigation infrastructure. Finally, the study develops a multivariate econometric model to quantitatively assess the impact of various factors, including household access to irrigation infrastructure, endowment of land resources, land productivity, household human resources, household non-land productive assets and so on and so forth, on household incomes /expenditures. The model provides quantitative estimates of the potential increases in incomes and expenditures through development of infrastructure and improved access to adequate water supplies. In short, the study provides an in-depth understanding of the role of irrigation infrastructure development on poverty alleviation

Analysis of the basic socioeconomic characteristics show that irrigated areas have larger households compared to rain-fed areas, but the rain-fed areas have a larger number of dependents. The dependency ratio is very high in the two rain-fed areas compared to the irrigated areas. The under-five mortality rate is generally higher in rain-fed areas than in irrigated areas. Similarly, in the rain-fed areas the number of years of schooling of the household head was less compared to irrigated areas. The proportion of members of school age (5-20 years) not in school is high and the quality of housing and access to pipe water low in the rain-fed areas. The cropping intensity is also very low in the rain-fed areas, except Sevanagala rain-fed area which has higher cropping intensity probably due to stable cropping system in this area. Labor use per hectare and wage rates are lower in Extension/rainfed (Rs.

173/day) compared to irrigated areas (above Rs.194/day). The value of household assets, including agricultural assets is much higher in the irrigated areas compared to rainfed areas. The gross value of production is also generally higher in irrigated areas. However, overall farm size is found to be higher in the rain-fed areas because households in these areas were allocated larger plots of land to compensate for lack of irrigation or they had encroached on state lands (Extension area). However, households under chronic poverty in both irrigated and rainfed areas had smaller land holdings than the transient poor or the non-poor households, suggesting that land size is one of the determinants of poverty levels. Thus the household basic characteristics clearly show that households in the irrigated areas, with access to irrigation infrastructure, are socio-economically better off than households with no access to irrigation infrastructure.

Analysis of household incomes in the sample areas shows that income patterns are fairly similar across strata. However, the level of incomes varies significantly, with highest annual incomes in Ridiyagama and Sevanagala (the two areas with relative greater access to water) and the lowest incomes in the Extension area. In Ridiyagama, incomes peak in March, April and May and then again in August and September. In the Extension area, incomes peak at a lower level from March to May and then decline during the rest of the months. What is found is a double peaking of income in Ridiyagama due to two seasons of cultivation, whereas in the Extension areas there is only a single peak. In the other irrigated areas there were single peaks due to lack of cultivation except for one season. Thus it is observed that availability of water is an important factor in providing regular incomes and even in irrigated areas with access to infrastructure, the lack of water could result in lower income levels.

Household expenditures were generally below that of incomes. The differences between income and expenditures were high in the Sevanagala and Ridiyagama areas but lower in the other areas. In the irrigated areas, incomes were much higher than expenditures during August and September. In the rain-fed areas incomes were higher than expenditure during March to September. However, the level of income was lower than in the irrigated areas. The expenditure pattern showed that there was a peak in April, which coincided with the local new-year festivals and harvesting time. This was found in all strata. Food was the major component of total expenditure. Food expenditure tracks total expenditure in all strata. The expenditure on food is relatively higher in irrigated areas. One of the major findings is that expenditures and income are higher in the irrigated areas than the rain-fed areas, but the pattern of expenditure is similar in all areas.

Non-crop income is a major source of income in irrigated as well as rain-fed areas except the Sevanagala area (rainfed and irrigated), where crop income is the major source of income. In the Extension area, the non-crop income is roughly three times that of the crop income. In other areas it is roughly double the crop income. This shows that except in the well-established permanent cropping systems with adequate markets (Sevanagala sugarcane cultivation) the major source of income is not from crops. In the Ridiyagama area, the non-crop income is higher than crop income. This is because Ridiyagama is an old established system, there may be more opportunities for non-farm employment.

Income inequality in the study area is only moderate with Gini coefficient of 0.38. Income distribution patterns show less variation across strata. The rain-fed areas had slightly higher Gini-Coefficients suggesting a slightly more skewed distribution of income than irrigated areas. In areas where the average incomes are higher, the income distribution tends to be more skewed. For example, Gini Coefficient for Ridiyagama is relatively higher. The bottom 40 percent of the households have received between 15-20 percent of the total income, while the top 10 percent have received between 20-30 percent of the income. This suggests that income distribution is moderately skewed in all areas. The level of inequality is found to be higher in farm households compared to non-farm households. The general conclusion is that there is moderate level of inequality in all areas, and the differences across strata are only marginal. The differences in inequality across strata are probably due to variations in land holdings, availability of irrigation, opportunities for diversified cropping and availability of non-agricultural sources of income.

The welfare cost of household expenditure fluctuations varied from 24 percent to 30 percent. The welfare cost of rain-fed farming was higher than irrigated farming and that of farmers higher than non-farmers. The highest welfare cost to households was in Ridiyagama. Overall, the welfare cost due to expenditure fluctuations did not vary much across strata. The welfare cost due to income fluctuations was found to be much higher in all strata and the magnitude of welfare cost of income fluctuations was four times that of the welfare cost of expenditure fluctuations. Here, too, the welfare cost of income fluctuation in rainfed areas was higher than in irrigated areas. The main conclusions are that welfare cost due to expenditure fluctuations is lower than that due to income fluctuations and the welfare cost of both income and expenditure fluctuations is relatively lower in irrigated areas compared to rainfed areas.

An analysis of monetary indicators of poverty with monthly income data shows that about 12 percent of the sample households are under chronic poverty, 69 percent are transient poor, and 19 percent are non-poor. Chronic poverty gap and chronic poverty gap squared are about twice that of transient poverty gap and transient poverty gap squared, respectively. The depth and severity of poverty, as measured by poverty gap and poverty gap squared respectively, are higher for the chronic poor than for transient poor. Highest chronic poverty is found to be in the Extension area, where quarter of a population is living under poverty throughout the year. The incidence of chronic poverty is quite low in all other areas, having access to irrigation infrastructure, and also in Sevanagala rainfed area. It should be noted that Sevanagala rainfed area is not a typical rainfed area, since the farmers can expect a regular income from growing a permanent crop -sugar cane, which has adequate marketing facilities as well as guaranteed output prices. In the Extension area, which can be considered to be a typical rainfed area, seasonal short-term crops are grown, and these crops do not have adequate marketing outlets.

Using quarterly income data, 16 percent of the sample households are classified as chronically poor, 59 percent as transient poor and 25 percent as non-poor, indicating that the number of chronic poor and non-poor households have increased while the number of

transient poor have decreased (when compared to poverty estimates based on monthly income data). Using annul data, 35 percent of the sample households were classified as poor.

The methodology adopted for estimating poverty indices, does influence the estimates of the poverty indices. Use of quarterly data instead of monthly data results in lower estimates of poverty (especially transient poverty). The incidence of chronic poverty is higher among non-farm households compared to farm households. Irrigated areas generally had lower levels of chronic poverty and a higher proportion of non-poor households but higher levels of transient poor households than typical rainfed areas.

Overall, the highest chronic poverty is found among non-farm households, and in areas with no access to irrigation infrastructure and is lowest in areas with access to irrigation infrastructure and adequate water supplies. This is regardless of whether monthly or quarterly data are used. The provision of irrigation facilities in the rainfed area can at least move up the chronically poor households to the transient poor group and gradually to the non-poor group.

Further analysis shows that households with income levels above 125 percent of the poverty line was the lowest in the Extension area, and for non-farm households. Moreover, the proportion of households with income levels below 50 percent of the poverty line was also higher in the Extension area and Kiribbanwewa but very low in other areas. Thus in the typical rainfed (Extension) area poverty levels are high compared to the irrigated areas. Similar results are obtained with non-monetary indicators of poverty. One can conclude from the above analysis that irrigation infrastructure plays an important role in alleviating poverty, particularly in reducing the incidence of chronic poverty. Other factors such as adequate water, marketing facilities, and systematic cropping can help to reinforce and boost benefits from irrigation infrastructure.

Results of regression analysis suggest that household monthly expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income share/timing of income flows. The analysis suggests that there are significant month effects in monthly expenditures in all strata, and these month effects are higher in areas with access to irrigation infrastructure. Differences in occupations and cropping patterns are important in influencing monthly income shares that in turn influence monthly expenditures, contributing to imperfect smoothing in consumption. The results indicate that monthly variations in consumption expenditures, that is month effects in expenditures, are higher for households in irrigated areas compared to rainfed areas, and higher for farm households compared to non farm households. Expenditures in August and September (Yala season) are much higher for households in strata with irrigation infrastructure compared to those households in strata without irrigation infrastructure, and it is this difference that is driving the results of test 4. These results are more clearer in comparison of households in irrigated (all) with those in rainfed areas, where month effects in expenditures for households in irrigated areas are higher and significant for all months, and patterns of monthly expenditures are different, especially during August and September. The results from these comparisons imply that household groups who have different income patterns, also have different expenditure patterns (although not in all months), suggesting that in addition to average monthly incomes and pure month effects (preferences, prices), timing

of income receipts do influence monthly expenditures (the case of imperfect smoothing). Household access to infrastructure helps in improving average incomes, and increasing monthly incomes during the dry season period. Therefore, households with access to irrigation infrastructure are in better position to smooth their expenditures compared to those without it. We can conclude that variations in monthly expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income share/timing of income flows. Overall, the results of the study imply that irrigation infrastructure helps to reduce income fluctuations and enable households to smooth their consumption.

The results of analysis using annual data on household incomes and expenditures suggest that education level of households heads, number of family earners, landholdings, gross value of product, household assets and access to irrigation infrastructure with adequate water supplies are the key determinants of household expenditure/income levels. The results suggest that irrigated area in general have higher expenditure levels compared to rainfed areas and that higher the number of family workers, land holdings and higher the education of the household head the higher the level of annual expenditures. Households in irrigated areas having access to irrigation infrastructure have around 28 percent higher expenditures compared to those in rainfed areas. The GVP and the value of agricultural assets owned by the household also contribute significantly to annual expenditures. The implications are that irrigation infrastructure, being an important and significant contributor to annual expenditures can provide considerable benefits to households and contribute substantially towards poverty reduction. Increasing productivity of agriculture and assistance in acquiring more agricultural assets will contribute to poverty reduction.

Summary of Findings

- Irrigation infrastructure has a beneficial impact, in terms of reducing poverty, particularly in reducing the incidence of chronic poverty, provided adequate supplies of water are available.
- The benefits of upgraded irrigation infrastructure over non-upgraded systems are less apparent. The availability of water appears to be more important as a factor in reducing poverty, and upgraded infrastructure becomes important insofar as it contributes to increased water supplies (both upstream and down stream).
- The dependency ratio and under five mortality rates are higher in rainfed areas compared to rainfed areas.
- A comparison of Body Mass Index (MBI) across strata indicates no significant differences. There are only few instances of underweight children. In general, BMI for households in irrigated areas shows an increase from survey one (June) to survey three (October). However, in rainfed areas, BMI for all age groups declines in t he second period (August) and increases during the third period (October) but does not reach the level of the first period (June) values. BMI for non-farm households is generally lower than that for farm households.
- A larger proportion of the school-aged population not in school is in rainfed areas compared to irrigated areas.

- The cropping intensity is low in the typical rainfed areas. However it is high in rainfed areas with good moisture retaining soils, systematic cropping and marketing facilities.
- Although farm sizes are larger in rainfed areas, there appears to be a relationship between poverty and land size. The chronically poor population had smaller land holdings than either the transient poor or the non-poor.
- Income levels are lower in rainfed areas. Income peaks during the year coincide with availability of water for cultivation. In double-cropped areas there are two peaks in income and in single cropped areas, a single peak in income.
- Labor use per hectare and wage rates are lower in Extension/rainfed (Rs. 173/day) compared to irrigated areas (above Rs.194/day).
- Incomes and expenditures are higher in irrigated areas, but the pattern of monthly incomes and expenditures are similar in both rainfed and irrigated areas.
- Non crop income makes up to 75 percent of total income in rainfed areas, while it is about 50 percent in irrigated areas.
- Income inequality is only moderate in both irrigated and rainfed areas. In areas where average incomes are high, income distribution is relatively more skewed. Differences in income inequality across strata are mainly due to variation in size of holdings, availability of irrigation water, opportunities for diversified cropping and availability of non-agricultural sources of income.
- The welfare cost of income and expenditure fluctuations is only marginally lower in irrigated areas than rainfed areas.
- Using monthly income data, 12 percent of the sample population is under chronic poverty, 69 percent is transient poor and the remaining 19 percent are not poor. The depth and severity of poverty are higher for the chronically poor than the transient poor households.
- Using quarterly income data, 16 percent of the sample population is classified as chronically poor, 59 percent as transient poor and 25 percent as non-poor.
- Using annul data, 35 percent of the sample households were classified as poor.
- Incidence of chronic poverty is highest in the typical rainfed areas, while irrigated areas have greater incidence of transient poverty.
- Overall, highest chronic poverty is found among non-farm households, and in areas with no access to irrigation infrastructure and lowest in areas with access to irrigation infrastructure and adequate water supplies. This is regardless of whether monthly or quarterly data are used.
- The typical rainfed area as characterized by the Extension area had a high proportion of its population earning monthly incomes less than 50 percent of the poverty line.
- The impact of irrigation on expenditure is 24 percent greater than that of rainfed farming.
- Production activities in irrigated areas also provide livelihood support to households in nearby rainfed areas.
- There are both month and average monthly income effects in monthly expenditures. The month effects are higher in the typical rainfed areas. Prices and preferences rather than monthly incomes play a bigger role in determining monthly expenditures in the typical rainfed areas.
- Variations in monthly household expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income

share/timing of income flows. The results indicate that monthly variations in consumption expenditures, that is, month effects in expenditures, are higher for households in irrigated areas compared to rainfed areas, and higher for farm households compared to non-farm households. Expenditures in August and September (Yala season) are much higher for households in strata with irrigation infrastructure compared to those households in strata without irrigation infrastructure, and it is this difference that influences the pattern of expenditures across months. These results are more clearer in comparison of households in irrigated (all) with those in rainfed areas, where month effects in expenditures for households in irrigated areas are higher and significant for all months, and patterns of monthly expenditures are different, especially during August and September. The results from these comparisons imply that household groups who have different income patterns, also have different expenditure patterns (although not in all months), suggesting that in addition to average monthly incomes and pure month effects (preferences, prices), timing of income receipts do influence monthly expenditures (the case of imperfect smoothing). Household access to infrastructure helps in improving average incomes, and increasing monthly incomes during the dry season period. Therefore, households with access to irrigation infrastructure are in better position to smooth their expenditures compared to those without it. It is concluded that variations in monthly expenditures depend on the level of average monthly incomes, month effects (prices and preferences), and to some extent on monthly income share/timing of income flows. Overall, the results of the study imply that irrigation infrastructure helps to reduce income fluctuations and enable households to smooth their consumption.

- Education level of households heads, number of family earners, landholdings, gross value of product, household assets and access to irrigation infrastructure with adequate water supplies are the key determinants of household expenditure/income levels.
- Most farmers (over 75 percent) believe that upgrading of the system/canal lining saved about 30 percent water as well as reduced labor use. About a third of the farmers reported that lining reduced water logging and a similar proportion indicated that it reduced seepage into home garden plots.

It is very clear from this study that access to irrigation infrastructure has a significant positive impact on poverty reduction, particularly in lifting people up from chronic poverty through increased crop productivity, higher overall farm production, greater employment, higher incomes and expenditures and overall improved livelihoods. While most benefits are received by those having land, non-farmers and landless people also benefit indirectly through increased demand for labor resulting from increased productivity and related enhancement in economic activities.

