# EVALUATION OF SOLAR POWERED DRIP IRRIGATION PROJECT - PHASE 2

**Implemented by Sustainable Agriculture Water Management Project under the Ministry of Agriculture**

**M.A.C.S. Bandara**
**M.T. Padmajani**



HARTI

# Evaluation of Solar Powered Drip Irrigation Project-Phase 2

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**M.T. Padmajani**

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**Hector Kobbekaduwa Agrarian Research and Training Institute**
**114, Wijerama Mawatha**
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# FOREWORD

Majority of the Micro Irrigation (MI) technologies dissemination had been implemented by either government institutions or non governmental institutions through subsidies/grants. Initiation of the MI technology can be traced back to 1980s and presently many institutions are involved in popularizing the MI technology. MI technology can be mainly categorized as sprinkler and drip but many steps have been taken to popularize mainly the drip technology especially in rural water scare areas in the country by the Sri Lankan government.

In the year 2004, the Ministry of Agriculture initiated promoting the micro irrigation technology through a subsidized programme called Sustainable Agriculture Water Management Project (SAWMP) to strengthen the government policy of introducing of new technologies to promote rural agriculture sector. The SPDI technology is a newly introduced technology coupled with the renewable energy as a remedy for energy shortage in rural poor farmers.

The present study has been conducted to study the evaluation of Solar Powered Drip Irrigation (SPDI) Project-Phase 2 of the project implemented by the Ministry of Agriculture. The evaluation was mainly focused on implementing approach and performance of SPDI kits with the modification incorporated in the phase 2 of the project. However, impacts and lesions learnt from the evaluation study are more important to plan and design future promotion of similar technology innovations.

In the Sri Lankan context, much attention is needed for water use efficiency in the water scare areas especially in the dry zone part of the county. So, SPDI is one of the best options I can see at the moment for the development of rural small holding agriculture sector. According to the *Mahinda Chintana* (Government's Development Policy) the vision for the future states that, "irrigation services are needed to be equipped with modern water management techniques to improve the water usage efficiency". In this background I am confident that this evaluation study will guide the policy makers and project implementers for similar projects implementations in an equitable and sustainable manner.

**E.M. Abhayaratne**

**Director**

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**M.A.C.S. Bandara**
**M.T. Padmajani**

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# ABSTRACT

As per *Mahinda Chintana* (Government's Development Policy) policy document the Government of Sri Lanka continued the promotion of micro irrigation technology under the Sustainable Agriculture Water Management Project (SAWMP) operated under the Ministry of Agriculture since 2004. The objective of the project was to uplift the living conditions especially of the dry zone marginal farmers through providing the modern water application technology called Solar Powered Drip Irrigation (SPDI). The second phase of this project was implemented in 2011 distributing 5000 SPDI kits among farmers under a loan scheme repayable within a period up to ten years, by paying more attention to the Northern and Eastern provinces, using a different approach compared to the one adopted in the phase 1. The major objective of this study is to evaluate the efficacy of providing solar powered drip irrigation kits and their impacts with changes done in the phase 2.

The SPDI phase 2 was implemented in seventeen dry zone districts. However, for this study only seven districts (Ampara, Badulla, Jaffna, Kurunegala, Matale, Mullaitivu, and Polonnaruwa) were selected by considering the availability of large number of beneficiaries. Total sample size was 368 beneficiaries. Multiple methods were adopted to gather necessary information and data for the study namely; key informant interviews, focus group discussions, and questionnaire survey. Field surveys were carried out in between June to September, 2012.

According to the findings only 14 percent of the beneficiaries had used the complete set of SPDI and majority of beneficiaries (53%) had used the SPDI without drip containing laterals. More than 35 % said that income had increased due to decrease of cost of production. Especially in the Kurunegala district, shifting from subsistence agriculture to water intensive high-value cash crops such as papaw, tomatoes, and banana were observed. The responsibilities of the stakeholders were not met with set criterion of the agreement signed. Many shortfalls could be observed in promotion, selecting beneficiaries, implementation, operation and maintenance, after sales services and the re-payment of the loan. Only about 11% of the beneficiaries had paid any instalment after the down payment, but nobody was making regular payment of instalments. The main reasons for the non-payment of the instalment were; non-payment of instalments by other farmers (55%), failure to generate sufficient income (27%), and expectation of loan write off from government as the government did for agricultural credits in the past (28%).

Beneficiary selection had not been properly done with the set criteria in this project. It is a vital factor for the success of the project and therefore in future interventions it is strongly recommended to pay more attention and to strengthen the beneficiary selection procedure. Strong monitoring and evaluation process is essential to guide all the stakeholders to fulfill their duties and responsibilities to achieve the project goals. Modifications in the second phase had no significant impact on the use of SPDI and the collection of loan repayments. Therefore, it is recommended that authority of installment collection be given to grass root level government officers with an incentive payment to encourage efficient loan installment collection.

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# ABBREVIATIONS

| | | |
|---|---|---|
| ADC | - | Agrarian Development Centers |
| AI | - | Agricultural Instructor |
| ARPA | - | Agricultural Research and Production Assistant |
| DCOs | - | District Coordinating Officers |
| DOA | - | Department of Agriculture |
| DOs | - | Divisional Officers |
| EWRM | - | Environmental and Water Resources Management |
| GN | - | Grama Niladhari |
| MI | - | Micro Irrigation |
| MPPT | - | Maximum Power Point Tracker |
| O&M | - | Operation and Maintenance |
| SAWMP | - | Sustainable Agriculture Water Management Project |
| SDO | - | Samurdhi Development Officer |
| SPDI | - | Solar Powered Drip Irrigation |

# CHAPTER ONE

# Introduction

## 1.1 Introduction

The dry zone covers nearly 2/3 of the Sri Lankan land area. It receives less than 1000 mm average annual rainfall. Traditionally, the farmers in the dry zone have relied more on surface water to satisfy both domestic and irrigation demands. Farming is one of the best livelihood options and might be the only option available. But water is a critical input for agriculture. Without sufficient irrigation water, it is not possible to get a good harvest and common drought incidences lead to precarious harvests.

With the low or scarce water situation, water use for agriculture should be more efficient and novel technologies like micro irrigation need to be used. However, Micro Irrigation (MI) technologies are comparatively expensive and poor farmers cannot invest a large amount of money for this kind of technology. Therefore to initiate and popularize micro-irrigation technology among the resource poor farmers, it is essential to introduce subsidy programmes or credit schemes.

## 1.2 Background of the study

In the past, large scale irrigation schemes fulfilled the water requirements in crop production in the dry zone as well as in the country. However, recently due to the current climatic conditions and the climate change scenarios most of the large-scale irrigation schemes have not met the ambitious targets identified at their inception.

In an effort to address the issue of scarcity of water, interest has been growing in the recent years to develop alternative water management practices that will improve productivity and livelihood of small-scale farmers. It is in this context that global initiatives as well as country perspective have been developed for small- holder irrigation. Sustainable Agriculture Water Management Project is one of the initiatives started by the Ministry of Agriculture to address water related issues. The government of Sri Lanka and several other organizations promoted the MI technologies in the past few decades. Significant efforts have been made and large sums of money through subsidy or loan schemes or as donations were invested to introduce and popularize MI technology among the rural farmers of the country.

Marginal subsistence farmers who possess small land holdings face many problems during cultivation. Adequacy, timeliness and reliability of water are the most pressing issues they face. Sometimes even if water is available, they require energy for lifting. Energy is quite expensive to the rural marginal farmers. Increasing fuel prices and depletion of fossil fuel reserves pose question marks on the reliability of fuel operated water pumping systems. Less availability of grid electricity to the farmer fields turn them to use fuel pumps to lift water to fields.

Further, the shortfall of electricity in Sri Lanka and the decreasing capacity of current water storage in reservoirs are also reasons which force to look for alternative conventional water pumping options. Providing drip system with solar powered pump is a good solution to the rural poor farmers to overcome those barriers. In the Solar Powered Drip Irrigation (SPDI) kits, solar energy is the source of electrical power for the system, bringing advantages of very low operating costs, high reliability and sustainability for operation in isolated communities.

*MahindaChintana* (Government's Development Policy) the vision for the future intended to introduce (*Mahinda Chintana*-2005, p43., *Mahinda Chintana*-2010, pp 81-82) multiple irrigation services and to further expand irrigation facilities while rehabilitating the existing schemes. It further states that, irrigation services will be improved with modern water management techniques improving water usage efficiency to improve agriculture activities during the water scare periods.

Therefore, in the year 2004, the Ministry of Agriculture initiated promoting the micro irrigation technology through a subsidized programme called Sustainable Agriculture Water Management Project (SAWMP). Through SAWMP nearly 5000 SPDI kits had been distributed in most of the drier parts of the county except in the Northern and Eastern provinces as a first phase of the micro irrigation technology dissemination. The second phase of the project introduced 5000 SPDI kits by giving more attention to the Northern and Eastern provinces on a different approach. The SAWMP includes mainly three stakeholders; namely Ministry of Agriculture as an implementing body, BP Solar (PVT) Ltd of Australia as a technology disseminator and the beneficiary community of the project. Each stakeholder is bound to fulfill his/its responsibilities and activities for successful implementation of the project as mentioned in the project agreement.

## 1.3 Sustainable agriculture water management project (SAWMP)

The project is intended to accomplish specific objectives for a certain target farmer group, that is, for popularization of solar powered drip irrigation technology for efficient and sustainable management of water, soil and plant nutrients in water deficit areas (Dry zone and Intermediate zone) while, raising farms' income and improving the lives of rural farmer families living in specially, the dry zones of Sri Lanka (SAWMP, 2011).

Initially, the project was designed to distribute 10,000 SPDI kits as the first and second phases of project, each phase distributing 5000 units. One unit of SPDI kit was priced at 3221 US dollars and SPDI systems were provided to farmers under a loan scheme repayable within a period up to ten years. This project was implemented under a loan scheme provided by the Australian government. The Australian government contributed 32.2 million US dollars for two phases of SPDI project (SWAMP, 2007). During the phase 1 of the SWAMP 5000 SPDI kits were distributed throughout the dry zone except the Northern Provincial districts and Batticoloa. The Phase II of the project supplied another 5,000 units, expanding coverage to 17 dry and intermediate zone districts including the districts in the North and the East.

### 1.3.1 Project area

The Ministry of Agriculture had launched the Sustainable Agriculture Water Management Project (SAWMP), first of its kind in the country in December 2004 and in January 2008 as the second phase (Table 1.1).

**Table 1.1: Distribution of SPDI kits during phase 1 and phase 2 as at 21.12.2010**

| No. | District | No of units | |
|---|---|---|---|
| | | Phase I | Phase II |
| 1 | Ampara | 352 | 536 |
| 2 | Anuradhapura | 1082 | 209 |
| 3 | Badulla | 124 | 96 |
| 4 | Batticaloa | 0 | 409 |
| 5 | Hambantota | 940 | 150 |
| 6 | Jaffna | 0 | 1080 |
| 7 | Kilinochchi | 0 | 161 |
| 8 | Kurunegala | 1228 | 563 |
| 9 | Mannar | 01 | 05 |
| 10 | Matale | 624 | 114 |
| 11 | Moneragala | 388 | 636 |
| 12 | Mulative | 0 | 156 |
| 13 | Polonnaruwa | 250 | 280 |
| 14 | Puttalam | 73 | 37 |
| 15 | Ratnapura | 15 | 05 |
| 16 | Trincomalee | 04 | 317 |
| 17 | Vaunia | 0 | 246 |
| Total | | 5100* | 5000 |

Phase I and Phase II as at 21.12.2010
*Including free systems (100)

### 1.3.2 Uniqueness of SAWMP

In order to ensure the implementation of its project on sound principles, the following project design were made in the program.

- There were three stakeholders, mainly SAWMP, BP solar and beneficiary farmers.
- 10,000 SPDI kits were distributed among 11 and 17 districts in phase 1 and 2 respectively.
- Target beneficiaries were the resource poor marginal farmers in the dry zone.
- Supply of SPDI kits was done by the Australian Company called BP Solar through its local agent, Solar Solutions (Pvt) Ltd.
- Systems were provided through low-interest loans expected to be recovered in ten years.
- One unit was worth of Rs.308,815 in the first phase and Rs.350, 000 in the second phase.
- SPDI kits were covered by three year comprehensive warranty

- Agriculture extension, seed and planting materials and forward trade agreements were planned to provide by the SAWMP/ Min. Agriculture.
- Training, capacity building, monitoring and evaluation were conducted among farmers and relevant officials by the SAWMP/ Min. Agriculture.

### 1.3.3 Introduction to solar powered drip irrigation kit

The Kit comprised of six major parts;

1. **Solar Panel:** This traps the solar energy and converts into electrical power to run the water pump. Photovoltaic systems were especially designed to supply water and irrigation in areas where there is no grid electricity supply. The main advantages of solar powered pumps are; practically zero maintenance, long useful life, non requirement of fuel, and finally simple installation.
2. **The Water Pump:** This operates with the electric power transmitted by the solar panel. It pumps maximum amount of water during the day.
3. **Maximum Power Point Tracker (MPPT):** MPPT adjusts the voltage on the solar array to maximize power generation and reduces voltage to suit the demands of the DC motor. It is programmed to control the pressure in the drip irrigation pipes and filter system.
4. **Filter:** includes 130 micron discs. It is installed between the water pump and main pipeline to filter the water directly pumped from the well before distribution through lateral pipelines.
5. **Fertilizer Injection System:** A small fertilizer tank is used for fertilizing the crop during irrigation. This tank is installed at the pump and filters assembly and is mounted beside the pump support frame. Fertilizer is added into the tank while the water pump is on.
6. **Drip System:** Drippers are placed at 30cm intervals in 1200m long lateral pipe line and contained 4000 drip points per kit.

## 1.4 Responsibilities of stakeholders

There are three main stakeholders. They are Sustainable Agriculture Water Management Project under the Ministry of Agriculture, BP Solar Company and Beneficiary farmers.

### 1.4.1 Sustainable agriculture water management project (SAWMP)

In the project proposal, the Ministry has agreed to conduct awareness programmes among farmers and all relevant officers in the field with the support of partner organizations about SPDI kits. Another task was selection of beneficiary farmers according to the set project criteria. This was mainly done through ARPA's in the agrarian service centers during the phase 1 but, during the phase 2, the project beneficiary selection was done mainly by District Coordinators appointed by the Ministry. The ARPA's had to attend this work while fulfilling his/her 58 duties assigned by the Agrarian Development Act (Lurdu, 2009). As too many duties had to be conducted by the ARPA's the beneficiary selections were not up to the set criteria the project wanted.

In relation to the drip technology, ensuring the supply of quality seeds and planting materials and other necessary inputs were also responsibilities of the SAWMP through line departments and institutes. Finally, the SWAMP needed to make assured mechanism to sell their produce by making forward trade agreements with markets to ensure a good price of their products and monitor the progress of the project at the field level to fine-tune the implementation mechanism and to realize the other issues related to technology, management etc.

### 1.4.2 BP solar company

The following responsibilities had to be fulfilled by the BP Solar Company. After fulfilling the requirements of selection, beneficiaries have to make a formal request to the implementing agency asking for a system. Thereafter, BP Solar technical person should visit his/her farm land and should assess the suitability of the given land for installation of the SPDI kit.

System installation, instruction of operation and maintenance are sole responsibilities of the BP Solar Company. Operation and maintenance manual had to be in the native languages and included in the installation package. During the three year of comprehensive warranty, all maintenance activities had to be carried out by the company free of charge. For that, local service centers had to be readily available with trained staff in all project sites. Further, they had to be located in easily accessible areas for the beneficiary farmers who needed support. Company needed to ensure proper maintenance supports and availability of spare parts in the locally setup service centers. Training programmes had to be carried out to train the local support staff (ARPAs', AIs') related to the technical matters of O&M activities of the system to enhance crop production.

### 1.4.3 Beneficiary farmer

Farmers are the most important stakeholders in the project. They got the SPDI kit under a loan scheme provided by the Ministry of Agriculture. They had to sign agreements with the Ministry of Agriculture for repayment of the subsidy received for the SPDI unit. Beneficiaries had to maintain the system properly to get the maximum use of it. Selected beneficiaries are scattered all over the districts.

### 1.4.4 Project implementation (SPDI phase 2)

Beneficiaries were selected according to the set criteria as follows,

a) Full time farmer resident in the dry zone
b) Resident in target area but with no access to grid electricity
c) Owns over 0.5 acres of land
d) Own an agro well able to provide 6000-7000 liters of water per day

Those were the pre conditions for selecting the subsidiary of SPDI kit. However, during the phase 1 of this project the above criteria were applied but selection was not according to the set criteria. There were no proper mechanisms established during the

beginning of the phase1. Implementation of the SPDI phase 2 had introduced different procedures in addition to the phase 1 set criteria.

Modification done in the phase 2 as follows:

a) District coordinators were newly appointed
b) Farmer selection criteria was further strengthened
c) Initial payment/down payment for SPDI units had increased
d) More SPDI kits were dispersed through Samurdhi Bank
e) Priority was given to the new locations/areas

The selection was mainly done by district coordinators appointed by the ministry of Agriculture. But in the phase 1 this was a duty of the ARPA's. Other than the beneficiary selection, location suitability, feasibility study on water source of the beneficiary, were also done by them. After selecting the beneficiaries, agreements were signed between the selected beneficiaries and the Ministry of Agriculture. Before signing the agreement, initial installment had to be deposited in the Govijana bank or Samurdhi bank relevant to the corresponding authority.

