

**FARMERS PARTICIPATION IN IRRIGATION
MANAGEMENT: THE CASE STUDY OF FARMER
ORGANIZATION BASED SMALL-SCALE IRRIGATION
SCHEMES IN TRINCOMALEE DISTRICT SRI LANKA**

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June 2016

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ABSTRACT

Agricultural intensification is presumed to be a necessary pre-condition for the development of the agricultural sector in Sri Lanka in general and in Trincomalee district in particular. The Agricultural policy of Sri Lanka gives high priority to the promotion of food sufficiency and security through irrigated agriculture. To this end, governmental and non-governmental organizations (NGOs) initiated small-scale irrigation schemes throughout the country including Trincomalee. Despite these efforts, however, smallholder farmers in the study area were found to be reluctant to participate in small-scale irrigation schemes. Therefore, the aim of this study was to analyse major demographical, socio-economic and institutional factors influence the participation of farmers in small-scale irrigation and income. The data were collected by distributing structured questionnaire among farmers. The overall sample size was 100 households, 50 from irrigation participant and 50 households from non-irrigation participant. Trincomalee district consists of 11 divisions. Each division 5 households were selected for irrigation participants and 5 for non-irrigation participants using stratified random sampling except Trincomalee, Town and Gravets division as it contains less number of farmers. Descriptive statistics and likert-scale analysis methods were used to analyse the data.

Factors affecting farmers' irrigation participation included gender, age, education, labour force, size of cultivated land, access to market, distance to water source, extension service and credit facilities. The respondents' individual characteristics; labour force, extension service and distance to water source had strong statistically significant relationship with the irrigation participation and age, gender, access to market, and credit facilities had moderately significant relationship. On the other hand, size of cultivated land, education did not have a statistically significant relationship with the irrigation participation. It disclosed further that irrigation participants had the higher income level than non-irrigation participants. Extension service, Distance to water source, Labour force, Access to market, Gender, Credit facilities, Age, Education, and Size of cultivated land were found in descending order of level significant factors which influence in small-scale irrigation participation with income. Hence, the study suggests that communities need to put emphasis on implementing projects by involving farmers in irrigation participation. Extension services such as advice, training, and demonstration should be made available to farmers by providing the required assistance to agricultural related projects. Communities need to be encouraged to establish saving and credit facilities to help them finance agricultural related activities and in addition, governments should establish organized marketing channels.

Keywords: Farmers; Small-scale Irrigation; Irrigation participants; Non-irrigation participants; Income; Trincomalee.

ACKNOWLEDGEMENT

My sincere gratitude is due to my supervisor Ch.QS. Dr. (Ms.) Thanuja Ramachandra for his intellectual and professional guidance and patience despite his other commitments. It was upon her the shape of this dissertation and its timely completion depended. I am also grateful to all academic staff members of the Department of Building Economics for their generous advice and counsel during the process of writing the dissertation.

Appreciation is due to the Agrarian Deputy Commissioner S.Punithakumar, district Deputy Director of Irrigation Eng.S.Rajagopalasingam and Director of Agriculture Department M.Hussain for their assistance, cooperation and permission to conduct my study in Trincomalee district and all Irrigation Department staffs their cooperation during data collection.

Special thanks are extended to farmers who were participating and those who were not participating in Trincomalee-district for the cooperation and assistance they gave me during data collection exercise.



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LIST OF ABBREVIATIONS

| Abbreviation | Description |
|--------------|--|
| DAS | Department of Agrarian Services |
| FAO | Food and Agriculture Organization |
| FMIS | Farmer Managed Irrigation Systems |
| FO | Farmer Organization |
| IFAD | International Fund for Agriculture Development |
| IIMI | International Irrigation Management Institute |
| km | Kilometer |
| ME | Man Equivalent |
| NGO | Non-Government Organization |
| OFC | Other Field Crop |
| RII | Relative Important Index |
| UNDP | United Nation Development Programme |
| UNCED | United Nations Conference on Environment and Development |



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Dissertation submitted in partial fulfilment of the requirements for the
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degree Master of Science in Project Management

Department of Building Economics

University of Moratuwa

Sri Lanka

June 2016

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Agriculture contributes substantially to the economic growth of many developing countries. It is often the leading sector of the economy as source of income, employment and foreign exchange. More than half of the developing countries population get their food from own-production. Agricultural output also is used as an input for industries so it can stimulate the growth of industrialization. Developing agricultural productivity thus contributes to income growth (UNDP, 2007). By the year 2025, 83 % of the expected global population of 8.5 billion is expected to live in developing countries. Yet the capacity of available resources and technology to satisfy the demands of this growing population in terms of food and other agricultural products remain uncertain. The world's food production depends on the availability of water, a precious but limited resource. The role of water as a social, economic, and life-sustaining good should be reflected in demand management mechanisms and be implemented through resource management, water conservation and reuse (UNEP, 2002). In Asia, irrigated agriculture produces rice as the major food crop because it is the region's staple food. Asian countries dominate the world's rice production and controlling 90 % of the total which South Asia contributing 31 % (FAO-RAP, 2004). The challenge for irrigated agriculture today is to contribute to the world's food production and to improve food security through more efficient and effective use of water.

Most of the river basins in Sri Lanka have been developed for irrigated agriculture, with paddy as the major crop. About 75% of the paddy cultivating area is irrigated during two main cultivatable seasons: namely 'Maha', the wet season from the middle of October till late March; 'Yala', the *dry season*, from the middle of April till early September. Cultivation during dry season is mostly confined to the wet zone and to irrigated areas in the dry zone. Rice is cultivated nearly 30 % (600000 ha) of the total agricultural land in Sri Lanka. According to the agricultural statistics from 1993-2003 in Sri Lanka (Department of Census and Statistics Department, 1993-2003), on the average 540,000 ha are cultivated during wet seasons and 320,000 ha during dry

seasons. Since 1977, about 155,000 ha of paddy lands were developed under large-scale irrigation development programs launched in the country and the total rice production was also increased as 100%. About 1.8 million farm families are engaged in paddy Cultivation Island wide. Sri Lanka currently produces 2.7×10^6 ton of rice yearly and manages to satisfy around 95 % of the domestic requirement. The per capita consumption of rice varies around 100 kg ha^{-1} depending on the price of rice, bread and wheat flour. However, to meet the growing needs of the population, it is necessary to produce more in the future. New irrigation developments can be proposed to increase total production. Since land and water are becoming scarce resources against the increasing demand, such proposals are less feasible. However in 2000, the national annual average yield of rice (3700 kg ha^{-1}) was around 50 % of the genetic potential of improved cultivars recommended for use in Sri Lanka. The predicted national average yield for the year 2005 was 4100 kg ha^{-1} (Dhanapala, 2000).

Small-scale irrigation is, usually on small land plots where farmers have the majority controlling influence, using a level of technology which they can operate and maintain the scheme effectively. Small-scale irrigation is, therefore, farmer-managed and farmers must be involved in the design process and, in particular, with decisions about boundaries, the layout of the canals, and the position of outlets and bridges. The preference for small-scale schemes are based on the perceived easy adaptability of the systems to local environmental and socio-economic conditions (Vaishnav, 1994).

The government of Sri Lanka has experimenting with a variety of approaches to build a strong institutional framework for irrigation management for nearly a decade and a half. The major focus has been on developing farmer organizations so that farmers can participate in irrigation management more effectively and coordinate with the state agencies responsible for irrigation management, so they can work with farmers in a joint management system (IIMI, 1990). Significant lessons have been learnt from previous researches in participatory irrigation management in some other countries. For an example, Philippines both cost savings and efficiency related to participation of irrigation have been documented in the Philippines. Svendsen (1994) showed that, in five major irrigation systems, equity of water supply increased,

particularly in the dry season, so that available water was spread over more of the service area while yields increased. Bagadion and Korten (1991) reported that mean equity contributions on participatory irrigation systems were 357 pesos/ha compared to 54 pesos/ha on non-participatory irrigation systems. A study by NIACONSULT (1993) found that National Irrigation Systems which adopted farmer participation had significantly higher collection efficiencies for irrigation service fees (74 percent vs. 45 percent for non-participatory systems), lower recurrent maintenance costs (1.8 vs. 4.6 pesos/ha), lower personnel costs (260 vs. 463 pesos/ha), higher dry season benefitted area (77 percent vs. 65 percent), and higher dry season rice yields (4650 vs. 4150 kilograms/ha). Taking costs and labour contributions into account, farmers' net income per month increased from 764 to 1,149 pesos after participation was initiated on three systems. These gains saw major improvements in the equity of water deliveries with participation irrigation management.

1.2 Problem Statement

Agricultural production in Sri Lanka is primarily rain fed, so it depends on monsoonal seasonal rainfall. As a result, there are frequent failures of agricultural production. Irrigation has the potential to stabilize or improve the agricultural production and mitigate the negative impacts of variable or insufficient rainfall.

This environmental degradation can reduce agricultural productivity, which in turn worsens food insecurity and poverty. In order to cater the growing food demand, some proportion of the pressure could be met by increasing productivity rather than extensive agriculture. The three methods to increase food production are increasing agricultural yield per a given plot, increasing the area of arable land, and increasing cropping intensity (number of crops per year). Irrigation has the potential to increase both yields and cropping intensity (Awulachew et al., 2010). According to previous studies (Nhundu et al., 2010, Gebremedhin and Peden, 2002, Hussain, 2006) irrigation increases agricultural productivity and farm income per hectare. It insulates the national agricultural economic sector against weather-related shocks and provides a more stable basis for economic growth and poverty reduction. It supports the process of transforming traditional method of agriculture into market oriented production of high value crops (Asfaw, 2007).

The present irrigation systems operate under a different social, economic and political system. The performance of work in the present system is on the basis of wage labour and not on the principle of 'Rajakariya'. Although the basic infrastructure (tanks, paddy lands, highland including settlements and network of irrigation) was essentially the same, new dimensions have been adopted to the recent constructions in response to external demands (ARTI, 1991). Farmers are merely concerned about receiving water for their farm plots. Their knowledge about characteristics of the irrigation system, administrative resources and water availability in the tank is meager. The main reason for this is the lack of effective communication between the farmers and officers engaged in irrigation system management. A well-organized Farmer Organization (FO) can play a major role in connecting the communication gap between the farmers and the system operators.

The Farmer Organization are functioning in almost all irrigation systems for a long time. These FOs are held responsible for organizing the maintenance work on the channels as well as the tank bund and other structures. Operation and maintenance of channels include cutting shrubs or weeding and earth work on channels, lubricating and painting sluice gates and clearing the spillway and turnouts. They are also responsible for implementing the decisions made at the cultivation meetings (Kanne meeting). However, most of the FOs do not fulfill the expectations regarding the operation and maintenance of the irrigation works because of the internal and external factors (Sivayoganathan et al., 2003).

More importantly, in Trincomalee district, where this study has to be conducted, studies are scanty and there no published works on the factors that determine farmers' participation in small-scale irrigation and its effects on income. To fill this knowledge gap it needs to be backed up with research. Hence, this study addresses the potential incentives that promote small holder farm households participation and the factors affects the irrigation participation in small-scale irrigation schemes. In general, there exists little empirical evidence related to the determinants of participation in small-scale irrigation and its effects on their income of rural farm households. Therefore, this study is aimed at primarily identifying, analysing and documenting the demographical, socio-economic and institutional factors affecting the farmers' participation in small-scale irrigation and income. This would provide a

base for policy makers and gives directions for further research, extension and development schemes that will benefit the schemes beneficiaries.

1.3 Research Questions

In this study the following research questions are addressed:

1. What are the demographical, socio-economic and institutional factors which determine the farmers' participation in small-scale irrigation in the study area?
2. Do the factors affect farmers' participation in small-scale irrigation management?
3. Which of those factors largely affect the small-scale irrigation participation and income in the study area?

1.4 Aim and Objectives of the Study

1.4.1 Aim

The ultimate aim of the study is to analyse major demographical, socio-economic and institutional factors influence the farmers' participation in small-scale irrigation and income.



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1.4.2 Objectives of the Study

1. Review of demographic, socio-economic and institutional factors affecting farmers' participation in small-scale irrigation.
2. To identify the effects of demographic, socio-economic and institutional factors affecting farmers' participation in small-scale irrigation.
3. To determine the level of significant of the factors which affect in small-scale irrigation participation with income

1.5 An Overview of Research Methodology

The first stage of the study involved a systematic literature review to understand the subject of the research problems and to identify the knowledge gaps. The review included farmer organization based small-scale irrigation schemes in Trincomalee district, and their communities. Based on the review, research questions, aim and objectives were established. The literature review contained the information gathered from books, research paper and research articles.

The second stage of the research process involved data collection. This research intended to collect both primary and secondary data and used for the study. The primary data gathered from household interview survey using structured questionnaire. The questionnaire was used to get the quantitative data in line with the research objective. The hundred numbers of sample were selected for the study from whole Trincomalee district. Fifty numbers were from irrigation participants and another fifty numbers were from non-irrigation participants. Ten numbers of samples, in which five from irrigation participants and another five from non-irrigation participants were selected in each division of Trincomalee district except Trincomalee Town and Gravets division as it contains very less farmers and irrigation schemes. The secondary data included information mainly from formal sources from Irrigation Department, Agrarian Department, and Agriculture Department. Published and un-published data were gathered in that category.

The third stage involved analysis of collected data. Data gathered was analysed in line with the study objectives already designed, and the findings were summarized and presented in clear manner. The findings from household interview survey were in an aggregated form of the whole divisions. The process of analysis will be carried out by using descriptive statistics such as frequency, percentage and chi square test. The output portion of data that is readily quantifiable will be discussed using tabulation and cross-tabulation of factors with frequency, percentage and chi square test result values in descriptive statistics and likert- scale analysis also used with Relative Important Index (RII).

The last stage of the research process involved drawing out conclusions and recommendations based on syntheses of the research findings.

1.6 Scope of the Study

The focus of the research study is to address the potential incentives that promote small-scale irrigation farmers participation and the factors affecting irrigation participation in small-scale irrigation schemes in Trincomalee districts, Sri Lanka. In general, there exists little empirical evidence related to the determinants of participation in small-scale irrigation and its effects on income of rural farm households. Therefore, this study is aimed at primarily identifying, analysing and

documenting the demographical, socio-economic and institutional factors affecting the farmers' participation in small-scale irrigation with their income.

1.7 Outline of the Dissertation

Chapter one provides an introduction of the thesis. It begins with a background of the research study and follows the statement of problem. The next section of the chapter presents the research questions, followed by the aim and the objectives of the research study. The chapter further outlines the overview of the research methodology adopted for the study. This is followed by scope of the study and outlines of the dissertation in the last two sections.

Chapter two presents the literature review carried out on books, past research papers and related articles in the internet and other textual materials. It starts with concepts and definition, followed by history of irrigation development. The next part of the section is the role of irrigation in alleviating food insecurity problems and income. Participation irrigation management in Asia and participatory irrigation management in Sri Lanka are following sections. The next following sections are small versus large-scale irrigation system in Sri Lanka and nature of small-scale irrigation system in Sri Lanka. The rest of the sections review with positive relationship with the factors of irrigation participation and income and negative relationship with the factors of irrigation participants and income in this chapter. At last, the review of Demographical, Socio-economical and Institutional factors affecting the farmers' participation in small-scale irrigation is presented.

Chapter three presents mainly on research methodology. In this chapter the description of the study area, the sources of data, the methods used to obtain the data and the methods used to analyse the data set are presented.

Chapter four gives the investigation and interpretation of data obtained using descriptive statistics. The data that is gathered from structured questionnaire survey is discussed using tabulation and cross-tabulation of variables with frequency, percentage values in descriptive statistics and likert- scale method also used.

Finally, conclusions drawn from the analysis of the data and policy implications as well as recommendation are given in chapter five.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

Irrigation is defined as the artificial application of water to arid land for growing crops. It is a profession as well as a science. A crop requires certain amount of water at certain fixed intervals throughout its period of growth. Irrigation is required at dry and last rainy period. Because at dry period irrigation play a pivotal role in order to produce food crops and cash crops, also at last rainy period in year 2013 as Sri Lankan situation especially in Trincomalee district rainy season as observed rainfall starts late and ends early, so in order to supplement the crop irrigation provides a greatest role in order to produce more yield.

In tropical countries like Sri Lanka, the first two of three essential requirements of plant growth, that is, moisture needs to be supplemented frequently by artificial application of water. Thus, irrigation is supplementary to rainfall when it is either deficient or comes irregularly or at unreasonable times. Water is the wealthiest resource of humanity. It not only helps in survival but also helps in making life comfortable and luxurious. Besides various other uses of water, the largest use of water in the world is made for irrigating lands.

2.2 Concepts and Definitions

Irrigation is “a continuous and reliable water supply to the different crops in accordance with their different needs”. When sufficient and timely water does not become available to the crops, the crops fade away, resulting in lesser crop yield, consequently creating famine and disasters: irrigation can, thus, save us from such disasters. Irrigation is one means by which agricultural production can be increased to meet the growing demands in Ethiopia (Awulachew et al., 2005). A study also pointed out that one of the best alternatives to consider for reliable and sustainable food security development is expanding irrigation development on various scales, through river anicuts, constructing micro dams, water harvesting structures, etc. (Robel, 2005).

Small-scale irrigation can be defined as irrigation, usually on small land plots, in which small farmers have the controlling influence, using a level of technology which they can operate and maintain effectively. Small-scale irrigation is farmer-managed and farmers must be involved in irrigation activities. According to the Sri Lankan situation, the cultivatable area of small-scale irrigation is less than 200 acres. This system comes under the purview of the Department of Agrarian Services. De Lange et al. (1997) showed small-scale irrigation is the development of traditional irrigation systems, which are used as complement to rain-fed crop production involving predominantly horticultural crops.