The impact of infrastructure development on poverty should be seen in relation to adequacy/inadequacy of water supplies, as infrastructure and water (being complementary) are both essential for access to water. As in the case of Ridiyagama, while infrastructure is not upgraded/lined but enough water availability ensures that farmers have access to adequate water supplies. Even if infrastructure is well developed, inadequate water supplies will reduce the impact of infrastructure on poverty. On the other hand, deterioration of infrastructure, if not maintained properly, leads to reduced water supplies, and could result in

overall reduced anti-poverty impact of water resources. We found very low incidence of chronic poverty in areas with irrigation infrastructure compared to those without irrigation infrastructure, and have suggested that irrigation infrastructure has played an important role in reducing the incidence of chronic poverty. The infrastructure needs to be maintained properly in order to continue to have its anti-chronic poverty impacts in the long run. The impact of infrastructure development/improvement on poverty should, therefore, be viewed in this perspective. Also, if water is adequate, infrastructure is well developed but the cropping patterns adopted are such that only low value crops are grown, the overall anti-poverty impact of water and infrastructure would be less. Development/improvement of irrigation infrastructure enables better control and overall better management of water, which creates conditions for more improved and diversified cropping patterns. The latter two are important for achieving greater anti-poverty impacts from infrastructure.

Thus, development of irrigation infrastructure alone may be a necessary condition for poverty alleviation, but it is not a sufficient condition. Overall, development of irrigation infrastructure increases household permanent incomes and expenditures, contributes to household income and expenditure smoothing, generates greater employment opportunities (and resulting higher wage rates for agricultural labor). In addition to these direct positive impacts on poverty and vulnerability, irrigation infrastructure attracts other physical infrastructure (such as roads, communication systems, schools and hospitals) which contribute to overall socio-economic uplift of rural masses.

Farmer perceptions on the impact of Irrigation Infrastructure

The sample households were posed some questions on how they perceived the impact of irrigation infrastructure development on poverty and the recent changes that had affected in their systems, with particular reference to the rehabilitation of their irrigation system involving the lining of canals. Most households felt that lining was a good thing. In general, they believed that lining of canals saved water and reduced labor requirement for irrigating their fields, but reduced seepage to their home gardens. A relatively small proportion of farmers believed that lining increased cropped are and yields as well as reduced water logging.

Most farmers believe that lining of irrigation canals saves water, except in Ridiyagama, and their assessment of water savings ranges from 20 percent to 30 percent, which may be an overestimate. Most farmers also believe that lining saves labor use. The estimates of labor saving ranges from about 16 to 32 days per year. Farmers in Sooriyawewa reported an increase in area cropped as a result of lining. Productivity increases due to lining was reported by a very small percentage of farmers (1 to 16 percent) and the increase in productivity also appeared to be overestimated. About a third of the households reported a reduction in water logging, but more than 70 percent of the households in Sevanagala reported reduced water logging in Maha season. Between 20 percent and 50 percent of the households also reported reduced seepage to their home gardens. Improved access to water by tail enders was reported in Yala, with 70 percent reporting in Sooriyawewa and none reporting in Ridiyagama. Around 20 percent to 30 percent of households reported that canal lining increased water to the poor. Timely receipt of water and adequacy of water was reported by about 90 percent of the households in Ridiyagama in Maha and by only 1 percent

to 3 percent of households in Sooriyawewa. This reflects the current water availability situation in these two schemes. In the other two irrigated areas, 20-30 percent of households reported adequate and timely supplies of water. The need for further rehabilitation of irrigation facilities was reported by over 90 percent of the households in Sevanagala irrigated and Ridiyagama areas, where no rehabilitation has been undertaken in recent times. Therefore farmer perceptions appear to reflect the varying field conditions in the strata, although some over estimates of actual benefits have been reported.

Policy Implications and Pro-poor Interventions

The results of the study suggest, that while irrigation infrastructure development has significant impacts in reducing poverty, providing irrigation infrastructure is only a part of the solution. What appears to be more important is the availability of adequate water for distribution within the system. Ensuring double cropping can have a substantial impact on poverty. Other factors such as marketing arrangements, input supplies, access to roads and other infrastructure would also contribute to poverty reduction efforts. The important pro-poor interventions, identified by this study, include development of irrigation infrastructure/small irrigation tanks, provision of land titles especially in the Extension area, and crop diversification and improved access to credit and marketing arrangements.

Development of irrigation infrastructure - small tanks

An intervention that is likely to have a large impact on poverty is the construction of small tanks or reservoirs to harness water resources within the local catchments. Water resources of these small tanks can be supplemented through diversions from other reservoirs or river sources. Water availability is crucial to increasing cropping intensity and productivity of land, two factors having substantial impact on poverty. Ridiyagama, which has adequate supplies of water, is a good example, as it has a low level of chronic poverty.

Small tanks in rainfed areas play an important role in rainfed farming systems in the dry zone. The cultivation system adopted helps to save rainwater from the wet season, for use during the dry periods later on in the wet season. Earlier on in the wet season, land preparation and initial cultivation activities are started with the first rains. Water collected in the tank can be saved for later use, as a supplementary source of irrigation, when it becomes critical to the success of the crop. The main sources of water supply for the small tank would be drainage from its own catchment and drainage from up stream tanks (particularly in cascade systems). During a high rainfall season, water may be saved for use during the next dry season as well. In addition, these small tanks could serve as a source of recharge for domestic wells, drinking water source for livestock and other domestic use by the households within the command area.

Within irrigated commands, small tanks can play a useful role in the efficient distribution of water. The source of supply of water to the small tanks may include rainwater from its own catchment and supplies diverted from the main reservoir of the irrigation system. The major advantages of these tanks include better distribution of water as well as timing of water

delivery, and additional water supplies from own catchments and from drainage from upstream areas. Therefore, the construction of these multipurpose small tanks in water-short irrigated and rainfed areas, which serve as a focal point for water reuse, better distribution and timing of water supply, will be an effective intervention for poverty reduction.

Investments in improved management of available water supplies is important for increasing access to larger areas. The benefits are derived through better distribution of the water which can enhance productivity and reduce poverty. In general, the cost of such interventions tend to be low, while the benefits can be quite substantial. However, the success of such interventions depends on attitude changes, greater participation of stakeholders, as well as physical improvements to the system.

Even well managed systems tend to deteriorate over time. Therefore, greater involvement of the beneficiary in the rehabilitation, maintenance and operation of the system will enable the system to continue to be well managed and successful over a longer period of time. These interventions, though less costly may take years to succeed, but the benefits could be enormous. Thus, strategies to reduce poverty over a long-term time frame should include interventions of this nature.

Land Titles

Most lands in irrigation systems are state owned. Certain limited rights have been granted to settlers on state lands. These include, mortgage rights, transfer to family members or heir and temporary or seasonal leasing out rights. The land cannot be sold in the market place or transferred to non-immediate family members. Since the state is the largest owner of land, these restrictions on land ownership have created an artificial land market, not conducive to optimal investments in land. One of findings of this study is that land size is related to poverty levels, suggesting that provision of full titles to land to those who have been already allocated land in irrigated areas and land allocations to the landless in the rainfed areas will have significant impacts on poverty. Almost all households in the Extension area expressed the need for land titles. Provision of land titles will give incentive to households for making long term investments in land development. One of the reasons why the Government has been unwilling to grant complete ownership of land to the settler, is the fear that eventually, the ownership will pass on to the rich farmers, merchants or traders. However, the provision of land even with the restrictions will have beneficial impacts on those who have no land at all and could lift them up from chronic or transient poverty.

Crop diversification, improved access to credit and marketing

As indicated earlier, crop diversification enables farmers to smooth incomes and consumption. Farmers growing high value crops, along with paddy, are generally in a better position, not only in terms of higher incomes/returns but also returns over extended period of time during the year. Therefore, encouraging crop diversification by providing information and facilitating marketing arrangements would help reduce transient poverty.

Improved access to credit and production linked to marketing has enabled sugarcane farmers even in Sevanagala rainfed area to obtain higher incomes. Chronic poverty levels are lower in the Sevanagala rainfed area than irrigated strata such as Kiribbanwewa and Sooriyawewa. This suggests that provision of inputs for crop production even in a rainfed production system, coupled with assured markets and prices, can have significant impacts on poverty. However, productivity on rainfed lands can be influenced by soil quality and climatic pattern and therefore such interventions should be made after careful evaluation of the suitability of soil and climate for the selected crop. Provision of credit will be an important instrument for fighting transient or temporary poverty.

In addition to the household level surveys and quantitative analysis presented above, participatory poverty assessments (PPAs) were undertaken through group discussions (with farmers as well as with agency officials), participatory mapping, wealth/well-being ranking and preference ranking in each of the five strata in Udawalawe Left bank system. Summary of the PRA results, including, the interventions identified by the local communities are presented after the next section on limitation of the study. It should be noted that results of the study and the pro-poor interventions proposed above, based on more detailed quantitative analysis, are very much in line with results of the PPAs.

Limitations of the study

The results and the conclusions of the study must be viewed in the light of certain potential limitations of the study. First, the study was undertaken during a period when a rehabilitation project was being implemented in two of the four irrigated areas (Sooriyawewa and Kiriibbanwewa). In these two areas, the earth canals were being lined with concrete. When the study commenced, rehabilitation activities in the two strata were at different stages of completion. There were some sections, where rehabilitation had been completed and no cultivation had taken place in the previous season (Maha), but water was provided for the current Yala season. In other sections, rehabilitation was just commencing, and the farmers had cultivated in the previous season (Maha), but were not able to cultivate in the current Yala season. In yet other sections, rehabilitation had been partly completed, and some farmers in the same canal were able to cultivate while others had to forego cultivation. In addition, the Uda Walawe reservoir faced water shortages due to the failure of monsoon rains during the study period. Therefore there were restricted water supplies even in canals ready for water release. However, water was released for permanent crops, such as bananas and a few OFC's such as chillies. Overall, the study was undertaken in a relatively abnormal year.

Second, one year is a relatively short period to understand the dynamics of poverty and the impact of infrastructure on poverty, particularly on temporary or transient aspect of poverty. Primary panel data covering a period of 2-3 years would be necessary to understand the dynamics of poverty and the role of infrastructure. Also, analysis using quarterly data may be necessary along with analysis using monthly data, particularly in estimating and analyzing transient poverty.

Third, since infrastructure in almost all sites in the study area was already rehabilitated/lined, no comparable sites were available to select a sample of a typical unrehabilitated (unlined canals) irrigation system, to compare with a typical rehabilitated system (lined canals) in order to determine the impact of canal lining on poverty. The diverse cropping patterns in the different strata, makes it difficult to do a one to one comparison of the effects of irrigation infrastructure, particularly rehabilitated vs. unrehabilitated, on poverty. For example, sugarcane, paddy and banana are grown in Sevanagala irrigated area, and sugarcane only in Sevanagala rainfed area. Paddy, banana, and OFCs area grown in Kiribbanwewa and Sooriyawewa, paddy and OFCs in the Extension area, and mainly paddy in Ridiyagama. Thus factors such as cropping patterns, marketing, and land quality etc, which also affect poverty, could mask the pure effects of irrigation infrastructure on poverty.

Participatory Poverty Assessments[2]: Summary

As mentioned above, in addition to the household level surveys (and quantitative analysis presented above), participatory poverty assessments (PPAs) were undertaken through group discussions (with farmers as well as with agency officials), participatory mapping, wealth/well-being ranking and preference ranking in each of the five strata in Udawalawe Left bank system. The main focus of the PPAs with groups of households/communities and with agency officials was to assess the poverty situation across strata, analyze the relationship between irrigation infrastructure development and poverty through participatory approach, and to obtain community perception of solutions to the poverty problem. The groups were asked to suggest effective interventions for poverty alleviation in the area. PPA sessions were conducted in the same areas from which household level survey data were gathered. This section provides summary of the key findings from PPAs, including, the interventions identified by the local communities. The information and most of the analysis below is completely based on the insights of the community groups.

Status of Infrastructure

Development of canal system and availability of water for cultivation in the command were ranked by the groups in four areas, using a score of 1 to 4 with 1 indicating very good and 4 indicating poor as shown table below.

[2] Thanks to Mr. Jinapala K. for extending help in organizing and conducting PPA sessions.

Table 11.1 Current status of irrigation infrastructure development

Strata	Status of irrigation infrastructure development	Rank
Sooriyawewa	Irrigation infrastructure is developed recently almost in the entire originally designed command area and farmers have access to irrigation water.	01
Kiriibbanwewa	Irrigation infrastructure development is available in the entire command area but farmers in some locations of the command have no access to irrigation water	03
Sevanagala	Irrigation infrastructure is available in the entire area, upgraded sometime back, but their condition is poor. Farmers in many locations find it difficulties to irrigate their lands.	02
Extension (Maurapura)	Irrigation infrastructure is not yet developed in any part of the area.	04

Ranks: 01= Very good, 02=good, 03=moderately good, 04= poor

Income and housing

The main source of income of a large percentage of families in all four strata is agriculture. The temporal variation in household incomes is significant in all strata. Cropping intensity and crop yields are major factors contributing to incomes from agriculture. Four strata were ranked by the groups for income levels, using a score of 1 to 4 with 1 indicating very good and 4 indicating poor as shown table below.

Table 11.2 Household Incomes

Strata	Income	Rank
Sevanagala	The irrigation infrastructure is developed in the entire area and also due to the rehabilitation carried out about 15 years ago, water management is easy but the condition of infrastructure is deteriorating. The mix- crops cultivated by farmers bring them good income (paddy and sugarcane). The sugarcane related employment is also available for farmers as well as for non-farmers. Less than 10 percent of the households go for wage labor outside the block. Therefore, the income is relatively high in this strata. About 70-80 percent of households receive approximately Rs 3000 to 8000 per moth while the rest receive less than Rs. 3000 per month.	01
Sooriyawewa	The irrigation infrastructure is recently improved. The main crop grown is paddy. About 30 percent of the households go outside for wage labor. Nearly 60 percent of the farmers receive monthly income between Rs.3000-8000 while the rest is getting about less than Rs 3000 per month.	02
Kiriibbanwewa	Although the rehabilitation of irrigation infrastructure has been carried out in most locations of the strata, some farmers do not receive water for crop production. About 30 percent of the households go outside for wage labor. About 50 percent of farming families receive monthly income between Rs 3000-8000 while the rest receive about Rs 1000-3000 per month.	03
Extension (Maurapura)	No irrigation infrastructure has been developed in this area. About 95 percent of the households go outside for wage labor. Monthly income of about 95 percent of the families is less than Rs 3000, and the rest receive about Rs 3000-4000 per month.	04

Ranks: 01= Very good, 02=good, 03=moderately good, 04= poor

The information given by the local communities indicates clear relations between development of irrigation infrastructure and the condition of the houses. Four strata were ranked by the groups for housing conditions, using a score of 1 to 4 with 1 indicating very good and 4 indicating poor as shown table below.

Table 11.3 Condition of houses

Strata	Condition	Rank
Sevanagala	Nearly 80 percent of the households have well developed and permanent houses	1
Kiriibbanwewa	About 65 percent of the households have permanent houses	2
Sooriyawewa	Nearly 64 percent of the households have permanent houses	3
Extension (Maurapura)	Only about 5 percent of the households have permanent houses	4

Ranks: 01= Very good, 02=good, 03=moderately good, 04= poor

Irrigation and Other Infrastructure

We observed positive relations between development of irrigation infrastructure and the availability of other social infrastructure such as education institutions, telecommunication, medical centers, roads, transport, drinking water and market etc. The information related to these services in four blocks are summarized in table 11.4.