Process of system installation was as follows;

- Farmers were expected to make requests to the ADC or Samurdhi bank and they had to open bank accounts.
- Eligible farmer had to pays Rs.10, 000/= as a down payment for the Kit at the Samurdhi Bank/Govijana Bank in the phase 2 (total value of a Kit was Rs.350, 000/=). Beneficiary farmer had to sign an agreement with the Ministry of Agriculture agreeing repayment of the total cost of the kit within 10 years in 120 monthly installments.
- Technical staff of the BP Solar had to install the kit and instruct farmers on maintenance and operation of the system.
- After 6 months of installation, farmers needed to start the re-payment in monthly installments (however, phase 1 of this project, After 01 year grace period, re-payments had to be done biannually) to Samurdhi Bank/ Govijana Bank.
- All maintenance activities had to be done during the warranty period by the BP Solar Company. The warranty could be claimed for the solar panel within 25 years after installation

### 1.4.5 Mode of re-payment

There were two institutions for the recovery of the cost of the system by the farmers. Those were ADC and Samurdhi Banks. If a farmer wished to get the drip system through the Samurdhi bank, after the recommendation of feasibility, they had to apply for a loan of Rs. 350, 000. Initial deposit of the Samurdhi beneficiary was Rs.5000 and for others Rs.10 000. The ADC beneficiaries had to deposit Rs.10, 000 in the ADC. At the time of awareness creation relevant officials of the Ministry of Agriculture had to inform all farmers regarding the total cost of the system and repayment plan. If a beneficiary farmer failed to pay the installments regularly, the line agency officers had the authority to withdraw the system.

## 1.5 Solar powered drip irrigation project phase 1

The SPDI phase 1 was implemented by the "Sustainable Agriculture Water Management Project (SAWMP)" operated under the Ministry of Agriculture. In SPDI phase 1 total value of the drip irrigation kit was Rs.308,815. To obtain the system the selected beneficiary had to make a down payment of Rs.5,000 at the Samurdhi bank or Govijana bank. The remaining cost had to be repaid after one year grace period within 10 years making biannual payments in 18 installments. Agreement was signed between the farmer and the Ministry of Agriculture for repayment arrangement.

Under the SPDI phase 1, only five per cent of the farmers used the complete set of SPDI, while another seven percent used the full system without fertigation kit. However, 56% of the users used the SPDI system without drip component.

According to the findings of the evaluation of SPDI phase 1 by Aheeyar *et al* in 2013, about 29% of the beneficiaries were not using the provided system at the time of their survey. The main reasons observed for the non-use of drippers were, blocking of drippers, difficulties in cleaning of drippers, lack of knowledge on the drip system, damage caused to drip lateral pipes by rodents, insufficient water supply from the drippers to crops, small land size and absence of water scarcity to use drip irrigation.

Only about 20 per cent of the beneficiaries had paid any installment after the down payment, but none of the beneficiaries had made regular payment of installment. Majority had not used the complete SPDI system. This was the reason for the failure to generate sufficient income. High capital cost of the system, lack of awareness about the repayment requirements at the time of system delivery, nonpayment of installment by other farmers, expectation of loan write off from government as the government did for agricultural credits in the past, local political influences for nonpayment and some other misconceptions were the main reasons for the nonpayment of the installments (Aheeyar *et al*, 2013).

## 1.6 Rationale

Phase 1 programme was not successful at the end due to several mismanagement practices and weak implementation mechanisms. During the phase 2 of the SAWMP, some of the loose implementation procedures had been tightened and new methodologies and new areas had been selected to popularize the drip technology among the farming community. Huge amounts of money had been invested for this project. Therefore evaluation is needed to assess the success of the project as well as to examine the new components of the project. Furthermore, the recommendations derived through the findings are of utmost importance to design and to implement this kind of projects in future in a successful manner.

## 1.7 Objectives of the study

The major objective of this study is to evaluate the efficacy of providing solar powered drip irrigation kits and their impacts with changes done in the phase 2.

The specific objectives of the study are;

i) To evaluate the intervention approach and fulfillment of responsibilities of different stakeholders with the modifications incorporated in the phase 2
ii) To examine the performance of SPDI kits and their level of usage
iii) To examine the method of repayments and its implications
iv) To evaluate the cropping intensity, reduced cost of cultivations by the use of SPDI kits for enhancing the family welfare of marginal resource poor farmers
v) To make recommendations/suggestions for future promotion of micro irrigation technologies and their sustainability.

# CHAPTER TWO

# Methodology

## 2.1 Site selection and sample size

The SPDI phase 2 project was implemented throughout the dry zone covering seventeen districts; These were Ampara, Anuradhapura, Badulla, Batticaloa, Hambanthota, Jaffna, Klilinochchi, Kurunegala, Mannar, Matale, Moneragala, Mullaitivu, Polonnaruwa, Puttalam, Ratnapura, Trincomalee and Vavuniya.

However, for this study only seven districts were selected purposely considering the availability of large number of beneficiaries with special attention given to the beneficiary dispersion. In the phase 2, systems have been delivered more or less equally through the Agrarian Development Centers (ADC) and the Samurdhi Bank with the existing institutional setup under the Government at the grass root level. Therefore, availability and the number of beneficiaries of both implementers (Samurdhi and ADC) were considered for evaluation and selection of the sites to minimize transport costs.

Sample size calculator was used to calculate sample number and 368 beneficiaries were selected with 95 per cent confidence level. Among the total beneficiaries, 170 from Samurdhi and 198 from ADC were selected for survey using stratified random sampling technique. The selected sites and the size of sample are given in table 2.1.

**Table 2.1: Beneficiary distribution and sample selection**

| District | Agrarian Development Centre | | Samurdhi Bank | | Total Sample |
|---|---|---|---|---|---|
| | No. of Beneficiaries | No. of Sample beneficiaries | No. of Beneficiaries | No. of Sample beneficiaries | |
| Ampara | 29 | 10 | 501 | 62 | 72 |
| Badulla | 89 | 12 | 6 | 01 | 13 |
| Jaffna | 1080 | 127 | 0 | - | 127 |
| Kurunegala | 71 | 9 | 495 | 67 | 76 |
| Matale | 6 | 3 | 107 | 14 | 17 |
| Mullaitivu | 202 | 25 | 0 | - | 25 |
| Polonnaruwa | 91 | 12 | 191 | 26 | 38 |
| Sub Total | 1568 | 198 | 1300 | 170 | 368 |

Survey Data, 2012

## 2.2 Data collection methods

The study adopted multiple methods to gather necessary information and data for the evaluation namely; key informant interviews, focus group discussions, and questionnaire survey.

**Key informant discussions** were conducted with the officials of the SAWMP, BP Solar Company, district and divisional officers of ADC's, Farmer leaders and District Coordinating Officers. Interviews were conducted to identify the achievements and issues of the SPDI project and the efficacy of the interventions made.

**Focus group discussions** were conducted in areas where large numbers of SPDI units had been dispersed with a view to gather qualitative information on effectiveness, efficiency and impacts of the project. **Sample survey** was planned in using the beneficiary list available in the SAWMP and stratified random sample was used to represent the beneficiaries under Samurdhi and ADC. Structured questionnaire was used to collect primary data from the selected beneficiary sample.

Impact was assessed by using agricultural, socio economic, and environmental factors. Family income, employment opportunities etc, were used to monitor the socio economic impact.

Regarding loan repayments, ability to pay from the SPDI kit was taken as indicators for the loan repayment and training for cultivation practices, environment and social behavior were used as indicators to measure the adoptability and social acceptance of the project.

## 2.3 Data analysis

Descriptive statistical methods were used to analyze the usage of SPDI and cropping pattern. In some cases the phase 1 and phase 2 activities were compared to analyze the success of implementation process with modifications (discussed in Chapter 1 under sub title 1.4.4 Project implementation) done in the phase 2.

## 2.4 Criteria for evaluation

The SPDI phase 2 was evaluated based on the following criteria

**Relevance of the objectives**: the interventions were evaluated in terms of their contribution for achieving desired objectives of the SPDI project

**Effectiveness:** the effectiveness of the SPDI project was evaluated in terms of effective use of the system, continuation of use, purpose of using the system, fulfillment of farmer's needs, impacts such as changes of cropping intensity, crop yield, farm income, water use efficiency, and cost of production.

**Success of modifications incorporated in the phase 2:** impact on implementation process with the modifications made in the phase 2 was evaluated in terms of

selections of beneficiaries, improvements of usage of the SPDI kits, improvements of the repayment process with the information available in SPDI phase 1.

**Sustainability:** sustainability of the SPDI project interventions was measured in terms of continuation of the technology use, improvement of farmer welfare, collection of repayments, mechanisms of after sale services and availability of proper mechanism for operation and maintenances activities.

## 2.5 Period of study

The study was completed within a period of nine months from the date of initiation of the kit in April 2012. Field surveys were carried out in between June to September months in the year 2012.

# CHAPTER THREE

# Project Interventions and Responsibilities by Stakeholders

## 3.1 Demographic characteristics of the sample

### 3.1.1 Age distribution

The distribution of the beneficiary sample farmers by age category is presented in table 3.1. Within sample, the average age of the beneficiaries interviewed was 43, where the youngest interviewee was 18 while the oldest was 77 years old and majority between 30 to 60 age category (Table 3.1).The average family sizes within the sample consisted of 4 family members.

**Table 3.1: Distribution of sample beneficiary farmers by age category**

| Age category (years) | No. of farmers | % of farmers |
|---|---|---|
| 30 and below | 51 | 13.9 |
| 31-40 | 117 | 31.8 |
| 41-50 | 104 | 28.3 |
| 51-60 | 68 | 18.5 |
| Above 60 | 28 | 7.6 |
| Total | 368 | 100.0 |

Survey Data, 2012

### 3.1.2 Education

Table 3.2 shows the education level of the sample beneficiary farmers and situation is more or less similar related to Samurdhi Bank beneficiaries and Agrarian Services beneficiaries. A limited (13 percent) had never received secondary education and most of them were over 50 years.

**Table 3.2: Level of education of sample beneficiary farmers**

| Level of education | No. of farmers | % of farmers |
|---|---|---|
| No Schooling | 2 | 0.5 |
| Primary Education- Grade 1-5 | 46 | 12.5 |
| Grade 6-11 | 90 | 24.5 |
| Up to GCE Ordinary Level | 160 | 43.5 |
| Up to GCE Advanced Level | 69 | 18.8 |
| Higher Education | 1 | 0.3 |
| Total | 368 | 100.0 |

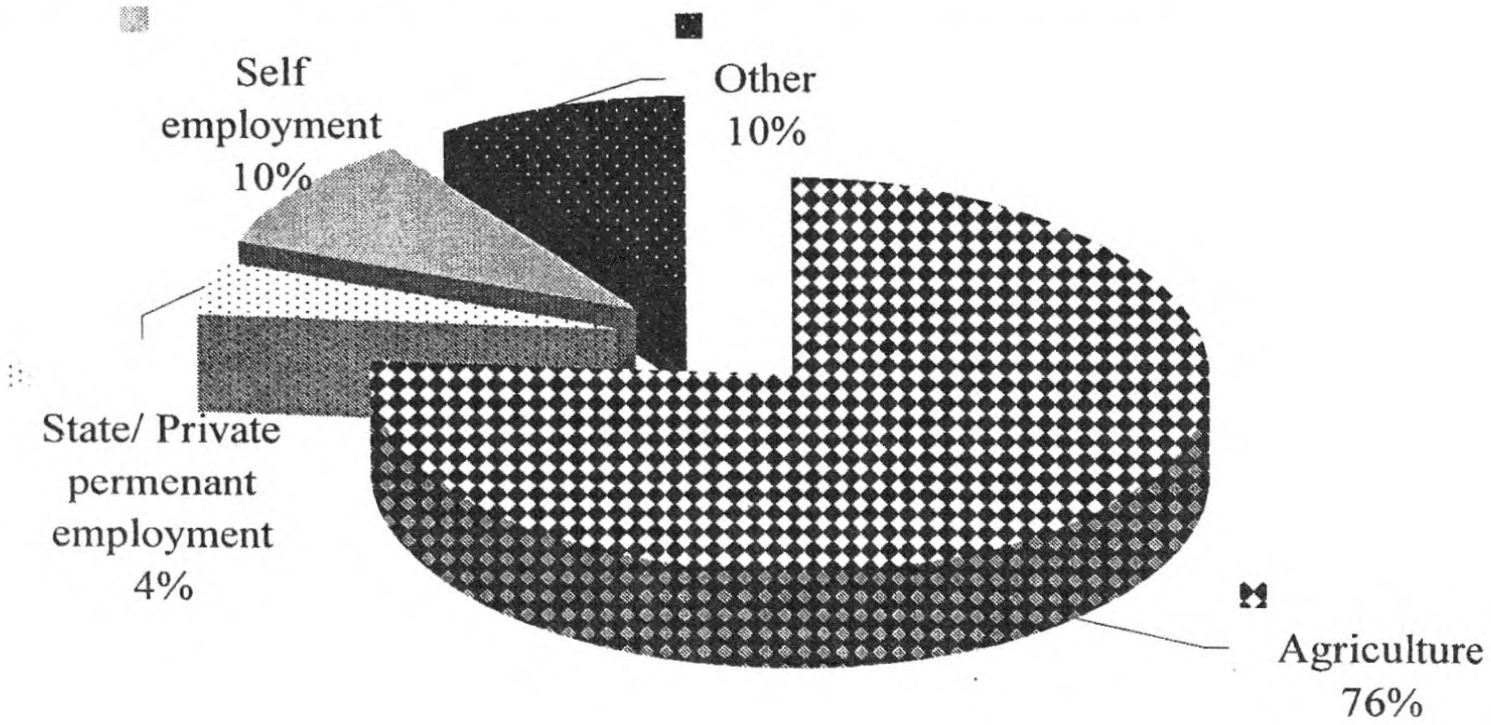
Survey Data, 2012

There is a significant correlation between age and education of the sample farmers indicating that younger farmers were more educated than the older ones (Pearsons correlation coefficient is – 0.343 and significant at 0.01 level).

### 3.1.3 Employment

The main employment of majority of sample beneficiary farmers (76%) was agriculture and only 24 per cent of them were engaged in secondary employments like self-employments and as agricultural and non-agricultural labourers. According to the figure 3.1, four per cent of the sample beneficiaries were state or private sector permanent job holders and other 10 per cent were self-employed. Other categories of beneficiaries were engaged in casual jobs and overseas employments. Some were unemployed.

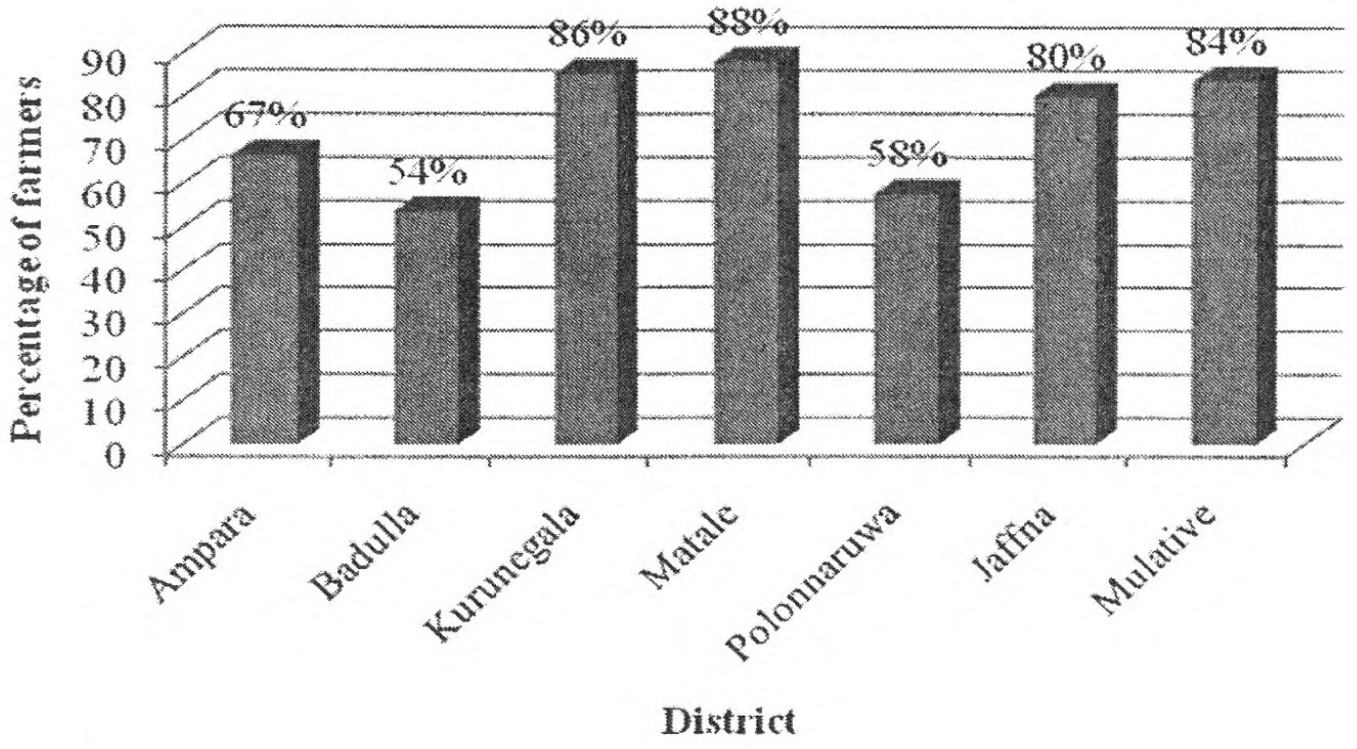
**Figure 3.1: Primary employments of the sample beneficiaries**




Survey Data, 2012

As presented in figure 3.2 more than 80 per cent of the beneficiaries in Kurunegala, Matale, Jaffna and Mullaitvu districts had satisfied selection criteria of being a full time farmer. But in the other three districts, Ampara, Badulla and Polonnaruwa nearly half the sample population were not full time farmers.

