Adoption of Parachute Technology by the Farmers in Anuradhapura District

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FOREWORD

Technology transfer is a pre-requisite to achieve competitiveness and sustained success in agriculture. Suitability of such technologies to field conditions should also be assessed in order to ensure that they are not in conflict with environmental, socio-economic and other related aspects of farming communities. Thus, the primary responsibility of researchers is to identify progress and setbacks of transfer and adoption of technologies and to initiate necessary measures to promote technology adoption.

The main focus of this report has been to identify progress and setbacks of '*parachute* method' which is a new technology invented by the Rice Research Institute at Batalagoda for broadcasting of seedlings in paddy cultivation. Study reveals that the technology has been popular among the farming community due to its high yielding potential resulting from undisturbed seedling vigour and increased number of tillers in a plant.

The study illustrates that timely water availability is a critical factor for farmers to adopt this technology. In addition, the dissemination process should include regular awareness creation and skills development that will contribute to attitudinal and behavioural changes among the farmers. Farmers should be equipped with adequate knowledge and skills and sufficient inputs should be ensured to them to facilitate the adoption of new technology. This will enable rapid penetration of the technology to the farming community within a short period and minimum effort by the extension personnel.

I hope this report will be useful to extension staff as well as to researchers and policy planners.

Lalith Kantha Jayasekara
Director/HARTI.

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We are very much indebted to the farming communities in Nachchaduwa scheme and Mahaweli ‘H’ system for sharing their valuable time to provide data and information during the field survey conducted by the HARTI. Our thanks are also due to the extension staff in the two study areas for their invaluable assistance extended to complete this study.

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Authors

EXECUTIVE SUMMARY

Termed as *parachute* method, a seedling broadcasting technology of rice was introduced to major irrigated areas in the country by the Rice Research Institute (RRI) at Batalagoda. This technology known as a low cost and high yielding technology for rice establishment, was introduced to Mahaweli H system in 2004/05 *maha* season and to Nachchaduwa scheme in 2006/07 *maha* season in the Anuradhapura district. The main focus of this study was to learn the adoption behaviour of this newly introduced technology.

Undisturbed seedling vigour, increased tillering and high yield are the particular characteristics of the *parachute* method. The study shows that there is a significant yield difference compared to broadcasting method indicating a 77.5% yield increase in the Mahaweli area. The binary logistic analysis used to find factors determining the adoption decision shows that farmer skills, labour availability, total land availability and input availability have a significant effect on adoption of *parachute* technology in *Mahaweli* areas. As revealed from Nachchaduwa scheme, uncertainty of water is a critical factor for non-adoption of this technology. Also, heavy rainfall is an obstacle for nursery management. Non-durability of trays, more time and labour needs for nursery management and inconvenience of nursery management are other constraints of *parachute* technology.

The process of transferring the *parachute* method is constrained due to inadequacy of demonstrations, delays in conducting awareness programmes, poor farmer knowledge in obtaining trays, staff shortages leading to limited farm visits, lack of regular training on field application of *parachute* method and lack of feedback. Negative attitudes of the farmers both general and specific to the *parachute* technology have also constrained the dissemination of technologies within the farming community.

Study emphasizes the need for dissemination of *parachute* technology among progressive and innovative farmers who have access to labour and who could afford additional cost of trays. Whilst skill training is a critical factor for wider adoption, proper awareness building followed by skill training, and solving problems relating to trays are required to promote the adoption of the *parachute* method. Water availability is a critical factor in this technology and therefore attempts to introduce the technology should be limited to cultivation seasons and areas where water availability is assured.

In general, demonstrations are conducted in the fields of progressive farmers who adopt the technology with minimum failures. Survey findings uncover this as a successful process for dissemination of technologies throughout the farming community. Overall, the weak extension service in educating farmers through individual, group and mass methods, less access to input and output markets and lack of dissemination of new technologies are the major constraints in the present extension management system.

Study recommends introduction of *parachute* method to other areas where water availability is assured. It also emphasizes the need for dissemination of parachute technology among progressive/innovative farmers who could afford the cost of trays and who have access to sufficient labour. Whilst skill training is a critical factor for widespread adoption, proper awareness building followed by skill training is highly important. Ensuring timely availability of trays through action to promote the production or importation of durable and low cost trays are required to promote the adoption of the *parachute* method. Overall, strengthening of entire technology transfer process through innovative knowledge management systems is proposed.