Table 11.4 Services available

Strata	Information on services	Rank
Sevanagala	The facilities such as electricity, drinking water, hospital, schools, roads, transport and other government service delivery offices such as post office, police etc are available within the area. About 70 percent of the families have easy access to these facilities. The telephone facilities are available in the area and about 4 percent of the population have obtained such facilities.	01
Sooriyawewa	Electricity, Hospital, school, especially good marketing center, some Government service delivery agencies are available within the block. Nearly 65-70 percent of the total families in the block have easy access to these facilities; Drinking water is available only (pipe water) for 5 percent of the population and also only about 2 percent of the population has access to telephone facilities.	02
Kiriibbanwewa	Only about 2 percent of the population have easy access to services of some government agencies mainly due to non-availability of such facilities in the vicinity. About 50 percent of the families have access to services of infrastructure facilities such as schools, markets, roads, drinking water system, and electricity. Telephone facilities are not available in the area	03
Extension (Maurapura)	About 30 percent of the families have access to roads, transport, etc. 10 percent of the families have access to schools, while other facilities are not available in the area and people have to travel to the neighboring block, Sooriyawewa for such facilities,	04

Ranks: 01= Very good, 02=good, 03=moderately good, 04= poor

Land Rights

Land and water are the most important resources on which entire livelihood systems of households are based. There are no formal water rights for the farmers but they have all the customary rights to receive water for livelihood activities if the water is available in the area. For land, people have formal (legal rights) in Sri Lanka and the situation with regard to legal rights to lands is different across the four strata. Four strata were ranked by the groups for land rights, using a score of 1 to 4 with 1 indicating very good and 4 indicating poor as shown table below.

Causes of Poverty

In the PRA sessions, the community groups and the agency personnel analyzed the poverty in the area and provided the reasons for poverty. Four strata were ranked by the groups by poverty situation, using a score of 1 to 4 with 1 indicating very poor and 4 indicating less poor/not poor as shown table below.

Table 11.5 Ownership of land

Strata	Ownership to land	Rank
Sevanagala	In the entire area nearly 100 percent of the farmers have freehold titles for the land they cultivate and use for home gardens.	01
Kiriibbanwewa	Small percentage of landholders has been issued with freehold titles called "Swarnabhoomi" or "Jayabhoomi". Some other group of farmers has been issued with "permits" from the MASL. In total about 60-80 percent of the households have either freehold titles or cultivation permits of MASL. The rest of the farmers do not have legal documents for the land they cultivate. (They are encroachers residing on government land).	02
Sooriyawewa	Only about 40-70 percent of the households has either permit issued by MASL or free hold titles. The rest of the households have no formal rights for the land	03
Extension (Maurapura)	Only about 5-10 percent of the households has freehold titles for the land. The rest do not have such rights.	04

Ranks: 01= Very good, 02=good, 03=moderately good, 04= poor

Table 11.6 Poverty situation and causes – community perceptions

Strata	Explanations of poverty and the reasons- by the agency personnel	Explanations of poverty and the reasons- by the farmers.	Rank
Maurapura	Reliable irrigation water supply is not available. Therefore, majority of farmers is heavily depended on rainfall for cultivation. Cultivation is possible only during wet season. Livelihood system is heavily dependent on one season income for managing the whole year.	Almost all the farmers have no access to reliable water for agriculture. They have no legal rights to the land they cultivate. Wild animals damage the crop on and often. There are no govt. organizations located in the vicinity to deliver the services needed.	01
Kiriibbanwewa	Some areas have no access to irrigation water, some farmers are not motivated enough to improve their agricultural productivity	Even after rehabilitation of irrigation infrastructure some areas in the block do not receive irrigation water. About 20 percent of the area of the block do not have irrigation infrastructure developed. Lack of service delivery organizations in the area is also a problem.	02
Sooriyawewa	The tail end portions of some canals do not receive adequate water for cultivation. There is a considerable area in the command that has not yet received water for irrigated agriculture.	Significant number of farmers has not yet received clear deeds for the lands. Many families have not been given highland for homestead. Significant area of the block does not receive water for irrigated agriculture, Tail-end farmers in some canals do not receive adequate quantity of water for cultivation.	03
Sevanagala	Some areas are still available for further development	The irrigation infrastructure system has not been rehabilitated for about 15 years.	04

Rank: 01= very poor 02= poor 03= moderately poor 04= not poor

Community suggestions for addressing the poverty issues

Most of the community groups in the PRA sessions made suggestions to develop irrigation for addressing the poverty problem. The suggestions made are given in the in table 11.7.

Table 11.7 Community suggestions for poverty alleviation

Block	Suggestions
Maurapura	♦ Make irrigation water available in the entire command and increase the water holding capacity of small tanks located in the area ♦ Issue permits for land occupied by the farmers. ♦ Make arrangements to provide agriculture related input services to the farmers. ♦ Improve infrastructure facilities such as roads, schools, health, electricity etc.
Kiriibbanwewa	♦ Part of the area that have not yet been provided with irrigation infrastructure should be provided with such facilities. ♦ Reconstruct or repair canals in which farmers find difficulties to obtain water even after the rehabilitation ♦ Make arrangements to provide other infrastructure for services such as electricity, education, health, etc.
Sooriyawewa	♦ Make arrangement to provide irrigation water to the areas that have nor yet been provided with water for cultivation. ♦ Some irrigation water distribution canals need rehabilitation. Such problems should be properly addressed. ♦ Provide separate land parcels for homesteads ♦ Improve the infrastructure facilities that deliver the services such as transport, communication, banking, health, education etc.
Sevanagala	♦ Develop irrigation infrastructure facilities to proved irrigation water for the areas that have not yet received water for sugarcane cultivation under irrigation ♦ The irrigation infrastructure already developed now need urgent rehabilitation.

Overall, the results from the PPAs are very much in line with results based on more detailed quantitative analysis.

Summing up, the study provides strong empirical evidence that irrigation infrastructure does have positive impact on poverty alleviation. Areas without access to irrigation infrastructure and adequate water supplies have the highest incidence, depth and severity of poverty. Areas with access to irrigation infrastructure generally have lower levels of chronic poverty and a higher proportion of non-poor. However, these areas also have significant incidence of transient poverty.

There is evidence that inequality in the study area is moderate. The differences in inequality between the various strata are marginal, and may be due to variations in land holdings, availability of irrigation, opportunities for diversified cropping and availability of non-farm income sources. Incomes and expenditures are higher in irrigated areas but the pattern of expenditure is similar in all areas, with food expenditure making up the largest share of total

expenditure. The welfare cost of income fluctuation is higher than that of expenditure fluctuation and these costs are lower for irrigated areas. Farm households, which are able to diversify their cropping with high value crops, are in a better position to achieve consumption smoothing. Irrigation infrastructure helps to reduce fluctuation and enable households to smooth their expenditures. Irrigated areas in general have higher expenditures than rainfed areas and households with access to irrigation infrastructure have around 28% more expenditure compared to rainfed areas. Irrigation infrastructure, while making a significant contribution to annual expenditure can assist substantially in reducing poverty levels.

The analysis of non-monetary indicators of poverty such as dependency ratio, mortality rate of children below five years, housing, education and other facilities, clearly demonstrate that households with access to irrigation infrastructure are socio-economically better off than households without access to irrigation infrastructure. The availability of water is critical to obtaining regular incomes and even in irrigated areas with access to irrigation infrastructure, the lack of water could result in lower incomes. Factors such as adequate water, marketing facilities, and systematic cropping can help to reinforce and boost the benefits from irrigation infrastructure.

Based on the evidence presented, one may conclude that access to irrigation infrastructure has significant impacts on poverty alleviation. It is also clear that irrigation infrastructure can help lift both farm and non-farm households out of permanent or chronic poverty, by increasing productivity, employment, incomes, expenditures and indirectly by enhancing related economic activities. Along with infrastructure development, availability of water is critical to the achievement of the stated benefits. Inadequate water supplies will reduce the impact of infrastructure on poverty, even if the infrastructure is well developed. Poor maintenance and can also lead to reduced water supplies and negate any positive impact on poverty alleviation. Similarly, even if water supply is adequate and the infrastructure well maintained, the cultivation of low value crops or the absence of marketing facilities can reduce the impact of infrastructure on poverty.

From the farmers' point of view, upgrading of irrigation infrastructure was considered as beneficial. They believed that upgrading saved water, and reduced labor requirements for irrigation. A few believed that upgrading increased yields, cropped area and reduced water logging. On the other side, farmers believed that upgrading by lining of canals reduced seepage to their home gardens.

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APPENDICES

Appendix A: Decomposition of Household Monthly Income into Farm, Non-farm and Transfer Income Components

Table A1 and Figure A1 below show monthly farm income for each stratum or block. Monthly farm income includes crop income, income from livestock and rental of agricultural assets. Farm incomes of all strata remained constant between October and February. This was because of the way in which this component was calculated. Data on income was obtained only on a seasonal basis in the first survey. Thus, the total income for the Maha season (October to February), was divided by five to obtain monthly income for the period October to February. Farm income remained low between October and February and increased sharply in March and remained more or less at this or a slightly lower level between March and May in all except the Sevanagala rainfed and irrigated strata. In the latter two strata, farm income remained high between October and March and fell considerably in April and May and increased sharply in June and July and increased even further in August and September. This was probably due to regular income being received from the regular harvesting of sugar cane throughout most of the year and the harvesting of paddy during this period, in the case of Sevanagala irrigated area.

In the Extension area, farm incomes were low between October and February, but increased sharply between March and May, dropped sharply in June and July and improved slightly over the next two months. High farm incomes were obtained in this area only between March and April. This was probably due to high reliance on the Maha season for any farm income in this area as mostly there is no Yala cultivation in this area. Thus the bulk of the farm income was obtained during the period from March to May, soon after the Maha season harvest. In the other three irrigated strata, farm income remained low and constant between October and February, but increased sharply in March to coincide with the Maha harvest and declined slightly to a lower level in April and May. Farm income dropped sharply in June and July coinciding with the dry months and increased sharply to their highest levels in August and September, reflecting the incomes received from the Yala season harvest. Farm incomes remained low during the periods October to February and during the period April to July, as cultivation was restricted in the Maha season in Sooriyawewa, due to rehabilitation and insufficient water. Thus farm income appears to reflect the cropping patterns in the different strata. The lowest farm income was observed in the Extension area, followed by Sooriyawewa and Kiribbanwewa areas. The highest farm income was received in Ridiyagama and Sevanagala areas.

Monthly farm income by category is shown in Figure A2. As one would expect, the non farmers had the lowest farm income levels in all months. Farmers income levels was consistently higher but followed the same pattern as the monthly income of non farmers. The incomes followed the seasonal harvesting patterns of Maha and Yala seasons, with an increase in April, and slightly lower incomes from May to July and a steep rise in August and September. Irrigated and rainfed farms had similar monthly incomes from October to May, but income levels of irrigated farms fell below that of rainfed farms in June and July and rose sharply in August and September.

Table A1 Total Monthly Farm Income (Rs.)

Total Monthly Farm Income Rs

	Sevena-gala I	Sevena-gala RF	Kirilbban-wewa	Sooriya-wewa	Extensi-on	Ridiyag-ama	Irrigated	Rainfed	Farmers	Non-farmers	All
October	3785	4443	828	1037	621	627	1567	2011	1898	324	1652
November	3785	4443	828	1037	621	627	1567	2011	1898	324	1652
December	3785	4443	828	1037	621	627	1567	2011	1898	324	1652
January	3785	4443	828	1037	621	627	1567	2011	1898	324	1652
February	3785	4443	828	1037	621	627	1567	2011	1898	324	1652
March	4622	4492	3318	2015	5576	10751	4767	5182	5364	2053	4847
April	869	75	2492	1019	5178	10334	3266	3323	3553	1785	3277
May	869	75	2492	1019	5178	10334	3266	3323	3553	1785	3277
June	7302	12419	1448	1196	369	1874	2865	4751	3679	788	3227
July	7302	12419	1448	1196	369	1874	2865	4751	3679	788	3227
August	11187	12957	7912	9407	1235	14569	10598	5498	10704	3744	9617
September	11187	12957	7912	9407	1235	14569	10598	5498	10704	3744	9617
Annual Income	62263	77609	31162	30444	22245	67440	46060	42381	50726	16307	45349
Average monthly income	5189	6467	2597	2537	1854	5620	3838	3532	4227	1359	3779

Figure A1

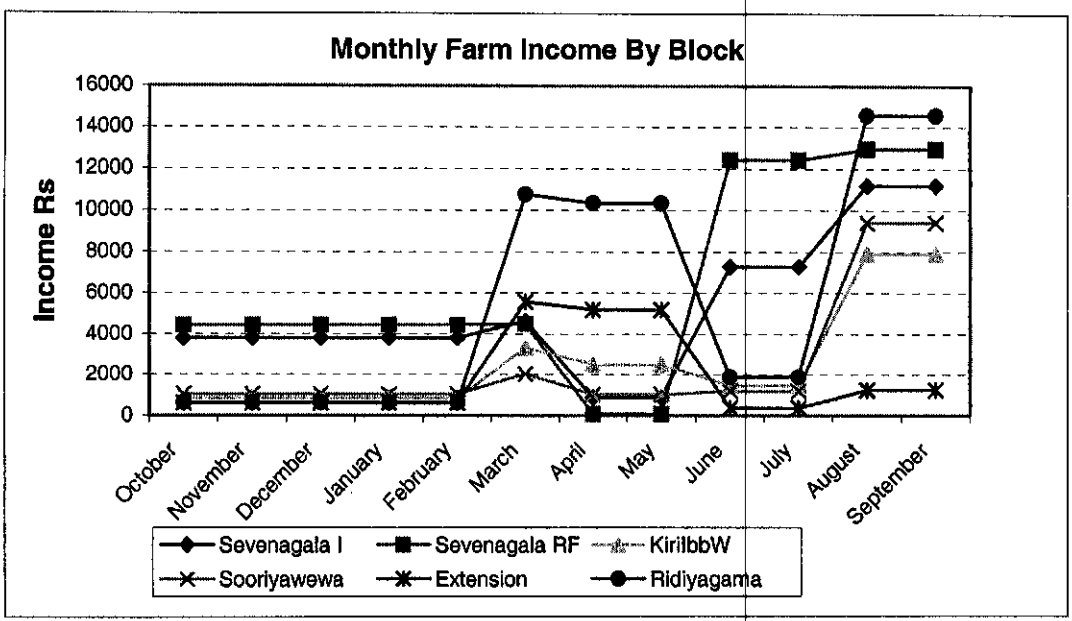


Figure A2

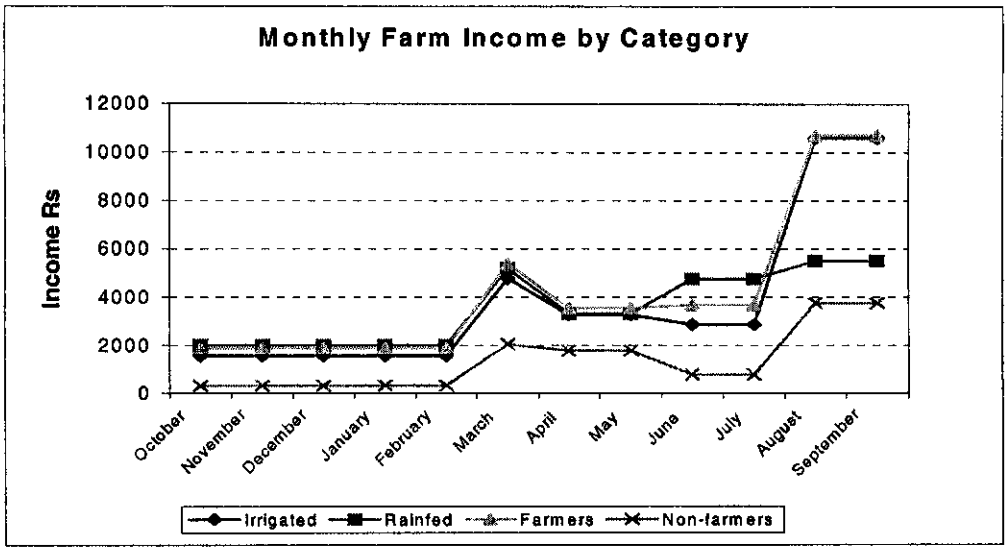


Table A2 and Figure A3 show the distribution of transfer income by Strata or Block. The highest transfer incomes was observed in the Extension area and the lowest in the Sevanagala rainfed area. The second highest incomes from transfers was in Ridiyagama, followed by Sooriyawewa, Sevanagala Irrigated area, and Kiriibbanwewa. High transfer incomes suggest that in the Extension area, this was due to necessity as income from other sources including farming was low. Government transfers through the Samudhri programme made a substantial contribution to transfer income in the Extension area. In Ridiyagama, the bulk of the transfers came from relatives working outside, because this area is more developed, with better education facilities and greater opportunities for obtaining permanent jobs. Ridiyagama also had higher levels of transfer incomes during April and May suggesting that relatives may be sending greater amounts for spending during the festive season.