Participation in Irrigation: refers to that the farmers taking part in any operations and maintenance activity in irrigation management such as channel clearing, weeding and desilting.

Household: is defined in this research as people living under the same roof and eating food from the same pot. That is, a household member who did not live independently during the survey time at least for six months.



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Rural area: is any locality that exists primarily to serve agricultural hinterland. In Sri Lanka, rural sector is geographically demarcated as the area outside the boundaries of local administrative authorities of municipal councils and urban councils.

2.3 History of Irrigation Development

Irrigation is a very old practice in the world. It is an old human activity and it has been practiced in many parts of the world for several thousand years. Rice has been grown under irrigation in India and Far East for nearly 5000 years back. The Nile valley in Egypt and the plain of Tigris and Euphrates in Iraq were under irrigation for 4000 years back (Peter, 1997).

Irrigation has formed the foundation of civilization in numerous regions for millennia. Egyptians have depended on the Nile's flooding of the delta for years, this may well be the longest period of continuous irrigation on a large scale. Mesopotamia, the land between the Tigris and Euphrates, was the bread basket for

the Sumerian Empire. This civilization managed a highly developed, centrally controlled irrigation system. In that same time frame, irrigation apparently developed in present day China and in Indus basin (Schilfgaard, 1994).

Irrigation has long history and played a key role in feeding, expanding populations and is undoubtedly destined to play a still greater role in the future. It not only raises the yields of specific crops, but also prolongs the effective crop growing period in area with dry seasons, thus permitting multiple cropping (two or three and rarely four crops per year) where only a single crop could be grown. Moreover, with the security provided by irrigation, additional inputs needed to intensify production such as pest control, fertilizer, improved varieties and better tillage become economically feasible. Irrigation reduces the risk of these expensive inputs being wasted by crop failure resulting from lack of water (FAO, 1997).

According to FAO (1997) 30-40 percent of world food production produce from an estimated 260 million ha of irrigated land or one sixth of the world's farmlands. Irrigated farms produce higher yield for most crops. FAO (2001) also reports that the role of irrigation in addressing food insecurity problem and in achieving agricultural growth at global level is well established. Clearly irrigation can and should play a pivotal role in raising and stabilizing food production especially in the developing parts of Africa.

2.4 The Role of Irrigation in Alleviating Food Insecurity Problems and Income

In many drought countries, including Sri Lanka, there has been an optimistic view regarding irrigation development as a strategy to sustain agricultural production and ensure food security. In such countries, the key constraint on further increase in agricultural production is the scarcity of water. Therefore, national planners are strongly attracted to irrigation as a means of supporting future food strategies. In this regard, Elahi (1988) pointed out that for countries with arid and semi-arid climates, the lack of uncertainty about rainfall along with rising demographic pressure on rain fed land, would strongly be pointed to irrigation as a prime candidate to support future food strategies in the medium and long term. Similarly, Dessalegn (1999) stated that, where rainfall is insufficient and uncertain, rain fed agriculture cannot

fully support food production, investment on water management schemes will help stabilize agricultural production and promote food security.

The need for irrigation development in drought prone regions is also promoted by many international development organizations. For instance, IFAD (1985) pointed out that small-scale irrigation schemes would stabilize agricultural production system and ensure food supply even in years with inadequate rainfall and increase the overall level of crop production in years with normal rainfall.

Another advantage of irrigation is that the possibility of intensification of agricultural practices, especially in areas where arable land is a scarce resource. Irrigation provides the means of maximizing production with double or multiple cropping, taking full advantages of modern technologies and high yielding crop varieties. Moreover, irrigation provides farmers an opportunity to grow high value crops like vegetables and fruits that require year round and generous supply of water to grow. Such diversification of agricultural products will ensure reliable income source to the farming community.



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The available literature on the socio-economic impact of small-scale irrigation development in some African and Asian countries generally indicate that irrigators have been found in a better position in terms of income, nutritional status and standard of living than their non-irrigation counterparts. For instance, in India Sing and Misra (1960) compared the Sardar canal irrigation and non-irrigating villages and made the following observation: (as cited in FAO 2000).

- “Gross farm output per acre is on the whole 8.6% higher in the channel irrigated villages than outside.
- The crop produce as distinct from the total farm output is 5.5% more with channel irrigation than without, mainly due to the cropping pattern under irrigation incorporating cash crops.
- The value of crop produce sold per acre is 48% higher in the channel irrigated area than outside.
- Total inputs per acre are 3.7% higher in terms of quantity in the channel irrigated area than outside, indicating more intensive farming under irrigation;

- Payment to outside labour, including casual and permanent farm labour is about 21% more in irrigated areas than outside.”

The above study clearly shows the benefits from irrigation in terms of improved crop productivity, income source and employment creation to the community and give better chance to assure household food security.

FAO (1997) also reported benefits from smallholder irrigation. In the socio-economic impact assessment of Hama Mavhaire, Hoyuyus and Nyaitenga irrigation schemes in Zimbabwe, it is reported that:“Farmers’ incomes from irrigated agriculture are significantly higher than incomes from dry land farmers. The report also indicated that levels of inputs in terms of quantity are higher in irrigation schemes than in dry land areas, suggesting that there is more intensive crop production in irrigation schemes than in dry land agriculture”.

In other African country, in the Gambia, in the study of an irrigation scheme in the village of Chakunda, Webb (1991) gave the following benefits of irrigation: (as cited in FAO 2000)

- “Increased income that was translated into increased expenditure, investment, construction and trade;
- Backward and forward linkages: traders were reportedly coming to purchase irrigation produce (rice) and in turn sell cloth, jewellery and other consumer items;
- Increased material wealth: at the village level, this was in the form of construction of a large mosque built through farmers’ donations and an improvement of the village clinic.
- At household level, increased wealth could be seen in 55 houses built in the village, fourteen with corrugated metal roofing.”

When we see the situation in Sri Lanka, empirical studies on the economic validity and socio-economic impact of smallholders’ irrigation development are very limited, except pronouncing some possible benefits of water resource development. The only practical observation available to the researcher was a study undertaken by Fuad Adem (2001) on small-scale irrigation and household food security on an irrigation scheme found in central Ethiopia. In this study, he has tried to examine the impact of

cash crops production (possible to grow through irrigation) on the food security status of irrigators. He also made a comparative observation on socio-economic situation between irrigators and their non-irrigation counterparts. As a conclusion, he has reported that many of the people who have been regular beneficiaries of periodic cash crop production are now more income secured and have better access to food.

Moreover, a study conducted by SCF (UK) (1999) on the North Wollo East plain Food Economy Zone reported that irrigators can plant three times per year and in most cases the production serves as a valuable source of income and the majority of the farmers who have irrigation plot have been categorized under rich wealth group in the community. Generally, all the available evidences show that irrigation development is a suitable option of rural development in order to reduce poverty and ensure household food security.

2.5 Participatory Irrigation Management in Asia

Community irrigation systems have been practiced from a time before in Asia and even today serve a significant portion of the total irrigable area. Many of these community systems have existed for centuries. While most are small, it is not unusual to find some serving 1,000 hectares or more. They have generally developed in mountainous or hilly areas based on the diversion of small or medium streams, especially in the Himalayas, northern Thailand, Laos, Vietnam, China, Japan, the Philippines and Indonesia, or on the construction of small tanks such as found in India and Sri Lanka. The need for community cooperation, and its successful realization, are most evident in areas of intense population pressure or limited water supplies, or both, where the organization of community labour and management is essential to gain access to and share water, and to minimize conflicts (Tang & Ostrom, 1992).

Lewis (1971) describes the zanjera irrigation societies of the densely populated Illocos region of the Philippines. He compares the behaviour of farmers in the zanjera with those who migrated to the less densely populated province of Isabela and found in the latter case no evidence of functioning irrigation associations, suggesting that the new context was not providing adequate incentives to collective action. He concluded that the behaviour of Illocanos is reflected in the differences in

the respective natural and social environments. Siy (1982), studying the zanjeras, and Yoder et al. (1987), studying the performance of irrigation organizations in the foothills of Nepal, concluded that the need to periodically mobilize labour to gain access to water through the construction and maintenance of channels and dams was among the most important factors accounting for sustainable farmer-managed irrigation systems. Leach (1961) describes the bethma system in Sri Lanka that enables all farmers in a given tank command to share the limited water supply during the dry season irrespective of the location of their paddy fields. Geertz (1980) and Lansing (1991), writing about the Balinese Subak, describe the sophistication of communal irrigation.

Traditional community based irrigation schemes are often praised for their endogenous mix of local wisdom and social cohesion, and sometimes romanticized (Tan-Kim-Yong, 1995 & Goldsmith, 1998). These systems are now exposed to new threats, as communities have become open to the world, agriculture has moved from subsistence to commercialization, villagers have diversified their economic activities, the cost of maintaining systems has risen, and competition for water is on the rise. Increased socio-economic heterogeneity as well as the intervention of the state in the construction or maintenance of weirs has often weakened social cohesion and collective action.

In addition, deforestation, afforestation, or changes in land use in the upper part of catchments have often altered the hydrological regime and water quality, impacting on downstream users (Starkloff, 1998). Traditional rights to water and longstanding rules for water sharing have been affected by the irruption of outsiders pumping or diverting water directly from the same sources, or by the state that has frequently superimposed large water storage and distribution infrastructures upon the existing systems. National laws are often limited to increasingly inadequate definitions of riparian rights and “reasonable use.” The confusion of legal repertoires reflects not only the conflict between local history and more recent state intervention, but also the conflict between flexibility and adaptation to microphysical and sociocultural contexts and top-down, capital-intensive, and large-scale macro-strategies of development.

The system of community based management and what comes under the more general term of common-pool resource management still delivers a convincing and appealing option for water management, as opposed to more commonplace emphases on state- or market-driven modes of regulation (Ostrom, 1994). However, the threats to the sustainability of communal management (due in part to rising wage rates, off-farm migration, decline of agriculture and changes in the rural economy, technical changes such as low-cost pumps) raise questions on whether this form of management can adapt to changing circumstances and new challenges.

Wittfogel (1957), one of many scholars to show interest in hydraulic societies, states that he had “long been impressed with the developmental lessons to be learned from the study of agrarian societies based on large-scale and government directed water works. These societies covered more territory, lasted for more years, and shaped more lives than any other stratified agrarian society.” Wittfogel argued that the necessity to muster the labour force necessary for huge flood control works and irrigation systems was conducive to totalitarian organization. Large waterworks were created for both irrigation and flood control. Irrigation made it possible to acquire food surpluses and release labour for other cultural or warfare activities. Among the non-hydraulic installations that grew with large scale hydraulic installations were defense works, far-flung roads, tombs, temples, and pyramids. Improvements in farming and increase in food supply permitted population growth, the limits of the growth being determined by the limited water supply to a society equipped with pre-industrial techniques (Steward et al., 1955).

In some areas, efforts to continue the intensification of irrigated agriculture led to environmental problems such as salinization, siltation, flooding, and disease epidemics such as malaria. Crop productivity stagnated or declined. As the productive limits of irrigation were approached, the hydraulic societies frequently moved into urban centers or conquered new territories in search of new resources for sustainability. But without the constant stream of technologies that characterize modern day agriculture, the limits to growth must eventually have been reached. With today’s growing concerns relative to environmental sustainability, it is worth to note that many of the ancient systems collapsed because societies could not manage environmental problems such as salinity, drought, or malaria.

The epitome of the hydraulic society in Asia is China (Wittfogel, 1957), although this is also an object of debate (Masubichi circa, 1970), while northern Vietnam may provide another example. Wittfogel's powerful intuition is undoubtedly insightful when applied to classical states like those of ancient Egypt, Mesopotamia or the Indus valley, and his theory of the state has later been tested in all kinds of climatic (in particular tropical and subtropical) and historical contexts. Critics have been prompt to point out situations where impressive hydraulic works were not necessarily the result of a powerful, centralized, bureaucratic and despotic state (Bali & Lansing, 1991), while, on the other hand, there was no shortage of such states associated with modest hydraulic achievements (Wijeyewardene, 1971). However, the intensity of the intellectual debate on Asian despotism in the postwar period has sent many researchers in a quest of hydraulic societies in Asia, which has not been always successful or convincing. Some scholars have tried to link irrigation and state formation in Java (Christie, 1995). Even the paradigmatic case of the Khmer empire and irrigation around Groslier's (1979) "hydraulic city" of Angkor, which has spurred much fascination for ancient hydraulic feats (e.g., Stargardt, 1986 and Stargardt, 1992 on Burma and southern Thailand), is now increasingly seen to owe much to imagination (Stott, 1992 & de Bernon, 1997).



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On balance, it seems that agro-hydraulic kingdoms have supported a high population density. The centralization of the economy was sometimes paralleled by the achievement of large-scale infrastructures (e.g., China, India, and northern Vietnam), but this was not always the case (e.g., Kingdom of Majapahit in Java, in the 14th century, Maurer, 1990). A large part of Southeast Asia long remained underpopulated. However, particularly in the more populated areas (e.g., Illocos region in northern Philippines and Java and Bali in Indonesia), autonomous indigenous systems of communal irrigation were the rule.

In sum, these earlier hydraulic developments already outline a dichotomy between large-scale, state-centered irrigation schemes and local communal systems. In both cases, however, the relation between water control and society is at the heart of the social fabric. Regardless of the direction in which causality runs, harnessing water on a large scale has been associated with the formation of many of early powerful states, while water was also a structuring element of community formation where small streams can be diverted or dammed for use in agriculture.

2.6 Participatory Irrigation Management in Sri Lanka

Irrigation is an integral part of Sri Lankan agriculture, since the very beginning of the island's recorded ancient civilization which dates back to the 5th century B.C. Throughout this period of 2,500 years, the economy of the country has been based major on irrigated agriculture. The peculiarity of irrigation in Sri Lanka lies in its indigenous technology, the dedication of the country's rulers, full participation of the farmers, and the sustainability of the irrigation systems for centuries. The drainage pattern with a large number of river basins and the monsoon rainfall distribution have provided the basis for irrigated agriculture in Sri Lanka. A large number of irrigation systems falls under the category of "minor irrigation schemes" which are also called "small irrigation" or "village irrigation." The International Irrigation Management Institute (IIMI) has categorized them as Farmer-Managed Irrigation Systems (FMIS). The scale of FMIS varies from very small irrigation schemes to large complexes of systems (in Nepal some FMIS extend up to 15,000 hectares [ha]) but according to the Sri Lankan situation, FMIS are those systems which have command areas of 80 ha (200 acres) or less. These systems come under the purview of the Department of Agrarian Services (DAS).



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The livelihood of dry-zone peasants of Sri Lanka is inseparably linked with the village tank which is the first element of a threefold system, Wewa (tank), yuya (rice field) and hena (upland swidden).

Out of the total irrigated and rain-fed area minor irrigation accounts for 40 percent and contributes to about 30 percent of the total irrigated area. According to the estimates of the Ministry of Lands and Land Development, there are some 23,000 village irrigation schemes, out of which 13000 tanks and the rest anicut schemes. Another source reveals that in 9 districts of the dry zone, there are 7,758 village tanks (FAO, 1980). The average irrigable area of these tanks varies from 4 to 56 ha (10 to 140 acres). It is also estimated that 50 % of the total village irrigation schemes in Sri Lanka are in working condition, providing ample opportunities for rehabilitation or improvement by different types of intervention. Today, with the recent Mahaweli development, the total share of minor irrigation schemes would still be a third of the total irrigated area in Sri Lanka. The small-scale irrigation systems developed in the

early period of Sri Lanka's history were community based and essentially farmer managed irrigation. The small tanks were collectively constructed, maintained and managed by the communities. The village was based on a tank and when more tanks were constructed as per the increased population they were called qamqoda. Since the inhabitants of early dry-zone settlements had farmers for generations, irrigation discipline has been an important part of their way of life throughout history. The experiences of developing small-scale irrigation systems managed by village communities had probably led to the development of larger irrigation systems found in the dry zone (Gunaratne & Maddurna Bandara, 1989).

The 12th century witnessed the beginning of the collapse of the highly developed irrigation systems that flourished in the dry zone. Then irrigation systems were abandoned, as the farmer communities that depended on the immigrated toward the wet zone of Sri Lanka. When the British introduced the plantation industry in the 19th century. They abolished Rajakariya (a task a person was duty-bound to do for the king), the irrigation sector in all parts of the island deteriorated further. Soon after, the British realized the importance of reviving these systems and started state-intervention programs for assisting minor irrigation systems.



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State intervention to refurbish minor irrigation works thus commenced during the British colonial period (about the mid-19th century). The British recognized the need to revive practices and customs that facilitated the construction, repair, and maintenance of irrigation works and those which controlled water distribution and agricultural practices. Before Ceylon (now Sri Lanka) gained independence in 1948 the rulers made attempts to meet the food requirement from within the local production resulting in the improvement of irrigation schemes, mainly large-scale irrigation works like Dewahuwa, Padaviya, Rajangana, etc. Emphasis was given to restoration of minor irrigation only in the late 1950s which became more intense since the early 1970s.

2.7 Small versus Large Scale Irrigation system in Sri Lanka

Irrigation systems can be classified according to various criteria including:

- Area or volume of the storage tank,
- Irrigable area or the number of crops that can be irrigated,
- Primary function (i.e. irrigation, flood control, electricity generation),
- The system of management, or the nature of the source of water (i.e. channel diversion, ground water or rainfed).

For administrative purposes irrigation tanks in Sri Lanka are classified according to the size of their irrigable area. It is major >600 ha, Medium 80-600 ha and Minor <80 ha as per Department of Agrarian Service (DAS). Medium and Major systems are the responsibility of the Irrigation Department, whilst Minor tanks come under the jurisdiction of the Department of Agrarian Services (DAS). Only the smallest tanks (<5-10ha) are privately owned and managed.