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CHAPTER ONE

Introduction

1.1 Background of the Study

The dissemination and adoption of appropriate technology and information provide the foundation for global competitiveness of agriculture. This requires new knowledge and technologies to be assimilated, objectively evaluated, systematically transferred to end-users and rightly altered in accordance with the feedback from subsequent field application by the end-users namely the farmers. This cyclic process characterized by two-way communication is thus a pre-requisite to ensure the above competitiveness.

Today, there is an ever-expanding knowledge base of new agricultural technology and information that are being developed by various institutions dealing with the agriculture sector in the country. The generation of technology and information is not always synonymous with their adoption and diffusion. This is due to attitudinal and behavioural aspects involved in the technology adoption process. The adoption of research-based technology by the small farmers is, in many cases, a direct function of the extension educational programmes offered to them through field level extension agents. Under the current context, the three fold authorities, the Department of Agriculture (DOA), Provincial Ministries of Agriculture and Mahaweli Authority of Sri Lanka (MASL) offer such extension/educational programmes to the local farmers.

Termed as *parachute* method, a seedling broadcasting technology of rice was introduced to major irrigated areas in the country by the Rice Research Institute (RRI) at Batalagoda. This technology known as a low cost and high yielding technology for rice establishment was introduced to Mahaweli 'H' system in 2004/05 *maha* season and to Nachchaduwa area in 2006/07 *maha* season through the Mahaweli and inter-provincial extension management systems in the Anuradhapura district. The main focus of this study was to learn the adoption behavior of this newly introduced technology in Anuradhapura district.

1.2 Significance of the Study

The effective dissemination of information and feedback from the end-user is very important in a number of ways namely (a) evaluating the strengths and weaknesses of a particular technology or information transferred to end-users (b) improving the productivity at farm level (c) understanding the viability of such technologies under field conditions. The investment on new technologies might become uneconomical in the absence of such information. The *parachute* method is known as a method of rice establishment with a number of positive features. However, there is lack of information pertaining to attitudinal and behavioural aspects of adoption of this technology, means of further improving it and its viability at farm level. This study attempts to fill the above information gap.

1.3 Objective

The main objective of this study is to understand the adoption behaviour of *parachute* method by the farmers in major irrigated areas in Anuradhapura district.

1.3.1 Specific Objectives

1. To study the attitudinal and behavioural aspects associated with the adoption of *parachute* technology by farmers.
2. To identify constraints and weaknesses in the transfer of *parachute* method and to suggest appropriate policy recommendations.

1.4 Study Limitations

The rate of adoption of *parachute* method in Nachchaduwa area was very low and therefore only a descriptive analysis is presented with regard to the Nachchaduwa area.

1.5 Organization of the Report

This report is organized into five chapters. The introductory chapter discusses the problem which gave rise to the need for this study and the main and specific objectives. The next chapter provides literature on *parachute* technology, different types of extension systems and constraints of technology transfer process in Sri Lanka. The third chapter explains the methodology. The fourth chapter is devoted to presentation and analysis and the last chapter draws conclusions and sets out recommendations.