Sevanagala rainfed area had high crop incomes but the lowest transfer income. This area is a relatively backward (being newly developed) and having less education and other facilities. Furthermore, the households settled have young families, with small children, therefore suggesting that very few relatives and neighbors may be in a position to assist them. High crop income also, makes these families ineligible for Samudhri or transfer payments. The other strata fall in between, having moderate transfer incomes.

Monthly transfer income by category is shown in Figure 4. Farms in the Extension area had the highest transfer income, followed by non-farm households. Irrigated farms had the lowest transfers with farm households having slightly higher level of transfer incomes than irrigated farms. For all, except rainfed farms, income transfers were higher in April and May, suggesting that these households regular transfers due to poverty reasons.

Table A2 Total Monthly Transfer Income (Rs.)

Total Monthly Transfer Income Rs

Month	Sevena-gala I	Sevena-gala RF	Kirilbban-wewa	Sooriya-wewa	Extensi-on	Ridiyag-ama	Irrigated	Rainfed	Farmers	Non-farmers	All
October	258	119	228	309	574	353	288	409	304	351	311
November	258	119	228	309	574	353	288	409	304	351	311
December	258	119	228	309	574	353	288	409	304	351	311
January	258	119	228	309	574	353	288	409	304	351	311
February	258	119	228	309	574	353	288	409	304	351	311
March	258	119	228	309	574	353	288	409	304	351	311
April	303	33	203	301	624	594	342	409	349	385	355
May	303	33	203	301	624	594	342	409	349	385	355
June	160	34	131	286	610	460	258	400	281	309	285
July	160	34	131	286	610	460	258	400	281	309	285
August	160	34	131	286	610	460	258	400	281	309	285
September	160	34	131	286	610	460	258	400	281	309	285
Annual Income	2794	916	2298	3600	7132	5146	3444	4872	3646	4112	3716
Average monthly income	233	76	192	300	594	429	287	406	304	343	310

Figure A3

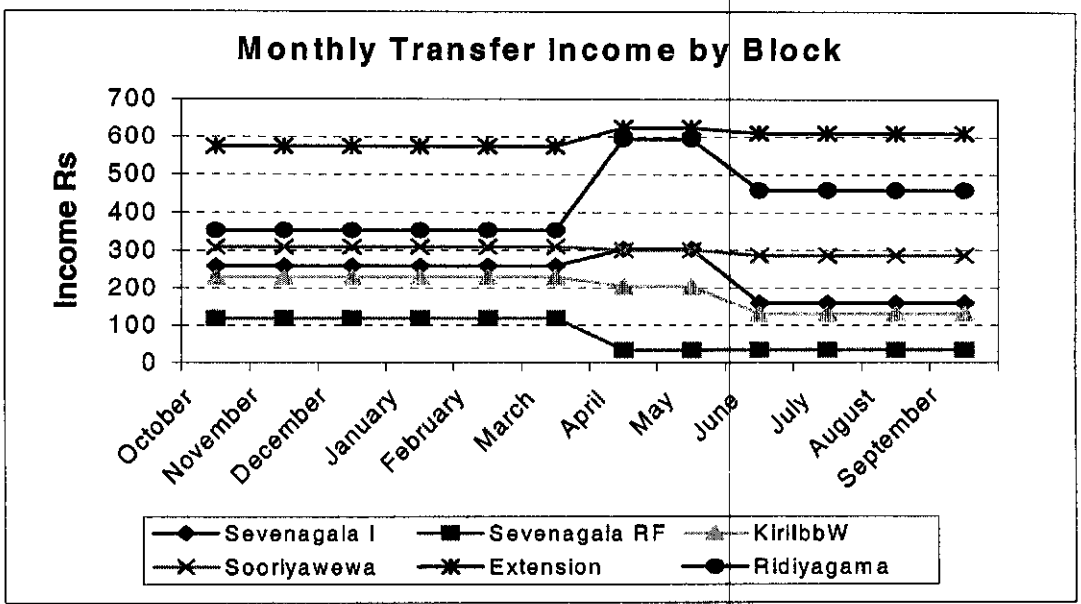
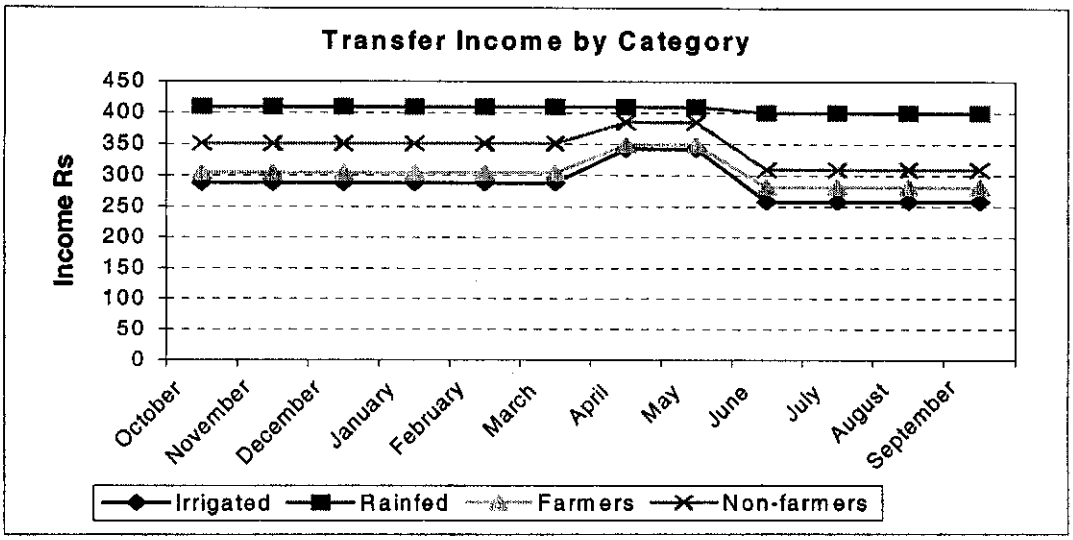


Figure A4



Monthly distribution of non farm income, which comprises wage income and income from all other sources except transfer and farm income is shown in Table A3 and Figure A5. Monthly incomes between October and February are constant in all strata. This is due to the way this income was calculated, as explained earlier in this chapter. Non farm income rises in April and May in all strata except, Sooriyawewa . Non-farm income declines in June and remains constant at this level up to September, in all strata. The highest non-farm income was received by households in Ridiyagama, followed by households in Sooriyawewa and Sevanagala irrigated area. The lowest non-farm income was received by households in Sevanagala rainfed area. The households in Extension area and Kiriibbanwewa received slightly higher non-farm incomes than those in Sevanagala rainfed area. The irrigated and farmer house households received generally higher non-farm incomes than the rainfed farm households. The non-farm households also received high non-farm incomes that remained more or less constant throughout the year. In the other three categories, non-farm incomes rose in April and May and dropped in June and remained constant thereafter. What this seems to suggest is that non-farm households receive regular non-farm and wage income based on work outside the farming area (in the surrounding urban towns and cities). The households in other categories may be receiving most of their non-farm income from within the agricultural or farming areas.

Table A3: Total Monthly Non -Farm Income (Rs.)

	Sevena-gala I	Sevena-gala RF	Kirilbban-wewa	Sooriya-wewa	Extensi-on	Ridiyag-ama	Irrigated	Rainfed	Farmers	Non-farmers	All
October	3181	2142	3080	4305	2940	4861	3884	2650	3599	3904	3647
November	3181	2142	3080	4305	2940	4861	3884	2650	3599	3904	3647
December	3181	2142	3080	4305	2940	4861	3884	2650	3599	3904	3647
January	3181	2142	3080	4305	2940	4861	3884	2650	3599	3904	3647
February	3181	2142	3080	4305	2940	4861	3884	2650	3599	3904	3647
March	3181	2142	3080	4305	2940	4861	3884	2650	3599	3904	3647
April	5411	3849	3472	4360	3794	5741	4710	3814	4649	3940	4539
May	5411	3849	3472	4360	3794	5741	4710	3814	4649	3940	4539
June	4275	3052	3081	3234	2869	4928	3808	2935	3636	3664	3641
July	4275	3052	3081	3234	2869	4928	3808	2935	3636	3664	3641
August	4275	3052	3081	3234	2869	4928	3808	2935	3636	3664	3641
September	4275	3052	3081	3234	2869	4928	3808	2935	3636	3664	3641
Annual Income	47008	32758	37748	47486	36704	60360	47956	35268	45436	45960	45524
Average monthly income	3917	2730	3146	3957	3059	5030	3996	2939	3786	3830	3794

Figure A5

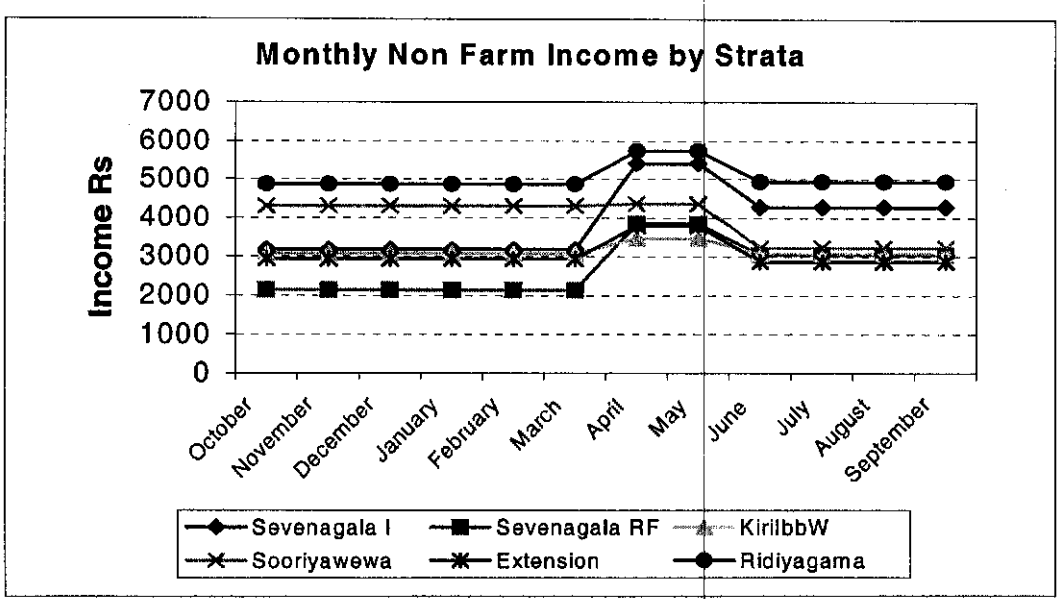


Figure A 6

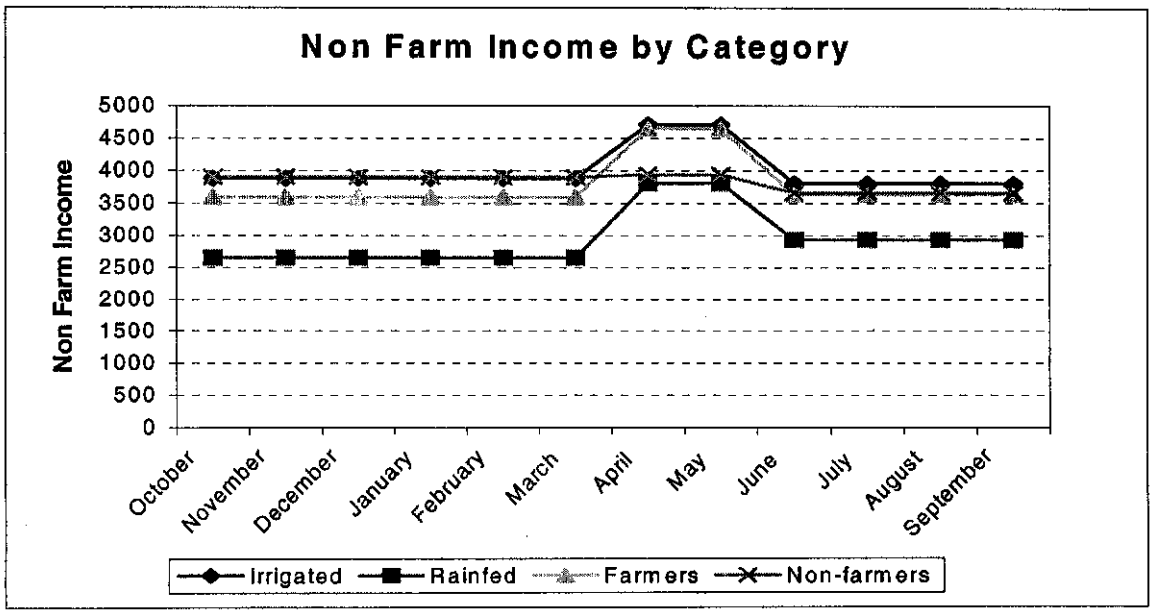


Table A 4: Household Average Monthly Total Incomes

	Sev-Irr	Sev-RF	Kirriban.	Soory	Extn.	Rydl	Irrigated-all	Rainfed-all	Farmers	Non-farmers	All
N	167	60	151	229	105	146	693	165	724	134	858
Oct.	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
Nov.	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
Dec.	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
Jan.	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
Feb.	7223	6704	4135	5650	4135	5841	5740	5069	5802	4579	5611
Mar.	8061	6753	6625	6628	9090	15965	8940	8240	9268	6308	8805
Apr.	6583	3958	6167	5680	9597	16669	8319	7546	8551	6110	8170
May	6583	3958	6167	5680	9597	16669	8319	7546	8551	6110	8170
Jun.	11737	15504	4660	4715	3847	7262	6932	8086	7597	4761	7154
Jul.	11737	15504	4660	4715	3847	7262	6932	8086	7597	4761	7154
Aug.	15622	16043	11124	12926	4713	19957	14664	8833	14621	7716	13543
Sep.	15622	16043	11124	12926	4713	19957	14664	8833	14621	7716	13543
Annual Income	112062	111281	71202	81523	66080	132945	97467	82517	99814	66377	94592
Average monthly income	9338	9273	5934	6794	5507	11079	8122	6876	8318	5531	7883

Appendix B: Decomposition of Household Monthly Expenditures into Food and Non-food Expenditure Components

Household average monthly food expenditure by strata and category is provided in Table B1. The highest level of food expenditure was in Ridiyagama, followed by Kriibbanwewa, Sevanagala irrigated, Sooriyawewa and Sevanagala rainfed areas. The lowest food expenditure was in the Extension area. The irrigated areas had higher levels of food expenditure compared to the rainfed areas. Likewise, the farmers' category had higher food expenditure than non farmers. Graphically it is represented in Figure 7. Ridiyagama food expenditure for all months is above that of all other strata. Food expenditure in the Extension area was the lowest for most months. The highest expenditure on food was in April for all strata and the lowest was in September for all strata, except for Sevanagala rainfed area. The highest expenditure in April coincides with the New Year celebrations. The lower expenditures on food in August and September is probably due to lower incomes during this period. The Yala harvest comes in September, and a rise in food expenditure is observed in October in all cases.

Table B1: Household Average Monthly Food Expenditure by Strata and Category

Monthly Food Expenditures (Rs.)