With respect to poverty focused potential for aquaculture, a more functional distinction lies in the greater ability of farmers and communities around smaller systems to manage their own water resources, with negligible intervention from external institutions. The Irrigation Department undertakes operation of major and medium irrigation systems with limited participation of farmer organizations. However, the distinction between small and large-scale systems according to this criterion has become less clear-cut with the recent appropriation responsibility for minor irrigation by a second governmental department; the Department of Agrarian Services (DAS). Day to day management operations, together with limited maintenance activities are delegated to farmer's organizations by the DAS, who in retain responsible for major maintenance operations. This has made negative impacts on water management as farmer's traditional sense of ownership has become eroded and communities increasingly dependent on external institutions. A second key distinction in our definition lies with the seasonal availability of water. Small-scale irrigation systems are 'non-system', that is their supply is not augmented with assured water supplies, or trans-basin diversions from larger rivers or reservoirs. Instead they are rain fed, directly harvesting rainfall and capturing runoff from ephemeral streams within their own catchments. They are often highly seasonal in nature. Most of the minor irrigation systems in the dry zone

conform to this definition. Other small-scale micro-irrigation systems such as agrowells rely on ground water extraction.

Today many of the land and water resources in the 103 river basins of Sri Lanka have been harnessed, particularly for irrigation in the dry zone and little scope exists for further large-scale developments (Wijesuriya, 1997). Increasingly, emphasis has been placed on the rehabilitation of minor irrigation resources alongside attempts to improve water use efficiency in both large and small-scale irrigation systems.

2.8 Nature of small-scale irrigation system in Sri Lanka

Irrigation tanks are made by the construction of earthen dams across seasonal streams. Maximum water spread typically ranges from 4-50ha, whilst 80% are 25ha or less whilst the average village tank is estimated to have a command area of 42ha (Land Commissions Report 1985). Rainfall, although relatively high (>1,000mm/year), is highly variable and soils are generally shallow and porous. Many tanks fill only in above average rainfall years. They receive most water during the Northeast Monsoon (October-June), in quantities of 20-30ha during the subsequent Maha cultivation season (October-March). Water levels reduce gradually from February-March onwards, but may fluctuate due to intermittent rains during the SW monsoon (April-June), evaporation and occasional water issue for agricultural purposes during the secondary Yala cultivation season (April-July). Many smaller tanks in upstream watersheds retain water for only 6-7 months of the year, and this highly seasonal and erratic water availability means that often only supplementary irrigation is possible. Tanks are often pumped below dead storage for emergency irrigation, which has implications for the maintenance of stocks of fish and other aquatic organisms. Each small tank has its own immediate catchment area but may also receive irrigation drainage water returns and over spill from tanks higher in the elevation. Therefore assessment of seasonal water storage potential requires an understanding of hydrology and farmer land and water management practices at the wider cascade level.

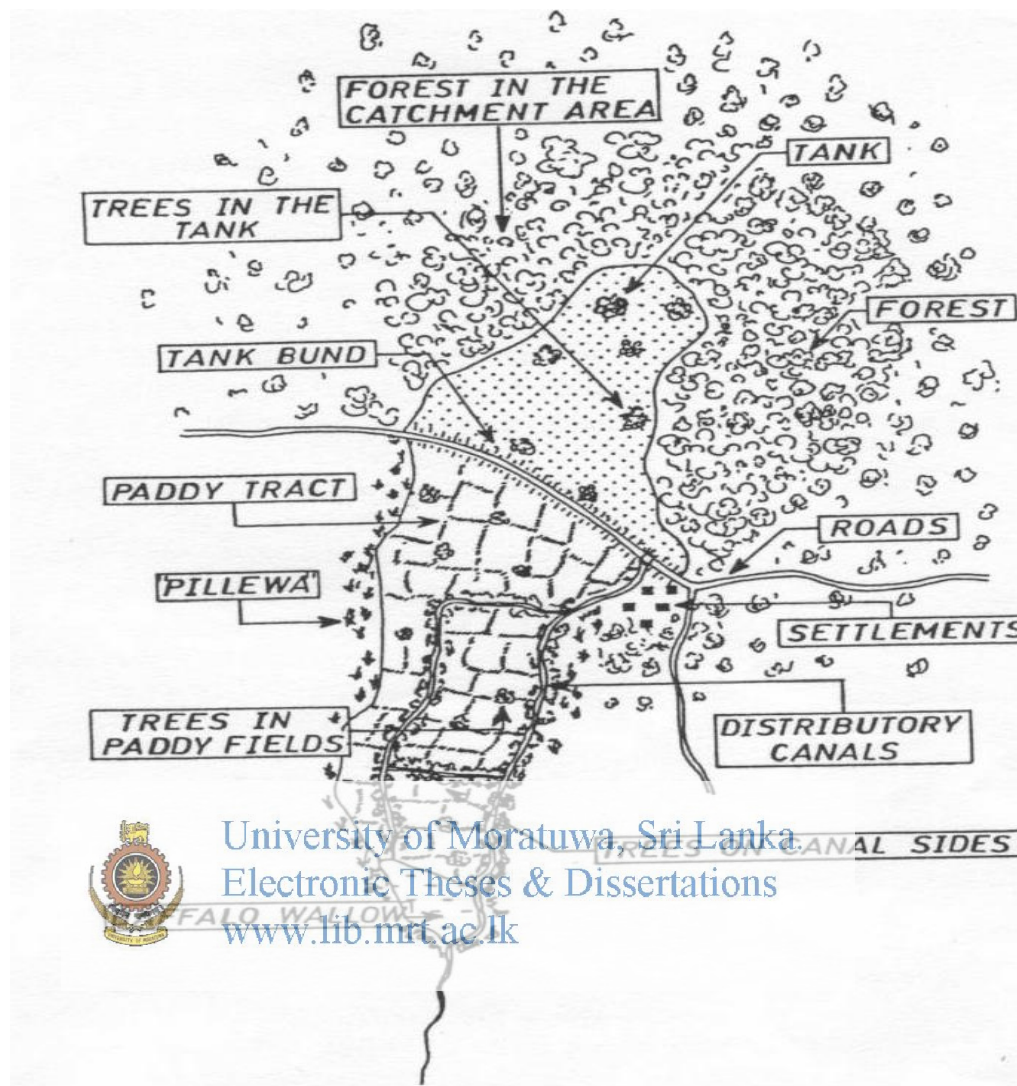


Figure 2.1: General layout of an irrigation tank

Source: (Ulluwishewa ,1991)

Figure 2.1 shows the general layout of an irrigation tank. Water is used mainly for paddy irrigation during the Maha season whilst a range of other field crops (OFC), are occasionally grown during the Yala season depending on water availability. Shifting or fixed upland cultivation, home gardening and fisheries are also important components of farming systems. Other secondary uses of the tank water include bathing, livestock and domestic purposes. Historic evidence shows an awareness of the need for good watershed management. Watersheds were divided into different

sections identified for specific purposes. People had their houses and home gardens close to the tanks, land close to the village was used for slash and burn (Chenna) cultivation, whilst forests in the catchment above the village tank were kept relatively undisturbed to minimize soil erosion and associated tank siltation. Traditionally, a pool receiving drainage water was maintained at the lowest point of the paddy tract for use as a buffalo wallow. This was often a permanent body of water and acted as a refuge for fish, which re-colonized other parts of the system during the rains (Ulluwishewa, 1994). The number of such wallows has declined as they are increasingly drained and put into agricultural production. This is associated with a trend of increasing farm mechanization and concomitant decline of draught livestock ownership. Increasing pressure on land and water resources has also associated to the accelerated breakdown of traditional watershed management practices. Many villages have access to one or more axial and a larger number of smaller radial tanks. A close association of kinship, land tenure and irrigation practice traditionally provided the basis for community irrigation management of these assets.

2.9 Empirical Literature Review



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This section reviews the previous research on small-scale irrigation participation decision and its effect on income. The related literature that examines the effect of irrigation on agricultural performance, poverty alleviation and household income.

2.9.1 Positive relationship with the factors of irrigation participation and income

In Nigeria, Nxumalo and Oladele (2013) reported that gender can be one of the influencing factor in farmers' participation in development programmes. Gender differences define how, in a specific social and cultural context, women and men interact and what is considered appropriate for either group, thus determining their development options and constraints. Oladele (2011) noted that it is widely believed that males are more dominant in the agricultural activities than is the case with females. Although females are not left out, they are more hands on in harvesting and processing. The sex of a farmer may have a negative or positive effect on the decision to participate in an agricultural practice. Female farmers are usually more coordination socially and may therefore be more likely to have links with an agricultural project. On the other hand, male farmers usually have more access and

regulate over resources. Males are also usually the decision makers and are also therefore well placed to participate in agricultural practices.

Age is a factor which can influence participation of an individual in development activities, age is a reflection of the characteristics of an individual in relation to ownership and regulate of resources such as land, cash, and labour. Young people are less conservative than older people and hence the farmer are more likely to participate in agriculture development activities than is the case with the latter (Mlelwa, 2010). A younger farmer is likely to participate in an agricultural project because younger farmers are usually more experienced and endowed hence they either may have experienced or may have observed the benefits of participating in an agricultural activities. Also older farmers may not be resource constrained to participate in an agricultural projects. There is a positive relationship between age and participation in an agricultural activities (Oladele, 2011).

As Mlelwa (2010) notes, poor and less educated people generally less confidence in their ability to improve their lives, people's level of education has a positive relationship to the level of participation. Education tends to broaden horizons beyond habits and traditions of an individual hence influencing an individual into participating in irrigation development activities.

Ogunbameru et al. (2011) in their study on irrigation schemes in Nigeria found that farmers who seek lucrative markets and good prices are doing better than those who prefer to sell locally. Schemes in the former category attract more farmers' participation than those in the latter category. Access to market by the respondents influence their participation in irrigation programmes. Similarly, the number of extension contacts has a positive influence on farmers' participation to projects. Farmers who are not visited are more likely to make negative decision against participation in the projects. It was not surprising that extension contact was a good predictor of participation, given the important role being played by extension personnel.

Binswanger and Quizon (1986) found that in India the effect of extending irrigated area by 10% on the rural poor farmers, resulted in an aggregate output exceeded by 2.7%, and a reduction in aggregate price level by 5.8%. With a secure water supply, farmers can select to invest in higher-yielding seeds, grow higher-value crops, and

harvest an additional crop or two each year. Irrigation also increased cropping intensity, farm income, and job opportunities for those that are landless rural poor.

Investigations made by Chancellor and Hide (1997) at 12 small irrigation schemes in Kenya and Zimbabwe, pointed out that access to irrigation water source generally contributed 25–80% of total family income. Farmers appeared to have a reasonable standard of living and were able to cover the cost of school expenditures and health needs. Further to that another Study done in Gambia, Zimbabwe, Tanzania and Kenya, women's access to irrigation land and control of the distribution of produce had an enormous impact on overall family nutrition and income of female-headed households (IPTRID, 1999). Yield improving inputs such as fertilizers are highly complementary with water and hence the demand for these inputs is influenced by availability of water. A study made by Madhusuda et al. (2002) in India stated that availability and access to irrigation water source coupled with the availability and access to new technologies high yielding varieties and fertilizers were major primary factors for the success of the green revolution in India. They noted that better access to irrigation water source has facilitated growth of cropping practices and inputs used, and contributed to the modernization of the agricultural sector.



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Empirical evidence from Australia showed that a dollar worth of output generated in irrigated agriculture generates more than five dollars' worth of value to the regional economy, which indicated irrigation development has a strong influence on effect on other sectors of the economy (Ali & Pernia, 2003).

FAO (1996) suggests that in developing countries irrigation can increase output for most crops by 100 to 400%, while also allowing farmers to reap the economic benefits of growing higher value cash crops. Less risky, more continuous and higher, levels of rural employment and income for both farm families and landless labourers can result from irrigated as compared to rain fed agriculture. Increased productivity is also observed to have an effect in decreasing overall food prices.

Moreover, Hussain and Hanjra (2003) also found that the productivity of irrigated agricultural lands were twice that of non-irrigated reference areas. The net productivity benefits are defined as the difference in net output values between irrigated and non-irrigated lands varied widely across settings from US\$23 to

US\$600 per hectare. They stated that a range of factors contribute the net productivity benefits of irrigation, and categorized these factors as: (a) farm level factors (i.e. crop yield differences, differences in production methods and technologies, land quality, types of cropping patterns, the degree of diversification towards high value crops and other farm enterprises, and farmers' access to support measures such as information, input and output marketing), (b) system level factors (i.e. condition of irrigation infrastructure and its maintenance, irrigation water allocation and distribution procedures and practices and related institutions) and (c) related policies (i.e. policies that influence land distribution patterns).

A study conducted by Francois et al. (2003), showed that 4 micro dams and 2 river anicut irrigation projects in Tigray, Ethiopia have been successful in enabling farmers to obtain a certain amount of wealth suggesting that farmers involved in irrigation management schemes have shown great improvement in their livelihoods, and earn higher incomes than non-irrigation users. The assessment further shows these beneficiary households were able to produce enough for the year round household consumption; build household assets such as different livestock, and build better improved houses which directly mitigate vulnerability to shocks. They also indicated that irrigation offers the rural population an alternative source of employment and income. The assessment concluded that the use of the irrigation schemes enhanced the livelihood of the beneficiaries and recommended the expansion of similar projects to the other regions.

Similarly, a study made by Lire (2005) in eight public managed micro dams and 29 surrounding villages in Tigray, Ethiopia showed that agricultural yield and farm profit have significantly increased in villages with closer proximity to the tanks than in those further away from the tank water resource. According to the study the overall evidence suggests that carefully designed irrigation tanks could significantly improve agricultural production and overall food security.

Irrigation not only contributes to increased crop production but may also decrease variability in production through improved control of the crop environment. In this respect an empirical study done in Nigeria showed that the proportions of population of irrigation beneficiaries that experienced crop failure and poor harvest dramatically decreased in comparison to the pre-irrigation status (Babatunde, 2006)

Ray et al (1988, cited in Lipton et al., 2003) indicated that, in comparison to non-irrigated conditions, the extending of irrigation has backed to a significant improvement in reduction uncertainty in the output of food grains as well as of other crops. Therefore, the poor are less likely to need to borrow, to increase consumption levels and so avoid the high capital market access costs that they usually face when borrowing. Further less risky production of staples or other crops allows them to take more risks with other activities, boosting diversification into higher risk but potentially higher income activities, such as cash crops for export or new non-farm activities.

The other commonly cited area that related with irrigation is the creation of additional rural labour employment. Since irrigation requires labour employment and real wages rise with the introduction of irrigation. Chambers (1988) showed that irrigation raises employment by increasing the number of days of work per hectare, per crop season and per crop year. He further noted that irrigation induced employment increases help to smooth seasonal troughs in agricultural employment and increase and steady wage rates for agricultural labourers. Lipton et al. (2003) argued that there are three sources of additional demand for labour created by irrigation. The first is irrigation facilities require labour for their construction and maintenance of irrigation infrastructure. Secondly, increases in multiple cropping (both dry and wet season cultivation), cropping intensity, and crop diversification as a result of access to irrigation also encourage higher farm labour employment, in migration and higher wage rates. They also stated that access to irrigation created additional labour by upholding non-farm rural output and employment. Chambers (1988) also cited several empirical studies across countries that show irrigation directly raises employment for landless labourers via increase in days worked per hectare, day worked per a cropping season, and additional employment in a second or third irrigation season. This increase in demand for labour has a direct effect on increasing wage rates. By creating more secure and stable rural communities, access to irrigation water source can also help stop the tide of relocation to already overcrowded cities and slums (van Hofwegen and Svendsen, 2000, & Chambers, 1988).

This evidence was also supported by a study conducted by Hussein et al. (2002) in Sri Lanka and Pakistan. They found that labour employment per hectare and wage rate were found to be substantially higher in irrigated settings than in non-irrigated settings. Furthermore, a study conducted by Hussein and Hanjra (2003) in south and south east Asia found that higher labour employment and wage rates were reported in irrigated than rain fed areas, and they concluded that this change in wage was a direct result of irrigation development. In addition, they provide evidence on the significant contribution of irrigation to employment generation in agriculture. They noted that the annual labour work per hectare in the Ganges-Kobadak irrigation system of Bangladesh was around 100 days more than that in nearby non irrigated areas. This additional labour demand has creates better full time employment opportunities for farm family members and also create employment opportunity for hired labour. Moreover, they indicated that hired labour used in irrigated settings was double compared to that of nearby non irrigated areas and the wage rate was 15% higher in the former than in the latter areas. Qiuqiong et al. (2005) argued that the green revolution in Asia would not have happened without substantial irrigation development. Without more irrigation many countries would have been unable to achieve the agricultural and economic growth rates required to achieve food security and reduce poverty. They stated that irrigation has been enormously effective in generating a variety of benefits such as improvements in productivity, employment, wages, incomes and consumption expenditures.

Another important issue in the income irrigation causal relationship is the issue of choice between small-scale versus large-scale irrigation systems. According to FAO (1986 as cited in Rahmato, 1999) small and traditional irrigation schemes are the dominant form of irrigation in much of Sub-Saharan Africa that could play vital role addressing drought and food insecurity. However the development programmes in Africa have not given sufficient attention to the small-scale and traditional based irrigation technologies. Van Koppen (1998) stated that small-scale irrigation schemes given their dispersed nature, and relatively small size, suitability for households under resource poor conditions, small-scale water harvesting are not likely to attract significant external support. However, she stated that small-scale irrigation scheme deliver the considerable potential for income improvement and equitable resource access.