**Figure 3.2: Percentage of fulltime farmers in selected districts**




Survey Data, 2012

## 3.2 Land availability

Out of the total sample population, the operational total land area was 959.21 acres. As indicated in table 3.3, out of the total sample population, 83 per cent beneficiaries had solely owned highlands and 49 per cent had solely owned lowlands. Out of the total sample population, 165 (45 per cent) beneficiaries had owned both highlands and lowlands.

**Table 3.3: Distribution of lands by ownership**

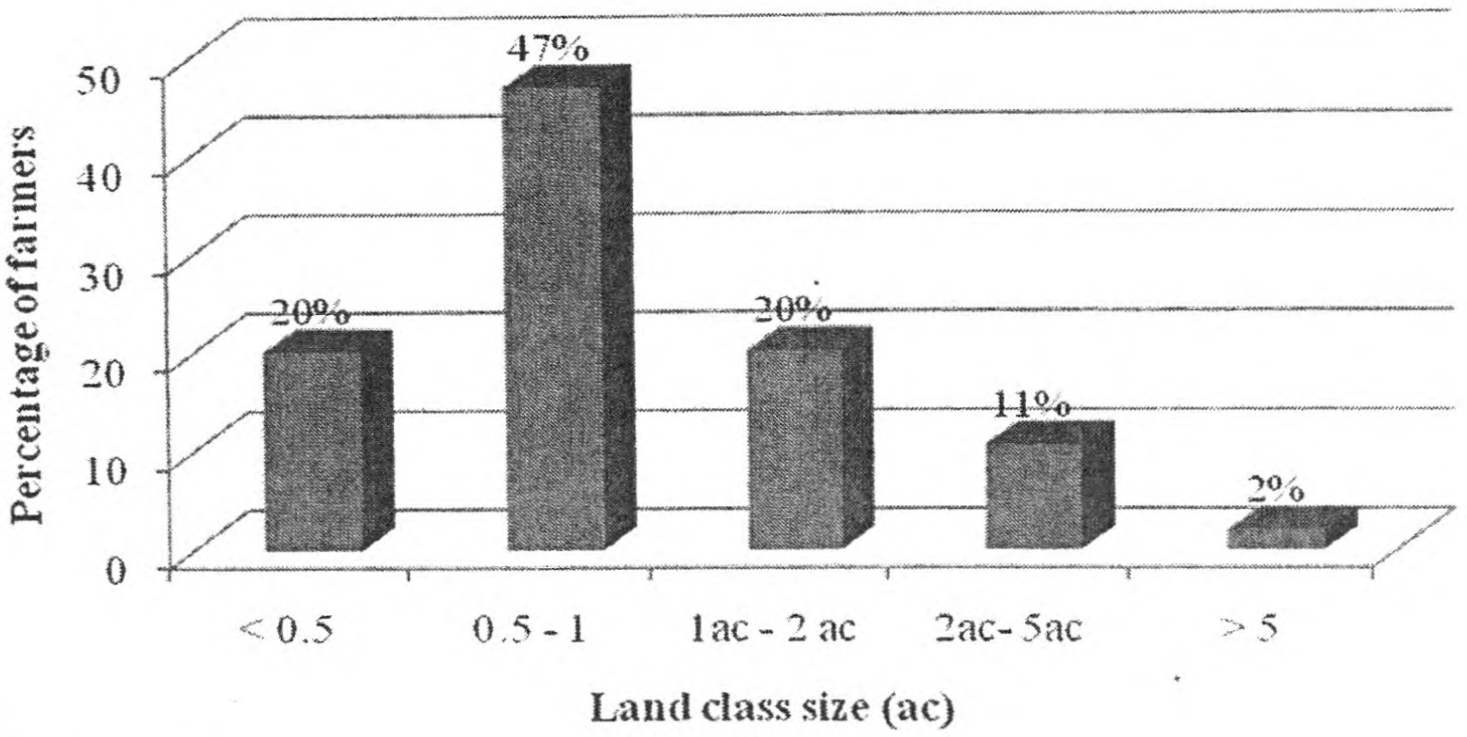
| Type of land | No. of farmers | % of farmers | Extent (ac) |
|---|---|---|---|
| Highlands- solely owned | 306 | 83.2 | 425.80 |
| Highlands- other ownerships* | 67 | 18.2 | 100.89 |
| Lowlands- solely owned | 179 | 48.6 | 352.44 |
| Lowlands- other ownerships* | 51 | 13.9 | 80.08 |

* referred tenure, leased in, mortgage, encroached, jointly owned

Authors' survey data 2012

As mentioned earlier, a farmer to be eligible to receive drip irrigation kit should own over 0.5 ac extent of cultivable land. However, the findings show that only about 80 percent of the total agrarian services beneficiary farmers owned over 0.5 ac of land (Figure 3.3). Among agrarian service centre beneficiaries there were two per cent of large scale land owners and the range of land size varied between 0.03ac to 30ac. Around 98 per cent of the beneficiaries of ADC had shared upland located in the village to obtain the SPDI system while 78 per cent of the Samurdhi Bank farmers owned uplands to themselves.

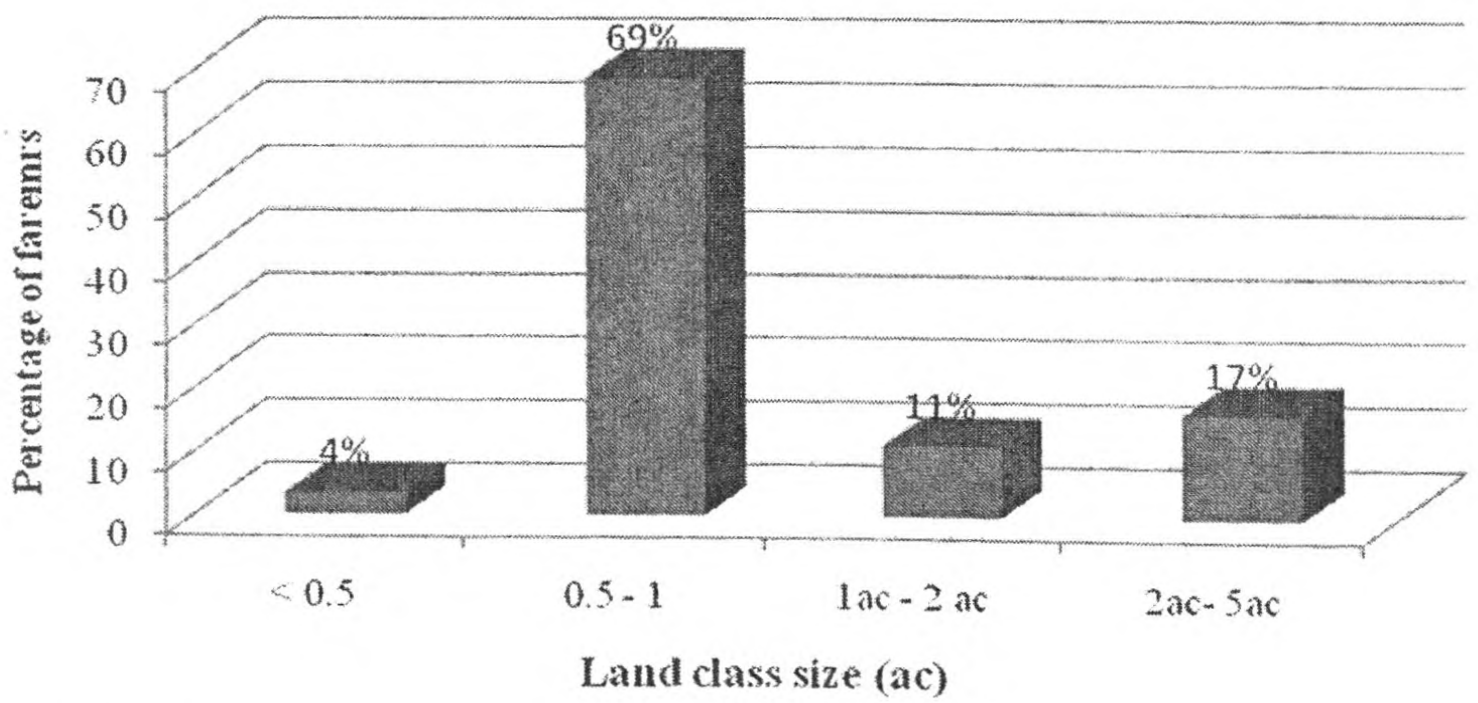
**Figure 3.3: Land size shown for obtaining the system by ADC beneficiaries**




Survey Data, 2012

The figure 3.4 indicates the land size shown to obtain the SPDI system by Samurdhi Bank beneficiaries. Of them more than 96 percent owned over 0.5 ac land extent. In the case of the Samurdhi Bank beneficiaries, land distribution varied between 0.25ac to 4ac.

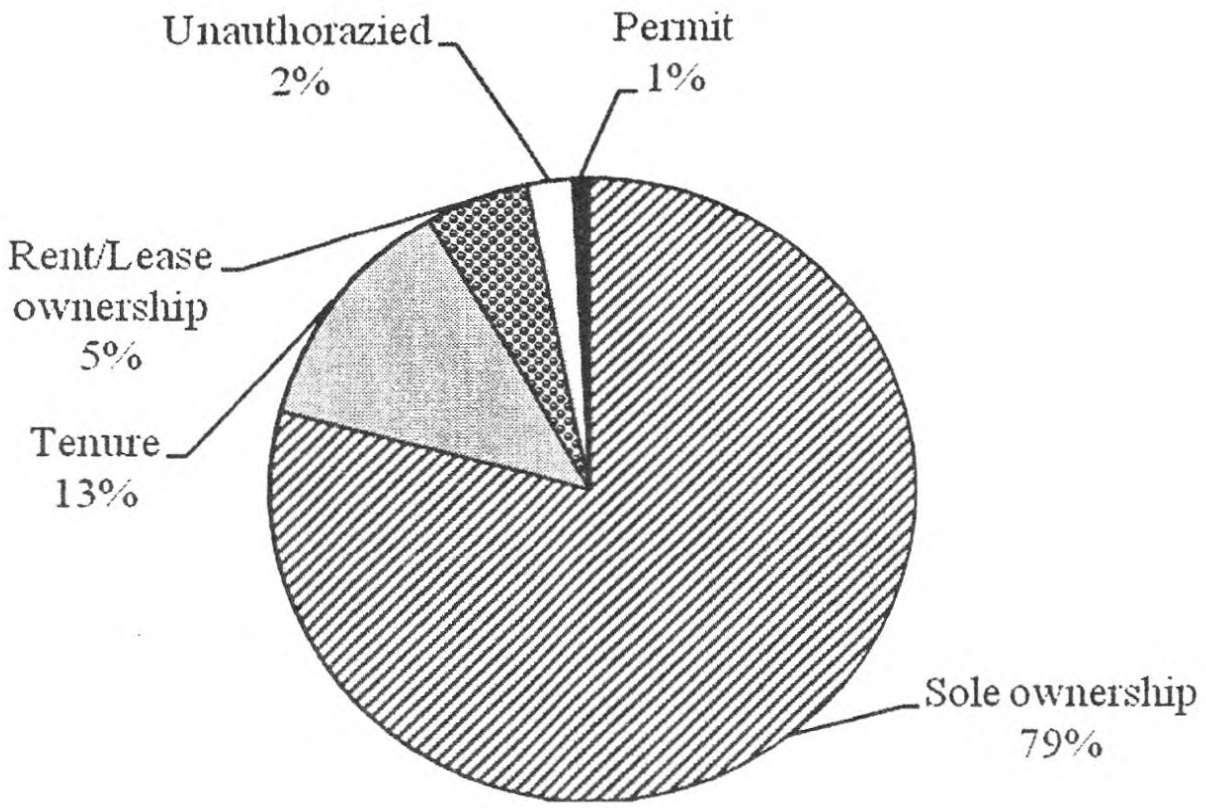
**Figure 3.4: Land size shown for obtaining the system by samurdhi bank beneficiaries**




Survey Data, 2012

Nearly 79 per cent of the farmers in both Agrarian Services and Samurdhi Bank categories had produced self owned land to obtain the SPDI system (Figure 3.5).

**Figure 3.5: Ownership of land in which the installation of the SPDI kit was proposed**

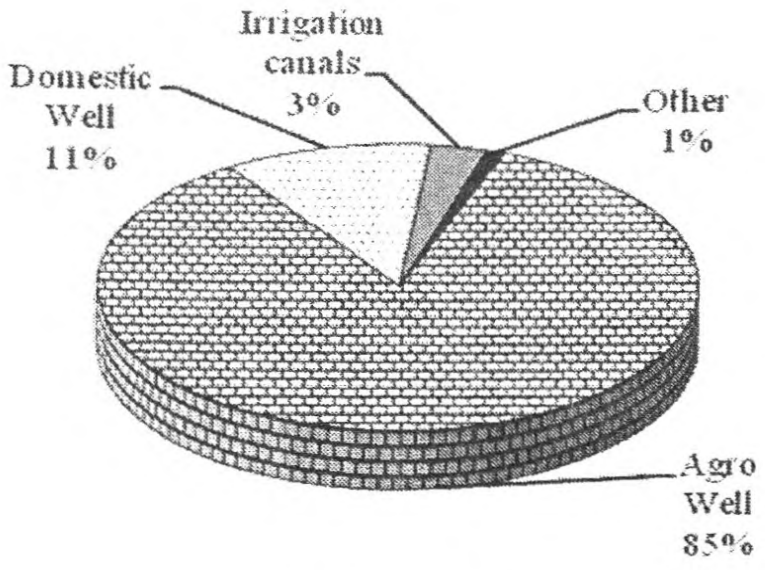



Survey Data, 2012

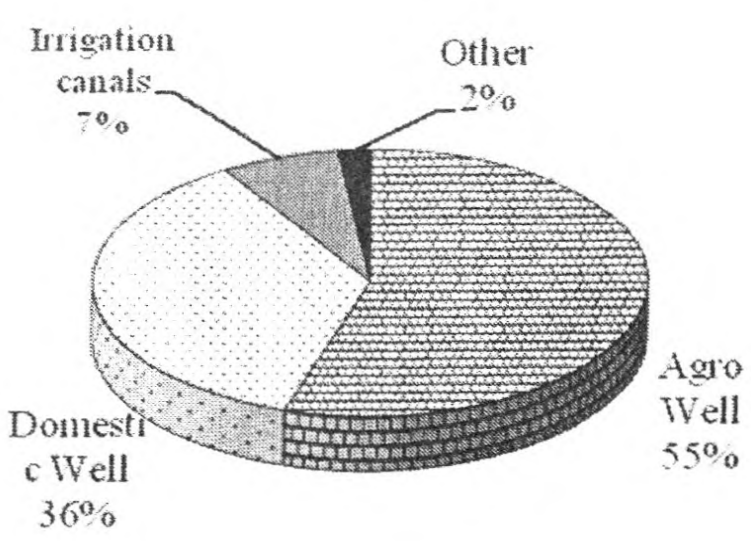
## 3.3 Water source

The source of water for drip irrigation system used in the study area is presented in figure 3.6. 85 percent ADC beneficiaries had agro wells to supply water for the system and another 11 per cent used domestic well to supply water. On the other hand only 55 per cent of the Samurdhi Bank beneficiary drip system holders had agro-well for use of drip system. Another 36 percent used their domestic wells to supply water for the system.

**Figure 3.6: Source of water used for the SPDI kit**




**ADC Beneficiaries**




**Samurdhi Bank Benericiaries**

Survey Data, 2012

Out of the total agro-well holders, 54 percent said that they had sufficient water to pump throughout the year and 40 percent said that they experienced water scarcities during certain periods of the year. Another 7 percent said that their agro wells were dry in some months. Out of total domestic well users 43 percent expressed that they had enough water around the year to use for the drip systems while 46 percent of the domestic well users said that they had faced water scarcities during some periods of the year. About 11 percent of the domestic well users experienced complete drying off of the wells in some months of the year.

Another condition set by the project to qualify to receive the SPDI system by a beneficiary was non- availability of grid electricity in the agriculture field. The findings show that about 83 percent of the sample population of agrarian services and 62 percent of the Samurdhi bank beneficiaries had no accessibility to grid electricity at the time of project implementation.