CHAPTER TWO

Literature Review

2.1 Introduction

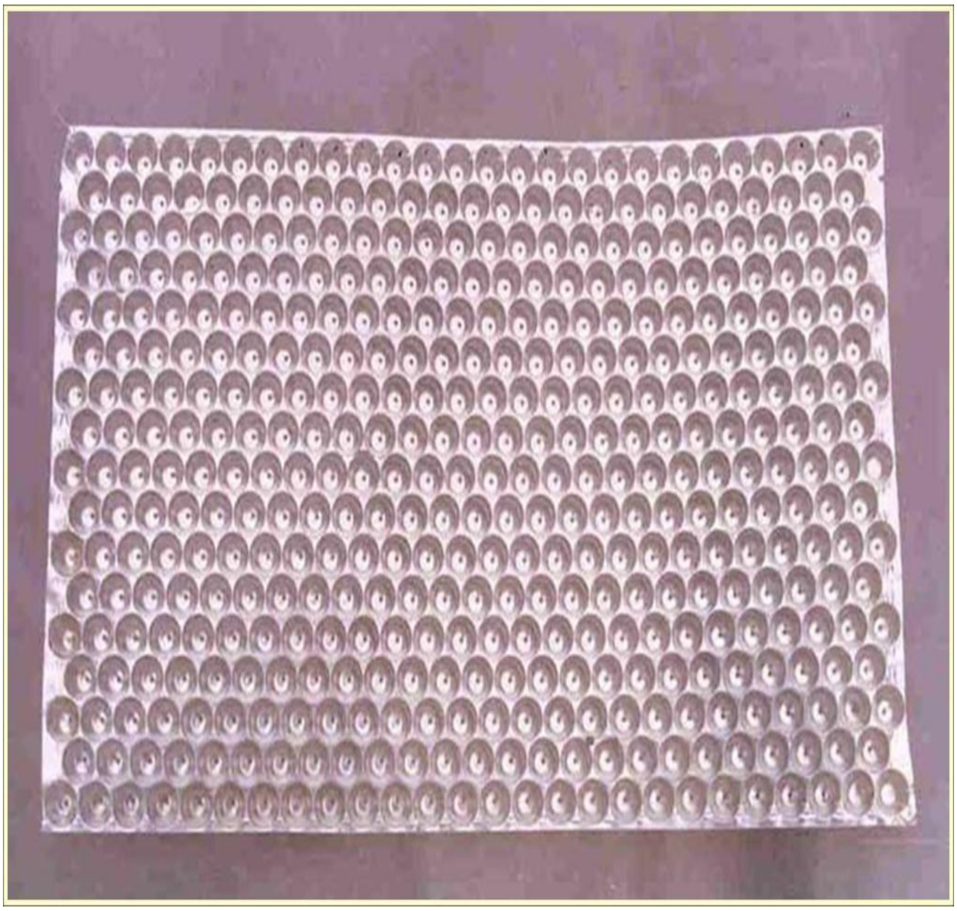
This chapter provides an introduction into *parachute* method and discusses and reviews the processes of adoption and diffusion of technology, different types of extension systems in the country and constraints on technology transfer process in the country.

2. 2 The *Parachute* Method

Parachute method is a technique of tossing rice seedlings, uprooted from plastic trays containing a soil ball, in a projectile manner into the puddled field. This technology as a method of field establishment of paddy was invented in China. The seedlings used for broadcasting are uprooted in such a way that sufficient soil adheres to the roots thereby dropping the seedlings upright. In order to ensure high percentage of seedlings planted upright by the broadcasting method, flexible plastic trays are used for preparation of nursery. A tray of 56 cm length, 34cm width and 2cm height contains 434 small plugs and ¾ of each plug is filled with mud. Then two to three healthy seeds are broadcast in each plug of the tray followed by placing of a thin soil layer over it. About 306 trays and a 100m² nursery are sufficient for an area of one acre. At the time of the survey, the cost of one tray was Rs. 27.00.

Little water is applied to the nurseries when required. The nursery so grown would take only 12 -18 days to attain a height of about 20cm and can be easily uprooted. Raising of seedling by using plastic trays not only save nursery bed area but also facilitate leveling of seedling bed and saves labour needed to lift seedling for broadcasting. The technique facilitates early transplanting, improves nutrient and environmental conditions for the seedlings besides promoting early tillering. It was modified to suit Sri Lankan conditions by the Rice Research Institute (RRI) at Batalagoda. Originally in China, the whole process was mechanized. In Sri Lanka, the technology was modified so that the plants can be broadcast manually.

The technology was first introduced to the areas where water availability is assured so as to avoid the risk of yield losses due to shortage of water. Therefore, the target groups were only paddy farmers in major irrigated areas who generally do not experience water shortages. It was popularized in Sri Lanka as a low cost alternative for high cost of production due to high cost of hybrid seed paddy. To reduce the cost of seed, it was required to reduce the seed requirement for which transplanting is essential. Transplanting is not preferred by the farmer due to high demand of labour.



Plastic Tray
(By S. N. Jayawardene, RRDI, 2009)

The *parachute* method is a better alternative for field establishment of paddy as it demands less labour. Whilst the technology was under experimentation, it was introduced to the field in 2005 in Ratnapura and Kegalle districts and gradually introduced islandwide. No strong efforts were made to popularize this technology. Few training programmes have been conducted. Leaflets and demonstrations available at the RRI are the other means of communication.