The FAO (1999) pointed out that many Sub-Saharan countries have realized the critical role of irrigation in food production. However, the relatively high cost of irrigation development combined with the insufficient physical infrastructure and markets access, poor investments in irrigation, lack of access to improved irrigation technologies, and lack of affordable and readily available water supplies, have been limitations for a relatively slow rate of irrigation development in this region. FAO further recognized fragmented and small land holding, unsecured or lack of land titles, high interest rates, and poor transportation and marketing facilities as further constraints affecting the capacity of farmers to invest and manage irrigation schemes.

Kumar (2003) also indicated that irrigation has contributed significantly in boosting India's food production and creating grain surpluses used as drought buffer. A study by Hussain et al. (2004) confirms that, access to reliable irrigation water can assist farmers to follow new technologies and strengthen cultivation, leading to increased productivity, overall higher production, and greater returns from farming. This in turn opens up new employment opportunities, both on farm and off farm and can improve incomes, livelihood, and the quality of life in rural areas. Hussain et al. (2004) identified five key dimensions of how access to good irrigation water contributes to socio-economic uplift of rural communities. These are production, income and consumption, employment, food security, and other social impacts contributing to overall improved welfare. The same study in Sri Lanka reported that irrigation development has been a major instrument used by the government in its effort to enhance food security and eradicate poverty for over 5 decades.

Ngigi (2002) disclosed that for the two decades in Kenya agricultural production has not been able to keep bound with the increasing population. To address this issue the biggest potential for increasing agricultural production lies in the development of irrigation. According to the same study, irrigation can assist in agricultural modification, enhance food self-sufficiency, increase rural incomes, create foreign exchange and provide employment opportunity when and where water is a constraint. The major contributions of irrigation to the National economy are food security, employment creation, and foreign exchange. In Ethiopia a study conducted by Woldeab (2003) identified that in Tigray irrigated agriculture has benefited some

households by providing an opportunity to increase agricultural production through double cropping and by taking advantage of modern technologies and high yielding crops that called for intensive farming.

A study by IFAD (2005) indicated that in Ethiopia, the construction of small-scale irrigation schemes has resulted in increased production, income and modernization in the Oromia and Southern Nation and Nationalities People (SNNP) regions. According to this study, the cash earned from selling vegetables and other production is commonly used to buy food to cover the household food demand during the food shortage months. The same study further added that during an interview conducted with some farmers, it was revealed that the hungry months reduced from 6 to 2 months (July and August) because of the use of small-scale irrigation. Moreover, the increase in variety of crops across the schemes and the shift from cereal livestock system to cereal-vegetable-livestock system is starting to improve the diversity of household nutrition through making vegetables part of the daily diet.

2.9.2 Negative relationship with the factors of irrigation participation and income



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Rosegrant and Everson (1992) found that they were unable to establish a positive link between irrigation investment and productivity in India. In the same way, study done by Jin et al. (2002) also did not observe a link between irrigation and the total factor productivity growth of any major grain crop in China between 1981 and 1995.

Ogunbameru et al. (2011) perceived that as the level of education increases with level of participation in agricultural programmes decreases, the higher the educational level of the farmer, the higher the chances of getting better earning jobs or the higher the tendency to be involved in politics and thereby decreasing the level of participation in irrigation management.

Empirical study conducted by Berhanu and Pender (2002) in Tigray Region, Ethiopia, stated that the effects of irrigation development on input use and the productivity of farming practices controlling all other factors were insignificant. They indicted that irrigation has restricted effect on the use of fertilizer and improved seed leading to less gain productivity from irrigation. However, they proposed the

reason why irrigation failed to improve productivity of farming practices, deserved further and careful study on the technical, institutional, governance and managerial aspects.

2.10 The review of Demographical, Socio-economical and Institutional factors

Different factors are expected to affect households' participation decision from small-scale irrigation in the study area. The major factors which affect the participation in small-scale irrigation were identified through the detail literature review are summarized in this section.

2.10.1 Demographic Factors

Demographic factors are personal characteristics are used to collect and evaluate data on people in a given population. Gender of the household head, Age of household were identified as the demographical factors through literature review affecting farmer's participation in irrigation.

a) Gender of the household head

Male household heads is expected to have higher income compared to female household heads because of better labour inputs used in male-headed households than the female headed ones. Moreover, with regard to farming experience males are better than the female farmers since it is assumed that male household heads have more exposure and access to information and new interventions than female household heads, which might enable them to participate in the small-scale irrigation as early as possible is higher than their counterpart (Mwaseba, 1991).

b) Age of the household head

Age is used to indicate the general experience of the household head. At younger ages the probability of participating in small-scale irrigation will increase. But as the farmer gets older and older his managerial ability and physical capacity are expected to decrease as a result the overall labour hours will decline and the demand for leisure will increase. Hence, age is expected to have positive and negative effect on farmers' decision to participate in small -scale irrigation (Nanai, 2009).

2.10.2 Socio-Economic Factors

Socio-Economic factors are the social and economic experiences and realities that help to mold one's personality, attitudes, and lifestyle. Level of Education of household head, Availability of family labour force, Size of cultivated land, Distance to nearest market, and Distance from the water source were identified as the socio-economic factors affecting farmer's participation in irrigation through literature review part.

a) Level of Education of the household head

Education has the impact on income improvement and poverty alleviation. It is likely that educated farmers would more readily adopt irrigation technologies and may be easier to train through extension support. Household heads that are literate are expected to have a better knowledge of how to make a living. Literate household heads are very ambitious to get information and use it. Thus, it is expected that household heads who are literate are more likely to use and benefit from small-scale irrigation and expected to have a positive relationship (Ogunbameru et al., 2011).

a) Availability of family labour force

Labour is one of the most extensively used inputs of agricultural production. Adoption of new technology demands additional labour force for different farming operations.

A household with large labour force can participate in small-scale irrigation more than a household with small number of labour force. In addition, Households with large family size will have more number of agricultural labours and hence, will have more agricultural production and more income provided that there is sufficient land to employ the existing labour (Lipton et al., 2003). Therefore decision to participate in small-scale irrigation is directly related to the level of family labour force.

b) Size of cultivated land

This refers to the total cultivated land size (both irrigated and rain fed) of a household. As the cultivated land size increases and other associated production factors remain constant, the likelihood that the holder gets more output is high. Hence farmland is the major input for agricultural production in rural households. Total cultivated land should have a positive relationship (Kamara et al., 2001).

c) Distance from the nearest market

It refers to the distance between the households' farm and the nearest market center. As the farmer is nearer to a market, the higher will be the chance of participating in small-scale irrigation. Especially for perishable commodities if the market place is located far away from the farm, the commodity may perish before arriving the market and to avoid such incidences the farmer sells his output for cheaper price reducing the income (Ogunbameru et al., 2011). Therefore, distance from market influence the farmers' decision to participation in small-scale irrigation.

d) Distance from the water source

It refers to the distance between farmers' residence to the water source. Nearness of the households to irrigation scheme is expected to determine the household's participation decision in small-scale irrigation positively. Hussain et al. (2004) identified a strong positive relationship between distance to water source and irrigation participant.

2.10.3 Institutional Factors



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Institutional factors are the factors established sets of rules derived from combination of human perception and action. The rules may be in the form of written down laws, or of norms, conventional and traditional practices accepted by a particular society.

a) Access to credit facility

Access to credit is an important source of investment. Those households who have access to credit have a better possibility of getting farm inputs. According to Norton et al. (1970), credit helps farmers purchase inputs such as seeds, fertilizers and chemicals. Therefore, it is expected that access to credit determines farmers' decision to participate in small-scale irrigation

b) Access to extension service

Access to extension service widens the household's knowledge with regard to the use of improved variety and agricultural technologies. Since it is as an important source of information, knowledge and advice to smallholder farmers. Mlelwa (2010), revealed that that an extension personnel is a change agent who assists farmers utilize their human and material resources.

2.11 Chapter Summary

Irrigation is a very old practice in the world. It is an old human activity and been practiced in many parts of the world for several thousand years ago. The small-scale irrigation systems developed in the early period of Sri Lanka's history were community based and essentially farmer managed irrigation. Small-scale irrigation is, usually on small land plots where farmers have the majority controlling influence, using a level of technologies which they can operate and maintain the scheme effectively. In many drought countries, including Sri Lanka, there has been a positive approach regarding irrigation development as a strategy to sustain agricultural production and ensure food security. Numerous studies conducted in past reveal that there is a strong positive relationship exist irrigation participation with agriculture production, income of farmers, poverty reduction, creation of employment and livelihood.

The review of related literature concluded that many demographic, socio-economic, institutional, factors such as Gender, Age, Education, Labour Force, Size of cultivated land, Access to market, Distance to water source, Extension service, Credit Facilities influence the participation in small-scale- irrigation with income. In contrast, few studies conducted in past concluded that there is no significant relationship irrigation participation with income of farmers and livelihood. The reason behind was, increasing productivity may reduce the price of agriculture production. This result may discourage the farmers to involve in irrigation participation. To overcome this issue, farmers shall select the cash crops to get the higher price to their agriculture production.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is a systematic way to solve a problem, and it is the main element in a research, which expresses the procedures how it is approached towards the indented findings. This section presents an overview of the study of an area description, research approach, the methods used for data collection and data analysis applied in the study. That is, it includes the data source and data collection methods, sample size and sampling techniques and methods of data analysis for the study.

3.2 Description of the Study Area

Trincomalee district, an attractive city with a natural harbour, attractive beauty, and military, commercial and historical importance, is situated in the Eastern coast of Sri Lanka. Trincomalee District is surrounded by Mulaithivu District in North, Anuradhapura District in West and Polonnaruwa and Batticaloa Districts in South. Trincomalee history goes back to a time of ancient. The Mahavamsa & Chulavamsa, the two great chronicles, mention the present Trincomalee as “Gokanna”, Gokarna, and “Gonagamaka” during the Anuradhapura and Polonnaruwa periods of island’s history.

The Trincomalee District is located in the Eastern Province, covering an area of 2,728 square kilometers. The district has been divided into 11 Divisional secretariat Divisions. The DS Divisions are further sub-divided into 230 Grama Niladhari Divisions. As per the 2012 census, the total population is 378,182. Among its population, 42 percent are Muslims, while the Sinhalese and Tamils consist of 26 percent and 31 percent respectively.

The major source of livelihood of the community is the agriculture and fishing. Paddy cultivation stands as the main agriculture crop in the District. The Kanthale Tank, Wendrasawewa, Morewewa, Mahadiwulwewa, and Galmittiyawa tank are some major tanks. There are three major irrigation projects; Kanthale, Alla Kanthale and Morewewa. Livestock & cattle breeding is another livelihood.

As Trincomalee is one of the world renowned coast and tourist destination, tourism industry is another important economic activity. Because of its excellent natural harbour and strategic positioning, international companies like Prima Ceylon and Tokyo Cement, IOC have located their manufacturing plants and distribution centers at Trincomalee.

Table 3.1: Land Distribution, Grama Niladari Divisions and Population in Trincomalee District

| S/N | Name of the Division | Area (SQ. Km) | No. of GN Divisions | No. of Villages | Population |
|--------------|----------------------|----------------|---------------------|-----------------|----------------|
| 01 | Trincomalee (T & G) | 148.0 | 42 | 112 | 97,234 |
| 02 | Padavisripura | 217.1 | 10 | 26 | 11,858 |
| 03 | Gomarankadawala | 285.0 | 10 | 41 | 7,339 |
| 04 | Kinniya | 146.9 | 31 | 107 | 64,451 |
| 05 | Seruwila | 279.0 | 17 | 28 | 13,546 |
| 06 | Muthur | 179.4 | 42 | 96 | 56,379 |
| 07 | Kanthale | 397.3 | 23 | 62 | 46,641 |
| 08 | Kuchchaveli | 313.3 | 24 | 86 | 33,100 |
| 09 | Morawewa | 322.4 | 10 | 41 | 7,946 |
| 10 | Thambalagamuwa | 244.4 | 12 | 48 | 28,356 |
| 11 | Verugai | 98.0 | 09 | 40 | 11,332 |
| Total | | 2,630.8 | 230 | 687 | 378,182 |

Source: Department of Census and Statistics, 2012

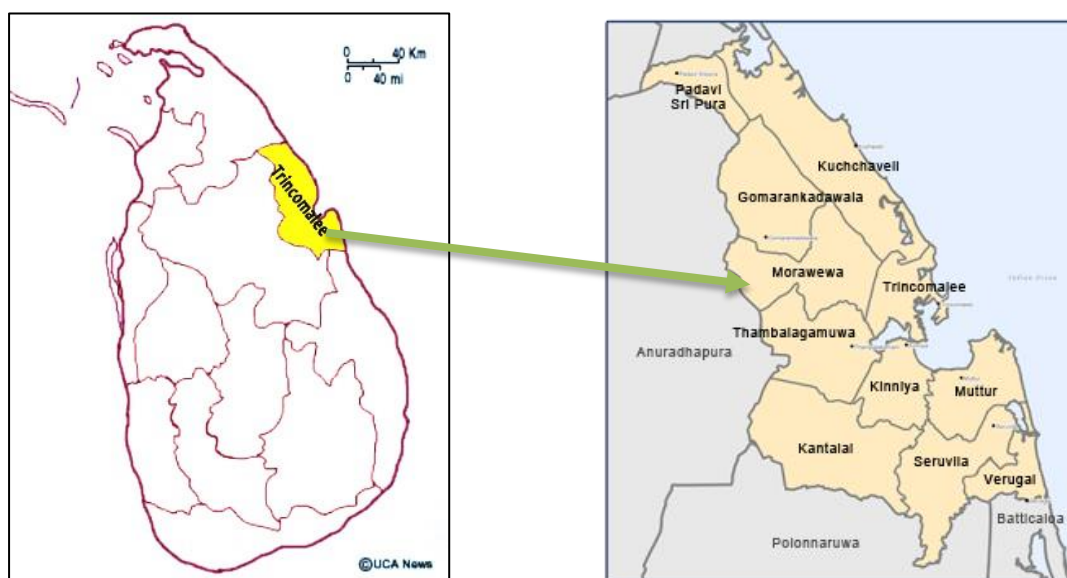


Figure 3.1: Coverage of Study Area

3.3 Research Approach

There are three main approaches to research, namely quantitative approach, qualitative approach and mixed approach. The quantitative approach involves the collection of quantitative data, which are put to rigorous quantitative analysis in a formal and rigid manner. This approach further includes experimental, inferential, and simulation approaches to research. Meanwhile, the qualitative approach uses the method of subjective assessment of opinions, behaviour and attitudes. Research in such a situation is a function of the researcher's impressions and insights. The results generated by this type of research are either in non-quantitative form or in the form which cannot be put to rigorous quantitative analysis. Usually, this approach uses techniques like in-depth interviews, focus group interviews, and projective techniques. Mixed method of research is a combination of quantitative, and qualitative methods.

Quantitative method of research approach was applied for this study. Quantitative research approach was adopted by statistical descriptive analysis such as frequency, percentage, chi-square test. Besides, Likert-scale analysis method also used as a quantitative approach.



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3.4 Data Source and Data Collection Techniques

Data can be collected from primary and secondary sources. Data which are collected first hand are called primary data and data which have already been collected and used by somebody are called secondary data. Primary data may be obtained by applying the methods of direct personal interviews, indirect oral interviews, information from correspondents, mailed questionnaire methods and schedule sent through enumerators. Besides, secondary data may be obtained basically from two sources such as published sources and unpublished sources. Published sources are like publications of different government and semi-government departments, research institutions and agencies.

For this study both primary and secondary sources had been gathered to collect the quantitative data. The conventional household survey was the main method used to collect quantitative primary information through a carefully designed structured

questionnaire which was prepared for the study. Information pertaining to households' demographic, socio-economic characteristics and institutional situations were obtained directly through the interview of sample household heads were the unit of analysis. Pre-testing of the questionnaire was carried out and depending on the results, some adjustments have been made to the final version of the questionnaire and proper data collection was started. My personal observation of the site helped me to understand the over-all process of irrigation development and data gathered through household survey. In addition to primary data, secondary data such as farmer's fertilizer subsidy and land insurance data were collected to distinguish the irrigation participants and non-participants. Irrigation Department, Agriculture Department and Agrarian Department, were some of the offices from which secondary data were obtained.

3.5 Sampling Method

Sampling methods are classified as either probability or nonprobability. In probability samples, each member of the population has known non-zero probability of being selected. Probability methods include random sampling, systematic sampling, and stratified sampling. In nonprobability sampling, members are selected from the population in some non-random manner. Random sampling is each member of the population has an equal and known chance of being selected. Systematic sampling is also called an n^{th} name selection technique. After the required sample size is calculated, every n^{th} record is selected from a list of population members. Stratified sampling is a subset of the population that share at least one common characteristic.

For this study, stratified random sampling technique was used and sample population was classified into two groups: irrigation participants and non-irrigation participant households from each divisions of Trincomalee district. Irrigation participants mean the farmers who involve in irrigation management activities and irrigate their agricultural land if the rain is not persist. Non-irrigation participants mean the farmers who do not involve in irrigation management activities and entirely depend on rain water. Sample households were identified using stratified random sampling technique from the list of households except Town and Gravets division because this division contains very few farmers. The overall sample size was 100 households, 50

from irrigation participants and 50 households from non-irrigation participants. Trincomalee district consists of 11 division. In each division 5 household. Sample households s were selected for irrigation participants and 5 for non- irrigation participants using stratified random sampling except Trincomalee Town and Gravets division. The list of total farmers households in the division and the lists of irrigation participants and non- irrigation participants households in these divisions were obtained from Irrigation Department, Agriculture Department and Agrarian Department.