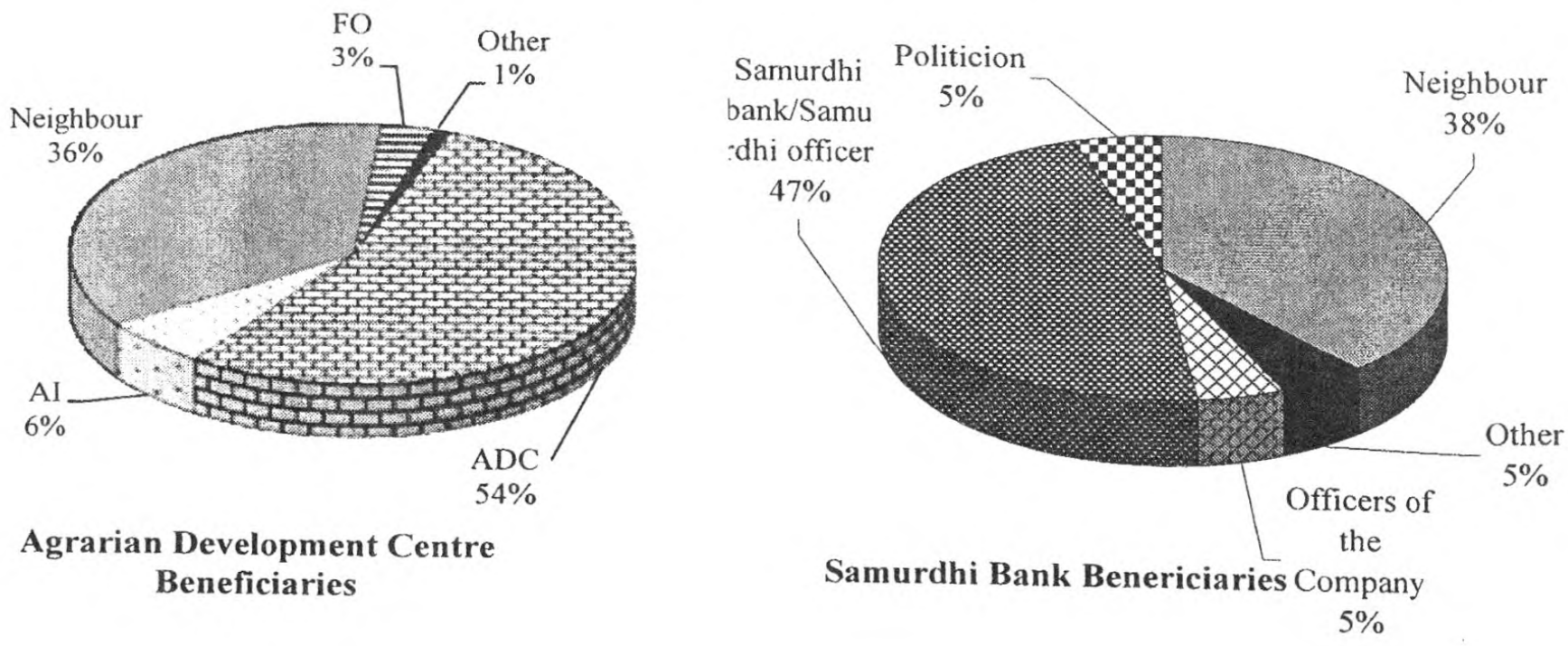
## 3.4 Stakeholder's responsibilities in the project

Three stakeholders of the project i.e. SWAMP or the Ministry of Agriculture, BP Solar Company and beneficiary farmers had different roles and responsibilities for the success of the project (discussed in Chapter 1). This section evaluates the discharge of those responsibilities by each stakeholder.

### 3.4.1 SAWMP or the ministry of agriculture

As mentioned in chapter two, one of the responsibilities of the officers of the Ministry of Agriculture was to create awareness on the project to farmers. Figure 3.7 represents the mode of awareness of sample farmers in ADC and Samurdhi Bank categories.

**Figure 3.7: Awareness about the project**




Survey Data, 2012

Nearly half the total beneficiaries in ADC category had gained awareness through the officers attached to ADC in the relevant area, which is the local level institution of the Ministry of Economic Development. Another 36 percent of the farmers had come to know about the project from the neighbouring farmer who had benefited from the project.

Further, beneficiaries were asked why they were willing to buy this SPDI system. Table 3.4 reveals that majority of them bought the SPDI kit believing that it was a fuel saver. Around 40 per cent had obtained this kit because it was given at a low cost.

**Table 3.4: Reasons for willingness to buy the SPDI kit**

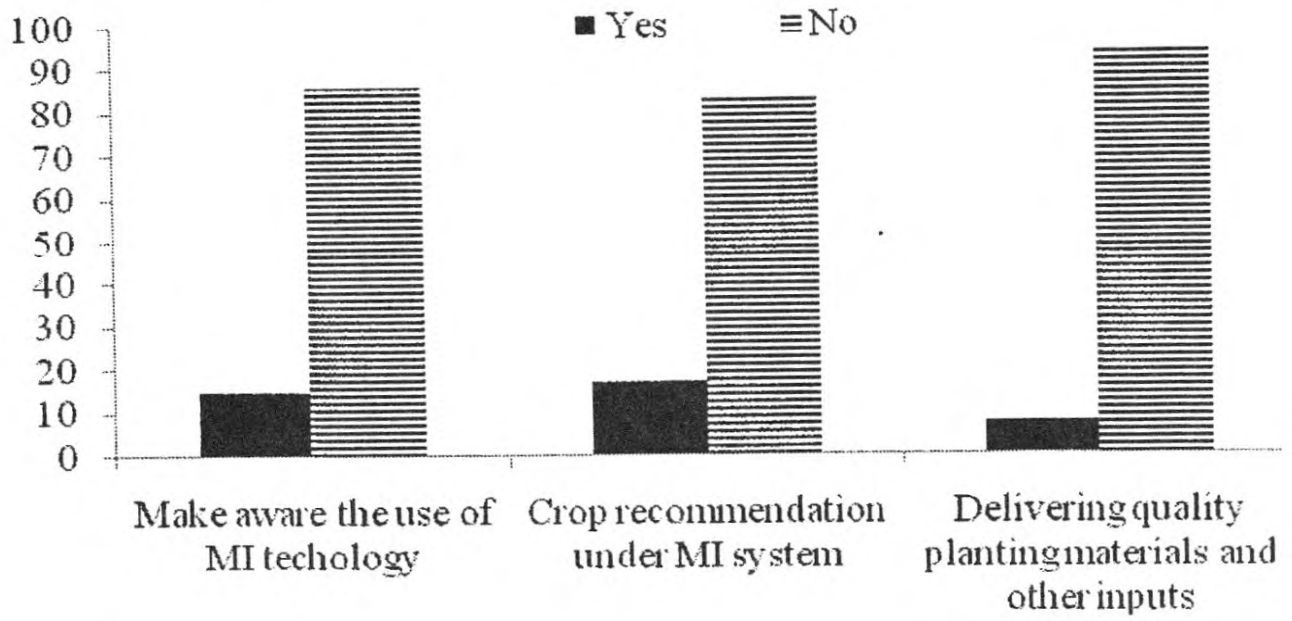
| Reasons | No of beneficiaries (N=368) | % by beneficiaries* |
|---|---|---|
| Given at a low cost | 146 | 39.7 |
| Considering its other uses | 80 | 21.7 |
| For future use | 64 | 17.4 |
| Real understanding about the uses of the SPDI kit | 28 | 7.6 |
| Due to installment plan | 72 | 19.6 |
| BP Solar officials said that it was profitable | 20 | 5.4 |
| Government officers said that it was profitable | 47 | 12.8 |
| Due to fuel saving | 220 | 59.8 |
| Due to water saving | 132 | 35.9 |
| Due to labour saving | 71 | 19.3 |
| Neighbouring famer said that it was profitable | 6 | 1.6 |
| Politician said that it was profitable | 2 | 0.5 |

* Multiple answers make the total percentage more than 100
Survey Data, 2012

In the Samurdhi bank category, 47 percent of the beneficiaries had received awareness from Samurdhi Bank or Samurdhi development officer in the relevant area. Another 38 percent received awareness about the project from neighbouring farmers.

In the project proposal the Ministry of Agriculture had agreed to provide knowledge on the usage of drip system for crop cultivation, crop recommendations for the drip irrigation farmers through the DOA, introduction of a programme to ensure the provision of timely and quality supply of seeds and planting materials and other necessary inputs to selected farmers (Figure 3.8).

**Figure 3.8: Responsibility of SAWMP/Min. of agriculture for dissemination SPDI technology**




Survey Data, 2012

Only 17 percent of the farmers had received training or guidance and recommendations from the related government officers regarding cultivation of crops under drip irrigation. Only 7 percent of the sample beneficiaries had received seeds and planting materials from the DOA. In the Jaffna and Mullaitivu districts no one in the sample had received any recommendation or planting materials.

### 3.4.2 BP solar company

One of the responsibilities of the BP solar company was the installation of the systems in the fields of selected farmers and provision of instructions to farmers on the usage of the system and operation and maintenance. Survey findings show that 95 percent of the systems had been installed in the field by the technical staff of the company, two percent were installed by farmers themselves and one percent had not yet installed the systems in the field.

Out of the total sample, 92 percent had received instructions regarding operation and maintenance and usage. 96 percent had received instructions from the BP Solar company officials. During the installation period, the company was responsible to provide an O&M manual with the SPDI kit to create some awareness on the usage of the SPDI system. But only 43 percent of beneficiaries had received the manual (Figure 3.9b). Another 36 percent said that they didn't get a manual and 21 percent had no idea about it. Only 69 percent of them had read it and 96 percent of them said that it was useful. (Figure 3.9a).

**Figure 3.9a: Usefulness of the manual**

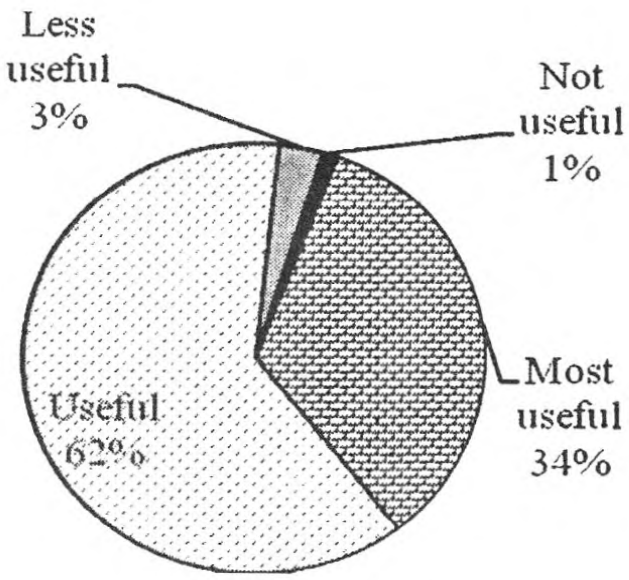
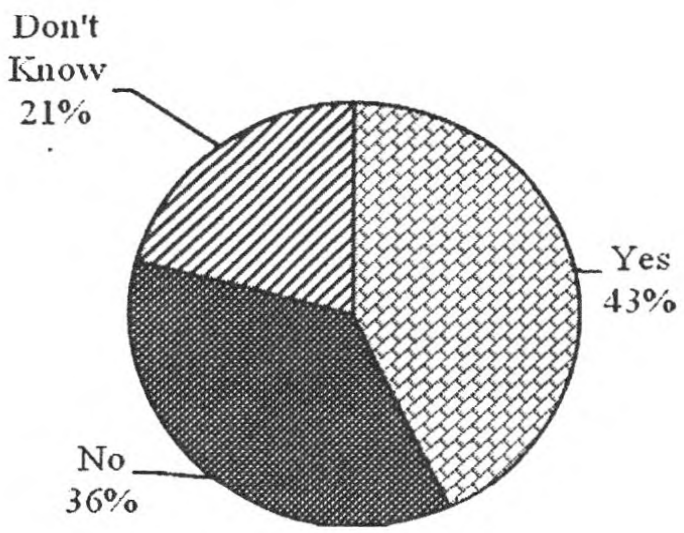



**Figure 3.9b: Receiving of operation and maintenance manual**




Survey Data, 2012

According to the agreement between the Ministry of Agriculture and BP solar company, all maintenance activities during the first three years had to be conducted by the BP solar company free of charge. Nearly 77 percent of the sample systems had been purchased by farmers in 2010, and therefore almost all the systems were still under the warranty period. Of the kits belonging to the total beneficiaries only 16 percent (59 systems) had to be repaired during this period. 51 percent of the maintenance needs were informed to the BP solar company and 47 percent of them had received service within one week. 37 percent of the complainants said that they didn't receive any service after their complaints. Most of the services received from the BP solar company didn't involve any payment. Only 9 beneficiaries said that they had to pay for it. However, this may have happened sometimes due to unawareness of the project agreement or due to human mistakes.

### 3.4.3 Beneficiary farmers

Farmers are the most important stakeholders in the project. They had signed agreements with the Ministry of Agriculture for repayment of the total cost of the drip system. However, within the sample, 6 beneficiaries out of 368 stated that they didn't sign any agreement with anybody but, they had received the system. Research findings provide evidence that 50 percent of the sample population had not been aware of the conditions stipulated in the agreement even though they had signed it.

According to the project implementation process, loan agreement had to be signed with the relevant ADC or the Samurdhi Bank. However, other than the ADC and Samurdhi bank, 13 per cent beneficiaries stated that they signed the agreement with the BP solar officials (Table 3.5). For example, in the Ampara district, it was 32 out of 72 beneficiaries.

**Table 3.5: Beneficiary responses regarding agreement signed with the agent**

| Agent | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| ADC | 179 | 48.6 |
| BP Solar Company | 49 | 13.3 |
| Samurdhi Bank | 133 | 36.1 |
| Never signed agreement | 6 | 1.6 |
| Not remember | 1 | 0.3 |

Survey Data, 2012

## 3.5 Repayment of loan installments

There were two institutions dealing with the recovery of the cost of the system from farmers. Those were Farmer Banks in ADC and Samurdhi Banks.

At the time of awareness creation, relevant officials of the Ministry of Agriculture had to inform all farmers regarding the total cost of the system and repayment plan. Table 3.6 shows the known loan repayment conditions by the beneficiaries under two categories. 93 percent of the ADC beneficiaries were aware of their initial payment which was Rs.10, 000 and that the rest had to be paid in twenty equal installments. Another five percent of the ADC beneficiaries said that initially they had to pay Rs.5000, then pay the complete down payment of Rs.10,000 and the balance in twenty equal installments.

**Table 3.6: Acknowledged condition of loan repayment by beneficiaries**

| Institute | Condition | No. of farmers | % of farmers |
|---|---|---|---|
| ADC | Initial payment of Rs.5000 and the balance in twenty equal installments | 2 | 1.0 |
| | Initial payment of Rs.10,000 and the balance in twenty equal installments | 184 | 92.9 |
| | Initial payment of Rs.5000 and make the down payment of Rs.10,000 and balance in 20 installments | 10 | 5.1 |
| | Rs.10,000 only | 2 | 1.0 |
| | **Total** | **198** | **100.0** |
| Samurdhi Bank | Initial payment of Rs.5000 and the balance in twenty equal installments | 7 | 4.2 |
| | Initial payment of Rs.10,000 and the balance in twenty equal installments | 26 | 15.3 |
| | Initial payment of Rs.5000 and make the down payment of Rs.25,000 and balance in 20 instalments | 4 | 2.4 |
| | Initial payment of Rs.5000 and make the down payment of Rs.10,000 and balance in 20 installments | 117 | 68.8 |
| | Rs.10,000 only | 16 | 9.4 |
| | **Total** | **170** | **100.0** |

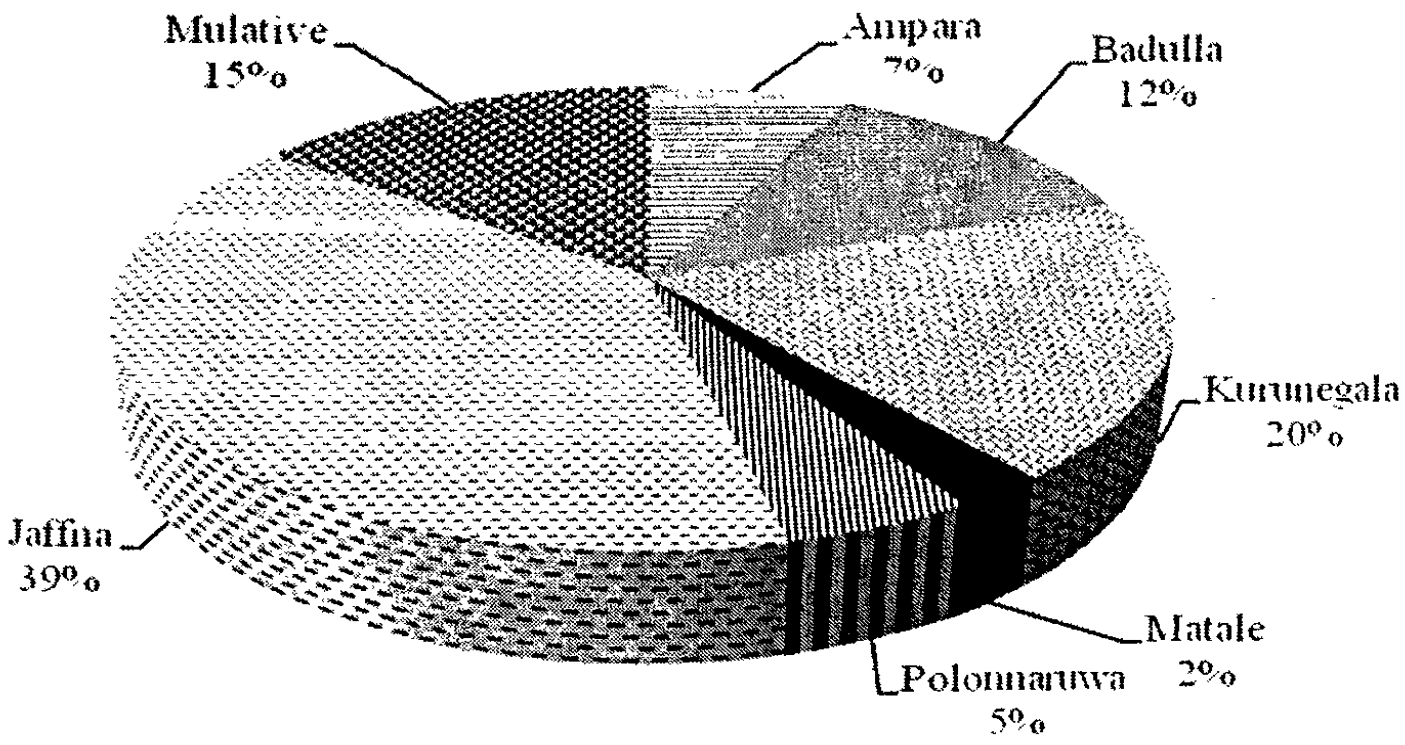
Survey Data, 2012

According to the survey results, 69 percent of the Samurdhi Bank beneficiaries knew that their initial payment was Rs.5000, and the down payment was Rs.10000 and that the rest had to be completely paid in twenty installments. Another 15 percent of the Samurdhi beneficiaries were informed that their initial payment was Rs.10, 000 and that they had to complete the balance payment in twenty equal installments.