N	Seve-nagalal	Sevena-gala RF	Kirilbban-wewa	Sooriya-wewa	Extensi-on	Ridiyag-ama	Irrigated	Rainfed	Farmers	Non-farmers	All
Oct.	3345	3264	3404	3149	2696	5195	3683	2903	3637	2974	3533
Nov.	3260	3190	3618	3141	2625	5270	3722	2830	3630	3126	3551
Dec.	3271	3188	3585	3145	2635	4833	3627	2836	3550	3066	3475
Jan.	3165	2953	3457	3065	2726	4684	3516	2809	3445	3029	3380
Feb.	3182	2913	3378	3019	2647	5074	3570	2744	3471	3088	3411
Mar.	3386	3070	3648	3131	2645	5207	3743	2799	3643	3119	3561
Apr.	4638	4165	4990	4227	3712	6429	4956	3876	4859	4151	4749
May	3681	3596	3629	3416	2795	4808	3820	3086	3758	3252	3679
Jun.	3428	2466	3434	3098	2784	4067	3455	2668	3370	2945	3304
Jul.	3583	2620	3622	3304	2755	4299	3650	2706	3561	2969	3468
Aug.	2798	2912	2596	2571	1391	3033	2728	1944	2633	2279	2578
Sep.	2563	2835	2584	2350	1167	2855	2559	1773	2442	2219	2408
Annual expenditures	40299	37172	41946	37616	30577	55756	43028	32975	41997	36217	41094

The pattern of food expenditure is the same for rainfed and irrigated farms as well as farm and non farm households. The food expenditure remains more or less constant from October up to March and then rises sharply in April and drops down to previous levels in May and June and drops further down in August and September. The irrigated farms and farm households spend more on food than rainfed farms or non-farm households. Monthly food expenditure of irrigated farms and farm households was almost equal for all months, while that of the non-farm households was slightly above that of rainfed farms.

Figure B1

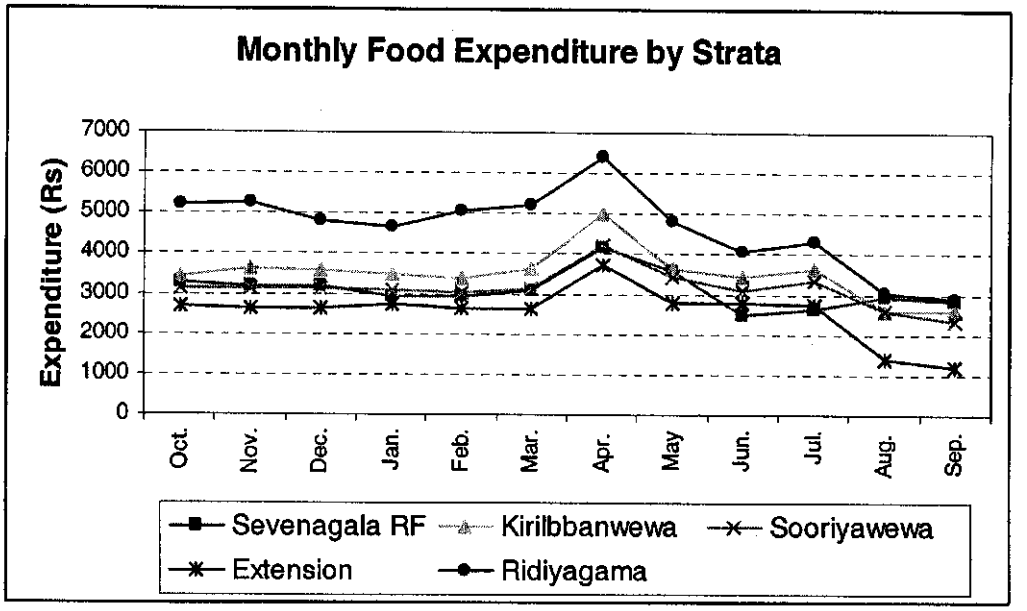
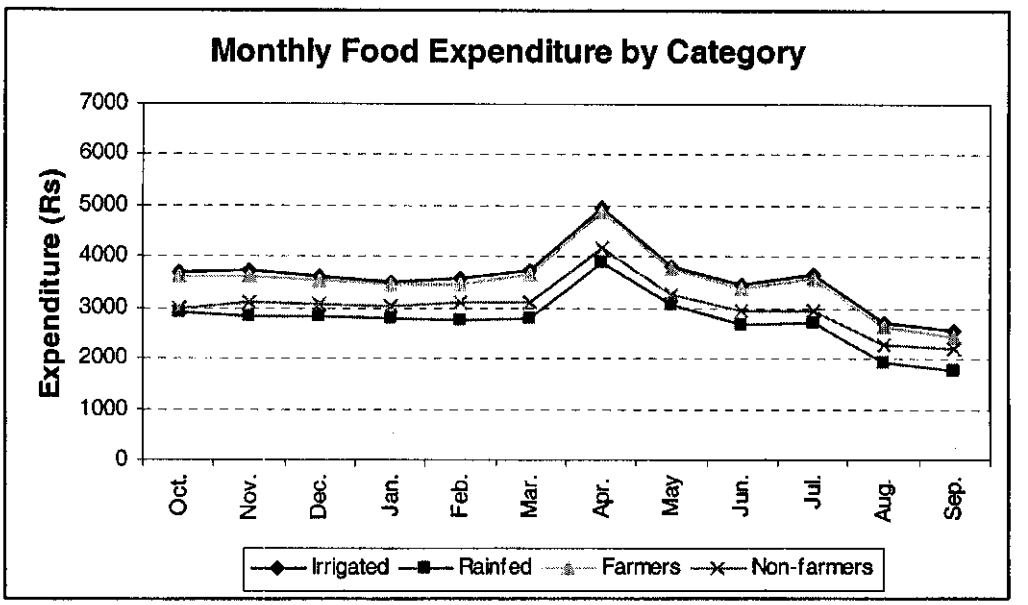


Figure B2



Household average monthly non-food expenditure is by strata and category are given in Table B2 and Figures B3 and B4. The monthly pattern shows three peaks, in January, April and September. The highest peak being in April followed by September and January. This pattern was observed in the case of all strata and categories. The highest expenditure level for all months was observed in Ridiyagama. In the case of all other strata, the levels were very similar except in August and September. The high non food expenditure in January, April and September probably coincides with expenses related to start of school year (January), new year holidays and beginning of Yala cultivation (April) and beginning of Maha cultivation (September).

Non food expenditure for irrigated farms and farm households was similar, with three peaks in January, April and September. In the case of rainfed farms and non farmers, there were only two peaks (January and April) and the expenditure levels were below that of irrigated farms or farmer households. The availability of irrigation and lands for undertaking farming activities enabled those households to reach higher levels of non food consumption, as in the case of food consumption.

Table B2: Household Average Monthly Non-Food Expenditures (Rs.)

Monthly Non Food Expenditures (Rs.)

Month	Seven agalal	Seven agala RF	Kirilbba n-wewa	Sooriya-wewa	Extensi-on	Ridiyag-ama	Irrigated	Rainfed	Farmers	Non-farmers	All
Oct.	1254	1775	1348	1503	1047	2097	1535	1311	1566	1092	1492
Nov.	1396	1331	1339	1809	1087	2150	1679	1176	1656	1182	1582
Dec.	1768	1348	1819	1572	1220	2434	1855	1267	1859	1109	1742
Jan.	1942	2061	1882	2484	2265	2826	2294	2191	2331	1968	2274
Feb.	1353	1260	1592	1844	1236	2690	1849	1244	1779	1480	1733
Mar.	1444	1485	1968	1831	1121	3511	2122	1254	2007	1670	1955
Apr.	4003	4184	4161	4228	3311	6075	4548	3628	4496	3700	4371
May	1801	1938	2210	2458	1572	3084	2377	1705	2279	2082	2248
Jun.	1602	1529	1383	1647	1743	3119	1889	1666	1865	1745	1846
Jul.	2090	1492	2371	2087	1522	3307	2406	1511	2330	1717	2234
Aug.	2170	1296	1988	2492	1273	2818	2373	1281	2284	1513	2163
Sep.	3239	2152	3236	3335	1425	4416	3518	1689	3407	1865	3166
Annual expenditures	64360	59024	67243	64907	49398	94283	71473	52898	69856	57341	67901

Figure B3:

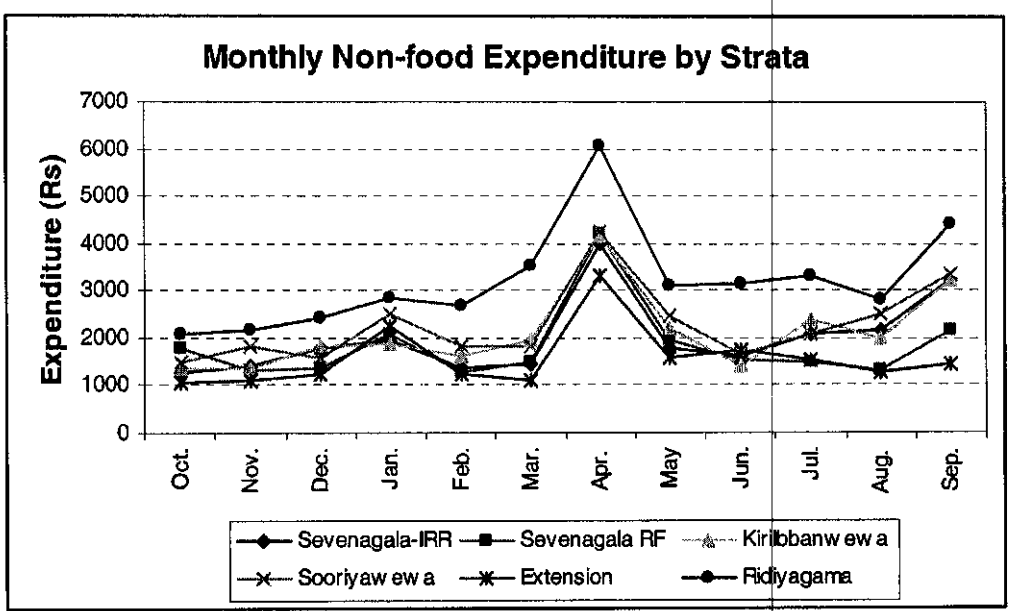


Figure B4

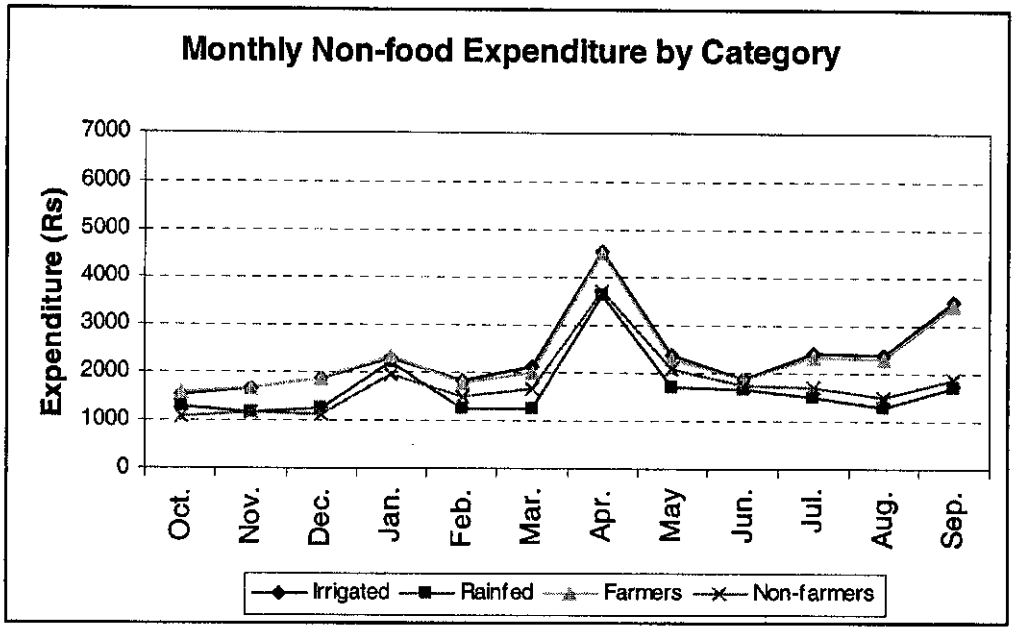


Table B 3: Household Average Monthly Non-food Expenditures (i.e. category 3- non-durable)

	Sev-Irr	Sev-RF	Kirriban.	Soory	Extn.	Rydi	Irrigated-all	Rainfed-all	Farmers	Non-farmers	All
Month	167	60	151	229	105	146	693	165	724	134	858
Oct.	595	597	572	572	474	843	635	519	635	489	612
Nov.	595	629	576	579	472	854	640	529	640	508	619
Dec.	595	567	581	567	493	756	616	520	614	509	598
Jan.	594	569	594	586	487	753	625	516	621	512	604
Feb.	575	549	572	578	477	801	623	503	615	521	600
Mar.	639	575	608	623	491	870	676	522	667	532	646
Apr.	828	761	774	804	627	1009	846	676	838	682	814
May	651	611	578	660	499	751	659	540	654	540	636
Jun.	618	446	555	557	499	801	623	480	606	536	595
Jul.	620	476	610	592	496	872	662	489	637	580	628
Aug.	666	585	615	685	506	788	687	535	688	493	658
Sep.	646	602	588	650	517	786	664	548	672	480	642
Annual expenditures	7622	6967	7223	7453	6038	9885	7956	6376	7888	6380	7652

Table B 4: Household Average Monthly Other Expenditures (i.e. durable expenditures)

Month	Sev-Irr	Sev-RF	Kirriban.	Soory	Extn.	Rydi	Irrigated-all	Rainfed-all	Farmers	Non-farmers	All
Oct.	659	1178	776	931	573	1254	900	793	930	603	879
Nov.	800	702	763	1230	615	1295	1038	647	1017	674	963
Dec.	1173	781	1238	1005	728	1678	1238	747	1244	600	1144
Jan.	1348	1492	1288	1898	1778	2073	1669	1674	1710	1457	1670
Feb.	778	711	1020	1266	758	1889	1226	741	1165	959	1133
Mar.	805	911	1360	1208	630	2640	1446	732	1340	1138	1309
Apr.	3175	3423	3388	3424	2683	5066	3702	2952	3658	3019	3558
May	1150	1328	1632	1798	1073	2333	1718	1166	1625	1542	1612
Jun.	984	1083	828	1090	1244	2318	1266	1185	1258	1209	1251
Jul.	1471	1016	1761	1494	1026	2435	1745	1022	1693	1137	1606
Aug.	1504	711	1373	1807	767	2030	1687	746	1596	1020	1506
Sep.	2592	1550	2648	2685	909	3630	2854	1142	2735	1385	2525
Annual expenditures	16439	14885	18074	19838	12783	28642	20489	13548	19971	14744	19154

Table B 5: Household Average Monthly Total Expenditures

Month	Sev-Irr	Sev-RF	Kirriban.	Soory	Extn.	Rydi	Irrigated-all	Rainfed-all	Farmers	Non-farmers	All
Oct.	4599	5039	4752	4653	3743	7292	5218	4214	5202	4066	5025
Nov.	4656	4522	4958	4950	3712	7420	5401	4006	5286	4308	5133
Dec.	5039	4536	5404	4717	3855	7267	5481	4103	5409	4175	5216
Jan.	5107	5014	5339	5549	4990	7511	5810	4999	5776	4997	5654
Feb.	4534	4173	4971	4863	3883	7764	5418	3988	5250	4567	5143
Mar.	4830	4555	5616	4962	3766	8718	5864	4053	5650	4789	5516
Apr.	8641	8349	9151	8455	7023	12504	9505	7505	9355	7851	9120
May	5482	5534	5838	5874	4366	7892	6197	4791	6036	5334	5927
Jun.	5030	3995	4817	4745	4527	7186	5344	4334	5235	4691	5150
Jul.	5673	4111	5993	5390	4277	7605	6057	4217	5891	4687	5703
Aug.	4968	4208	4585	5063	2664	5851	5102	3225	4917	3792	4741
Sep.	5801	4987	5820	5685	2592	7272	6077	3463	5850	4085	5574
Annual expenditures	64360	59024	67243	64907	49398	94283	71473	52898	69856	57341	67901