3.6 Method of Data Analysis

The appropriate methods of data analysis are determined by data types and variables of interest, the actual distribution of the variables, and the number of cases. Different analyses of the same data set may reflect or represent different aspects of the underlying data structure. Data may be analysed by the methods of exploratory, descriptive and inferential. Exploratory type of data analysis often occurs when a program is new, and it is unclear what to expect from the data. Descriptive analysis is the most common type of data analysis, this approach will summarize the findings and describe the sample. Inferential statistics allow us to draw conclusions about the larger population from which the sample is drawn.



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In this study, descriptive statistics and Likert-scale analysis techniques were used to summarize information (data) collected from the sample. It was employed to explain the demographic, socio-economic and institutional behaviour of household characteristics by applying descriptive statistics such as percentage, frequency and chi-square test.

In order to identify the first research objective of "review of demographical, socio-economical and institutional factors affecting the farmer's participation in small-scale irrigation in Trincomalee district, Sri Lanka", a detail literature review was carried out on books, past research papers and related articles in the internet and other textual materials.

To find the second research objective is to "identify the effects of demographic, socio-economic and institutional factors affecting farmers' participation in small-

scale irrigation", the factors identified from first objective were taken as the hypothesis and those factors were analysed using descriptive statistical techniques such as frequency, percentage and chi-square test. Those results were summarized and the number of respondent (frequency) in each category irrigation participant and non-participant and total sample household were tabulated and presented with frequency, percentage with the help of Bar Charts. Using the results obtained in above analysis, chi-square test was carried out to find out the significant relationship with the factors. It is a statistical method assessing the goodness of fit between a set of observed values and those expected values. The formula for calculating chi-square (χ^2) is: $\sum (O-E)^2/E$. That was, chi-square is the sum of the squared difference between observed (O) and the expected (E) divided by the expected data in all possible categories.

The third research objective is to "determine the level of significant of the factors affecting the small-scale irrigation participation with income of farmer's household". To get the reliable answer for this third objective, three different methods were used. First method was, the income level obtained from questionnaire survey in each category irrigation participant and non-participant and total sample households were tabulated and presented with frequency, percentage with the help of Bar Charts. Second method was, the farmers were asked about their preferences in questionnaire survey that whether they accept or not with the factors which really influence in irrigation participation with income. The information gathered from questionnaire survey were tabulated and presented with frequency and percentage. Third method was Likert-scale analysis. The level acceptance of factors affecting participation irrigation management with income were asked to farmers from questionnaire and weighted the information from 1 to 5 (1- strongly disagree, 2- disagree, 3- slightly agree, 4- agree, 5- strongly agree). Relative Importance Index (RII) will be calculated for each and every factor as per the frequencies of responses of each item by using the formula: $RII = \sum W_n \times 100 / A \times N \times 100$. Where, W-Weight assigned to each type of response, n - Frequency of responses for each type, A- Highest weight assigned, and N- Total number of responses.

3.7 Chapter Summary

The data needed for this study were collected from primary and secondary sources. Further, a structured questionnaire was used to collect the primary data of farmers who involve in irrigation participation and non-irrigation participation in small-scale irrigation management. As well as the primary data, secondary data also was collected from published and unpublished documents from Irrigation Department, Agriculture Department and Agrarian Department. Hence, Sample population was stratified into two groups as irrigation participant and non-irrigation participant. Stratified random sampling technique was applied to select the 100 samples from total population, 50 samples from irrigation participant and 50 samples from non-irrigation participant. Trincomalee district consists of 11 divisions. Each division 5 households were selected for irrigation participants and 5 for non-irrigation participants except Trincomalee, Town and Gravets division as it contains very less irrigation schemes and farmers. Ultimately the quantitative research approach was carried out to analyse the data obtained from primary and secondary sources. For the quantitative data analysis, descriptive statistics technique was used such as frequency, percentage and chi-square test. Besides, Likert-scale analysis technique was also used with Relative Importance Index (RII).



CHAPTER FOUR

RESEARCH FINDINGS

4.1 Introduction

This chapter presents the findings of research objectives based on the collected data using the descriptive statistics technique and Likert-scale analysis explained in methodology part in chapter three. The first research objective, ‘review of demographical, socio-economical and institutional factors affecting the farmer’s participation in small-scale irrigation in Trincomalee district Sri Lanka’ is answered in section 2.10 of review of related literature chapter. The second research objective (Section 4.2) identifies the effects of demographic, socio-economic and institutional factors affecting farmers’ participation in small-scale irrigation. The third research objective (Section 4.3) determines the level of significant factors which effects in small-scale irrigation participation with income of household. These research objectives (Section 4.2 and Section 4.3) are answered through structured questionnaires which were issued among the farmers in Trincomalee district and analysed using descriptive statistical techniques and Likert-scale analysis.



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The descriptive statistical analysis made use of tools such as frequency, percentage and chi-square test. These tools were used to identify the demographic, socio-economic and institutional factors affecting farmer’s participation in small-scale irrigation and the effects of income of farmers’ households. In addition, likert-scale analysis were employed to determine the level of significant factors affecting irrigation participation with income of household.

4.2 The effects of demographic, socio-economic and institutional factors affecting farmers’ participation in small-scale irrigation

This section presents, the demographical, socio-economical and institutional factors identified from literature survey were taken as the hypothesis and those factors were analysed using descriptive statistical techniques such as frequency, percentage and chi-square test.

4.2.1 The effects of Demographical factors

a) Gender of household head

Sample households were composed of both male and female household heads. Gender of the household head was an important variable influencing the participation decision in irrigation. The findings in Table 4.1 and Figure 4.1 show that total sample household heads 75% of them are male headed while 25% are female headed households. When we see the comparison with irrigation participants and non - irrigation participants, irrigation participant households 12% are headed by female and the remaining 88% is by male headed household. The corresponding figure for non - irrigation participants is 38% and 62% is by female and male household heads respectively.

The gender difference of household heads in irrigation participation and non-irrigation participation indicated that it makes great influence in irrigation participation. This is due to multiple roles women play apart from participating in irrigation management, and which include attending to all household duties.

Table 4.1: Distribution of Gender of household

| Respondents | Participants | | Non-Participants | | Total | |
|--------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| Male | 44 | 88 | 31 | 62 | 75 | 75 |
| Female | 06 | 12 | 19 | 38 | 25 | 25 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

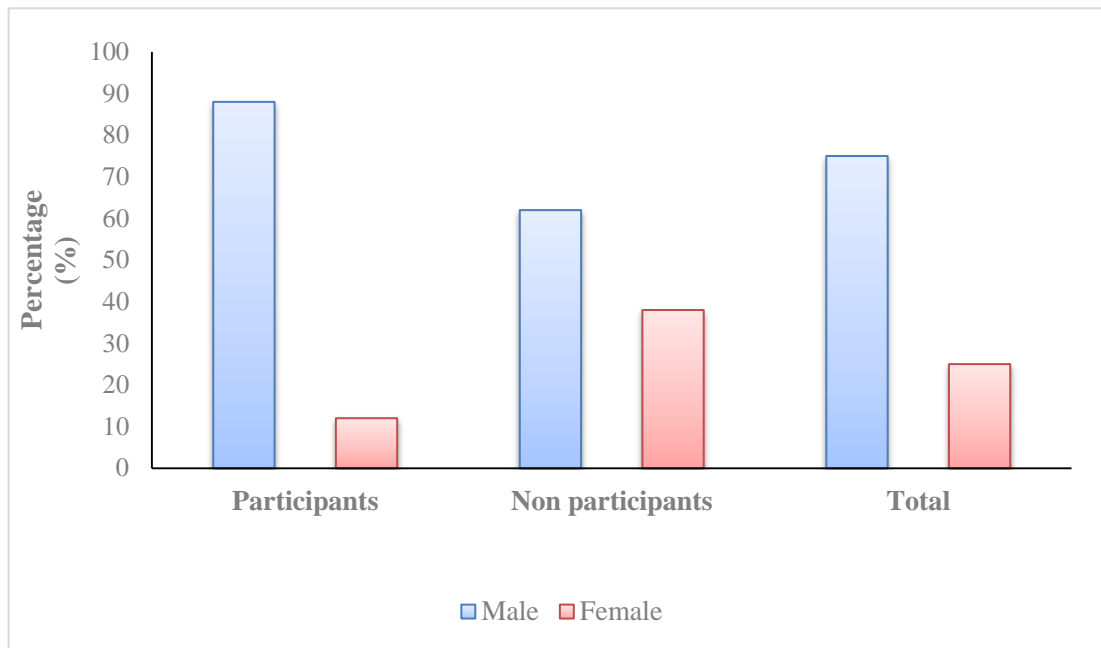


Figure 4.1: Distribution of Gender of household

b) Age of Household head

The results in Table 4.2 and Figure 4.2 reveal that total sample house hold head 74% were between the age categories from 18- 28 years to 51-61 years and 26% were in the category of 62-72 years. If we compare in detail classification with irrigation participants and non-irrigation participants, 92% of farmers who were participating in irrigation were between the age categories from 18- 28 years to 51-61 years and 8% were 62-72 years. On the other hand, 56% of farmers who were not participating in irrigation were between the age categories from 18- 28 years to 51-61 years and 44% were in the category of 62-72 years.

This analysis shows that, majority (92%) of the farmers who were participating in irrigation were below 61 years of age while 44% of farmers who were not participating in irrigation were above 61 years of age. This is due to the fact that farmers are able to participate and take risk when they are young.

The result clearly indicates that age of household is one of the major influencing factor to determine the participation in irrigation management activities.

Table 4.2: Distribution of Age of household head

| Respondents | Participants | | Non-Participants | | Total | |
|--------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| 18-28 | 8 | 16 | 2 | 4 | 10 | 10 |
| 29-39 | 15 | 30 | 14 | 28 | 29 | 29 |
| 40-50 | 14 | 28 | 6 | 12 | 20 | 20 |
| 51-61 | 9 | 18 | 6 | 12 | 15 | 15 |
| 62-72 | 4 | 8 | 22 | 44 | 26 | 26 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

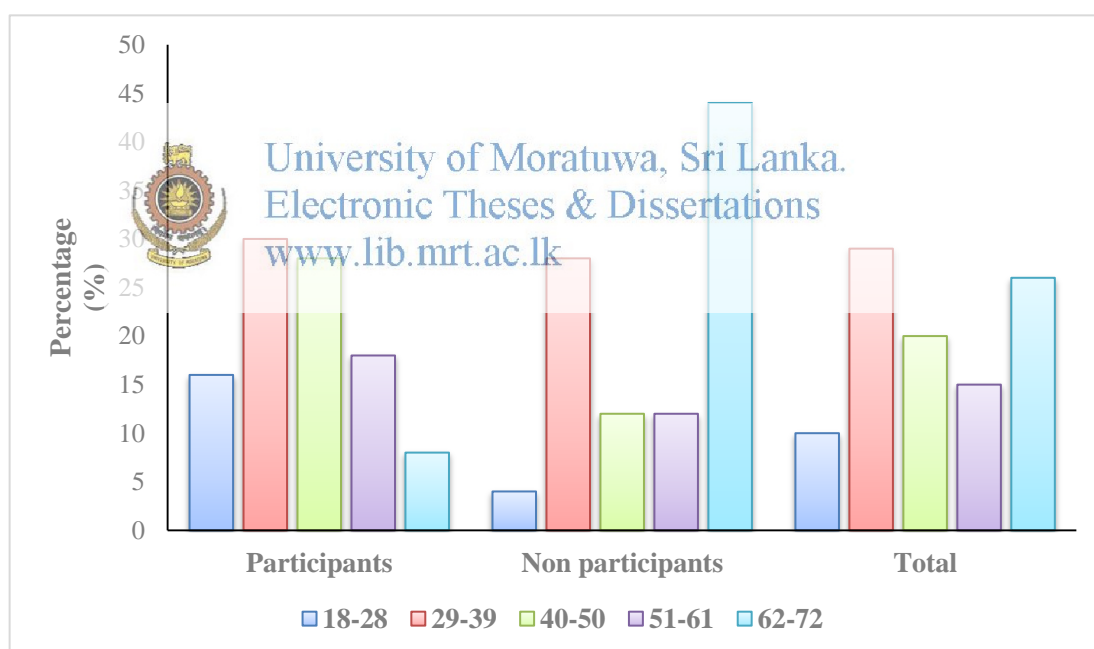


Figure 4.2: Distribution of Age of household head

4.2.2 The effects of Socio-Economic factors

a) Level of Education of the household head

Education plays a key role for household decision in technology adoption. It creates awareness and helps for better innovation and invention. This factor is a discrete: 0 if illiterate, 1 if elementary (grade 1-6) complete, 2 if Junior (grade 7&8) complete and 3 if high school and above (grade 9 and above). The distribution of total sample respondents in terms of literacy level in Table 4.3 and Figure 4.3 has shown that, 15% were illiterate, means at least they cannot read and write, 80% had attended elementary education from grade 1 to 6, 3% were exposed to formal education from grade 7 to 8 and the remaining 2% have succeeded in reaching higher levels of grade 9 and above.

The comparison by access to irrigation reveals that 10% of the participants and 20% of the non-participants were found illiterate, 82% of the participants household heads and 78% of the non-participants household heads attended elementary education from grade 1 to 6, 6% of the participants and 0% non-participants attended junior education from grade 7 to 8, 2% participants and 2% of non-participants of small-scale irrigation were exposed to higher levels of grade 9 and above.



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The study indicated that there is no significant relationship with the education level and irrigation participants and non-irrigation participants. This could explain that the level of education doesn't influence in participation decision of small-scale irrigation.

Table 4.3: Distribution of education level of household

| Respondents | Participants | | Non-Participants | | Total | |
|--------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| Illiterate | 5 | 10 | 10 | 20 | 15 | 15 |
| Elementary | 41 | 82 | 39 | 78 | 80 | 80 |
| Junior | 3 | 6 | 0 | 0 | 3 | 3 |
| Higher | 1 | 2 | 1 | 2 | 2 | 2 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

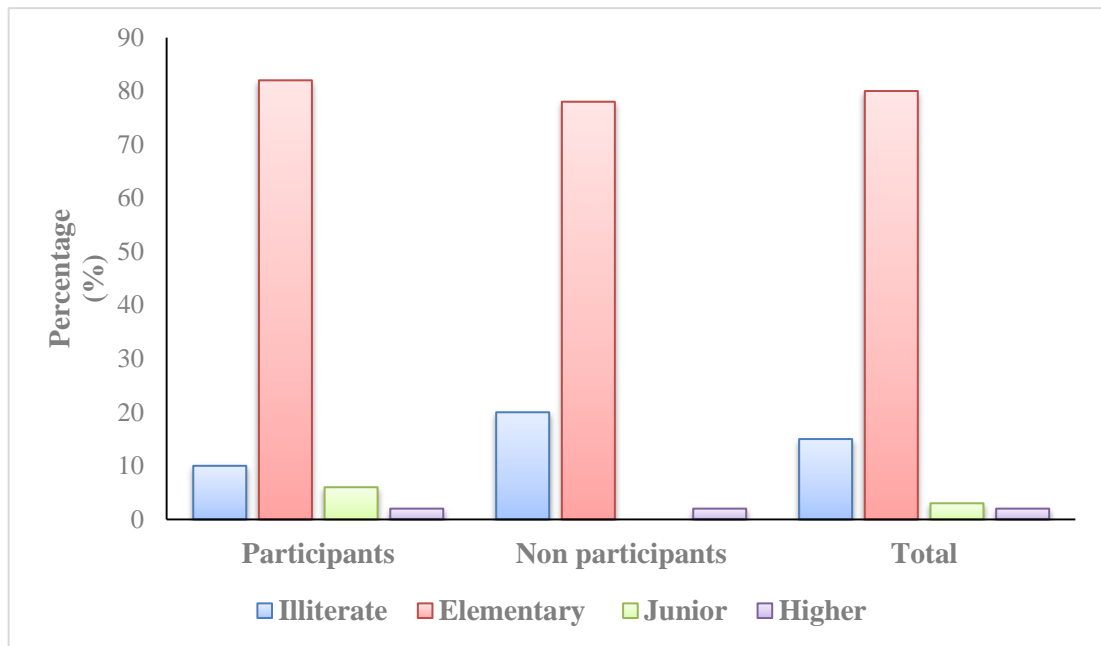


Figure 4.3: Distribution of education level of household

b) Availability of Family Labour Force

The size of labour force in households & experience contribute for variation on participation decision in small-scale irrigation. The main source of labour for crop production either in the irrigated or rainfed agriculture in the study area is family labour. The man equivalent (ME) of the economically active family labour force was calculated for the sample respondents based on Haile (2008) (See Annex-B).

According to the Table 4.4 and Figure 4.4, the distribution of total sample respondents in terms of man equivalent (ME) of the economically active family labour has shown that, 19% total sample household were 0-2 ME, 47% were 2-4 ME, 30% were 4-6 ME and the remaining 4% were 6-8 ME. Further, the result shows that 60% of farmers who were participating in irrigation management were in the category between 4-6 and 6-8 of man equivalent (ME) of the economically active family labour, on the other hand, only 8% of farmers who were not participating in irrigation management were in the category between 4-6 and 6-8 of man equivalent (ME) of the economically active family labour.

This results shows that irrigation participants household had greater man equivalent (ME) of economically active labour than non-irrigation participants. Therefore, family labour force is one of the significant determinant factor of participation in irrigation management.