Anyhow except three percent of the total sample population, almost all the farmers were aware at the time of purchasing the system that they had to pay the total cost of the system. Out of the total ADC sample population, 69 percent had paid Rs.10,000 as initial payment and another 6 percent had paid Rs.5000. 25 percent of ADC beneficiaries had paid amounts in between Rs.10, 000 and Rs.20, 000. In Samurdhi Bank category more than 89 percent had paid Rs.5000. Another 10 percent had paid Rs.10, 000 and almost all of them were non Samurdhi allowance holders.

According to the agreement signed between the Ministry of Agriculture and beneficiary farmers, six months after installation, beneficiaries were bound to pay the installment monthly. However, only 11 per cent (41 beneficiaries) had paid any installment. District wise percentage distribution of beneficiaries who paid installment is illustrated in figure 3.10.

**Figure 3.10: Percentage of sample beneficiaries who paid any installment**




Survey Data, 2012

Out of total who paid, only 32 ADC beneficiaries (16%) had paid any installment other than the down payment. Maximum installment paid by a farmer was Rs.10, 000 and only two people had paid that much. Out of the farmers who paid installments nearly 50 percent had paid around Rs.5000 and others had paid less than that. In the Samurdhi Bank category, only 9 beneficiaries (5%) had paid any installment other than the down payment. In the Samurdhi bank category there was only one beneficiary who had paid Rs.72,000 in 18 installments. Even though more than 90

percent of the beneficiaries had been aware of the repayment conditions at the time of purchasing the system but no one had continued the repayment.

## 3.6 Reasons for non-payment

As mentioned in the previous section, no one had continued to pay the installments. Farmers gave many reasons for nonpayment of installments (table 3.7). The main reason given by them was that many others had not paid the installments. Farmers considered that if any penalty was imposed it was for all and not only for one. Most of the farmers had purchased the system because of the lower initial payment at the time of purchasing. As this was a government project some farmers (27 percent) did not have a real sense of responsibility for repayment. Another 27 percent of selected beneficiaries stated that income generated from this system was not sufficient to pay the installment.

**Table 3.7: Reasons of nonpayment of regular installments**

| Responses | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| Not bound to make the full payment | 30 | 8.2 |
| Additional income earned by the SPDI system wasn't sufficient | 99 | 26.9 |
| Project was funded by the Australian government aid | 32 | 8.7 |
| Government will consider this as bad debts | 26 | 7.1 |
| Local politicians advised not to pay | 27 | 7.3 |
| Other farmers do not pay. So why should we pay? | 202 | 54.9 |
| Since this is a government project, no need to pay back | 101 | 27.4 |
| SPDI system was malfunctioning and cannot be used further | 11 | 3.0 |
| Beneficiaries of the phase I was not paying. So why should we? | 36 | 9.8 |
| Beneficiaries of the phase I advised us to not to pay | 3 | 0.8 |
| The real value of the system was less than the given value | 22 | 6.0 |
| Monitory difficulties | 15 | 4.1 |
| No authorized person to regularly collect the installments | 72 | 19.6 |
| BP solar officials said not to pay | 2 | 0.5 |
| Not aware of repayment | 9 | 2.4 |
| Not installed yet | 1 | 0.3 |

* Multiple answers make the total percentage more than 100
Survey Data, 2012

26 percent of the farmers in the Jaffna and Mullaitivu districts said that they did not have proper mechanism to repay and even they did not know where to pay and who the responsible people regarding repayments.

Further, during the survey, beneficiaries were asked about their awareness of the SPDI phase 1and more than 52 percent of the selected beneficiaries stated that they were aware of the SPDI project phase 1. In addition, 55 per cent out of them said (table 4.9) that re-payment was not done as other beneficiaries too did not pay. Another 10 percent mentioned that they didn't pay because of non regular payments of the phase 1 beneficiaries. There was a significant correlation between knowing about the SPDI phase 1 and paying installments by sample farmers.

Another 27 per cent of the beneficiaries believed that this was a government subsidy programme and there was no need to pay back. Further, beneficiaries were misguided by local politicians and some BP solar officials (16 %) who had said that there was no need to pay as this was a grant from the Australian government to the Sri Lankan government for uplifting the resource poor farmers in the dry zone. Some other farmers expected that although this project was given on repayment basis, after a certain period of time government will write off this loan as the past governments did for the agricultural loans (7.1 %). 27 per cent of the beneficiaries mentioned that they could not pay back the installments due to difficulties of obtaining expected benefits from the project. Further, six per cent said that the system was not worth as stated by the SAWMP. They believed that they could buy this kind of product for a lesser price in the open market.

# CHAPTER FOUR

# Effective Usage of the Solar Powered Drip Irrigation System

This chapter mainly discusses the usage of the SPDI kit, methods of use, training provided for operation and maintenance, and selection of suitable crops cultivable under SPDI.

## 4.1 Different methods of SPDI kit usage

The SPDI kits consisted several parts (see Chapter 1, section 1.3.3). Mainly it consisted of solar panel, maximum power point tracker, water pump, filter, fertigation unit, main line and drip containing laterals. To lift the water through solar powered pump, considerable sunlight is needed. Normally, in cloudy situations pump cannot be operated due to low power generation through solar panel.

Table 4.1 indicates the usage of SPDI kits during the surveyed period. Nearly 90 per cent of beneficiaries had used the SPDI kit for some purpose. However, 1.4 per cent of the SPDI kits were never used. All the uninstalled (never used) SPDI kits were found in the Badulla district. The usage of the SPDI kit has statistically correlated in 0.05 significant level with attributes such as availability of grid electricity in the farmers' field (P= 7.449), availability of water (P= 12.813), source of water (P= 37.871) and technical difficulties or problems encountered during usage (P= 73.379).

**Table 4.1: Present status of SPDI kit usage**

| Status of use | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| Used up to date | 331 | 89.9 |
| Used till recently but not used now | 18 | 4.9 |
| Used in few initial seasons only | 14 | 3.8 |
| Never used | 5 | 1.4 |

Survey Data, 2012

According to the information gathered from the survey, several methods of using the SPDI kits were found. Method of use of SPDI kits are mentioned in table 4.2. At the time of the survey around 24.4 per cent of beneficiaries had been using the complete SPDI kits with or without fertigation unit for agricultural activities (completed SPDI kit consists of solar panel, maximum power point tracker, water pump, filter, fertigation unit, main line and drip containing laterals). Another 53 per cent beneficiaries had used the SPDI kits without drip containing laterals. 12.5 percent beneficiaries had not used the system for given purposes though it was provided for crop cultivation. Nearly 10.1 per cent of the beneficiaries had not used the SPDI kits for any purposes.

**Table 4.2: Method of use of the SPDI kit**

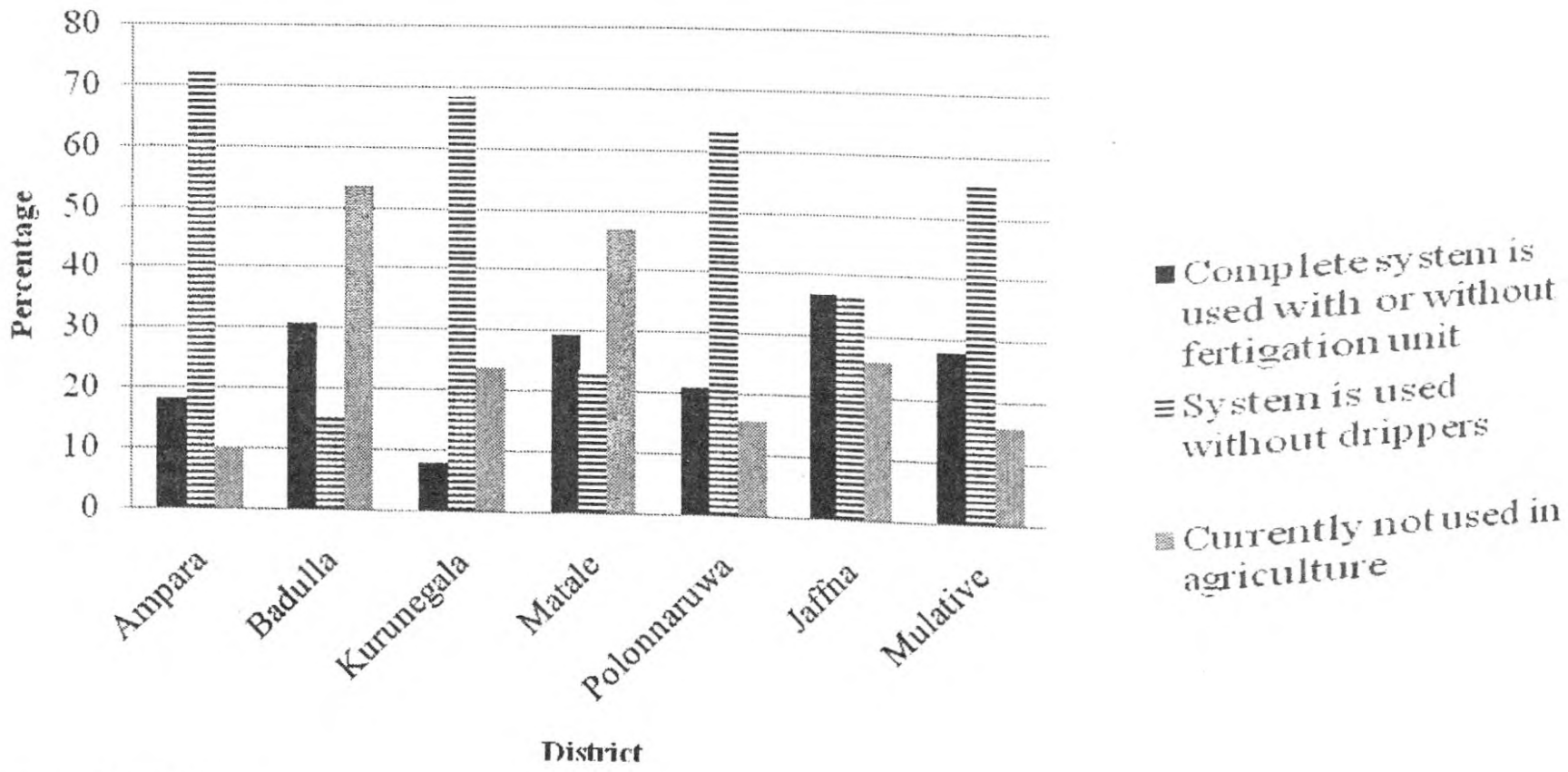
| Type of use | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| Used complete system for agriculture | 53 | 14.4 |
| Used the system without fertigation unit for agriculture | 37 | 10.0 |
| Used the system without dippers for agriculture | 195 | 53.0 |
| Used for domestic activities | 46 | 12.5 |
| Not used now | 37 | 10.1 |

Survey Data, 2012

Further, method of use of SPDI kit has shown significant correlation with attributes such as water availability (P=11.43), changes in farm income (P=30.02) and technical difficulties or problems encountered during usage (P=36.284) at a 0.05.

Nearly 30 per cent beneficiaries of the Matale, Jaffna, and Badulla districts had used the complete system for cultivation (Figure 4.1). Higher percentages for non agricultural use were found in Badulla and Matale districts. Mullaitivu, Ampara and Polonnaruwa districts had shown comparatively good results in agricultural use even though there had been a higher percentage of non use of drip containing laterals.

**Figure 4.1: Method of use of the SPDI kit by districts**

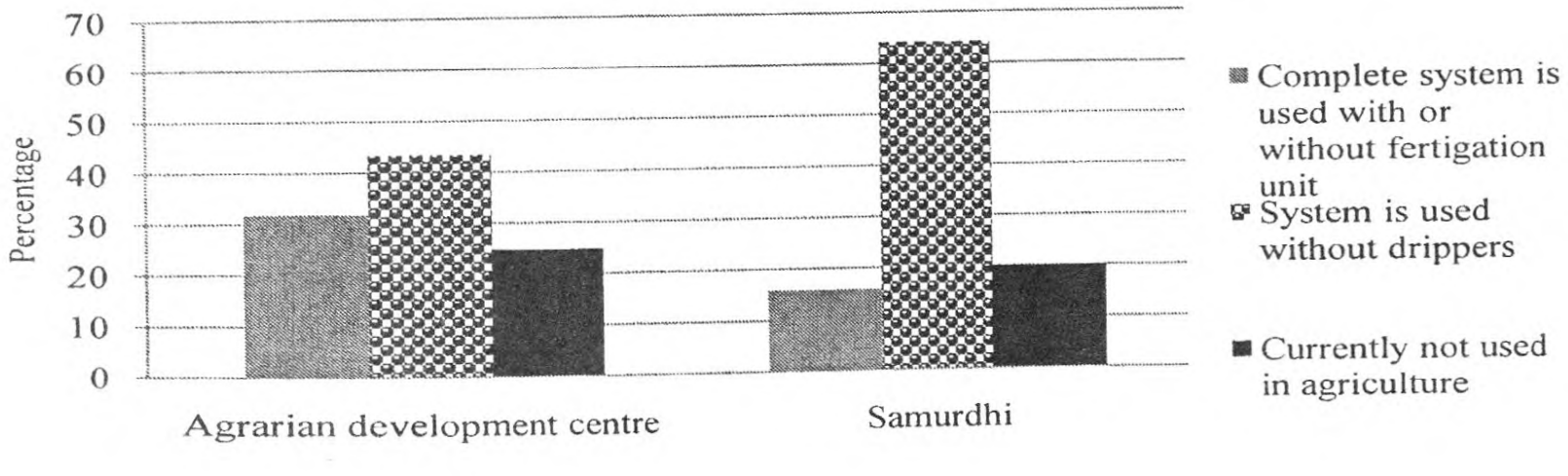



Survey Data, 2012

The SPDI kits had been distributed mainly through the Samurdhi bank and ADC. Among the implementing agencies, higher percentage of the complete system usage and non usage for agricultural activities were found in ADC (fig 4.2). However,

higher percentage of SPDI kit usage without drip containing laterals was observed in the Samurdhi Bank category.

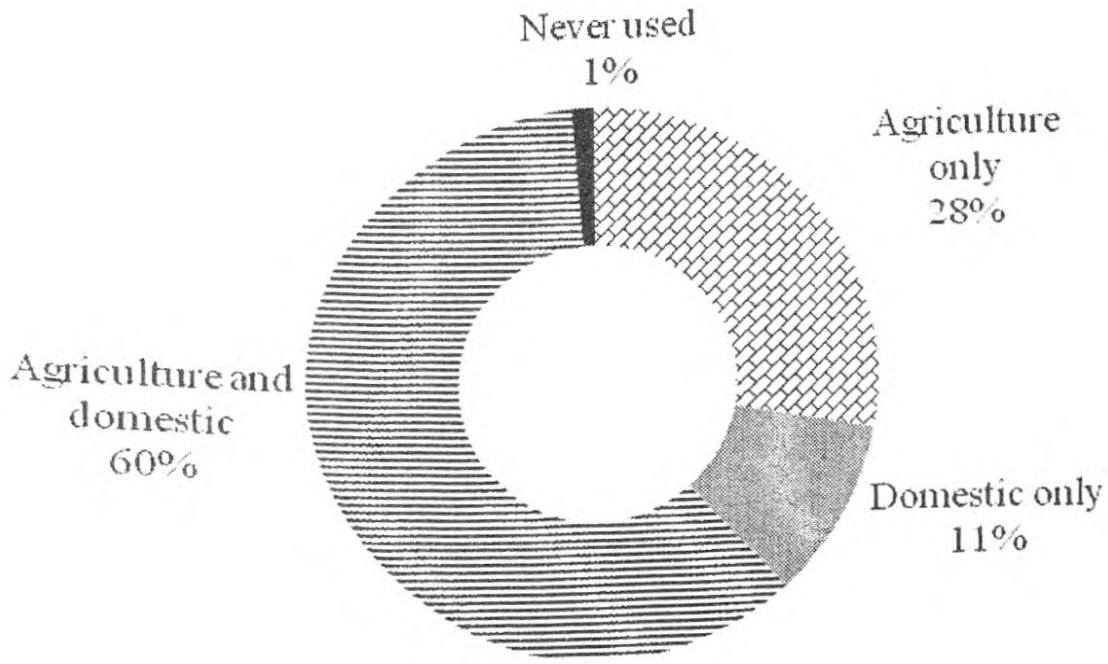
**Figure 4.2: Method of use of SPDI kit by implementing agency**




Survey Data, 2012

Figure 4.3 illustrates the purposes for which the SPDI kit was used. More than 60 per cent of the beneficiaries had used the system either for agriculture or for domestic purposes and nearly 28 percent had used the system for agriculture only (However in this figure, method of use is not being considered but only shows the purpose of use). This clearly indicates that the system was used for other needs.