Figure B 5 Household Monthly Income and Expenditure – Sevanagala Irrigated

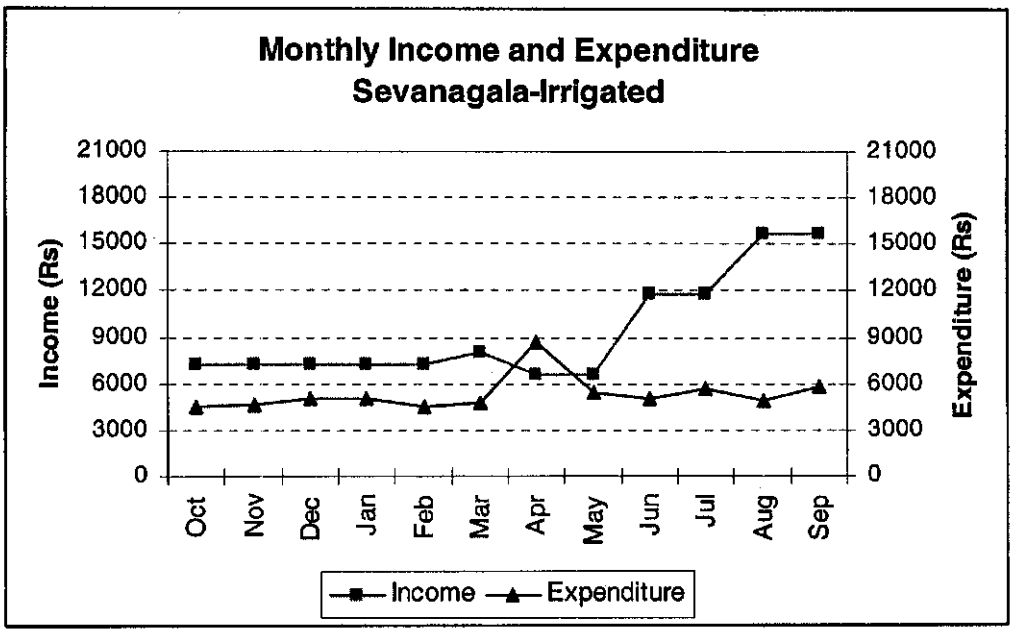


Figure B6 Household Monthly Income and Expenditure – Sevanagala Rainfed

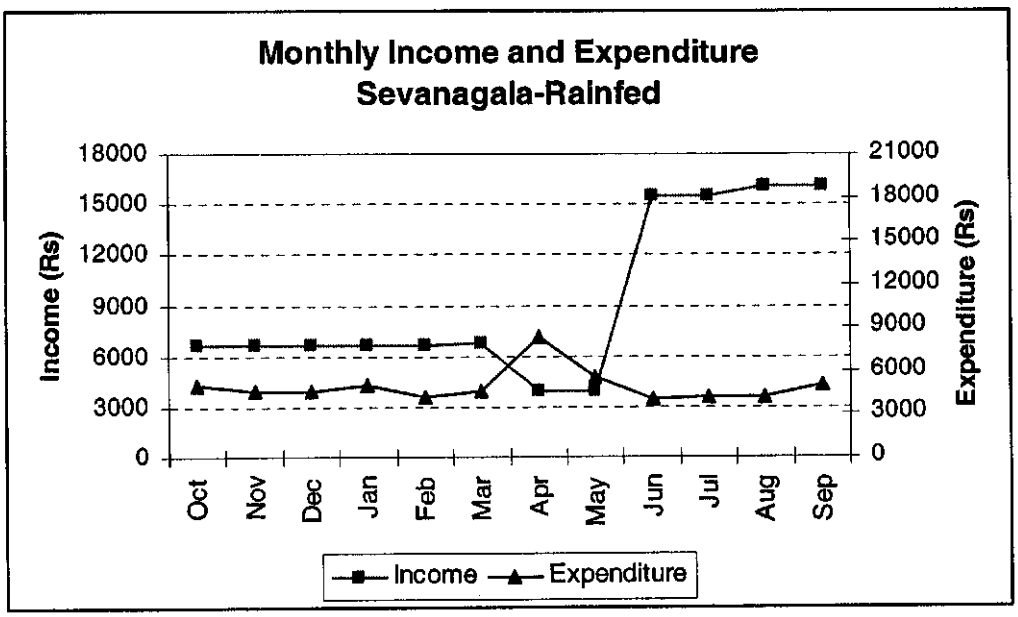


Figure B7: Household Monthly income and Expenditure – Extension Area

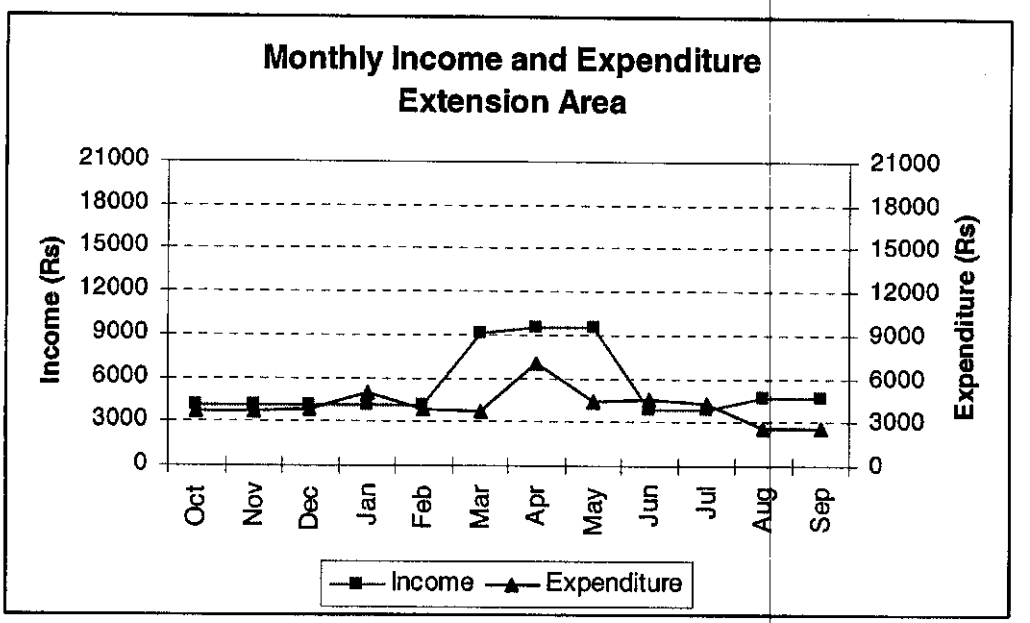


Figure B8: Household Monthly Income and Expenditure - Ridiyagama

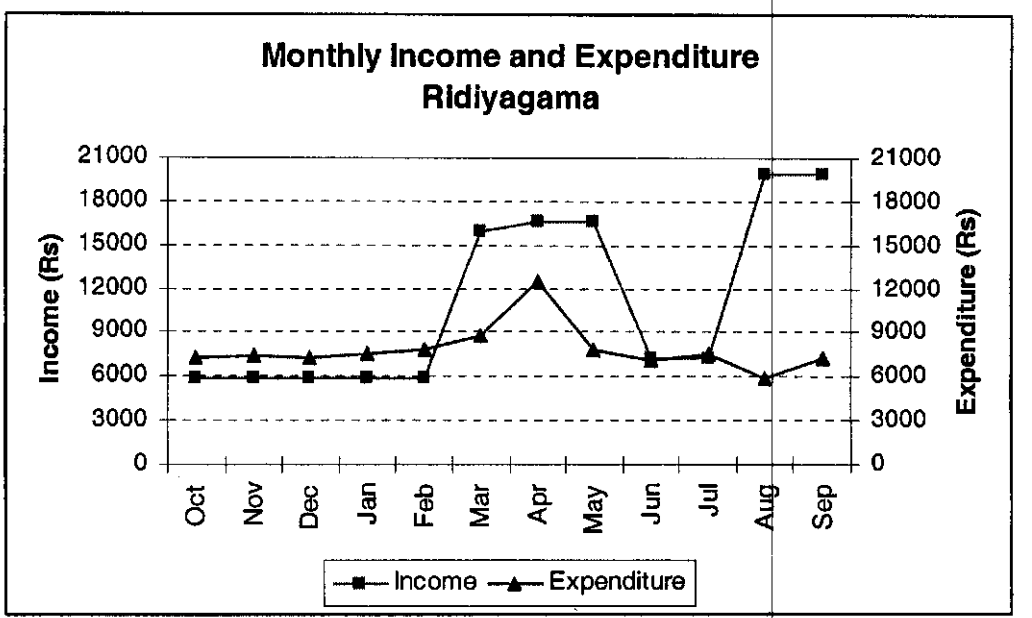


Figure B9 Monthly Income and Expenditure - Irrigated

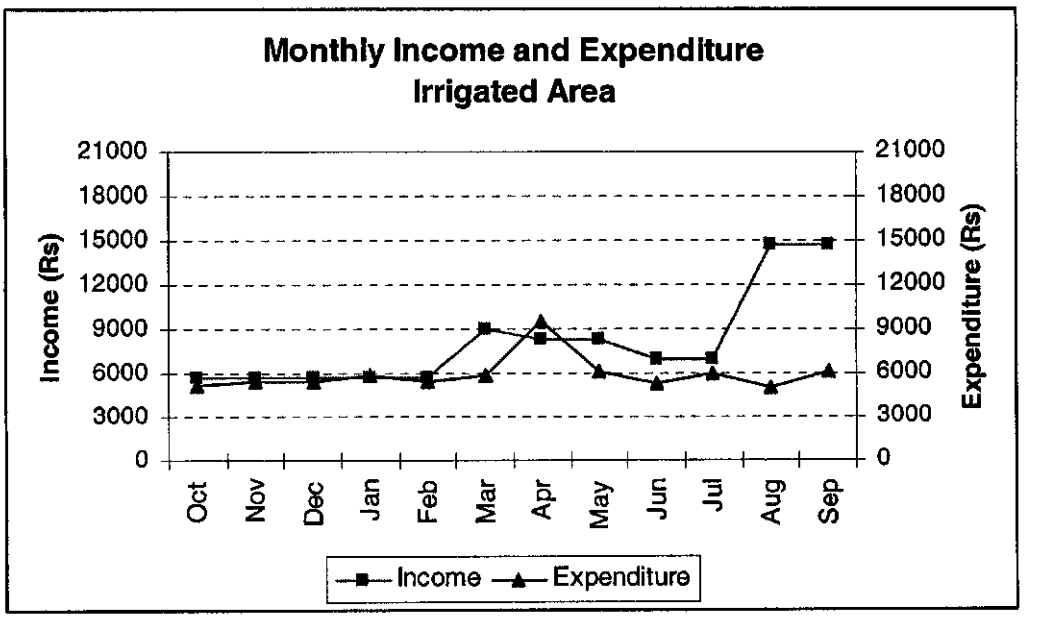


Figure B10: Household Monthly Income and Expenditure - Rainfed

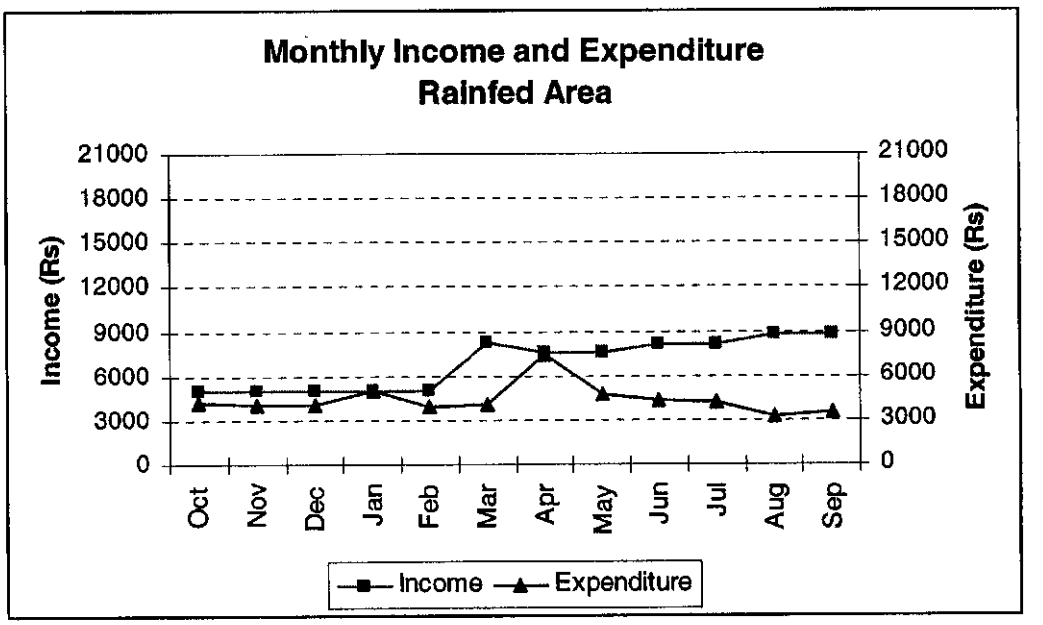


Figure B11: Monthly Income and Expenditure - Farm

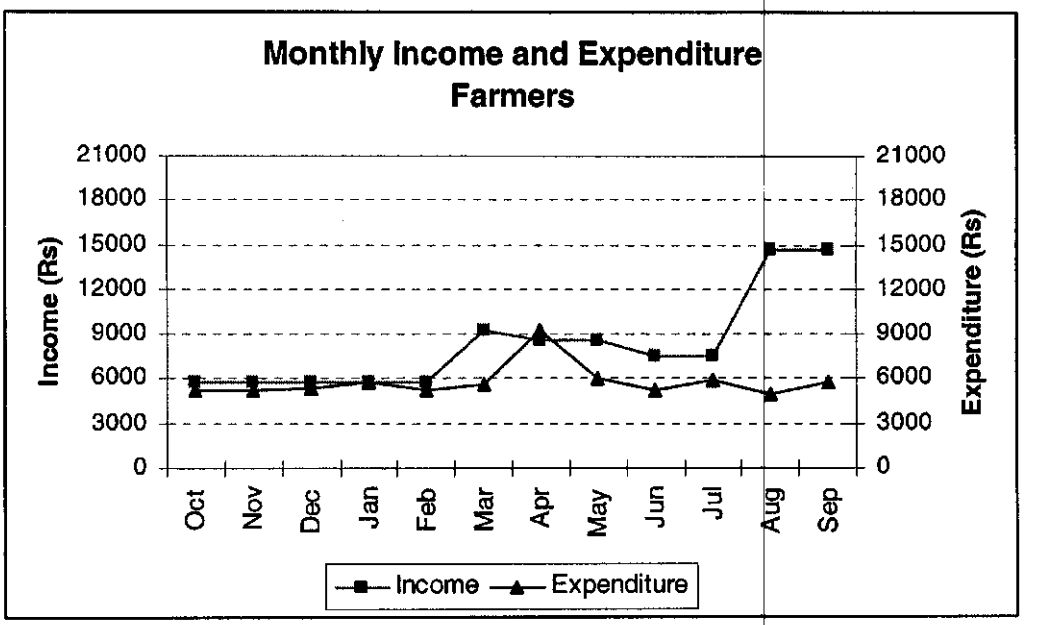
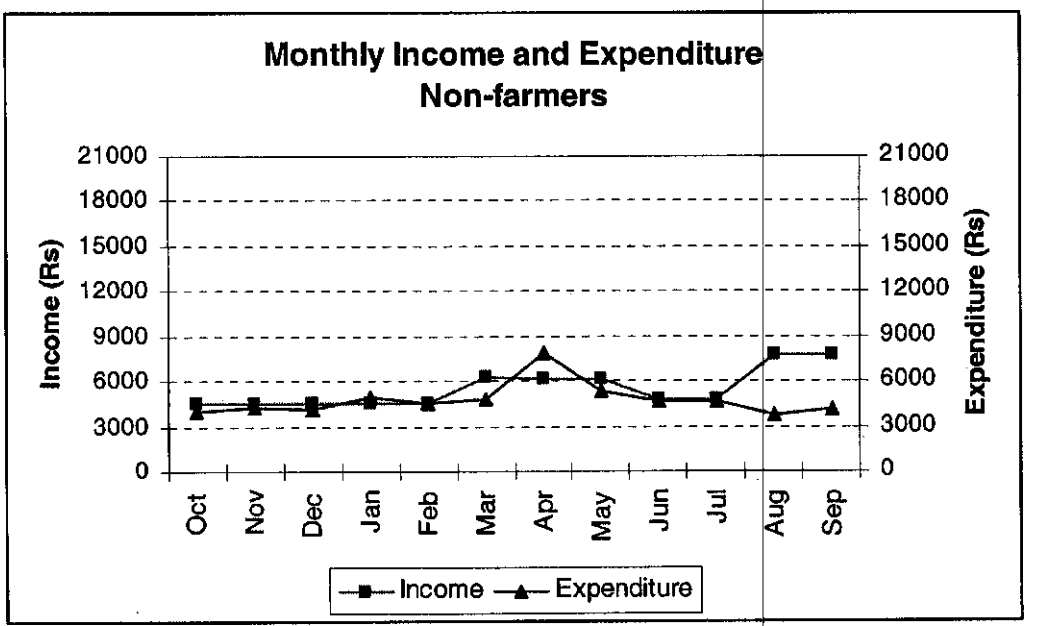