Table 4.4: Distribution of family labour force of household

| Respondents | Participants | | Non-Participants | | Total | |
|---------------------------------|--------------|-----------------------|------------------|-----------------------|------------|-----------------------|
| | Frequency | | Frequency | | Frequency | |
| Family Labour Force (ME) | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| 0-2 | 5 | 10 | 14 | 28 | 19 | 19 |
| 2-4 | 15 | 30 | 32 | 64 | 47 | 47 |
| 4-6 | 26 | 52 | 4 | 8 | 30 | 30 |
| 6-8 | 4 | 8 | 0 | 0 | 4 | 4 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

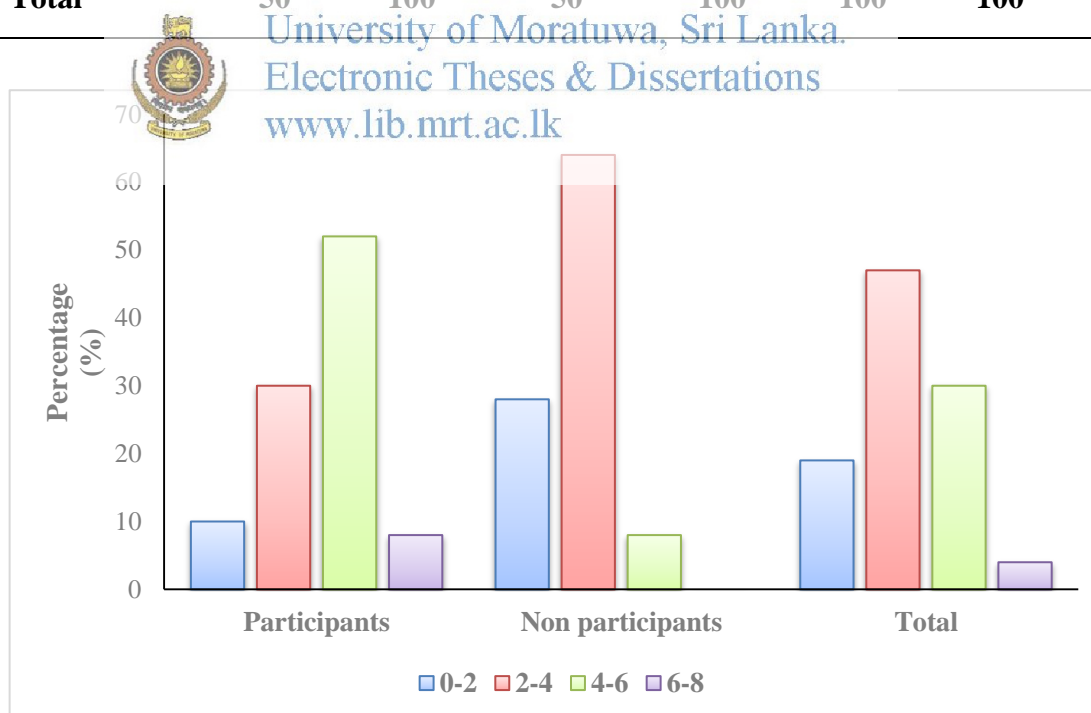


Figure 4.4: Distribution of family labour force of household

Labour shortage was reported to be one of the problems faced by the sample respondents for weeding, harvesting, threshing, watering, livestock herding and ploughing. Findings from the study demonstrated from the total sample respondents,

49% total sample household reported that they faced labour shortage. The breakdown of this information reveals that about 64% of the participants and 34% of non-participants of small-scale irrigation had faced labour shortage.

c) Size of cultivated Land

The result in Table 4.5 and Figure 4.5 shows that 90% of farmers in total sample household had the cultivated land size under the categories of 0-2, 3-5 and 6-8 acres, the rest of 10% farmers had the cultivated land size under the categories of 9-11, 12-14, and 15-17 acres. With the comparison of irrigation participants and non-irrigation participants, 84% of farmers who were participating in irrigation had cultivation land size under the categories of 0-2, 3-5 and 6-8 acres, the remaining 16% farmers had the cultivated land size under the categories of 9-11, 12-14, and 15-17 acres. On the other hand, 96% of farmers who were not participating in irrigation had the cultivation land under the categories of 0-2, 3-5 and 6-8 acres, the rest of 4 % farmers had the cultivated land size under the categories of 9-11, 12-14, and 15-17 acres.

This analysis illustrates that the both farmers who were participating and not participating in irrigation management had nearly similar cultivation land area. This result indicates that cultivation land size doesn't influence to determine the participation in irrigation management decision.

Table 4.5: Distribution of cultivated land of household

| Respondents | Participants | | Non-Participants | | Total | |
|--------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| 0-2 | 8 | 16 | 15 | 30 | 23 | 23 |
| 3-5 | 22 | 44 | 28 | 56 | 50 | 50 |
| 6-8 | 12 | 24 | 5 | 10 | 17 | 17 |
| 9-11 | 6 | 12 | 2 | 4 | 8 | 8 |
| 12-14 | 1 | 2 | 0 | 0 | 1 | 1 |
| 15-17 | 1 | 2 | 0 | 0 | 1 | 1 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

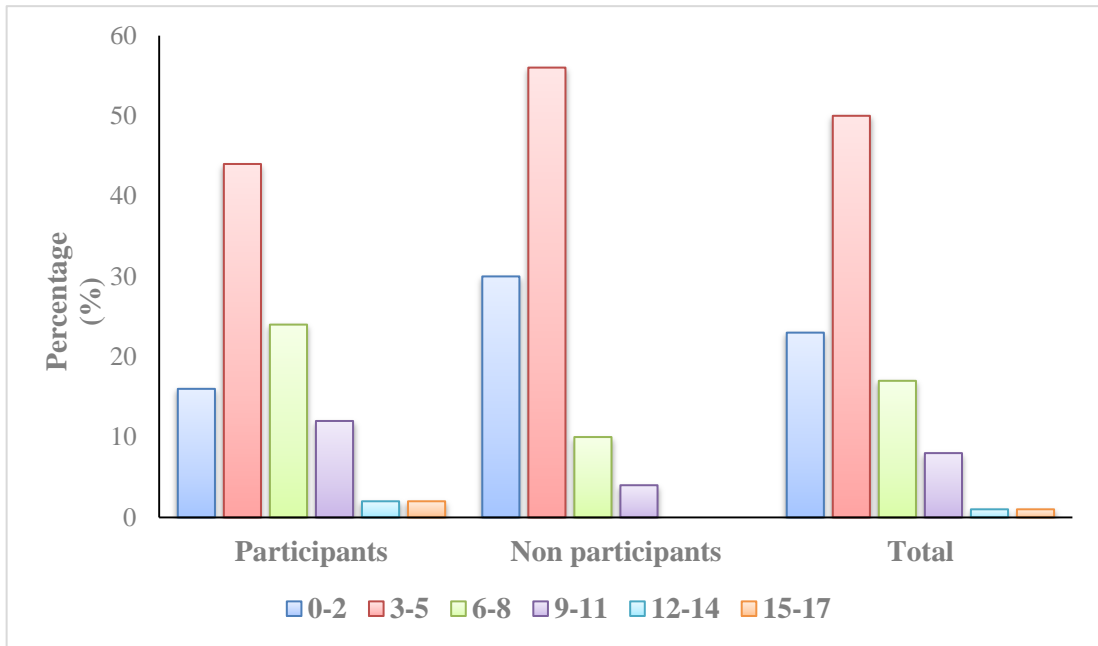


Figure 4.5: Distribution of cultivated land of household

d) Distance to nearest market

According to the table 4.5 and Figure 4.6, the distribution of total sample respondents in terms of distance to nearest market, 56% of farmers were in categories of 0- 2 km and 3-5 km and other 44% farmers were in categories of 6-8 km, 9-11km and 12-14 km. In addition, the result shows that 84% of farmers who were participating in irrigation management had distance to nearest market were in categories of 0- 2 km and 3-5 km and remaining 16 % of farmers were in categories of 6-8 km, 9-11km and 12-14 km. On the other hand, only 28% of farmers who were not participating in irrigation management had distance to nearest market were between 0- 2 km and 3-5 km and rest of 72% of farmers were in categories of 6-8 km, 9-11km and 12-14 km.

This analysis expresses that, the farmers who were participating in irrigation management had less distance to nearest market than farmers who were not participating in irrigation management. This result indicates that distance to nearest market has the strong relationship to determine the participation in irrigation management decision.

Table 4.6: Distribution of distance to nearest market of household

| Respondents | Participants | | Non-Participants | | Total | |
|--------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| 0-2 | 15 | 30 | 4 | 8 | 19 | 19 |
| 3-5 | 27 | 54 | 10 | 20 | 37 | 37 |
| 6-8 | 5 | 10 | 23 | 46 | 28 | 28 |
| 9-11 | 3 | 6 | 7 | 14 | 10 | 10 |
| 12-14 | 0 | 0 | 6 | 12 | 6 | 6 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

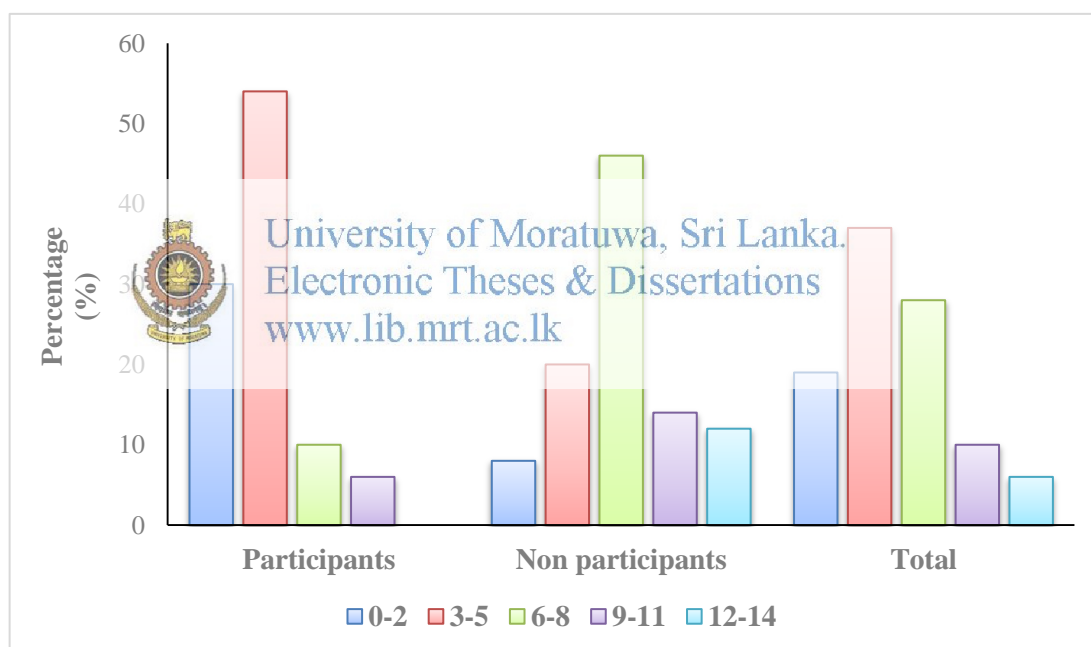


Figure 4.6: Distribution of distance to nearest market of household

e) Distance from the water source

The results of Table 4.7 and Figure 4.7 illustrate that 50 % of farmers in total sample household were in the category of 0-2 km distance to water source and other 50% of farmers were in the categories of 3-5 km and 6-8 km distance to water source. Further to that, 76% of farmers who were participating in irrigation management had distance from water source in the category of 0- 2 km and remaining 24% of farmers were in the categories of 3-5 km and 6-8 km distance to water source. On the other hand, only 24% of farmers who were not participating in irrigation management had distance from the water source were between 0- 2 km and rest of 76% farmers were in the categories of 3-5 km and 6-8 km distance to water source.

This analysis shows that, the farmers who were participating in irrigation management had less distance to water source than farmers who were not participating in irrigation management. This result indicates that distance to water source is a major determinant factor of participation in irrigation management decision.

Table 4.7. Distribution of distance from the water source to household

| Respondents | Participants | | Non-Participants | | Total | |
|--------------------------------------|--------------|-----------------------|------------------|-----------------------|------------|-----------------------|
| | Frequency | Percentage (%) | Frequency | Percentage (%) | Frequency | Percentage (%) |
| Distance to water source (km) | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| 0-2 | 38 | 76 | 12 | 24 | 50 | 50 |
| 3-5 | 7 | 14 | 29 | 58 | 36 | 36 |
| 6-8 | 5 | 10 | 9 | 18 | 14 | 14 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

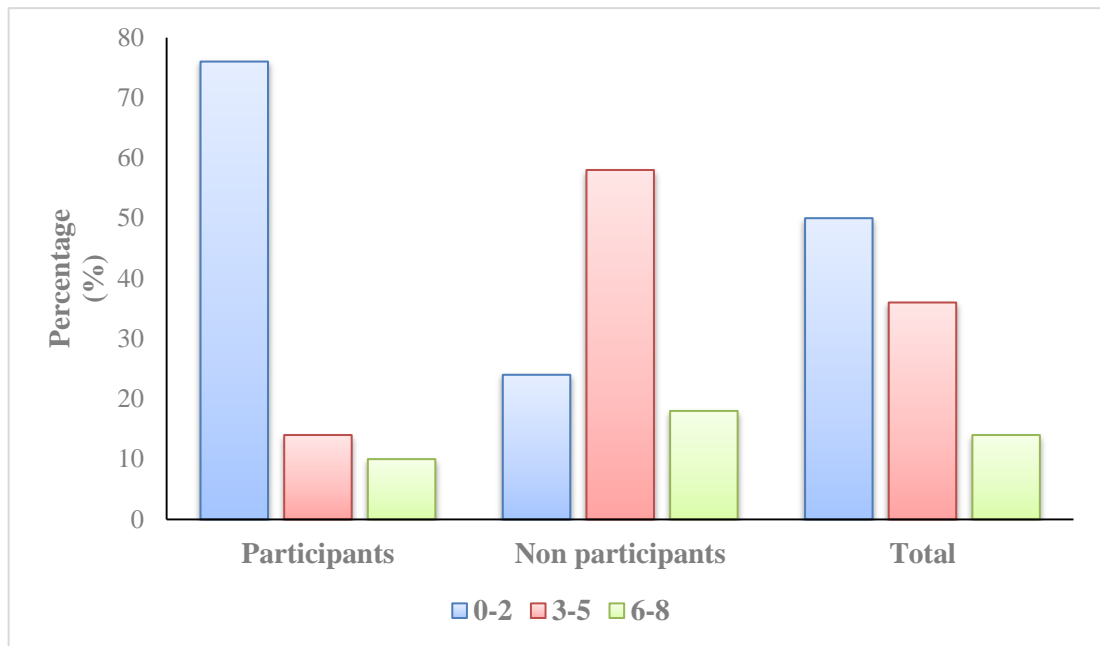


Figure 4.7: Distribution of distance from the water source of household

4.2.3 The effects of Institutional factors

a) Access to extension Services

As per the survey result in Table 4.8 and Figure 4.8 reveal that, 68% of the total sample households got extension service. With regard to the frequency of extension contact among the total respondents 12% contact three times and above per month, 21% twice per month, 35% once per month, and the remaining 32% have no contact with extension agents. When we compare with irrigation participants and non-irrigation participants, majority of the irrigation participant households get support from extension agents when compare to non-irrigation participants. According to the survey 92% of the participants (40% of farmers got once/month, 30% of farmers got twice/month and 22% of farmers got thrice/month) and 44% of the non-participants (30% of farmers got once/month, 12% of farmers got twice/month and 2% of farmers got thrice/month) got extension services. On the other hand 8% of participants and 66% of non-participants didn't get the extension services. Extension service here refers to advice, training, demonstration related to crop and horticultural production.

Above results clearly indicate that, access to extension service has the strong relationship with irrigation participation decision making.

Table 4.8: Distribution of access to extension services of household

| Respondents | Participants | | Non-Participants | | Total | |
|-------------------------------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| Access to Extension services | | | | | | |
| No Contact | 4 | 8 | 28 | 56 | 32 | 32 |
| Once / month | 20 | 40 | 15 | 30 | 35 | 35 |
| Twice/month | 15 | 30 | 6 | 12 | 21 | 21 |
| Thrice/month | 11 | 22 | 1 | 2 | 12 | 12 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

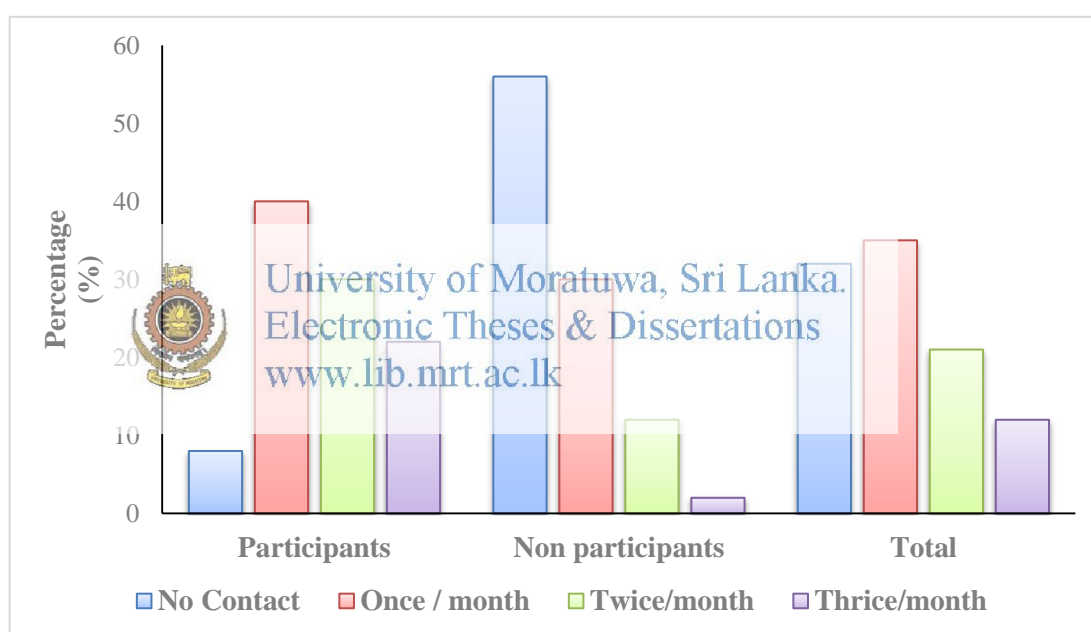


Figure 4.8: Distribution of access to extension services of household

b) Access to credit facility

The survey results indicate in Table 4.9 that 63% of the total sample household utilized credit facilities while 37% of the total sample households did not take credit due to various reasons. The comparison to irrigation participants with non-irrigation participants disclosed that 78% of irrigation participants and 48% of the non-irrigation participants had utilized credit facilities although the access is equal to all households without any difference, while 22% of the irrigation participants and 52% of the non-irrigation participants did not take credit. This implies that irrigation participants had better access to credit compared to non-irrigation participants.