**Figure 4.3: Purpose of the SPDI use**

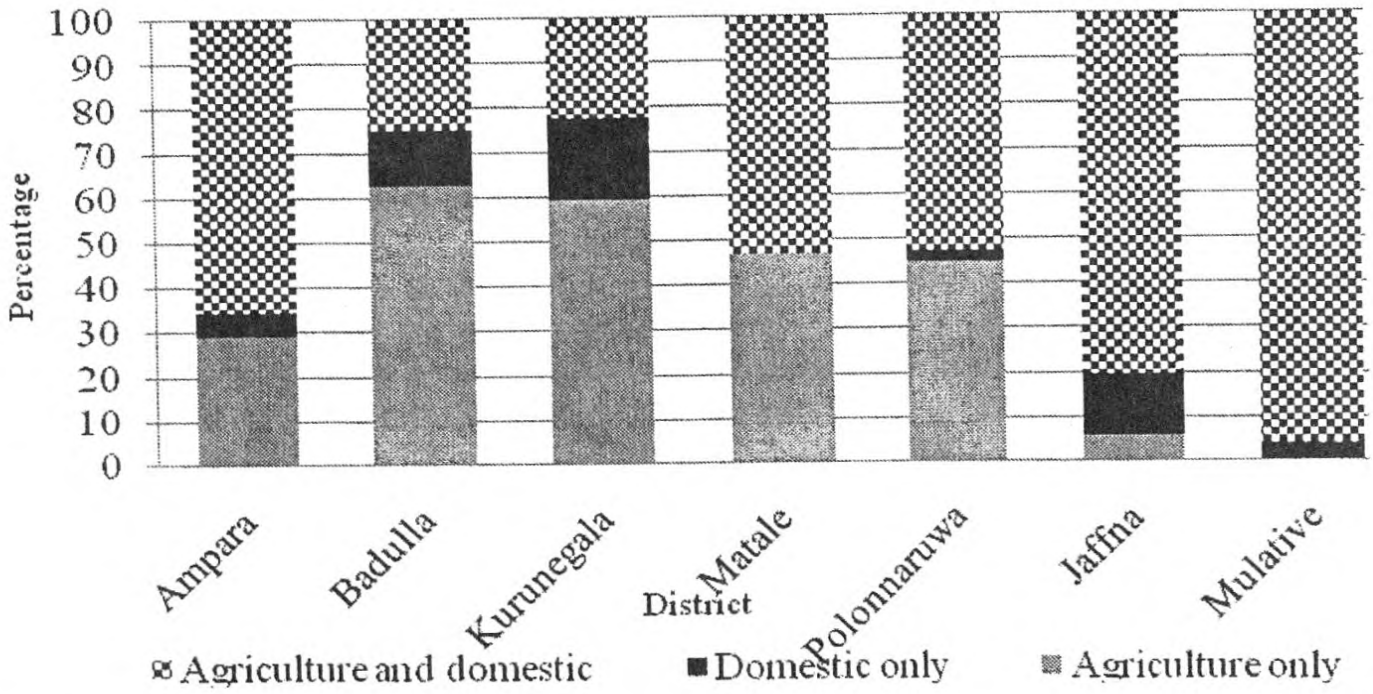



Survey Data, 2012

Figure 4.4 illustrates the purposes of use of the SPDI kit by sample districts. The SPDI kits had been used for agriculture and domestic purposes in all districts except in Mullaitivu. Nearly five per cent of the beneficiaries of Jaffna had solely used the kit for agriculture purposes. This indicates the difficulty of finding domestic water in the

Northern areas. In the Matale district none of the beneficiaries had used the system for domestic purposes only.

**Figure 4.4: Purpose of use of SPDI kit by districts**




Survey Data, 2012

## 4.2 Usage of different components of SPDI kits and their applications

During the survey, farmers were asked about the use of different components of the SPDI kit for agriculture and other relevant activities. In the phase 2 survey, solar panel and solar powered water pump were used by everybody for some purpose other than non users (1.4 per cent). According to the information given in the table 4.3 more than 82 per cent of beneficiaries had not combined the fertigation system to the SPDI application. However, around 17 per cent of beneficiaries had tried this at least in a few seasons.

**Table 4.3: Use of fertigation unit for fertilizer application**

| Status of use | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| used up to date | 53 | 14.4 |
| used till recent but not used now | 33 | 9.0 |
| used only in the initial few seasons | 23 | 6.3 |
| used only one season | 28 | 7.6 |
| Never used | 229 | 62.2 |
| Not received | 2 | 0.5 |

Survey Data, 2012

Reasons for non use of fertigation unit are given in Table 4.4. About 50 percent of the farmers had not used the fertigation unit due to non use of drip containing laterals.

Collectively, 30 per cent of the beneficiaries had not used the fertigation unit due to unawareness of the technology and because there was no confidence in using it.

**Table 4.4: Main reasons for not using the fertigation unit**

| Reason | No of beneficiaries (N=310)* | % of beneficiaries |
|---|---|---|
| Clogging of drippers | 10 | 3.23 |
| Effectiveness of application | 10 | 3.23 |
| Lack confidence on the fertigation unit | 27 | 8.71 |
| Lack of knowledge on usage of fertigation unit | 40 | 12.90 |
| No any especial advantage of using the fertigation unit | 17 | 5.48 |
| Malfunctioning due to use | 3 | 0.97 |
| Without drip parts, fertigation unit is not applicable | 158 | 50.97 |
| Fertigation unit not received | 7 | 2.26 |
| Kit is not used for agricultural purposes | 38 | 12.26 |

* Number of beneficiaries who have used the SPDI kit or who had never used it are omitted in calculating the percentages.

Survey Data, 2012

Filter is a more important component in the drip irrigation technologies. It prevents entering unwanted substances and controls entering clay particles to the system coming with water. This will stop the system clogging and make even flow inside the drip lateral tubes. However, situation is worse in the use of filter with SPDI kit (table 4.5). More than 42 per cent of beneficiaries had not used the filter. This can create problems in blocking in-line drippers.

**Table 4.5: Use of the filter unit of the SPDI kit**

| Status of use | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| used up to date | 212 | 57.6 |
| used till recently but not used now | 25 | 6.8 |
| used only in the initial few seasons | 14 | 3.8 |
| used only one season | 16 | 4.3 |
| Never used | 101 | 27.4 |

Survey Data, 2012

Study also attempted to find the usage of drip components with the system. The phase 1 had experienced higher percentage (88%) of unused drips containing lateral part even though it is a very important and required part of the drip technology. Findings revealed that only 24.5 per cent of the beneficiaries had used the drip containing laterals for their system (Table 4.6). That means, more than 75 per cent of the SPDI kits had been operated without drips.

**Table 4.6: Use of drip containing laterals in SPDI kit**

| Status of use | No of beneficiaries (N=368) | % by beneficiaries |
|---|---|---|
| used up to date | 90 | 24.5 |
| used till recently but not used now | 33 | 9.0 |
| used only initial few seasons | 33 | 9.0 |
| used only one season | 33 | 9.0 |
| Never used | 178 | 48.4 |
| Part or system has been stolen | 1 | 0.3 |

Survey Data, 2012

## 4.3 Encountered problems in the use of the SPDI Kit

A significant issue (Table 4.7) recognized by the farmers during the use of SPDI kit was difficulty of water pumping during cloudy days (78 %). Around 20 per cent of the beneficiaries said that power of water pump was not sufficient to provide required amount of water to the crops. Actually, this is not scientifically correct for all crops. But, water intensive or drought intolerant crops like banana and papaw need more water during the fruit ripening stage. However, this can change (Crop Water Requirement) as a result of local climatic conditions and growth stage of the crop.

**Table 4.7: Problems encountered during the use of the SPDI kit**

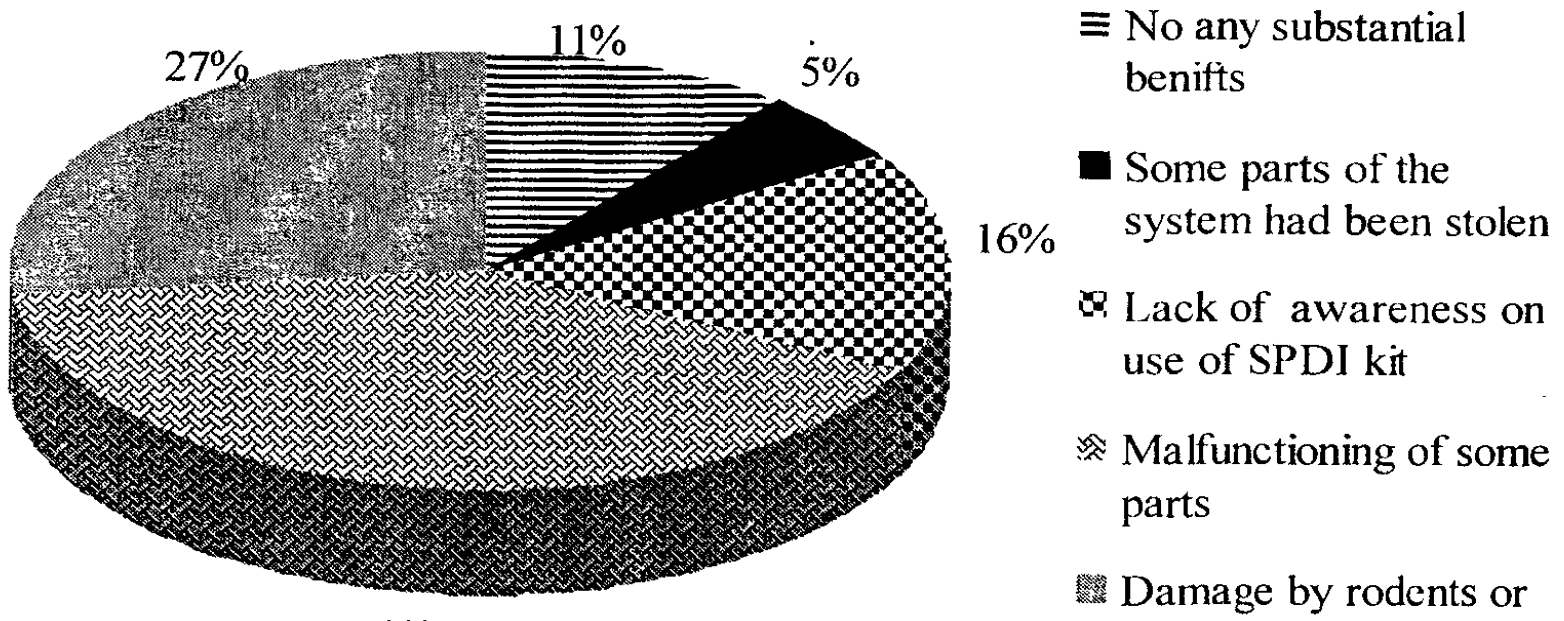
| Weaknesses | No. of farmers (N=368) | Percentage of farmers* |
|---|---|---|
| Pump does not operate during cloudy days | 286 | 77.7 |
| Power of the water pump is not sufficient | 73 | 19.8 |
| Blockages of drippers | 55 | 14.9 |
| Theft problems | 41 | 11.1 |
| Damages done by rodents and other animals | 17 | 4.6 |
| More labour and time is required to clean the drippers | 7 | 1.9 |
| Difficulties in land preparation and weed management | 6 | 1.6 |
| Difficulties of adjusting spacing between two drippers | 4 | 1.1 |
| Believed that the crop will be damaged due to excess watering | 3 | 0.8 |
| Found faults with the system | 3 | 0.8 |
| No wetting of crop leaves | 2 | 0.5 |
| Not sufficient water | 2 | 0.5 |

*Multiple answers make the total percentage more than 100

Survey Data, 2012

Various reasons expressed by farmers for not using the system at the time of the survey is illustrated in figure 4.5. Around 41% of the non users had faced problems due to malfunctioning or break down of some parts of the SPDI kit.

**Figure 4.5: Reasons for not using SPDI kit (at the time of survey)**




Survey Data, 2012

Another 27% of beneficiaries of SPDI kits stated that they were damaged by rodents or farm animals. Non availability of spare parts and poor post project support services are the main causes for the situation. However, 16 per cent of the users said that they didn't use the SPDI kit due to lack of awareness of using the system. This is clearly associated with the responsibilities of the BP solar company. Another 11 per cent of non users stated that the system was not used because there were no substantial benefits. Five per cent non users had lost their system or parts of the system in the field due to theft.

## 4.4 Training, awareness and supporting facilities given by the implementing agencies

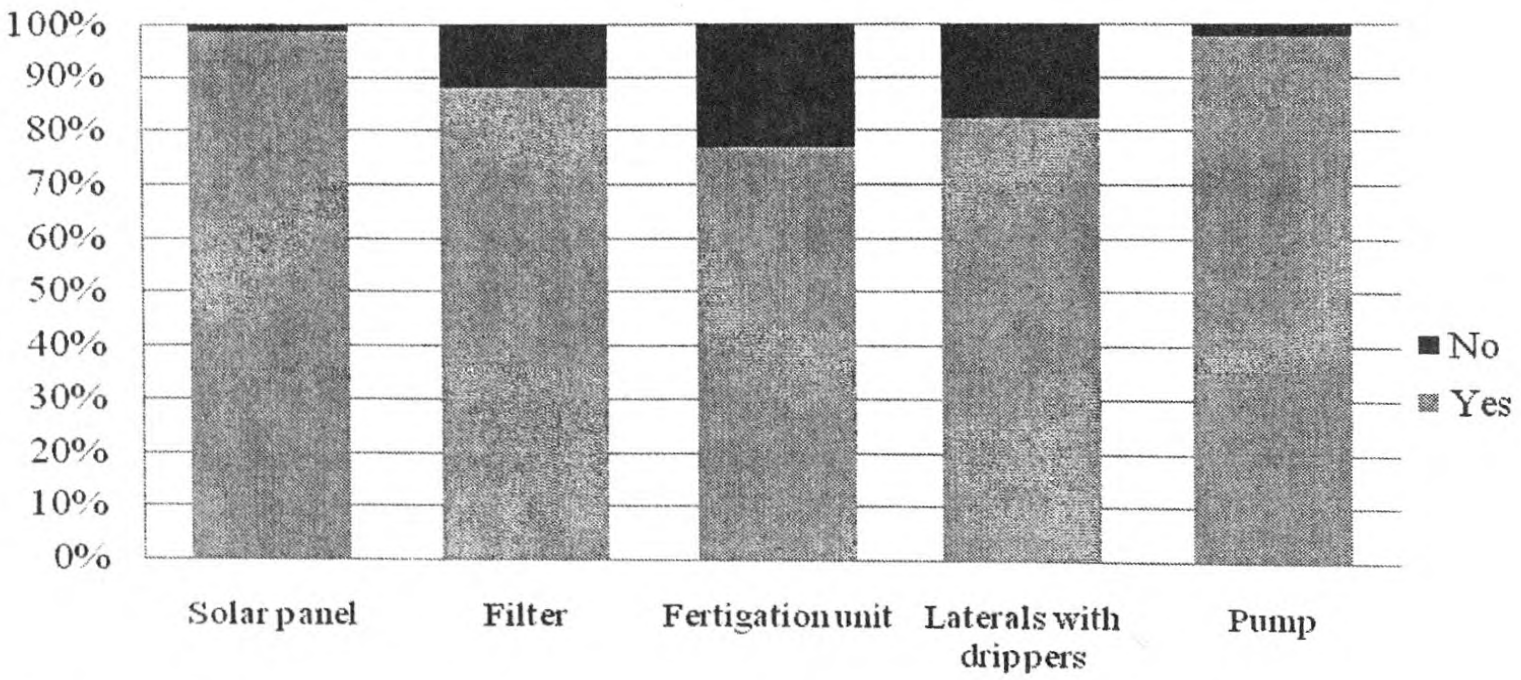
In many technology innovations, awareness and training are very important prior to the implementation process. The implementation stage is the stage in which farmers acquire, install and start to use the technology. This stage seemed to present most problems for the potential beneficiaries. Of the negative factors affecting implementation of the SPDI, lack of technical support service and awareness of the technology use were the main problems in many technology innovations. This has resulted because of lack of availability of spares and additional kits, and poor operation and maintenance of the SPDI kit.