Figure B12: Household Monthly Income and Expenditure – Non Farm



Appendix C: Poverty Indices – Using Monthly Data

Appendix Table C 1: Poverty Head Count – Based on Monthly Expenditure

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiribanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non Farm	All
Head Count (No. of Observations)	167	60	151	229	105	146	693	165	724	134	858
Overall Poverty	0.91	0.95	0.79	0.90	0.97	0.81	0.86	0.96	0.89	0.87	0.88
Chronic Poverty	0.08	0.05	0.07	0.03	0.11	0.01	0.05	0.09	0.06	0.05	0.06
Transient Poverty	0.83	0.90	0.72	0.87	0.86	0.80	0.81	0.87	0.83	0.82	0.82
No. of non-poor	0.08	0.05	0.21	0.10	0.04	0.19	0.14	0.04	0.12	0.13	0.12
Poverty Gap											
Chronic Poverty	0.46	0.47	0.48	0.49	0.57	0.49	0.47	0.55	0.49	0.55	0.50
Transient Poverty	0.15	0.16	0.15	0.18	0.25	0.11	0.15	0.21	0.16	0.17	0.16
Poverty Squared Gap											
Chronic Poverty	0.25	0.25	0.27	0.28	0.36	0.28	0.26	0.34	0.28	0.34	0.29
Transient Poverty	0.06	0.08	0.07	0.08	0.12	0.05	0.07	0.11	0.07	0.08	0.07

Appendix Table C 2: Poverty Head Count – Based on Household Monthly Expenditure Categories I & II

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
Poverty Head Count Expenditure											
- Category I (1)	0.08	0.05	0.07	0.03	0.11	0.01	0.05	0.09	0.06	0.05	0.06
- Category I (3)	0.48	0.52	0.42	0.47	0.28	0.62	0.49	0.36	0.47	0.46	0.47
- Category I (4)	0.08	0.05	0.21	0.10	0.04	0.19	0.14	0.04	0.12	0.13	0.12
- Category II (1)	0.04	0.02	0.03	0.03	0.11	0.00	0.03	0.08	0.04	0.02	0.04
- Category II (2)	0.15	0.15	0.09	0.14	0.29	0.06	0.11	0.24	0.14	0.15	0.14
- Category II (3)	0.25	0.27	0.25	0.27	0.29	0.14	0.23	0.28	0.24	0.23	0.24
- Category II (4)	0.23	0.27	0.19	0.26	0.11	0.17	0.22	0.17	0.21	0.20	0.21
- Category II (5)	0.33	0.30	0.44	0.31	0.20	0.64	0.41	0.24	0.38	0.40	0.38

Appendix Table C 3: Poverty Gap – Based on Household Monthly Expenditure – Categories I & II

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
Poverty Gap Expenditure											
- Category I (1)	0.46	0.47	0.48	0.49	0.57	0.49	0.47	0.55	0.49	0.55	0.50
- Category I (3)	0.07	0.07	0.08	0.09	0.09	0.07	0.08	0.08	0.08	0.09	0.08
- Category I (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Category II (1)	0.56	0.52	0.61	0.56	0.59	0.00	0.58	0.58	0.57	0.66	0.58
- Category II (2)	0.38	0.42	0.38	0.40	0.39	0.37	0.39	0.40	0.40	0.37	0.39
- Category II (3)	0.21	0.21	0.21	0.21	0.23	0.19	0.21	0.23	0.21	0.22	0.22
- Category II (4)	0.10	0.07	0.11	0.11	0.14	0.11	0.11	0.10	0.10	0.12	0.11
- Category II (5)	0.05	0.06	0.05	0.07	0.06	0.06	0.06	0.06	0.06	0.07	0.06

Appendix Table C 4: Poverty Gap Squared – Based on Household Monthly Expenditure – Categories I & II

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated all	Rainfed All	Farm	Non farm	All
Poverty Gap Squared Expenditure											
- Category I (1)	0.25	0.25	0.27	0.28	0.36	0.28	0.26	0.34	0.28	0.34	0.29
- Category I (3)	0.03	0.03	0.04	0.04	0.05	0.03	0.03	0.04	0.03	0.05	0.03
- Category I (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Category II (1)	0.34	0.27	0.40	0.36	0.38	0.00	0.37	0.37	0.36	0.46	0.37
- Category II (2)	0.18	0.26	0.19	0.22	0.21	0.19	0.20	0.22	0.21	0.17	0.21
- Category II (3)	0.08	0.09	0.08	0.08	0.10	0.07	0.08	0.09	0.08	0.09	0.08
- Category II (4)	0.05	0.03	0.05	0.04	0.07	0.05	0.04	0.05	0.04	0.06	0.04
- Category II (5)	0.01	0.04	0.03	0.03	0.03	0.02	0.02	0.03	0.02	0.03	0.03

Appendix Table C 5: Poverty Head Count – Based on Household Monthly Expenditure (Monthly Indices)

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Head Count – Expenditure											
- October	0.63	0.52	0.51	0.64	0.72	0.31	0.54	0.65	0.55	0.59	0.56
- November	0.61	0.50	0.50	0.62	0.73	0.30	0.53	0.65	0.55	0.56	0.55
- December	0.61	0.48	0.45	0.63	0.71	0.34	0.53	0.62	0.54	0.55	0.54
- January	0.58	0.50	0.43	0.53	0.62	0.28	0.47	0.58	0.49	0.50	0.49
- February	0.63	0.63	0.49	0.62	0.67	0.29	0.52	0.66	0.55	0.51	0.55
- March	0.59	0.53	0.43	0.60	0.73	0.27	0.49	0.66	0.53	0.49	0.52
- April	0.16	0.13	0.15	0.14	0.18	0.06	0.13	0.16	0.14	0.11	0.14
- May	0.49	0.42	0.40	0.50	0.61	0.25	0.42	0.54	0.43	0.45	0.45
- June	0.53	0.70	0.50	0.57	0.65	0.40	0.51	0.67	0.55	0.49	0.54
- July	0.41	0.58	0.40	0.44	0.65	0.36	0.41	0.62	0.46	0.41	0.45
- August	0.60	0.60	0.56	0.60	0.86	0.55	0.58	0.76	0.62	0.60	0.62
- September	0.56	0.58	0.48	0.51	0.89	0.49	0.51	0.78	0.56	0.58	0.56

Appendix Table C 6: Poverty Gap – Based on Household Monthly Expenditure (Monthly Indices)

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Gap – Expenditure											
- October	0.32	0.31	0.32	0.29	0.39	0.23	0.30	0.37	0.32	0.31	0.31
- November	0.33	0.33	0.31	0.29	0.41	0.24	0.30	0.38	0.32	0.33	0.32
- December	0.33	0.33	0.30	0.28	0.40	0.23	0.29	0.38	0.31	0.34	0.31
- January	0.29	0.25	0.28	0.31	0.34	0.22	0.29	0.31	0.30	0.27	0.29
- February	0.31	0.27	0.28	0.32	0.38	0.23	0.30	0.34	0.31	0.30	0.31
- March	0.29	0.28	0.30	0.30	0.35	0.26	0.29	0.33	0.30	0.28	0.30
- April	0.26	0.37	0.25	0.29	0.34	0.24	0.27	0.35	0.28	0.34	0.29
- May	0.30	0.25	0.28	0.28	0.37	0.23	0.28	0.34	0.29	0.29	0.29
- June	0.27	0.40	0.34	0.37	0.37	0.36	0.34	0.38	0.35	0.33	0.35
- July	0.30	0.44	0.34	0.41	0.33	0.36	0.36	0.37	0.36	0.39	0.36
- August	0.35	0.29	0.37	0.35	0.51	0.34	0.35	0.45	0.37	0.42	0.37
- September	0.33	0.26	0.40	0.35	0.54	0.30	0.34	0.47	0.37	0.39	0.37

Appendix Table C 7 Poverty Gap Squared – Based on Household Monthly Expenditure (Monthly Indices)

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Gap Squared – Expenditure											
- October	0.15	0.14	0.14	0.12	0.20	0.08	0.13	0.18	0.14	0.15	0.14
- November	0.15	0.16	0.13	0.11	0.22	0.09	0.12	0.20	0.14	0.15	0.14
- December	0.15	0.16	0.13	0.11	0.21	0.08	0.12	0.20	0.14	0.16	0.14
- January	0.13	0.11	0.12	0.13	0.15	0.07	0.12	0.14	0.13	0.12	0.13
- February	0.13	0.11	0.11	0.14	0.20	0.09	0.12	0.17	0.14	0.12	0.13
- March	0.12	0.12	0.12	0.13	0.17	0.10	0.12	0.15	0.13	0.12	0.13
- April	0.10	0.24	0.10	0.14	0.14	0.11	0.11	0.17	0.12	0.16	0.13
- May	0.13	0.10	0.12	0.11	0.18	0.08	0.11	0.16	0.12	0.12	0.12
- June	0.11	0.27	0.18	0.22	0.19	0.20	0.18	0.22	0.19	0.18	0.19
- July	0.13	0.31	0.19	0.25	0.17	0.20	0.20	0.22	0.20	0.21	0.20
- August	0.17	0.12	0.21	0.17	0.31	0.15	0.17	0.25	0.19	0.22	0.19
- September	0.15	0.11	0.23	0.18	0.33	0.14	0.17	0.27	0.20	0.20	0.20

Appendix D – Poverty Indices Using Quarterly Data

Appendix Table D 1 Poverty Head Count (Quarterly Indices) – Based on Household Income – Quarterly Data

Item		Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Head Count – Income		167	60	151	229	**105**	146	693	165	724	**134**	858
QTR 1	Oct.	0.42	0.60	0.68	0.60	**0.69**	0.58	0.57	0.65	0.59	**0.55**	0.59
	Nov.											
	Dec.											
QTR 2	Jan.	0.41	0.60	0.60	0.57	**0.53**	0.34	0.49	0.56	0.51	**0.48**	0.51
	Feb.											
	Mar.											
QTR 3	Apr.	0.29	0.30	0.48	0.60	**0.35**	0.19	0.41	0.33	0.39	**0.43**	0.40
	May											
	Jun.											
QTR 4	Jul.	0.28	0.28	0.37	0.30	**0.70**	0.29	0.31	0.55	0.34	**0.41**	0.35
	Aug.											
	Sep.											

Appendix Table D 2 Poverty Head Count – Based on Household Expenditures – Quarterly Data

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	**Extension Area**	Ridiyagama	Irrigated all	Rainfed All	Farm	**Non farm**	All
Head Count (No. of Observations)	167	60	151	229	**105**	146	693	165	724	**134**	858
Total Poverty											
- Chronic Poverty	0.23	0.21	0.15	0.21	**0.39**	0.08	0.18	0.33	0.21	**0.18**	0.20
- Transient Poverty	0.50	0.52	0.50	0.55	**0.51**	0.47	0.51	0.51	0.50	**0.55**	0.51
- Non-poor	0.26	0.27	0.35	0.24	**0.10**	0.45	0.31	0.16	0.29	**0.27**	0.28
Poverty Gap											
- Chronic Poverty	0.34	0.32	0.36	0.32	**0.42**	0.28	0.33	0.40	0.35	**0.35**	0.35
- Transient Poverty	0.12	0.11	0.12	0.12	**0.16**	0.08	0.12	0.14	0.12	**0.13**	0.12
Poverty Squared Gap											
- Chronic Poverty	0.60	0.54	0.69	0.59	**0.85**	0.47	0.60	0.78	0.65	**0.66**	0.65
- Transient Poverty	0.20	0.19	0.20	0.18	**0.29**	0.11	0.18	0.25	0.19	**0.22**	0.19

Appendix Table D 3 Poverty Head Count (Quarterly Indices) – Based on Household Expenditures – Quarterly Data

Item		Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Poverty Head Count – Income		167	60	151	229	**105**	146	693	165	724	**134**	858
QTR 1	Oct.	0.58	0.52	0.50	0.62	**0.70**	0.31	0.52	0.64	0.54	**0.55**	0.54
	Nov.											
	Dec.											
QTR 2	Jan.	0.58	0.52	0.44	0.57	**0.68**	0.27	0.48	0.62	0.51	**0.47**	0.51
	Feb.											
	Mar.											
QTR 3	Apr.	0.29	0.30	0.24	0.30	**0.47**	0.11	0.24	0.41	0.28	**0.25**	0.28
	May											
	Jun.											
QTR 4	Jul.	0.50	0.57	0.43	0.49	**0.84**	0.38	0.46	0.74	0.51	**0.54**	0.51
	Aug.											
	Sep.											

Appendix E: Body Mass Index (BMI)

During the household level surveys (in June, August and October), heights and weights of household heads and family members were measured. These data re used to calculate indicators of poverty other than those based on income and expenditure data. One of these indicators used here is the Body Mass Index (BMI), where the BMI is defined as the ratio of a person's weight (in kilograms) to the person's height (in meters) squared, i.e., weight/(height) ^{2}. BMIs are calculated for different age categories (1-4, 5-9, 10-14, 15-19, and 20-24) for each of the three surveys. The results are presented in Appendix Table E1.

Except the first two age groups, the BMI shows an increase from survey one (June) to survey three (October) in the case of irrigated areas. In the first two age groups, the BMI declines or declines and then increases over these three periods. In the rainfed areas, the BMI for all age groups declines in the second period (August) and increases during the third period (October) but does not reach the level of the first period values. This implies that in the rainfed areas, the nutrition levels decline during the second or dry period and increases slightly over the third period, with the first period or the Maha rainy period showing the highest levels of nutrition.

An analysis of Farm and Non Farm households show that BMI for non-farm households is lower than for farm households except for the 10-14 age group. The BMI declines and increases slightly over the three periods of the survey, in the case of non farm households. In farm households, the BMI tends to increase from period one to three, except in the first and last age groups, where it declines and then increases slightly in the last period. The results suggests that the nutritional levels are lower for non-farm households and tends to decline during the dry period, when there are less opportunities for work in agriculture.