Respondents reported in Table 4.10 about problems revolving around credit were related to many factors. 20% of total sample respondents refrained from credit because of high interest rate, 9% because of its unavailability on time, 8% because of shortage of money for down payment, and 0% of the sample households said that they didn't want credit. The comparison to irrigation participants with non-irrigation participants, 12% irrigation participants and 28% non-irrigation participants had not used the credit facilities because of the high interest rate, 4% irrigation participants and 14% non-irrigation participants failed to get credit facilities because of non-availability on time and finally 6% irrigation participants and 10% non-irrigation participants didn't use the credit facilities because of shortage of money for down payment. This results reveal that, high interest rate is the main reason the farmers refrained to get the credit facilities in both categories.

Table 4.9: Distribution of access to credit facility of household

| Respondents | Participants | | Non-Participants | | Total | |
|------------------------------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| Access to Credit Facilities | | | | | | |
| Yes | 39 | 78 | 24 | 48 | 63 | 63 |
| No | 11 | 22 | 26 | 52 | 37 | 37 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

Table 4.10: Distribution of problems in credit facilities of household

| Respondents | Participants | | Non-Participants | | Total | |
|---------------------------------|--------------|----------------|------------------|----------------|-----------|----------------|
| | Frequency | | Frequency | | Frequency | |
| Problems to Credit facilities | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| High interest rate | 6 | 12 | 14 | 28 | 20 | 20 |
| Not available on time | 2 | 4 | 7 | 14 | 9 | 9 |
| Shortage money for down payment | 3 | 6 | 5 | 10 | 8 | 8 |
| No need | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 11 | 20 | 26 | 52 | 37 | 37 |

4.2.4 Chi-square test results of factors affect the irrigation participation of households



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Table 4.11 shows a summary of Chi-square (χ^2) test results of factors affect the irrigation participation of households, based on the results obtained from previous analysis. Two independent demographical factors namely gender and age were found to be significantly related to the level of participation. Three independent socio-economic variables, namely labour force, access to market and distance to water source were found to be significantly related to the level of participation. Similarly, independent institutional variables, namely, extension contact and access to credit facilities, were found to be significantly related to the level of participation of respondents in irrigation management. The remaining factor, namely, education and size of cultivated land did not have significant relationship with the level of participation of the respondents.

Table 4.11: Chi-square test results

| Factors/ Independent Variables | Chi-Square (χ^2) | P-Value | Level of Significant |
|--------------------------------|-------------------------|---------|----------------------|
| Demographic Factors | | | |
| Gender | 4.51 | 0.033 | Moderate |
| Age | 9.95 | 0.041 | Moderate |
| Socio-Economic Factors | | | |
| Education | 2.36 | 0.501 | Weak |
| Labour Force | 15.27 | 0.001 | Strong |
| Size of cultivated land | 4.87 | 0.432 | Weak |
| Access to market | 16.67 | 0.002 | Moderate |
| Distance to water source | 14.05 | 0.001 | Strong |
| Institutional Factors | | | |
| Extension service | 15.45 | 0.001 | Strong |
| Credit Facilities | 4.82 | 0.028 | Moderate |



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Above results show that Labour force, Extension service and Distance to water source are $P \leq 0.001$ significant level. This information shows those factors have strong significant relationship with irrigation participation.

Age, Gender, Access to market, and Credit facilities are $P \leq 0.05$ significant level. This information shows those factors have moderately significant relationship with irrigation participation.

Size of cultivated land and Education factors failed to show any significant relationship with irrigation participation.

4.3 The level of significant factors which influence in small-scale irrigation participation with income

i) Income level verse Irrigation participants and non-participants

According to results in Table 4.12 and Figure 4.9 show that 8% of total sample respondents had monthly income below Rs.10, 000 monthly, 46% had an income of between Rs.10, 000 - 20,000, 39 % had an income of between Rs.20, 000 - 30,000, 6% had an income between Rs.30, 000 - 40,000 and 1% had an income of between Rs.40, 000 and 50,000. With the comparison of irrigation participants and non-irrigation participants, 6% of the respondents who were participating in irrigation had monthly income below Rs.10, 000 monthly, 36% had an income of between Rs.10, 000 - 20,000 and 46% had an income of between Rs.20, 000 - 30,000 and 10% between Rs.30, 000 - 40,000 and 2% had an income of between Rs.40, 000 - 50,000.

On the other hand, 10% of the respondents who were not participating in irrigation had monthly income below Rs.10,000 monthly, 56% had an income of between Rs.10,000 - 20,000 and 32% had an income of between Rs.20,000 - 30,000 and 2% between Rs.30,000 - 40,000 and 0% had an income of between Rs.40,000 and 50,000.

The findings show further that 58% of the respondents who were participating in irrigation had the income of above Rs.20,000 monthly while only 34% of the respondents who were not participating in irrigation had the income of above Rs. 20,000 monthly. The result clearly explores that the farmers who were participated in irrigation management had improved their income level than the farmers who were not participated in irrigation management.

Table 4.12: Distribution of Income of household

| Respondents | Participants | | Non-Participants | | Total | |
|--------------------|--------------|----------------|------------------|----------------|------------|----------------|
| | No | Percentage (%) | No | Percentage (%) | No | Percentage (%) |
| Income/ month (Rs) | | | | | | |
| 0 - 10,000 | 3 | 6 | 5 | 10 | 8 | 8 |
| 10,000 - 20,000 | 18 | 36 | 28 | 56 | 46 | 46 |
| 20,000 - 30,000 | 23 | 46 | 16 | 32 | 39 | 39 |
| 30,000 - 40,000 | 5 | 10 | 1 | 2 | 6 | 6 |
| 40,000 - 50,000 | 1 | 2 | 0 | 0 | 1 | 1 |
| Total | 50 | 100 | 50 | 100 | 100 | 100 |

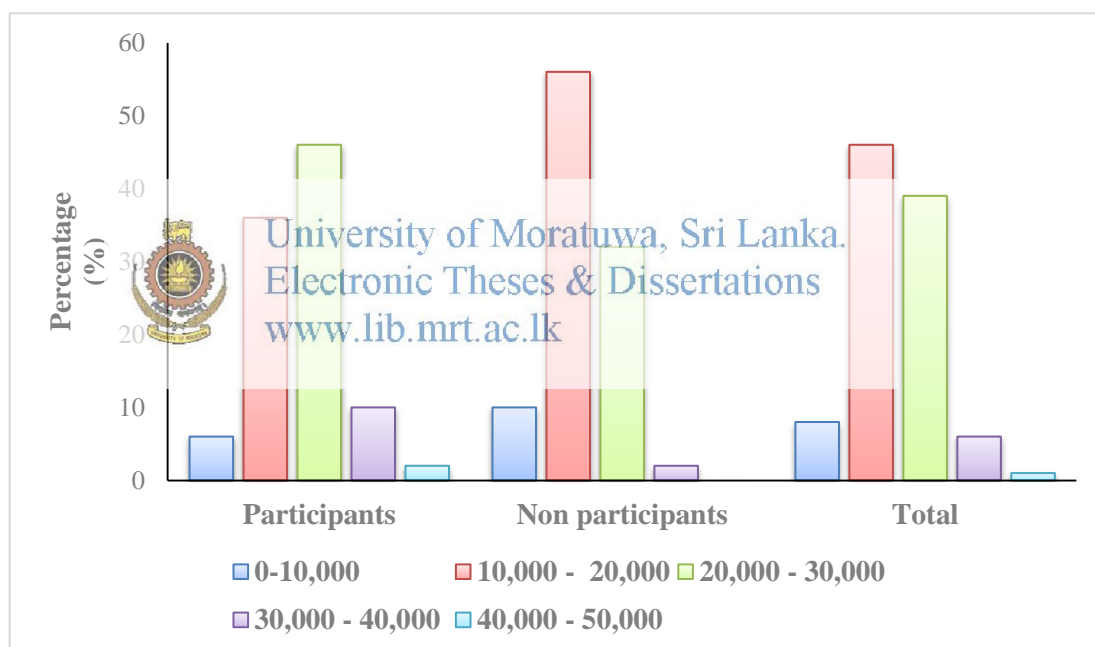


Figure 4.9: Distribution of Income of household

ii) The preference factors of respondents in irrigation participation with income

The respondents were asked to mention the factors that effects the irrigation participation with income. The findings are summarized in Table 4.13. 73% of the respondents cited, Gender as a factor that effects the irrigation participation with income. This is due to female-headed households face shortage of labour and market

information, made them rent or share out their land to the male headed household heads. 68% of participants informed Age as a factor and about 55% of participants reported Education level as a factor influencing irrigation participation with income. About 91% of farmers revealed that labour force is an important factor. The reason was, labour shortage is main problem identified during the study. Farmers were faced labour shortage problem during weeding, harvesting, threshing, watering, and ploughing.

Hence, 53% farmers reported size of cultivated land is an important factor effecting participation irrigation with income. During the study it was identified some farmers rent out their lands due to various reason like lack of machinery, seed shortage, labour shortage and disability. About 65% mentioned access to markets as a dominant factor. Limited transport and storage facilities made access to market a problem. Due to bulk nature of the crops, farmers are obliged to sell their produce at nearby markets mainly at reduced prices.

Further, About 83% farmers reported Distance to water source is a factor influence the participation irrigation with income. When the distance to water source is longer farmers were hesitate get the irrigation from it due to the cost.



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At last, 87% of the participants cited poor extension contact as a factor. Agricultural training is one of the major components of agricultural extension service system, geared at educating and motivating the farmers. The number of extension contacts has a positive influence on farmers' participation to the projects. Farmers who are not visited are more likely to make negative decision against participation in the projects. As mentioned earlier, it was not surprising that extension contact was a good predictor of participation, given the important role being played by extension personnel. Poor access to credit facilities is mentioned as a factor by 70% of the respondents. Credit is an essential instrument for enabling farmers to acquire improved agricultural techniques and thus speeding up the adoption of new technologies.

Table 4.13: Distribution of preference factors of respondents

| Factors | Frequency | Percentage |
|--------------------------|-----------|------------|
| Gender | 73 | 73 |
| Age | 68 | 68 |
| Education | 55 | 55 |
| Labour Force | 91 | 91 |
| Size of cultivated land | 53 | 53 |
| Access to market | 65 | 65 |
| Distance to water source | 83 | 83 |
| Extension service | 87 | 87 |
| Credit Facilities | 70 | 70 |

iii) Likert-scale analysis of factors affect the irrigation participation with income of house holds

Farmers were asked to mention the factors which affect the irrigation participation with income in questionnaire. Based information received from questionnaire, the analysis was done using the technique Likert-scale method. The results of analysis are tabulated in table 4.14.

According to that, the factor extensive services had the strongest relationship verse irrigation participation with income. Ogunbameru et al. (2011) also found the similar results that, number of extension contacts had a positive relationship with irrigation participation and it improves income level.

Next to extension service, distance to water source was found as an influence factor of irrigation participation with income. The studies conducted by Chancellor and Hide (1997), Madusha et al. (2002) further strengthened our result and they found irrigation distance to water source contributed 25-80% of family income. Labour Force is the third order of significant factor according to the results. Related to this results, FAO (1996), Chambers (1988), Lipton et al. (2003) and Hussein and Hanjra (2003) state that irrigation decrease the unemployment and increase the wage rate.

Table 4.14: Likert-scale analysis

| Factor | Strongly Disagree 1 | Disagree 2 | Moderate 3 | Agree 4 | Strongly agree 5 | Relative Importance (RII) | Order of Significance |
|-------------------------------|------------------------|---------------|---------------|------------|---------------------|------------------------------|-----------------------|
| Demographic Factors | | | | | | | |
| Gender | 0 | 8 | 8 | 19 | 65 | 88.2 | 5 |
| Age | 15 | 8 | 7 | 14 | 56 | 77.6 | 7 |
| Socio-Economic Factors | | | | | | | |
| Education | 9 | 5 | 30 | 16 | 40 | 74.6 | 8 |
| Labour Force | 0 | 0 | 2 | 15 | 83 | 96.2 | 3 |
| Size of cultivated land | 15 | 14 | 11 | 18 | 42 | 71.6 | 9 |
| Access nearest to market | 0 | 0 | 10 | 15 | 75 | 93.0 | 4 |
| Distance to water source | 0 | 0 | 0 | 11 | 89 | 97.8 | 2 |
| Institutional Factors | | | | | | | |
| Extension service | 0 | 0 | 0 | 9 | 91 | 98.2 | 1 |
| Credit Facilities | 2 | 13 | 9 | 17 | 59 | 83.6 | 6 |

Then, access to nearest market was identified as the fourth induce factor of participation in irrigation management with income. In connection with, Ogunbameru et al. (2011) found access to market by the respondents influence their participation in irrigation programme and income levels. Gender and credit facilities were found significant factors of order fifth and sixth. Nxumalo and Oladele (2013) reported that gender can be one of the influencing factor in farmers' participation in development programmes. Hence, age was the seventh order of significant factor. In related to that, Mlelwa (2010) found that young people are likely to participate in irrigation than older people.

Finally, education and size of cultivated land were found as very less significance and their order were eighth and ninth. In contrast, Mlelwa (2010) noted that, poor

and less educated people generally less confidence in their ability to improve their lives, people's level of education has a positive relationship to the level of participation. Similarly, Kamara et al. (2001) found that, total cultivated land should have a positive relationship with income of a household.

4.4 Chapter Summary

The demographical, socio-economical and institutional factors identified through literature review were analysed using descriptive statistical analysis technique such as frequency, percentage to check the effects of small- scale irrigation participation. From this analysis the answer of second research objective was obtained. In addition, chi-square test was done to check the reliability of descriptive statistical test results. From this analysis it was found that, Labour force, Extension service and Distance to water source had strong significant relationship with irrigation participation. Further, Age, Gender, Access to market, and Credit facilities had moderately significant relationship with irrigation participation. Size of cultivated land, Education had failed to show the significant relationship with irrigation participation.



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Hence, Income level of irrigation participants and non-irrigation participants analysis, preference factors of respondents and likert-scale analysis were used to get the answer third research objective of determining the level of significant factors which effects in small-scale irrigation participation with income. From these analysis, it was found that irrigation participants' income level is higher than non-irrigation participants and Extension service, Distance to water source, Labour force, Access to market, Gender, Credit facilities, Age, Education, and Size of cultivated land were found in descending order of level significant factors which influence in small-scale irrigation participation with income.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Understanding the factors such as demographic, socio-economic and institutional influencing the households' participation in small-scale irrigation is useful for future policy designs. This study attempted to analyse major demographical, socio-economic and institutional factors influence the participation of farmers in small-scale irrigation and income in Trincomalee district, Sri Lanka. On the basis of the information collected from 100 households and taking into account all the methodological drawbacks of studying the factors of smallholder rural farm households' participation in small-scale irrigation and income, descriptive statistical analysis was carried out and compared with two groups such as irrigation participants and irrigation non-participants with respect to important demographic, socio-economic and institutional variables. Likert-scale analysis also was applied to determine the level of significant of the factors affecting the small-scale irrigation participation with income of farmers' household.



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This chapter completes the documentation of this study by presenting conclusions and recommendations. Therefore, the research objectives are reviewed and conclusions are presented. Recommendation for the future research are also identified. Moreover, this chapter presents the summary of achievement of objectives and conclusions in section 5.2, in section 5.3 limitation of the study, in section 5.4 recommendations are also described and finally section 5.5 offers suggestions for further research.

5.2 Achievement of Objectives and Conclusions

The aim of the research was to analyse the major demographical, socio-economic and institutional factors influence the farmers' participation in small-scale irrigation and income. Corresponding to this aim, three objectives have been formulated.

The first objective was to review the literature, on demographical, socio-economical and institutional factors affecting the farmer's participation in small-scale irrigation

in Trincomalee district Sri Lanka. It was found that, factors of demographic: Gender and Age, Socio-economic: Education, Labour force, Size of cultivated land, Access to market and Distance to water source, Institutional: Extension service and Access to credit facilities were identified as the influence factors of participation in small-scale irrigation.

The second objective was to identify the effects of demographic, socio-economic and institutional factors affecting farmers' participation in small-scale irrigation. It was found that, Labour force, Extension service and Distance to water source were found in chi-square test results that 0.001. This results imply that they have a strong significant relationship with irrigation participation. Age, Gender, Access to market, and Credit facilities were found as 0.041, 0.033, 0.002 and 0.028 respectively. Those factors have the moderately significant relationship with irrigation participation. Size of cultivated land, Education had failed to show the significant relationship with irrigation participation and their chi-square test results were 0.432 and 0.501 respectively. In addition, Labour shortage was one of the problem faced by respondent for weeding, harvesting, threshing, watering, livestock herding and ploughing. 64% of irrigation participants, and 34% non-irrigation participants faced labour shortage problem. Because comparatively irrigation participants cultivate more land and they use irrigation, so they need more labours than non-participants. The respondents who didn't get the credit facilities, they reported because of high interest rate, not available on time and shortage of money for down payment were reasons.