During the surveyed period, farmers were asked about awareness created on the SPDI kit installation, operation, maintenance and about the type of crops which could be easily grown under SPDI. Further, other supports like, inputs and other materials provided were also examined.

### 4.4.1 Awareness related to use

Study attempted to find out level of awareness of using the different components of the SPDI kit under SAWMP. Figure 4.6 shows the farmer's perception about the use of different components of the SPDI kit. Higher percentage of unawareness can be seen in the use of fertigation unit (23%) and the next is the drip containing laterals (18%). This shows how important to implement awareness programmes to make them use the components that are very essential to achieve the project objectives.

**Figure 4.6: Beneficiaries' knowledge about how to use different components in the SPDI kit**




Survey Data, 2012

### 4.4.2 Training needs

Beneficiary perceptions of their training needs were obtained during the survey. About 43 percent of farmers expressed that there were training needs. Of those who required training needs, 62 percent requested training on O&M activities of the SPDI system and the rest were interested on crop cultivation using the SPDI system.

# CHAPTER FIVE

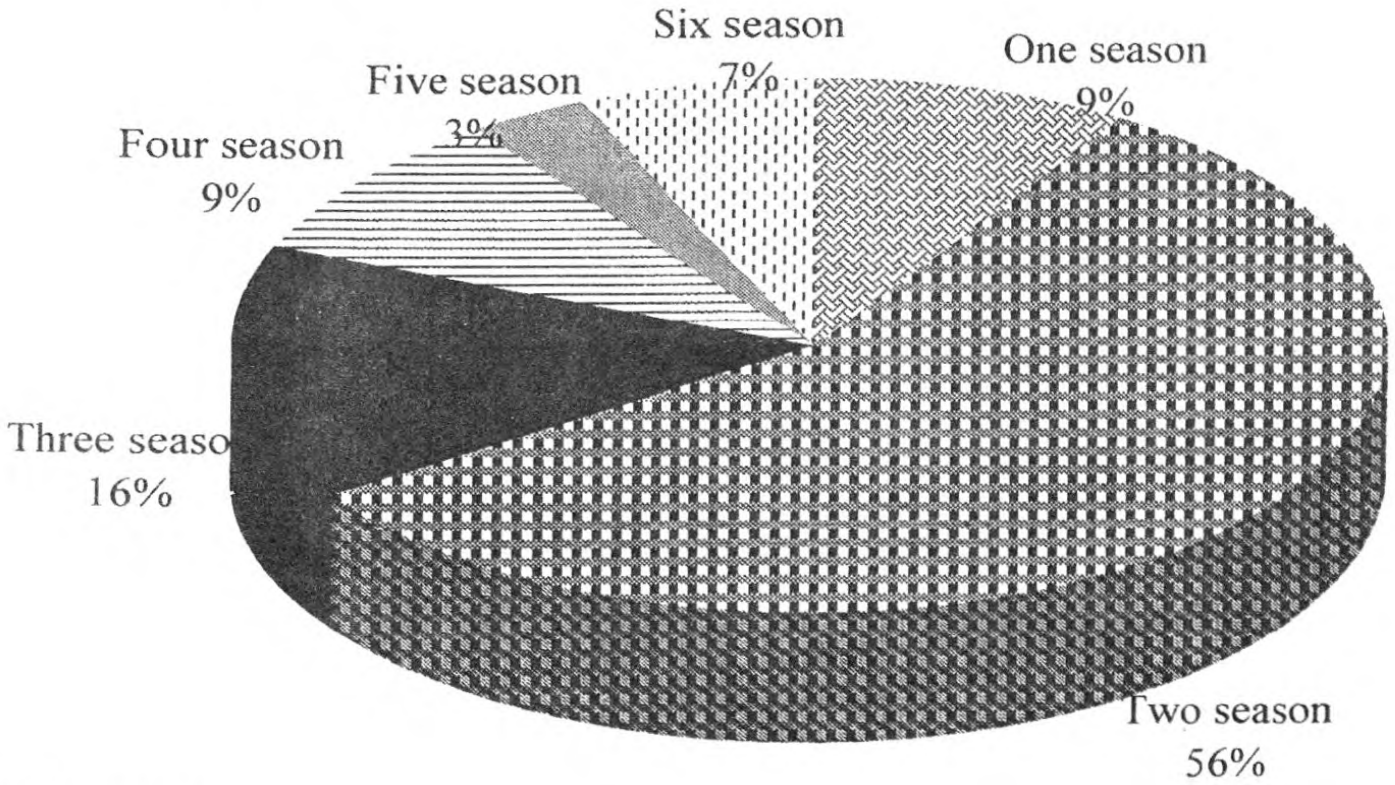
# Impacts of Solar Powered Drip Irrigation Project

There are several impacts of the drip technology particularly on cropping patterns. Further, it has changed crop varieties and also the extent of cultivation. More specifically, micro-irrigation adoption has encouraged farmers to increase their overall cropping intensity or to shift their cropping patterns to high-value, water intensive crops. By introducing SPDI, SAWMP expected to increase farmer's income, saving habits, labour, and to reduce cost of production by reducing use of fossil fuel, use of fertilizer through fertigation unit etc.

## 5.1 Cropping pattern and cropping intensity

Around 90 beneficiaries out of 368 had used the complete system with or without fertigation unit for crop cultivation. More than 70 per cent of beneficiaries had started to practice SPDI in the year 2010. Study revealed that majority of them had used the system for only two seasons per year (Figure 5.1) but 6 of out of 53 had used the system for 3 seasons per year (Total period of the use).

**Figure 5.1: No. of seasons cultivated using the full SPDI kit (Percentage of complete system with or without fertigation unit)**




Survey Data, 2012

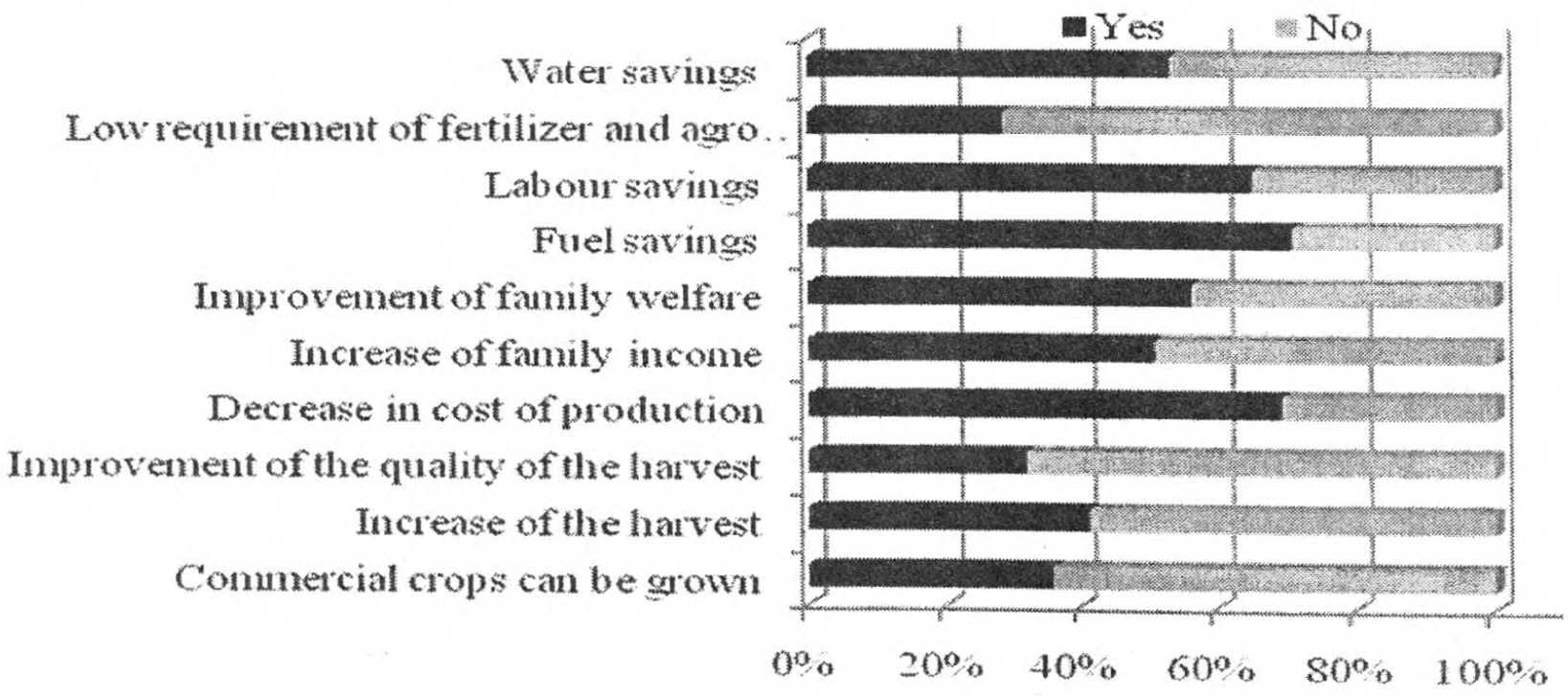
In the Kurunegala district, a change in cropping pattern was observed. It had shifted from subsistence agriculture to water intensive high-value cash crops such as papaw, tomatoes, and banana.

## 5.2 Impact on agricultural activities

Beneficiaries' perceptions of the impact on the use of SDPI kits were also assessed (Figure 5.2). 71 per cent of beneficiaries said that there was fuel saving by using the SPDI kit while 29 per cent said that there was no fuel saving. Some stated that the water they received from the SPDI kit was not sufficient during cultivation period. This water shortage was fulfilled by pumping using kerosene or electricity.

Drip system has the potential to improve the quality of the harvest because it is a form of precision irrigation, and applies water directly to the root zone. Each plant is able to receive the right amount of water at regular intervals, and less water is lost in conveyance. More than 50 per cent of beneficiaries agreed that there were some improvements in saving fuel, water, labour etc. Further, they said improvements could also be observed in family welfare, family income, quality and quantity of harvest as a result of using the SPDI kit.

**Figure 5.2: Advantages of using the SPDI kit**




Survey Data, 2012

## 5.3 Impact on cultivable land extent

Cultivable land extent has been discussed in the chapter 3 section 3.2. According to the information, majority of beneficiaries had owned 0.5 to 1 ac land parcels. However, total cultivated land extent under the SPDI kits was 340 acres. 13 acres bare land extent had been cultivated newly with the use of SPDI kit and that was proportionately about four per cent. This is one good sign for promoting drip technology.

## 5.4 Impact on livelihood

The project objectives, were saving water, fuel, labour, and reducing cost of production, while increasing crop yield, cultivable extent, and leisure time of family especially of women. In dry zonal agriculture watering is done mostly by women.

Majority of the women said, the SPDI kit had reduced the time spent for watering and this has clearly (figure 5.2) improved family welfare. 40 per cent of the beneficiaries stated that there were no any improvements or any changers in farm income due to the introduction of the SPDI kit to their farm land (table 5.1). But, more than 35 per cent said that income had increased due to decrease of cost of production.

**Table 5.1: Change in farm income due to use of the SPDI kit**

| Reason | No. of farmers (N=368) | Percentage of farmers |
|---|---|---|
| No change in farm income | 148 | 40.2 |
| Increase of income due to decreases of the cost of production | 130 | 35.3 |
| Increase of income due to increase in yield | 34 | 9.2 |
| Increase of income due to use of saved time for other work | 25 | 6.8 |
| Increase of income due to changes of crops | 18 | 4.9 |
| Increase of income due to increase of the cultivated extent | 11 | 3.0 |
| Increase of income due to yield quality improvements | 2 | 0.6 |

Survey Data, 2012

# CHAPTER SIX

# Achievements in SPDI Project Phase 2

## 6.1 Achievements in beneficiary selection criteria

### 6.1.1 Employment

Even with the modification done in phase 2, there is no improvement in beneficiary selection at the point of primary employment of the beneficiary compared with the phase 1. (During the phase 1 of this project more than 83 per cent of the beneficiary's primary employment was agriculture but in phase 2 only 76% of beneficiaries were full time farmers.) When systems were given to non-full time farmers they did not utilize the system fully and for given purpose.

### 6.1.2 Land availability and land ownership,

In the process of beneficiary selection, the Samurdhi Bank had considered the requirement of land availability more than ADC farmer selections. However, all the SPDI kits distributed in Jaffna and Mullaitivu districts belonged to the ADC and no any district coordinators were appointed in those two districts. Non availability of proper institutional mechanism leads to improper selection.

Land ownership is a very important factor in considering the sustainability of the SPDI project. If the land is not solely owned by the beneficiary it will result in problems in operation and installing the system regularly. However, around 21 per cent of the beneficiaries not fulfill this requirement related to land ownership. When system was given to farmers who had land on lease or temporary ownerships they had the risk of losing their land in next season. In such situations it is a loss of government money and chances of other full time needy farmers.

Even though the phase 2 of SPDI project introduced several modifications, those modifications had not met the beneficiary selection requirements as mentioned in the project proposal.

### 6.1.3 Water source and water availability

As discussed previously, in some districts nearly half the beneficiaries do not have agro-well to supply water and they faced water scares situations in some periods of the year. This situation leads to hinder the utilization of drip system in its full capacity. Solar powered drip system is most suitable for water scared dry zone of Sri Lanka but some systems have been given to the areas where they do not have experienced water stress situation even during a part of the year. In such situations farmers do not used full drip system. That means most of them used the system without the drip containing laterals. Therefore it is of utmost importantance to select most suitable areas and farmers to get the full benefit of SPDI kit.

## 6.2 Achievements in fulfillment of stakeholder responsibilities

### 6.2.1 Ministry of agriculture

At the time of implementing the Phase 2 of this project SWAMP had introduced District Coordinating Officers (DCOs') for each district to deal with project activities. This was a major administrative change in phase 2 compared with phase 1 of this project. One of the duties of this DCOs' is to create awareness among farmers on this project but, out of 368 sample beneficiaries, only three beneficiaries had received awareness on the project through DCOs'. Awareness creation before providing the system is not at a satisfactory level. This proved by most of the farmers not being fully aware on the conditions included in the agreement. Some farmers had no idea whether they signed the agreement or if signed with whom. However, during the field survey in the Jaffna and Mullaitivu districts it was revealed that there was no DCO appointed by the SWAMP in that particular areas. So, improvement of the beneficiary selection cannot be expected in phase 2 especially in Jaffna and Mullaitivu districts. However, within the sample, 6 beneficiaries out of 368 stated that they didn't sign any agreement with anybody but, they had received the system. This can be due to beneficiaries forgetting issues regarding the agreements or due to mistakes of officials. These types of issues could be seen in the phase 1 as well. Research findings provide evidence that 50 percent of the sample population had not been aware of the conditions stipulated in the agreement even though they had signed it.

However, other than with the ADC and Samurdhi Bank, 13 per cent beneficiaries stated that they signed the agreement with the BP solar officials. For example, in the Ampara district, it was 32 out 72 beneficiaries. This was common in the areas where there was a shortage of relevant government officials appointed for the project. In those places company officials had been very active and had promoted the system. Therefore, those beneficiaries had believed that the agreement they singed was with the company. However, this was something beyond the company responsibility and not a set criterion in the project itself.

According to the procedure, after creating awareness, the interested farmer had to submit an application requesting a system. Thereafter, ADC or Samurdhi Bank officers had to go to the field and examine the suitability of the location and water source to acquire the system. According to the evaluation of the SPDI project phase I, land and water source feasibility was not strictly followed by the ministry or the line agency (Aheeyar *et al* 2013). But in the Phase 2 about 86 percent of the Samurdhi Bank beneficiary farmers responded that the suitability of water source was assessed prior to selecting the beneficiary farmer. This was less than 20 percent of the ADC beneficiaries because the SPDI project phase 2 implemented via ADC operated mainly in the Northern Province. All beneficiaries in Jaffna and Mullaitivu said that no one came to the field to check the feasibility prior to installing the system in the field. This was due to shortage of government officials in those war affected areas.

Providing crop recommendations, planting materials, knowledge related to drip technology and facilitating proper marketing channel to sell harvest are most

important responsibilities of the Ministry of Agriculture on achieving success of this project. Evaluation on phase 1 also reveals that these duties were not fulfilled by ministry. In phase 2 even with newly appointed DCOs' these services were not provided at a satisfactorily level.

The SPDI project phase 1 evaluation shows external interventions by some other parties (politicians and BP Solar Company) in promoting the SPDI systems other than relevant government officials (Aheeyar *et al*, 2013). Such interventions were still there in selecting beneficiaries in the second phase as well.

### 6.2.2 BP solar company

51 percent of the beneficiaries who needed maintenance of the system had informed about their needs to the service centre maintained by the BP Solar Company in the district. However, due to lack or shortage of trained staff or lack of required spare parts most of the beneficiaries were unable to rectify the problem. These were some of the drawbacks when considering the usage of the complete systems of the SPDI. Lack of proper maintenance and non availability of spare parts had led to frequent breakdowns in the systems. If system does not work for more than one week it leads to crop failure especially in dry areas. When farm plot is prepared for drip irrigation it is not convenient to adopt another methods of irrigation like flood irrigation. Therefore quick response is needed in this regard.