A comparison of BMI in the different Blocks shows that in almost all the blocks and age groups, there are only a few instances of underweight children. In the Sevanagala irrigated area, children in the age group 5-9 were found to be underweight during the second survey period. There were no underweight children in any of the age groups or survey periods in both the Sevanagala rainfed and Extension areas [The fact that BMI levels are higher in rainfed areas may be due to the reason that households in these areas have been receiving more food aid (relief for prevailing drought) than those in irrigated areas]. In Kiriibbanwewa, children in the 5-9 age group were found to be underweight, during the second and third survey periods. In Sooriyawewa, underweight children in the 5-9 age group were observed in the first and third surveys. In Ridiyagama underweight children were observed in the 10-14 age group in the first survey. In all blocks, the underweight problem appeared to be prevalent in the 5-9 age group followed by the 10-14 age group.

Appendix Table E1Table: Body Mass Index

Item	Sevanagala, Irrigated	Sevanagala Rainfed	Kiriibanwewa	Sooriyawewa	Extension Area	Ridiyagama	Irrigated All	Rainfed all	Farm	Non farm	All
Survey-I (June 2001)											
BMI-Age 01-04	15.41 (34)	16.00 (21)	15.29 (22)	14.66 (45)	15.34 (29)	15.83 (34)	15.25 (135)	15.62 (50)	15.48 (140)	14.96 (45)	15.35 (185)
BMI-Age 05-09	14.03 (50)	14.22 (35)	13.97 (37)	[illegible]	13.86 (40)	14.34 (31)	13.92 (201)	14.03 (75)	13.87 (227)	14.31 (49)	13.95 (276)
BMI-Age 10-14	15.27 (47)	14.89 (23)	15.45 (49)	15.00 (93)	14.94 (43)	[illegible]	15.11 (229)	14.92 (66)	15.17 (255)	[illegible]	15.07 (295)
BMI-Age 15-20	18.73 (63)	18.72 (15)	18.37 (56)	17.56 (84)	18.63 (39)	17.80 (48)	18.08 (251)	18.65 (54)	18.24 (264)	17.78 (41)	18.18 (305)
BMI-Age 21-24	19.50 (79)	20.04 (11)	19.47 (49)	18.86 (63)	20.90 (27)	18.97 (39)	19.23 (230)	20.65 (38)	19.44 (221)	19.39 (47)	19.43 (268)
Survey-II (August 2001)											
BMI-Age 01-04	15.16 (33)	15.27 (21)	15 (23)	15.01 (38)	15.04 (27)	14.44 (22)	14.98 (116)	15.14 (48)	15.13 (123)	14.71 (41)	15.02 (164)
BMI-Age 05-09	[illegible]	14.09 (32)	[illegible]	13.80 (74)	13.85 (37)	14.90 (24)	13.91 (182)	13.96 (69)	13.87 (207)	14.16 (44)	13.92 (251)
BMI-Age 10-14	15.74 (43)	15.02 (20)	15.25 (47)	15.61 (97)	14.81 (40)	15.36 (32)	15.52 (219)	14.88 (60)	15.52 (244)	[illegible]	15.38 (279)
BMI-Age 15-20	18.33 (51)	18.40 (13)	18.76 (47)	17.62 (61)	18.37 (34)	17.58 (40)	18.06 (196)	18.38 (47)	18.27 (217)	[illegible]	18.12 (246)
BMI-Age 21-24	19.17 (57)	19.47 (9)	19.26 (37)	19.48 (43)	19.53 (26)	19.04 (33)	19.25 (170)	19.51 (35)	19.27 (165)	19.37 (40)	19.29 (205)
Survey-III (October 2001)											
BMI-Age 01-04	14.50 (31)	14.99 (22)	14.28 (19)	15.00 (41)	15.38 (29)	16.25 (26)	15.03 (117)	15.21 (51)	15.18 (127)	14.79 (41)	15.09 (168)
BMI-Age 05-09	14.06 (49)	14.83 (35)	[illegible]	[illegible]	14.00 (35)	14.56 (24)	13.89 (160)	14.42 (70)	13.93 (195)	14.71 (35)	14.05 (230)
BMI-Age 10-14	15.73 (37)	15.07 (21)	15.42 (32)	15.58 (64)	15.09 (33)	15.60 (32)	15.59 (165)	15.08 (54)	15.54 (196)	14.82 (23)	15.47 (219)
BMI-Age 15-20	18.49 (57)	20.31 (13)	18.84 (40)	18.30 (52)	18.42 (23)	17.86 (39)	18.38 (188)	19.10 (36)	18.57 (195)	18.03 (29)	18.50 (224)
BMI-Age 21-24	19.69 (64)	18.87 (12)	19.53 (40)	19.65 (44)	20.28 (21)	19.74 (28)	19.65 (176)	19.77 (33)	19.65 (170)	19.75 (39)	19.67 (209)

Estimated cut off point for underweight children and adolescents[1]

	Boys		Girls		Average Boys	Average Girls	Average
BMI-Age 02-04	14.75	14.00	14.30	13.60	14.38	14.00	[illegible]
BMI-Age 05-09	13.75	14.00	13.50	13.70	13.88	13.60	[illegible]
BMI-Age 10-14	14.25	15.50	13.90	15.40	14.88	14.70	[illegible]
BMI-Age 15-20	16.25	18.50	16.00	17.40	17.38	16.70	[illegible]
BMI-Age 21-24	18.60	19.00	17.50	17.80	18.80	17.70	[illegible]

[1] Estimates based on ; Himes JH and Deitz WH, Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. *American Journal of Clinical Nutrition. 1994;59:307-316*

The BMI showed an increase between the first and third surveys in Ridiyagama, except in age group 1-4, where it declined in the second survey and increased again in the third survey. This may be a reflection of the high water availability and higher cropping intensity leading to better food availability. In Sooriyawewa, the BMI increased between the first and second surveys and then declined in the third survey, except in the last two age groups (15-20 and 21-24), where it increased. This may be due to reduced cultivation in the third survey period due to the on-going rehabilitation in this area. In the Extension area, BMI declined in the second survey period and increased in the third survey period for all age groups, reflecting the reduced food supplies during the dry period in this area.

Nothing conclusive can be said about the nutrition levels in the different blocks, but Sevanagala irrigated appears to be nutritionally better off than the other areas. Reduction of food supplies due to the general drought that prevailed in the area (during the study period) and food assistance program seems to have distorted the picture

Appendix F: Welfare Cost of Household Income and expenditure Fluctuations

Appendix Table F 1: Welfare cost of fluctuations in household monthly incomes based on monthly Income data

	N	STD	CV	m/y (RRA=2)	m/y (RRA=4)
Sevanagala-Irrigated	167	6701	0.725	0.649	1.299
Sevanagala-Rainfed	60	8011	0.646	2.319	4.638
Kiriibbanwewa	151	4727	0.937	1.340	2.681
Sooriyawewa	229	5252	0.759	1.195	2.391
Extension Area	105	4065	0.739	0.601	1.202
Ridiyagama	146	9604	0.845	0.807	1.613
Irrigated all	693	6404	0.808	1.013	2.027
Rainfed all	165	5500	0.705	1.226	2.452
Farmers	724	6653	0.804	1.147	2.294
Non-farmers	134	3944	0.700	0.553	1.106
Chronic Poor	126	1482	0.675	1.758	3.516
Transient poor	549	6378	0.868	1.108	2.217
Non-poor	183	9056	0.624	0.407	0.814
All	858	6230	0.788	1.054	2.109

Appendix Table F 2: Welfare cost of fluctuations in household expenditures based on quarterly expenditure data

Strata	N	STDEV	CV	m/y (RRA=2)	m/y (RRA=4)
Sevanagala-Irrigated	167	4950	0.297	0.123	0.245
Sevanagala-Rainfed	60	4227	0.292	0.129	0.258
Kiriibanwewa	151	4916	0.279	0.102	0.204
Sooriyawewa	229	5023	0.308	0.130	0.261
Extension Area	105	4385	0.333	0.137	0.274
Ridiyagama	146	7585	0.311	0.118	0.236
Irrigated all	693	5522	0.300	0.120	0.239
Rainfed all	165	4327	0.318	0.134	0.268
Farmers	724	5442	0.304	0.124	0.249
Non-farmers	134	4481	0.297	0.112	0.224
Chronic poor	177	2516	0.233	0.071	0.141
Transient poor	439	5756	0.348	0.155	0.310
Non-poor	242	6483	0.274	0.102	0.203
All	858	5292	0.303	0.122	0.245

Appendix Table F 2: Welfare cost of fluctuations in household income based on quarterly income data

Strata	N	STDEV	CV	m/y (RRA=2)	m/y (RRA=4)
Sevanagala-Irrigated	167	16350	0.595	0.615	1.231
Sevanagala-Rainfed	60	23173	0.547	3.514	7.028
Kiriibanwewa	151	11533	0.812	1.340	2.679
Sooriyawewa	229	12533	0.609	1.114	2.227
Extension Area	105	8472	0.524	0.371	0.741
Ridiyagama	146	22585	0.658	0.587	1.173
Irrigated all	693	15353	0.660	0.932	1.864
Rainfed all	165	13818	0.533	1.514	3.027
Farmers	724	16269	0.662	1.166	2.333
Non-farmers	134	8510	0.497	0.381	0.761
Chronic poor	138	3325	0.532	1.782	3.564
Transient poor	502	17453	0.779	1.210	2.419
Non-poor	218	16968	0.373	0.194	0.389
All	858	15057	0.636	1.044	2.087

Appendix G Regression Results

Appendix Table G.1 Regression Results – Determinants of Annual Expenditure (Income)

Dependent Variable: Annual Expenditures			
	Coefficient	STE	t
(Constant)	15331	3808	4.03
HHSY	962	247	3.89
ANFM	5866	718	8.17
GVP	0.083	0.013	6.38
ALH	7653	1443	5.30
AGA	0.108	0.017	6.35
D1	8729	3333	2.62
D2	1729	4220	0.41
D3	13948	3228	4.32
D4	15385	3095	4.97
D6	31893	3404	9.37

N = 857 R = 0.386 , Adj R = 0.379 df = 10
STE = Standard Error
HHSY= Household Head Schooling Years
ANFM= Average Number of Family Workers
GVP
ALH = Average land holding (ha)
AGA= Agri Assets
D1= Dummy for stratum 1(Stratum 1= 1, 0= otherwise)
D2= Dummy for stratum 2 (Stratum 2= 1, 0= otherwise)
D3= Dummy for stratum 3 (Stratum 3= 1, 0= otherwise)
D4= Dummy for stratum 4 (Stratum 4=1, 0= otherwise)
D6= Dummy for stratum 6(Stratum 6=1, 0= otherwise)

Appendix Table G.2: Regression Results – Determinants of Annual Expenditure (Income) – Irrigated versus Non -Irrigated

Dependent Variable: Annual Expenditures			
	Coefficient	STE	t
(Constant)	11137	3619	3.08
HHSY	1226	253	4.84
ANFM	6160	739	8.33
GVP	0.090	0.013	6.89
ALH	9097	1452	6.26
AGA	0.110	0.017	6.47
D1	16519	2385	6.92

N = 857 R = 0.336 , Adj R = 0.331 df = 6
STE = Standard Error
HHSY= Household Head Schooling Years
ANFM= Average Number of Famly Workers
GVP
ALH = Average land holding (ha)
AGA= Agri Assets
D1= Dummy for irrigated/non-irrigated 1(Irrigated=1, and non-irrigated =0)

Appendix Table G.3: Regression Results – Determinants of log Annual Expenditure (Income) – Irrigated versus Non –Irrigated

Dependent Variable: Log Annual Expenditures			
	Coefficient	STE	t
(Constant)	10.159	0.052	195.37
HHSY	0.019	0.004	4.69
ANFM	0.107	0.011	9.73
GVP	0.00000138	0.000	7.35
ALH	0.113	0.021	5.38
AGA	0.00000133	0.000	5.31
D1	0.244	0.034	7.18

N = 857 R = 0.349 , Adj R = 0.345 df = 6

STE = Standard Error

HHSY= Household Head Schooling Years

ANFM= Average Number of Famly Workers

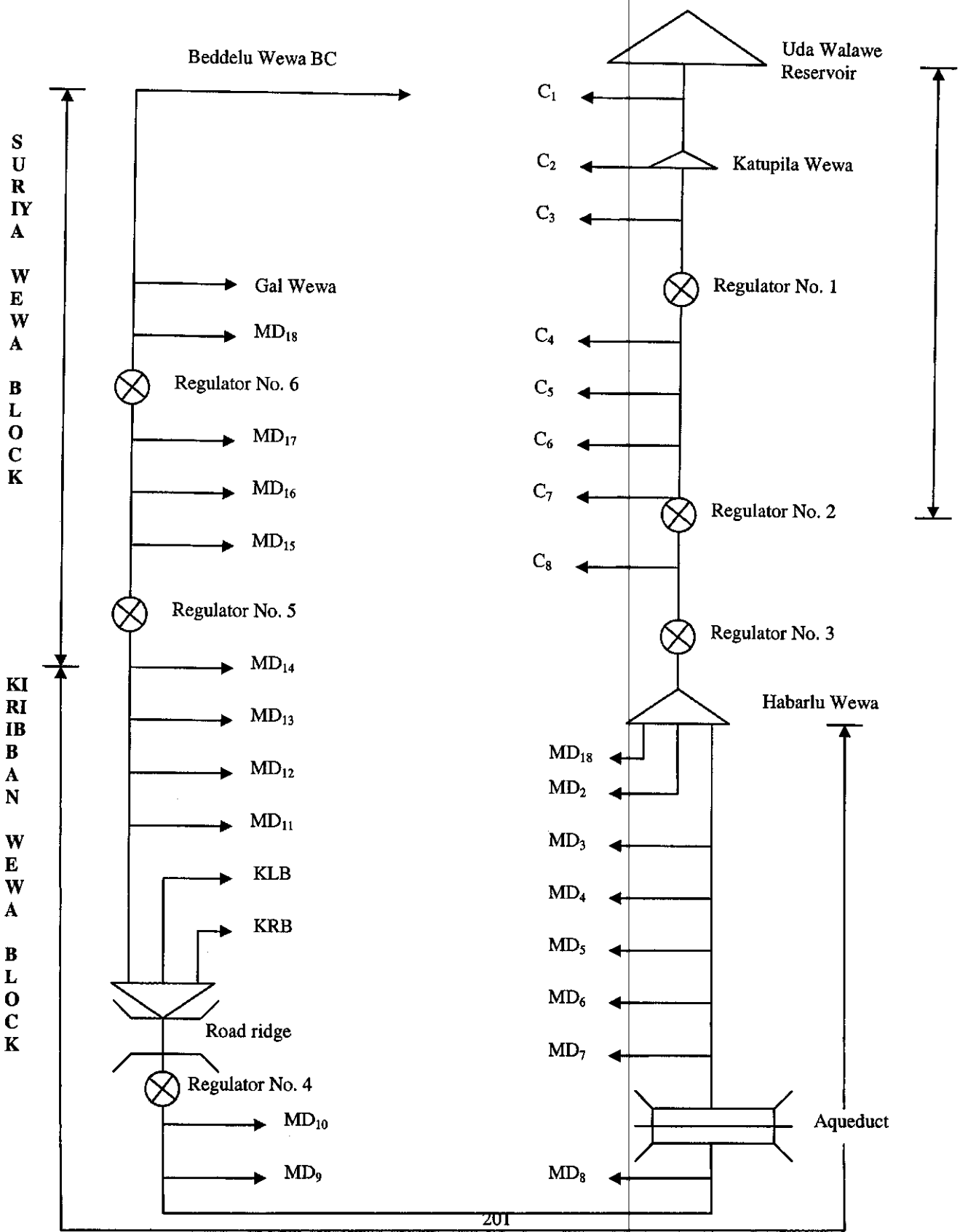
GVP

ALH = Average land holding (ha)

AGA= Agri Assets

D1= Dummy for irrigated/non-irrigated 1(Irrigated=1, and non-irrigated =0)

Appendix H.1 Walawe Left Bank Irrigation System



Appendix H.2 Map of the Study Area