The third objective was to determine the level of significant factors which effects in small-scale irrigation participation with income of household. It was found from income level verse Irrigation participants and non-participants analysis, 58% of the respondents who were participating in irrigation had the income of above Rs.20,000 monthly while only 34% of the respondents who were not participating in irrigation had the income of above Rs. 20,000 monthly. It disclosed that irrigation participants had the higher income level than non-participants. Further, preference factors of respondents and likert-scale analysis revealed that Extension service, Distance to water source, Labour force, Access to market, Gender, Credit facilities, Age, Education, and Size of cultivated land were found in descending order of level

significant factors which influence in small-scale irrigation participation with income.

5.3 Limitation of the study

This study is limited to small- scale irrigation participation of farmers. Small-scale irrigation is, usually on small land plots where farmers have the majority controlling influence, using a level of technology which they can operate and maintain the scheme effectively. According to the Sri Lankan situation, the cultivatable area of small-scale irrigation is less than 200 acres. This system comes under the purview of the Department of Agrarian Services. Other than the small- scale irrigation, large-scale irrigation also available and its cultivatable area is more than 200 acres. The cultivation lands comes under major and minor irrigation tanks are in this category. The central irrigation department and provincial irrigation department are the organizations responsible to manage this large-scale irrigation schemes.

5.4 Recommendations

Based on the findings what we have got in the analysis part the following policy recommendation remarks can be drawn for further consideration and improvement of irrigation development and income in the district Trincomalee, Sri Lanka.

The study revealed that participation in small-scale irrigation increases household income, there are no sufficient sources of water even for those who take part in irrigation. Therefore, the government has to incentivize farmers to undergo water conservation practices and in addition to surface water the water board, has to also dig underground water for small-scale irrigation is likely to be valuable for future irrigation development.

Extension service is a corner stone of agricultural practices in general particularly for irrigation development. Access to extension services was positively and very significantly related to both farm households' participation in small-scale irrigation and income. We recommend Agricultural faculties around Sri Lankan Universities and colleges to train quality development agents especially irrigation experts in adequate number to the rural areas would increase the contact and flow of information between the Agriculture Inspector and farm households to increase their

participation in small-scale irrigation, thereby enhance the production and productivity of the rural sector.

The gender difference of household heads in irrigation participation and income indicated female-headed households face shortage of labor and market information, made them rent or share out their land to the male headed household heads. As a result the likelihood of participation and income of female headed household heads are less than the male headed household heads. Therefore, the government has to find out ways to increase their probability of participation and enhance their income. For instance, ensuring property ownership (e.g. motor pump) to female-headed households and provide subsidized credits are some mechanism of increasing female-headed household's participation in small-scale irrigation and enhance their income level.

Furthermore earning from irrigation are affected by the marketing channel, in part because the main irrigated crops are harvested at similar times by farmers and are perishable. Since there is quality deterioration of their products due to lack of efficient storage and post-harvest processing mechanisms, farmers sell their products by cheap prices during harvest period. Therefore, an effective marketing system will facilitate irrigation participation. Hence, the concerned bodies like governmental extension services, farmers' cooperatives and non-governmental market organizations should support the further development of the efficient marketing systems in the study area. This may include provision of marketing facilities and information provision. In addition to this the government should establish irrigation co-operative and integrate to market is crucial in order to the farmers get reasonable price for their produce.



5.5 Further Research

Following could be given as suggestions for future research.

- a) This study can be further progressed to analyse large-scale irrigation participation of farmers in Trincomalee district. The government of Sri Lanka allocating sufficient funds to maintain the vast amount of irrigation structures in the country. Under the present financial crisis in the country, it is highly unlikely to invest such a huge allocation for operation and maintenance of irrigation structures.
- b) This study focused on only the factors affecting irrigation participation in small-scale irrigation. The cost and benefits of farmers engaging in irrigation participation was not included in this study. Therefore, this study further extended to find the cost and benefits of farmers while they are involving in irrigation participation. This results really motivate the other farmers who are not participating in irrigation management.
- c) This study can be extended for further investigation on productivity variation among the farmers. Irrigation participants and non-irrigation participants. This result will helpful to the government to invest further on irrigation related development activities in future.



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REFERENCE

- ARTI, (1991). *The Integrated Management of Major Irrigation Schemes*. An Assessment. Research
- Asfaw, D. (2007). *Scaling up Agricultural Water Development in Africa, the Case of Ethiopia*. Minister of Water Resources, Federal Republic of Ethiopia
Australian Journal of Agricultural and Resource Economics, 49, 159–175.
- Awulachew, S.B., Merrey, D.J., Kamara, A. B., Van Koopen, B., De Vries, F., Penning and Boelle, E. (2005). *Experiences and Opportunities for Promoting Small- Scale/Micro Irrigation and Rainwater Harvesting for Food Security in Ethiopia*. IWMI Working Paper 98, 2005.
- Bagadion, B.U. & Korten, F.F. (1991). *Developing irrigators' organizations: a learning process approach*. In: M.M. Cernea (Ed) *Putting People First: Sociological Variables in Rural Development*, 2nd edition (pp 73–112). World Bank, Washington, DC.
- Conference on Environment and Development. Joahannesburg Summit, 26th Aug04th Sep, Agenda 21, ch. 14- 18.
- Department of Census and Statistics, Colombo, Sri Lanka, 1993-2003. *Paddy average yield and production*. Electronic publications and database on the website <http://www.statistics.gov.lk/agriculture/index.htm>.
- Dessalegn Rahmato, (1999). *Water Resources Development in Ethiopia: Issues of Sustainability and Participation*. Discussion paper No 1. Forum for Social Studies. Addis Ababa, Ethiopia.
- Dhanapala, M.P., (2000). *Bridging the rice yield gap in Sri Lanka*. Food and Agriculture Organization of the United Nations. Regional office for Asia and the Pacific, RAP Publication 2000/16.
- Elahi, A., (1988). *Irrigation Development in Sub-Saharan Africa: Future Prospects*. In: Guyle M.etal (eds.), *Developing and Improving Irrigation and Drainage systems*. The World Bank.
- FAO, (1997). *Assessment of the Socio-Economic Impact of Smallholder Irrigation on Smallholder Farmers in Zimbabwe*. FAO Sub-Regional Office for East and Southern Africa (SAFR), Harare.
- FAO, (2000). *Socio- Economic Impact of Smallholder irrigation Development in Zimbabwe*. FAOSub-Regional Office for East and Southern Africa, Harare.

- FAO RAP, (2004). *Selected indicators of food and agriculture development in Asia Pacific region*. Food and Agriculture Organization of the United Nations, Regional office for Asia and the Pacific, RAP Publication 2004/20, pp.3-23.
- Forsyth & Timothy, (2002). *Science, myth, and knowledge: Testing Himalayan degradation in Thailand*. *Geoforum* 27(3): 375-392.
- Fuad Adem, (2001). *Small-Scale Irrigation and Household Food Security: A Case Study from Central Ethiopia*. Discussion Paper No 4. Forum for Social Studies. Addis Ababa.
- Geertz & Clifford, (1980). *Organization of the Balinese Subak*. In *Irrigation and agricultural development in Asia*. Perspectives from the social sciences, ed. Coward, E. Walter Jr., pp. 70-90. Ithaca, NY: Cornell University Press.
- Goldsmith & Edward, (1998). Learning to live with nature: The lessons of traditional irrigation. *The Ecologist* 28(3).
- Gunaratne, W., & Madduma Bandara, C.M., (1989). *Management of village irrigation in the dry zone of Sri Lanka*: unpublished paper.
- Haile, T., (2008). *Impact of irrigation development on poverty reduction in Northern Ethiopia*. PhD thesis, National University of Ireland, Cork.
- IFAD, (1985). *Ethiopian Small-Scale Irrigation*. Main Report. Volume 1,3, Addis Ababa, Ethiopia.
- IIMI, (1990). *Resource mobilization for management proceedings of the workshop on major irrigation schemes*. International Irrigation Management Institute, Colombo, Sri Lanka.
- Lansing, J. S., (1991). *Priests and programmers: Technologies of power in the engineered landscape of Bali*. Princeton, NJ: Princeton University Publishers.
- Leach & Edmund Ronald, (1961). *Pul Eliya, a village in Ceylon: A study of land tenure and kinship*. Cambridge: Cambridge University Press.
- Lewis & Henry T., (1971). *Ilocano farmers: A comparative study of two Philippine barrios*. Honolulu: University of Hawaii Press.
- Masubichi, Tatsuo & Circa, (1970). *Wittfogel's theory of oriental society and the development of studies of Chinese social and economic history in Japan*. The Developing Economies.

- Maurer & Jean-Luc, (1990). *Irrigation, rice culture at gestation de leau en Indonesia: landmodernization des traditions agro hydraulics Java et Bali*. Revue de Geography de Lyon, 65(1), pp. 27-37.
- NIACONSULT, (1993). *An Evaluation of the Impact of Farmers' Participation on Bank, the National Irrigation System's performance*. Report commissioned by the participants learning group, Social Development Department, World Washington, D.C, processed.
- Ostrom & Elinor, (1992). *Crafting institutions for self-governing irrigation systems*. San Francisco, CA: Institute for Contemporary Studies.
- Ostrom, Elinor, (1994). *Neither market nor state: Governance of common-pool resources in the twenty-first century*. IFPRI lecture series. Washington, D.C. International Food Policy Research Institute Perspective. Journal of International Development Vol. 3. No 4 July institute, Washington. project in India.
- SCF(UK), (1999). *The North Wollo East Plain Food Economy Zone*. Baseline Report. AddisSing. V. And Misra. N. (1960), Cost Benefit Analysis: A case study of the Sarda canal irrigation.
- Sivayoganathan. C., Devarajah. K., & Robuchon.G., (2003). *Impact Assessment of the Minor Tank Development Programme. Integrated Food Security Project, Trincomalee*.
 University of Moratuwa, Sri Lanka.
 Electronic Theses & Dissertations
www.lib.mut.ac.lk
- Siy & Robert M., (1982). *Community resource management: Lessons from the Zanjera*. Quezon City: University of the Philippines Press.
- Stargardt & Janice, (1986). *Hydraulic works and Southeast Asia politics*. In Southeast Asia in the 9th and 14th centuries, eds. David G. Marr and A. C. Milner, pp. 23-39. Singapore: Institute of Southeast Asian Studies.
- Starkloff, R., (1998). *Water scarcity in Kitulwatte: The social causes and consequences of environmental degradation in a highland Uva village of Sri Lanka*. World Development 26(6): 913-932.
- Steward, Julian H., Robert M., Adams, Donald Collier, Angel Palerm, Karl A., Wittfogel and Ralph L., (1955). *Irrigation civilizations: A comparative study*. Social Science Monographs. Washington, D.C.: Pan American Union.
- Stott & Philip, (1992). *Angkor: Shifting the hydraulic paradigm*. In *The gift of water: Water management, cosmology and the state in Southeast Asia*, ed. Jonathan Rigg, pp. 47-58. London: School of Oriental and African Studies.

- Svendsen M., & Rosegrant M.W., (1994). *Irrigation development in Southeast Asia beyond 2000*: Tang, Shui Yan. 1992. Institutions and collective action: Self-governance in irrigation. San Francisco, CA: Institute for Contemporary Studies Press.
- Tan-Kim-Yong & Uraivan, (1995). *Muang-fai communities are for people: Institutional strength and potential*. Bangkok: Chulalongkorn University Social Research Institute.
- Ulluwishewa R., (1991). *Soil fertility management of paddy fields by traditional farmers in the dry zone of Sri Lanka*. Journal of Sustainable Agriculture. Haworth Press Inc. Vol. 1(3).
- Ulluwishewa R., (1995), *Traditional practices of inland fishery resources Management in the Dry Zone of Sri Lanka: implications for sustainability*. Environmental conservation. 22. 2. 127-132.
- UNCED, (2002). *Conservation and management of resources for development*. United Nations.
- UNDP, (2007). *Globalization, Agriculture and the Least Developed Countries* [Internet]. Issues Paper, Istanbul. 9-11 July 2007. Available from: <http://www.unohrrls.org>.
- Vaishnav T. (1994). *Increasing Food Production in Sub-Saharan Africa through Farmer-Managed Small-Scale Irrigation Development*. Ambo 23: 524-64.  www.lib.mrt.ac.lk **University of Moratuwa, Sri Lanka**
Electronic Theses & Dissertations
- Walker, A., (2003). *Agricultural transformations and the politics of hydrology in northern Thailand*. Development and Change 34(5): 941-964. Washington. D.C.
- Webb. P., (1991). *When Projects Collapse, Irrigation Failure in the Gambia from Household*.
- Wijesuriya, (1997). Irrigation Resources. In 'Arunja's Atlas of Sri Lanka'. (Perera E.A ed).
- Wijeyewardene & Gehan, (1971). *Hydraulic society in contemporary Thailand*. Canberra: Australian National University.
- Wittfogel, Karl A., (1957). *Oriental despotism: A comparative study of total power*. New Haven and London: Yale University Press.
- Yoder, Robert, Edward D., Martin, Randolph Barker, & Tammo S., (1987). *Variations in irrigation management intensity: Farmer-managed hill irrigation systems in Nepal*. Paper prepared at Cornell University, Ithaca, NY for the Water Management Synthesis II Project. WMS Report 67.

Appendix-A: Sample Questionnaire

Survey Questionnaire

The questionnaire is prepared to undertake a study “to analyse major demographical, socio-economic and institutional factors influence the participation of farmers in small-scale irrigation and income”. Dear respondents, the result of this study will help different stakeholders and policy makers to make appropriate measures on irrigation development in the future. Your responses are confidential. Therefore, you are kindly requested to provide genuine responses. Thank you for your time and cooperation.

1.0 Background Information

1.1 Name of Division _____

1.2 Household head name (Optional): _____

1.3 Category of the household

Irrigation user non-user

2.0 Household Demographical characteristics

2.1 Gender of the household head

Male Female

2.2 Age of the household head

18-28 29-39 40-50 51-61 62-72

3.0. Household Socio-economic characteristics

3.1 Education level of the household head

Illiterate Elementary (grade 1-6) complete

Junior (grade 7&8) complete High school and above (grade 9 and above)

3.2 Age and sex of all household members of Family Labour Force

Total Number of household member's _____

| Member No | Name (Optional) | Gender 1. Male 2. Female | Age |
|-----------|-----------------|--------------------------------|-----|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

3.2.1 Do you face labour shortage?

Yes No

3.3 The number of cultivable area in acres

- 0-2 3-5 6-8 9-11 12-14 15-17

3.4 Distance from the nearest market place from your cultivable land in km

- 0-2 3-5 6-8 9-11 12-14

3.5 Distance between the sources of water to your irrigated land in km

- 0-2 3-5 6-8

4.0 Household Institutional Characteristic

4.1 Do you receive any sort of extension services available in your locality?

- Yes No

4.1.1 How often do you get assistance from extension officers per month?

- Once Twice Thrice

4.2 Did you receive credit facilities for your agricultural production?

- Yes No



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4.2.1 If 'yes' what are the sources?

- | | |
|--|--|
| <input type="checkbox"/> Banks | <input type="checkbox"/> Friends/relatives |
| <input type="checkbox"/> Traders | <input type="checkbox"/> Micro finance |
| <input type="checkbox"/> Local lenders | <input type="checkbox"/> Others |

4.2.2 If 'no' what are the reasons?

- | | |
|---|---|
| <input type="checkbox"/> High interest rate | <input type="checkbox"/> Not available on time |
| <input type="checkbox"/> No need | <input type="checkbox"/> Shortage of money for down payment |
| <input type="checkbox"/> Other | |

5.0 Factors affecting small-scale irrigation participation with income

5.1 Please indicate the monthly income from agriculture

- 0-10,000 10,000-20,000 20,000-30,000 30,000-40,000
 40,000-50,000

5.2 Do you agree that the following factors effects irrigation participation with income?

- | | | |
|--------------------------|------------------------------|-----------------------------|
| Gender | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Age | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Education | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Labour Force | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Size of cultivated land | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Access to market | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Distance to water source | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Extension service | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Credit Facilities | <input type="checkbox"/> Yes | <input type="checkbox"/> |

5.3 If yes, Please indicate the level of significant of the factors, those affects the irrigation participation and income.

- | | Low | | | | | High |
|--------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|------|
| Gender | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Age | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Education | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Labour Force | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Size of cultivated land | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Access to market | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Distance to water source | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Extension Services | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |
| Credit Facilities | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 | |



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Appendix-B: Conversion factors used estimate man equivalent

| Years of age | Men | Women |
|---------------------|------------|--------------|
| 0-1 | 0.33 | 0.33 |
| 1-2 | 0.46 | 0.46 |
| 2-3 | 0.54 | 0.54 |
| 3-5 | 0.62 | 0.62 |
| 5-7 | 0.74 | 0.70 |
| 7-10 | 0.84 | 0.72 |
| 10-12 | 0.88 | 0.78 |
| 12-14 | 0.96 | 0.84 |
| 14-16 | 1.06 | 0.86 |
| 16-18 | 1.14 | 0.86 |
| 18-30 | 1.04 | 0.80 |
| 30-60 | 1.00 | 0.82 |
| 60plus | 0.84 | 0.74 |

Source: Haile (2008)