Uprooted Plants from the Nursery
(By S. N. Jayawardene, RRDI, 2009)

The Nursery
(By S. N. Jayawardene, RRDI, 2009)

2.3 Innovation and the Process of Adoption/Diffusion

"Adoption" refers to the stage in which a particular technology is selected for use by an individual. "Innovation" is similarly used with the nuance of a new or "innovative" technology being adopted. "Diffusion" refers to the stage in which the technology spreads to general use and application.

Diffusion of an innovation occurs through a series of steps. This process is a type of decision-making and occurs by a series of communication channels over a period of time. Ryan and Gross first indicated adoption as a process in 1943 (Rogers, 1962) where it is categorized as: awareness, interest, evaluation, trial, and adoption. This was later re-termed as: knowledge (first, one must hear about the innovation), persuasion, (second, they must be persuaded of the value of the innovation) decision (they then must decide to adopt it), implementation (the innovation must then be implemented) and confirmation (finally, the decision must be reaffirmed or rejected)**.** The focus is on the user or adopter. The rate of adoption is defined as the relative rate with which groups adopt an innovation. It is usually measured by the length of time required by people to adopt an innovation (Rogers, 1962). Innovators are the first individuals to adopt an innovation. Innovators are willing to take risks, are generally young in age, and have closest contact to scientific sources and interact with other innovators. Early adopters are the next category of individuals to adopt an innovation. They too are typically younger in age, are more educated, and are more socially forward than late adopters (Rogers 1962, p. 185). Early majority are individuals who adopt an innovation after a varying degree of time. This time of adoption is significantly longer for the innovators and early adopters. Late majority are individuals who adopt an innovation after an average number have adopted the technology. These individuals approach an innovation with a high degree of skepticism. Late majority are typically skeptical about an innovation, have below average social status, very little financial strength and keep contact with others in late majority and early majority. Laggards are individuals who are the last to adopt an innovation. Unlike some of the previous categories, individuals in this category have an aversion to change-agents and tend to be advanced in age. Laggards typically tend to be focused on “traditions”, have lowest social status, lowest financial fluidity, oldest of all other adopters and are in contact with only family and close friends.

A strong promotion is required to ensure the conditions necessary for technology adoption and diffusion. Training in its technical aspects and application to real needs is crucial for a technology to move beyond innovators and early adopters (Moore,1991). Time for experimentation and development of applications is essential. Successful users are required to motivate other users for the technology to be accepted by the majority.

2.4 Constraints in the Technology Transfer Process

Under the T&V system the extension worker and *Krushi Viyapthi Sevakas* (KVSs) met farmers fortnightly and actively involved in the solving of field extension issues. Along with the termination of the T&V system there was the conversion of 2,300 KVSs to the position of *Grama Niladharis (*GNs), which led to the virtual breakdown in the link between farmers and the extension services because they were assigned with other duties in addition to the extension duties. Under this project, the Field

Extension Team (FET), which was represented by Agricultural Instructors, Coconut Development Officers, Livestock Development Instructors and Extension Officers who worked within a particular agrarian service centre level, had links with the farming community.

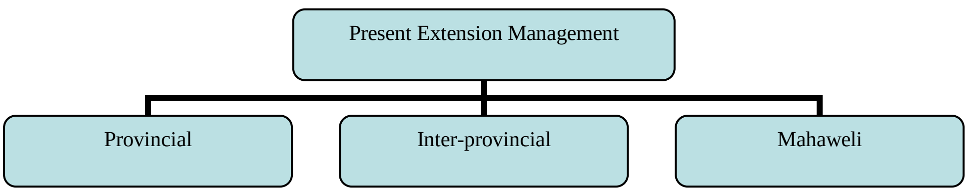
Consequent to the withdrawal of the Second Agricultural Extension Project (SAEP), a cadre of village level officers was appointed and was later named Agricultural Research and Production Assistants (ARPAs). Today, the ARPAs function as the link between farmers and agricultural support services including agricultural extension services. It is often claimed that time-to-time changes taking place in the field extension cadre have largely constrained the technology transfer process at the grass-roots level. In addition, a number of obstacles constrain the technology transfer process in the smallholding agriculture sector in the country. Tabor and Samaratunga (1994) have pointed out that the highly fragmented, partially decentralized and under-financed nature of the extension services has severely restricted the flow of results in agricultural research and development.