### 6.2.3 Beneficiary farmers

Responsibility of beneficiary farmers is to use SPDI kit in its maximum potential to get better harvest and enhance their livelihoods. Nearly 90 Percent of the farmers had used drip system for some kind of purpose but only 14 percent of them used the complete system. If it is not used with drippers the objective of giving solar powered drip system is failed. Research findings clearly show that level of usage and mode of use is directly related to the level of water scarcity As an example in the Jaffna district most of the beneficiaries had used the complete system because it is hard to supply water from other sources in Jaffna.

During the phase 1 of the SWAMP, only 12 per cent of the beneficiaries had used the complete system either with or without fertigation unit (Aheeyar *et al*, 2013). However, improvements could be seen in the phase 2 (24.5%). On the other hand, nearly 23 per cent of beneficiaries had not used the SPDI kit for agriculture activities. This is a complete deviation from the project objectives. This means that on the whole 75.6 per cent of the beneficiaries had not adhered to the project objective of water use efficiency (no use of the drip part) and of the purpose of use.

Higher percentage of unawareness can be seen in the use of fertigation unit (23%) and the next is the drip containing laterals (18%). This shows how important to conduct awareness programmes to make them use the components that are very essential to achieve the project objectives.

## 6.3 Usage of different components of SPDI kits and their applications

**Fertigation unit**

Fertigation unit is given with the SPDI kit to improve the fertilizer use in an efficient manner with low labour. However, that project objective was not achieved in an acceptable manner. Indeed, fertigation through SDPI kit was yet to gain popularity. Training on this matter is important to make aware of the resource use efficiency by beneficiary farmers. Work in this regard has to be done by the horticulture officials to disseminate the technology.

**Use of drip tapes**

More than 75 per cent of the SPDI kits given in phase 2 had been operated without drips. Without drip containing laterals, fertigation through fertigation tank is not possible. Also efficient use of water is difficult without drippers. Indeed, whole concept of drip technology collapses if the SPDI kit is used without drip containing laterals.

## 6.4 Encountered problems in using SPDI unit for agriculture

According to beneficiaries when suns get covered by a small cloud, pumping stops due to low solar radiation. This will create problems of uniform application of water. To overcome such problems, adding a battery to the solar panel can make the storage of additional energy to be released when needed. This mechanism makes uniformity of application.

However, use of storage reservoir is another solution for uncertainty of solar pump operations during cloudy days. Reservoirs not only provide a buffer for crop water needs which can be met in time but also allow sediments to settle down, thus reducing water filtration requirements and preventing blocking of drippers. Further, storage reservoirs are recommended even when the sole source of water is groundwater (wells). They provide a buffer in case well pump malfunctions or in other unanticipated circumstances.

Beneficiaries believed that the drip tapes given with the system was in poor quality. Most of the drip tapes were blocked and couldn't be used continuously. Time to time several methods and chemicals were introduced to rectify the problem. But none of them were successful. However, use of filter is much important to prevent clay or silt particles entering into the system. Quality of water is crucial in drip irrigation management. Therefore, choices of filters need to match with the water quality and filters must be properly managed. In spite of filtration, drip tape must be flushed frequently depending on the amount and kinds of sedimentation in the tape. Technically, in extreme conditions chlorine or other chemicals need to be added periodically to the drip to kill bacteria and algae in the drip lines that may clog the drippers.

However, most of the beneficiaries had not used the drip containing laterals because of frequent blockages of drips. In Sri Lanka, in most of the drier parts, ground water is

little bit salty. Water salinity also creates problems to the drip tapes by accumulating salt in the drip openings. Frequent flushing is required to clean the drip tapes after being used. Many cases were reported about damages caused by rodents. Rodents must be controlled, especially where drip tape is laid to provide irrigation for a number of seasons.

Providing a proper tool kit for operation and maintenance is essential for proper management. But, the researchers couldn't find any information regarding a tool kit given to any beneficiary. Without proper tools malfunctioning systems could not be repaired while fixing the laterals to the main line. Another problem mentioned by the beneficiaries was difficulty of changing the spacing between two drips. If the farmer wanted to change his previous crop to another one, he needed to change the spacing of drips accordingly.

## 6.5 Loan repayment

Number of beneficiaries in the SPDI phase 2 are making continuous loan repayment. The study conducted to evaluate the phase 1 had shown that re-payments mechanism was not properly functioning (Aheeyar *et al*, 2013). Similar conditions could be observed in the phase 2 too. In the phase 1 of SPDI, 80 beneficiaries had paid any installment out of 369 and in the phase 2, 41 out of 368 numbers. However, no any progress of repayment could be observed in the phase 2 even though changes had been introduced in the implementation process.

### 6.5.1 Reasons of non-payment of regular installments

There was a significant correlation between knowing about the SPDI phase 1 and paying installments by sample farmers. This indicates that those who were aware of the phase 1 of this project were more reluctant to pay any installment (Pearson's correlation coefficient is – 5.154 and significant at 0.01 level). Farmers had thought that if beneficiaries of the phase 1 had not paid and no any legal action had been taken, it would be the same with them also. They believed that any legal penalty against the phase 1 defaulters should be initiated before coming to them.

By observing the above reasons for not paying installments, several arguments can be made. The signed agreement between the Ministry of Agriculture and beneficiaries was not strong enough to take any legal action against the defaulters. Most of the selected beneficiaries had obtained the system without knowing its actual usefulness. They had taken it because of low down payment, given in the installment plan believing the system was useful. Without any legal penalty against defaulters in the phase 1, the legal validity and practicability of the conditions of the agreement were not adequate to push the beneficiaries to make regular installment payments.

# CHAPTER SEVEN

# Conclusions and Recommendations

## 7.1 Major findings

### Demographic features

- Youngest interviewee was 18 while the oldest was 77 years old and majority was between 30 to 60 years.
- The average family size within the sample consisted of 4 family members. More than 60 per cent of the beneficiaries' formal education was beyond the GCE ordinary level.
- A significant correlation can be seen between age and education of the beneficiary farmers indicating that younger farmers are more educated than older ones.

### Selection criteria

1. **Employment**

- The majority of sample beneficiary farmers' (76%) main employment was agriculture and four per cent of the sample beneficiaries were state or private sector permanent job holders and 10 per cent were self-employed and another 10 per cent did various off farm jobs.
- More than 24 per cent of selected beneficiaries had not come within the minimum beneficiary selection requirements.

2. **Agricultural land**

- Around 21 per cent of the beneficiaries had not met the selection procedure related to land ownership and it was not in accordance with the set criteria even in the phase 2.
- In the Samurdhi Bank beneficiary selection fulfillment of the requirement of land availability was better than the ADC selections.

3. **Water source**

- Among ADC beneficiaries 85 percent had agro wells to supply water for the system and 11 percent had used domestic well to supply water.
- Only 55 per cent of the Samurdhi Bank beneficiaries had agro-wells to supply the water for drip system.
- Water availability is a key element for the sustainability of the SPDI usage. Comparatively, in ADC selection of beneficiaries regarding water source was better than in Samurdhi Bank category.

4. **Grid electricity to the farm land**

- About 83 percent of the sample population of ADC and 62 percent of the Samurdhi Bank beneficiaries had no accessibility to grid electricity for their farmland at the time of `project implementation.

**Awareness of the SPDI programme under SWAMP**

- Nearly half the total beneficiaries had gained awareness through the officers attached to the Samurdhi and ADC.

**Agreement**

- 50 percent of the sample population had not been aware of the conditions stipulated in the agreement even though they had signed it.
- About six farmers out of 368 were not aware of the agreement and had never signed any document with any agency.
- 13 per cent beneficiaries stated that they had signed the agreement with the BP solar officials and this was common in the areas where there was shortage of government officials appointed for the project and where many activities of the implementing process had been done by company officials. However, this was something beyond the company responsibility and was not a set criterion in the project itself.
- Majority of beneficiaries bought SPDI kit believing it as a fuel saver. Around 40 per cent of them bought this kit because it was given at a low initial installment.
- Around 95 percent of the SPDI systems had been installed in the field by the technical staff of the company, two percent had been installed by farmers themselves and one percent of the beneficiaries had not yet installed the systems.

**Repair and maintenance**

- Out of total selected systems, only 16 percent (59 systems) had needed any kind of repair.
- 51 percent of the maintenance needs were informed to the BP Solar Company and 47 percent of them had received service within a period of one week.
- 37 percent of the beneficiaries said that they didn't receive any service for their complaints related to repairs. Most of the service receivers from the BP Solar Company didn't make any payment for services, but only 9 beneficiaries said that they paid for it. That may be due to unawareness of the agreement or due to need for keeping good relations with the technicians.
- There was no proper monitoring mechanism after the sales services provided by the company.

## Training on cultivation

- Only 17 percent of the farmers had received training or guidance and recommendations from the related government officers regarding cultivation of crops under drip irrigation and only 7 percent of the sample beneficiaries had received seeds and planting materials from the DOA.
- In the Jaffna and Mullaitivu district no one in the sample stated that they had received any recommendation or planting materials under this project.
- 43 per cent of the respondent farmers were interested in going for training on SPDI and related technologies. Among the required training needs, 62 percent requested training on O&M activities of the SPDI system and the rest were interested in training on crop cultivation using the SPDI system.

## Performances of the SPDI kit

### Method of use

- Around 25 per cent of beneficiaries had used the complete SPDI kits with or without fertigation unit for agriculture activities.
- Another 53 per cent beneficiaries had used the SPDI kits without drip containing laterals.
- 12.5 percent beneficiaries had not used the system for crop cultivation.
- Nearly 9 per cent of the beneficiaries had not used the SPDI kits for any purpose at the time of the survey. This is one of the observed failures of meeting the SWAMP objectives.
- All reported uninstalled (never used) SPDI kits were found in the Badulla district.
- During the phase 1 of the SWAMP, only 12 per cent of the beneficiaries had used the complete system either with or without fertigation unit. However, improvement could be seen in the phase 2.
- Significant correlation could be observed with the usage of the SPDI kit and type of water source, availability of water in the water source, availability of grid electricity to the farm, technical or encountered problems during usage of the SPDI kit and changes of farm income due to SPDI kit.

### Use of different components of the drip system

- More than 82 per cent beneficiaries had not amalgamated the fertigation unit to the SPDI kit. However, around 17 per cent of them had tried this at least few seasons.
- 42 per cent of beneficiaries had not used the filter to their SPDI kit. This could result in problems related to blocking in-line drippers.
- Drip containing laterals is the most important and essential part of the drip technology. The phase 1 of the SWAMP experienced 56% of unused drips

containing lateral and in the phase 2 it was 53 per cent. Without drip containing laterals, fertigation through fertigation tank is not possible. Also efficient use of water cannot be practiced without drippers. Indeed, the whole concept of drip technology collapses with the absence of drip part.

- Significant percentage of unawareness could be seen in the use of fertigation unit (23%) and the drip containing laterals (18%).

**Re-payment of loan**

- Even though more than 90 percent of the beneficiaries were aware of the repayment conditions at the time of purchasing the system, no one had continued the repayment.
- Only 11 per cent (41 beneficiaries) had paid any (at least one) installment. The main reason given by farmers is, "if others do not pay why should we pay". Farmers perceived that if there was penal action it was for all and not only for one.
- Most of the farmers' main reason for purchasing this system was the low initial payment.
- 27 percent of selected beneficiaries stated that income generation from this system was not sufficient to pay the installment.
- Farmers (26%) in the Jaffna and Mulative districts said that there was no proper mechanism to repay and even they did not know where to pay and who the responsible people were on repayments.
- Significant correlation could be observed between knowing about the SPDI phase 1 and paying installments by sample farmers indicating that those who were aware of the phase 1 of this project were more reluctant to pay any installment (Pearson's correlation coefficient is – 5.154 and significant at 0.01 level). This means that farmers perceived that beneficiaries of the phase 1 had not paid and no any legal action had been taken against them. Therefore they believed that any legal penalty should be inflicted against the phase 1 defaulters before they are punished.
- Another group of beneficiaries thought that,
  - This was a Government subsidy programme and there was no need to pay back (26%).
  - Some expected that although this project was given on repayment basis, after a certain period of time government would write off this loan as the past governments did for agricultural loans (7.1 %).
  - Six per cent said that the system was not worth as stated by the SAWMP. They believed that they could buy this kind of product for a lesser price in the open market.
  - Beneficiaries were misguided by local politicians and by some BP solar officials (16 %) saying that there was no need to repay because this was a grant from the Australian government.

- 27 per cent of the beneficiaries mentioned that they could not pay back the installments due to difficulties of obtaining expected benefits. Most of the selected beneficiaries had not obtained the system by knowing its actual usefulness.

- However, no any progress of re-payment could be observed in phase 2.

**Cropping pattern and cropping intensity**

- Study revealed that majority of beneficiaries had used the system for only two seasons per year.
- In the Kurunegala district, a change in cropping pattern was observed. Shifting from subsistence agriculture to water intensive high-value cash crops such as papaw, tomatoes, and banana were observed in the district.
- In the Badulla district, an increase in vegetable production was observed.

**Socio economic impacts**

- 71 per cent of beneficiaries agreed that using the SPDI kit had helped to save fuel.
- More than 50 per cent of the beneficiaries agreed that there were some improvements in saving fuel, water, labour etc.
- Further, they said improvements could be also observed in family welfare, family income, quality and quantity of the harvest by using the SPDI kit.

**Impact on cultivable land extent**

- Under the SPDI kits there were total cultivated land extent of 340 acres.

**Impact on livelihood**

- Majority of women said that, the SPDI kit had reduced the time spent for watering and there was improvement in family welfare.
- 40 per cent of the beneficiaries stated that there were no any improvements or any changers in farm income due to introduction of the SPDI kit to their farm land. But, more than 35 per cent said that income had increased due to decrease of cost of production.

**Encountered problems related to the SPDI kit**

- The significant issue recognized by farmers during the use of the SPDI kit was water pumping difficulties during cloudy days (78%).
- Around 20 per cent of the beneficiaries said that power of water pump was not sufficient to provide required amount of water to the crops. Actually, this is not scientifically correct for all crops. But, water intensive or drought intolerant crops like banana and papaw need more water during fruit ripening stage. However, this

can change (Crop Water Requirement) due to local climatic conditions and growth stage of the crop.

- Beneficiaries believed that the drip tapes given with the system were poor in quality. Most of the drip tapes were blocked and could not be used continuously.
- 41% of the beneficiaries did not use the system due to malfunctioning or breakages of some parts of the SPDI kit.27% of beneficiaries' SPDI kits were damaged by rodents or farm animals. Non availability of spare parts and poor post project support services were the main causes for this condition.

## 7.2 Conclusions

1. Main objective of the SPDI project is to enhance the efficient usage of water on water scarce situations as well as to improve the efficiency of input and labour by using the drip system. According to the findings larger proportion of beneficiaries did not use drip containing lateral part.
2. Usage of complete system had been hindered because of incompatibility of the system with attributes like water availability, water source, changes of farm income due to the SPDI kit and technical or encountered problems during usage. Those attributes have to be given more weightage during beneficiary selection for sustainability of the project.
3. No positive impact could be seen on the beneficiary selection, usage of the SPDI kit and repayment mechanism even with modifications introduced during the phase 2.
4. The responsibilities of the stakeholders were not met with set criterion of the agreement signed. Many shortfalls could be observed in promoting, selecting beneficiaries, implementing, operation and maintenance, after sales services and the re-payment of the loan. Especially, in the Northern and Eastern provinces beneficiary selections were mainly done by the BP solar company by using middlemen in the villages, though it was the responsibility of the Ministry of Agriculture. More than 50 percent of the beneficiaries complained that they didn't know the conditions of the agreement even though they had singed it. More awareness programmes have to be conducted to give a clear picture of the conditions and responsibilities of the agreement before they sign the agreement.
5. Blocking of drippers, improper operations of water pump during cloudy days, durability of the drip tapes, damage of drip containing laterals by rodents, non availability of spare parts and poor post project support services can be listed as the main problems encountered during operation of the SPDI units.
6. Beneficiaries stated that the use of the SPDI kit had helped to save fuel, water and labour while observing increases of family welfare, family income, quality and quantity of harvest.
7. The agreement signed between the Ministry of Agriculture and beneficiaries was not strong enough to take any action against the defaulters. Due to certain shortcomings of the conditions of the agreement the project had not been able to push the beneficiaries to make regular installments.

## 7.3 Recommendations

1. Successful usage of the complete SPDI system is strongly related to attributes like water availability, water source, availability of grid electricity to the farm land, changes of farm income due to the SPDI kit and technical or encountered problems during usage. Therefore in future interventions it is strongly recommended paying more attention and strengthening the beneficiary selection procedure.
2. Strong monitoring and evaluation process is essential to guide all the stakeholders to fulfill their duties and responsibilities to achieve the project goals.
3. Modifications in the second phase had no significant impact on the collection of loan repayments. Therefore, it is recommended that authority of installment collection be given to grass root level government officers (GN, ARPA, AI, DO, SDO etc.) and to pay an incentive to them to encourage efficient installment collection.
4. Establishment of proper institutional structure in selected areas prior to the implementation of the project is essential to conduct proper awareness campaigns among farmers as well as collecting installments in future interventions.
5. Agreements signed in these kinds of projects should be strong enough to recover the cost, if beneficiaries failed to pay back the loan.

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P. O. Box 1522
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