2.5 Present Extension Management Systems in the Non-Plantation Agriculture Sector in Sri Lanka

Agricultural Extension in non plantation agriculture sector in Sri Lanka is highly devolved and managed by three different authorities namely the Department of Agriculture (DOA), Provincial Ministry of Agriculture and Mahaweli Authority of Sri Lanka (MASL) (Figure 2.1).

1. Provincial extension system is launched by the Provincial Department of Agriculture in each province. This includes areas under minor irrigation and rain-fed agriculture.
2. Inter-provincial extension system is launched by the Extension and Training Division (ETD) of the Department of Agriculture. This includes areas under minor irrigation and rain-fed agriculture and also major irrigation areas other than Mahaweli areas.
3. Mahaweli extension system is launched under the Mahaweli Authority of Sri Lanka (MASL) in Mahaweli areas.

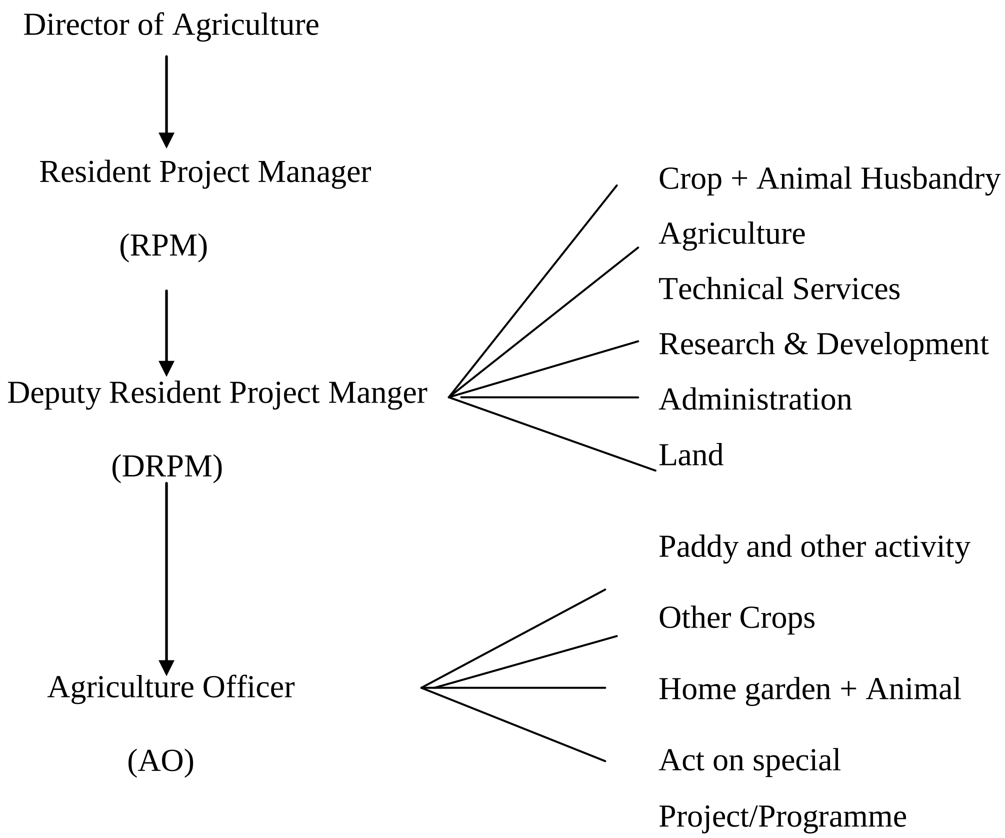
Figure 2.1: The Present Extension Management System in the Non-Plantation Sector in Sri Lanka



The Mahaweli extension system in each zone is as follows: The Director of Agriculture is followed by the Resident Project Manager (RPM) and Deputy Resident

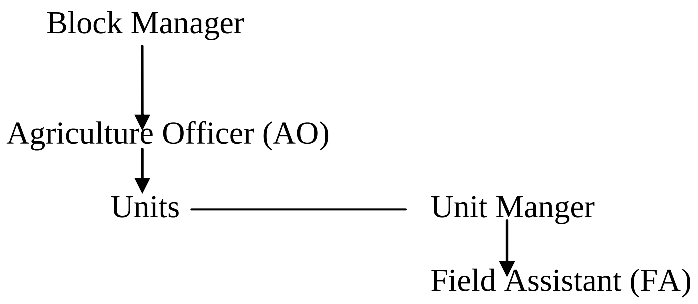
Project Manager (DRPM). DRPM is responsible for many aspects as shown in Figure 2.2. Agricultural Officers (AOs) work under the DRPM and the lowest level officers are the Field Assistants who are the links between the farmer and the higher officials. Agricultural Officers also take over different subjects as given in Figure 2.2. If the Mahaweli "H" zone is taken into account, it is divided into 7 divisions and each division has a block manager (Figure 2.3). Generally each block has 4-5 units. In a unit, there is a Unit Manager under whom are the Field Assistants. The Field Assistants are the final contact point to the farmer in the chain of command. The Mahaweli farmers have no contact with AI of the DOA. It is through the Divisional Officer of the Agrarian Service Centre as well as through the Assistant Commissioner, who attend seasonal meetings where decisions with regard to relevant subjects such as the distribution of fertilizer subsidies are made.

Figure 2.2: Structure of the Mahaweli Extension Management System



Source: Mahaweli Block Office, System 'H', 2009.

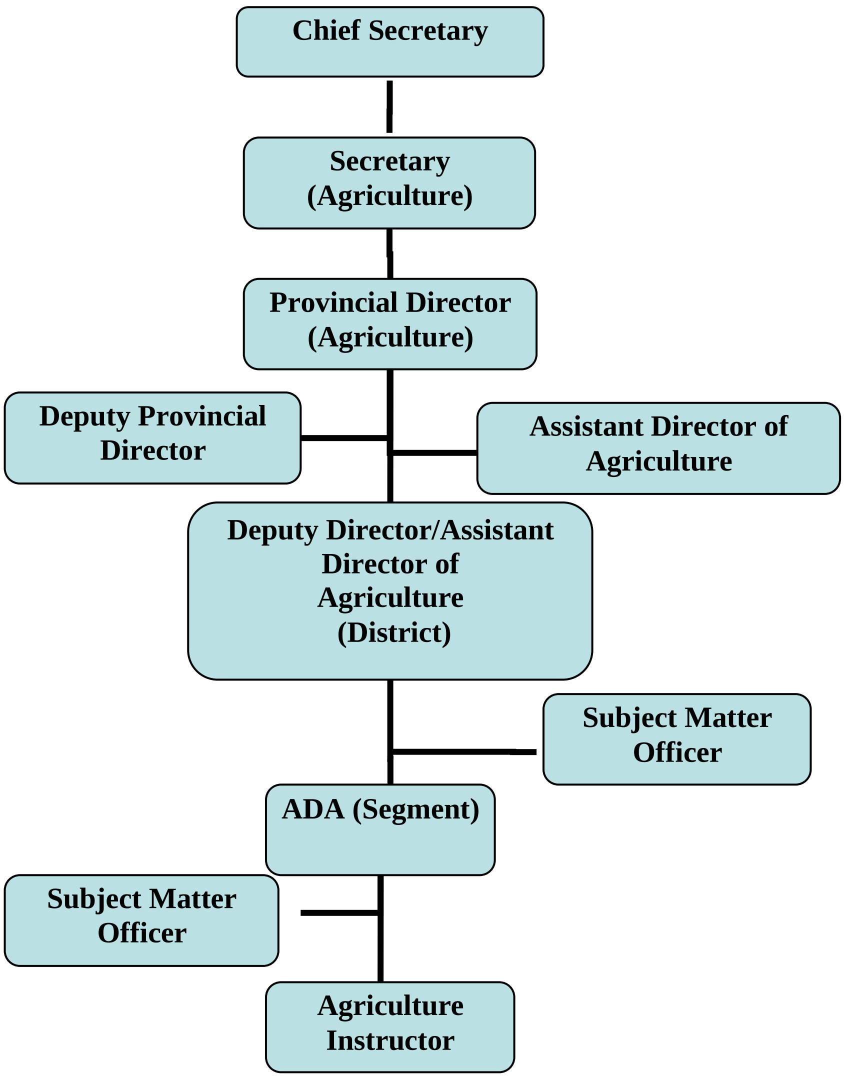
Figure 2.3: Staff at a Block Office in Mahaweli ‘H’ Zone



Source: Mahaweli Block Office, System ‘H’, 2009.

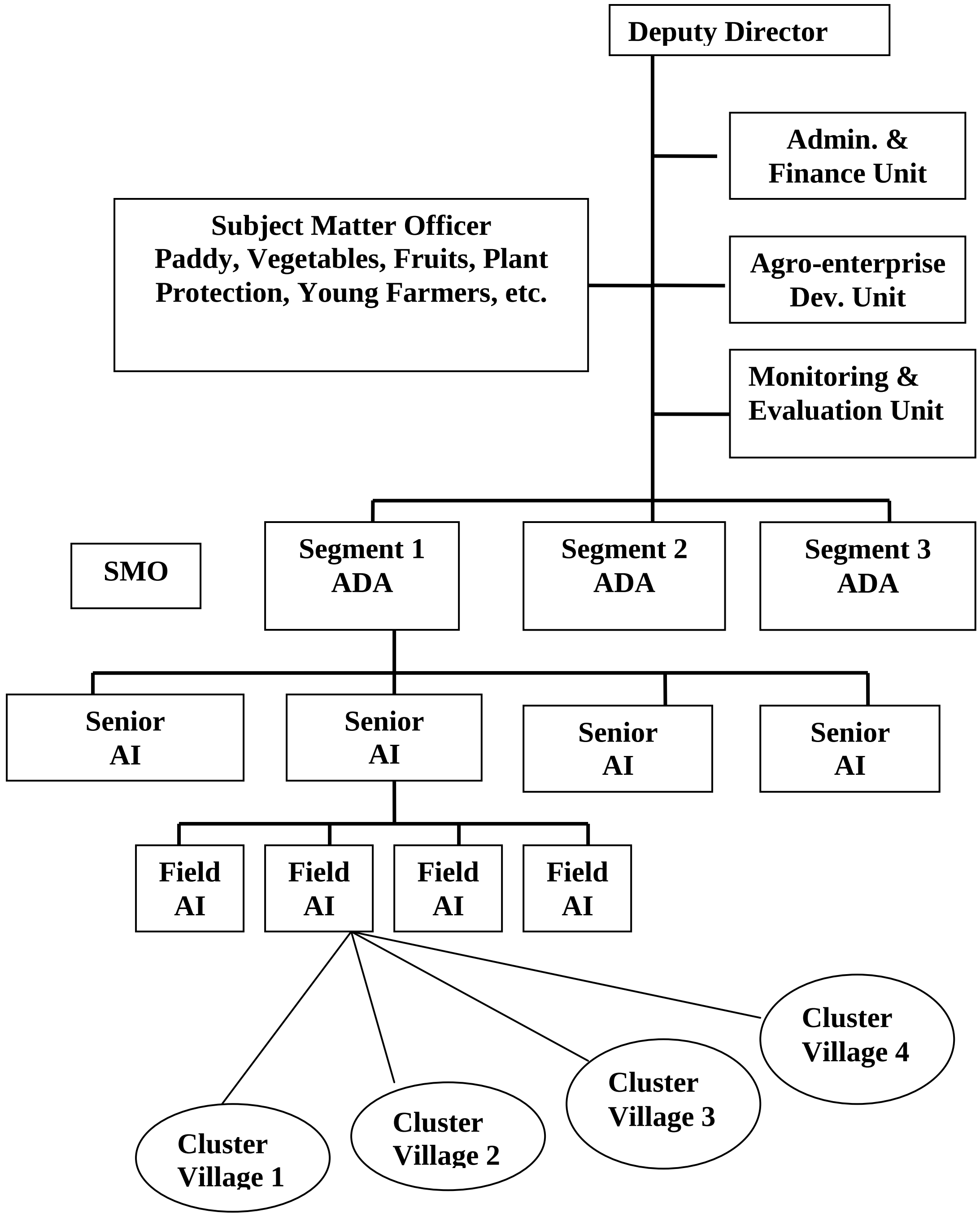
The figure 2.4 illustrates the structure of the provincial system of extension management and figure 2.5 illustrates the inter-provincial extension system.

Figure 2.4: Structure of the Provincial Extension Management System



Source: Department of Agriculture, 2009.

Figure 2.5: Structure of the Inter-provincial Extension Management System



Source: Department of Agriculture, 2009.

CHAPTER THREE

Methodology

3.1 Study Locations

The *parachute* method has been introduced to major irrigated areas in Mahaweli and inter-provincial areas of the Anuradhapura district. Having discussed with the officials of higher management of Mahaweli and Inter-provincial extension management systems, Mahaweli ‘H’ system and Nachchaduwa major irrigation scheme were chosen as study locations for this study. Agriculture Instructor (AI) division is the primary unit of study location in Nachchaduwa scheme and Mahaweli unit is the primary unit of study location in Mahaweli ‘H’ system and the study sites were chosen as shown in the Table 3.1.

Table 3.1: Study Locations and Sample Size

Study Sites	Sample size
Shrawastipura and Hidogama AI divisions in Nachchaduwa area	66
Kalankutiya and Huriigaswewa units in Mahaweli ‘H’ system	68

Source: Survey Data, 2009.

Farmers were chosen for data collection from the lists given by the respective Agriculture Officer (AO) and AIs in Mahaweli and Nachchaduwa areas respectively. Accordingly, 34 adopters and 34 non-adopters were chosen from Mahaweli ‘H’ system. However, in Nachchaduwa area there were only ten adopters of *parachute* technology in the AI divisions selected. In addition to these ten farmers, 56 adjoining farmers were interviewed to find out the reasons for non-adoption. The study was carried out in the year 2009 and the time specific data were gathered for 2008/09 *maha* season.

3.2 Data collection

The study employed three approaches for data collection:

a. **Personal interviews with key extension personnel and field level extension staff in the two locations.**
    1. Director Extension - Provincial Department of Agriculture in the North Central Province.
    2. Assistant Director - Department of Agriculture- Anuradhapura district.
    3. Agriculture Officer - Mahaweli ‘H’ System
    4. Agriculture Instructors - Shrawastipura and Hidogama AI divisions of Nachchaduwa area.
    5. Mr. Senarath Jayawardena- Research Officer at Batalagoda Rice Research Station.
    6. Field Assistants- Mahaweli ‘H’ System.

b. Sample Surveys

Sample survey was largely designed to understand the vital component of the technology adoption by the individuals through a structured questionnaire designed to achieve the study objectives.

c. Collection of Secondary Information

Data and information pertaining to different extension management systems were gathered through the review of secondary sources of information. Further, qualitative information was reviewed from published and unpublished sources of information available.

3.3 Data Analysis and Presentation

Data gathered from different sources have been analyzed through SPSS 16 statistical package. The analyzed data are presented in tabular and graphical forms. Both simple descriptive statistics and inferential statistics are presented in the report. A regression analysis has been carried out with regard to Mahaweli 'H' system in order to understand the determinants of technology adoption by farmers.

3.3.1 Determinants of *Parachute* Technology Adoption by Mahaweli Paddy Farmers

The factors affecting *parachute* technology adoption is econometrically estimated to test the significance of farmer characteristics-personal, technology-related and extension related - on the adoption process.

To adopt or not to adopt technology is a discrete choice. Discrete choice econometric models have been widely used in determining factors affecting discrete economic decisions. This study has utilized a logit model because the dependent variable is dichotomous and the model is computationally simpler. The logistic regression is part of a category of statistical models called Generalized Linear Models. This broad class of models includes ordinary regression and ANOVA as well as multivariate statistics such as ANCOVA. Logistic regression enables a researcher to predict a discrete outcome from a group of variables that may be continuous, discrete, dichotomous or a mixture of any of these. The predictor variable in logistic regression can take any form. This is because logistic regression makes no assumption about the distribution of the independent variables; -they do not have to be normally distributed, linearly related, or of equal variance within each group.

Dependent variable can take the value 1 with a probability of adoption θ (P*i*), or the value 0 with probability of non-adoption 1-θ (1-P*i*). The relationship between the predictor and response variables is not a linear function in logistic regression. Instead, the logistic regression function is used, which is the logit transformation of θ:

$$\theta = \frac{e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_i x_i)}}{1+e^{(\alpha+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_i x_i)}}$$

Where α = the constant of the equation and, β = the co-efficient of the predictor variables.

An alternative form of the logistic regression equation is:

$$\mathbf{logit}\left[\theta(\mathbf{x})\right] = \mathbf{log}\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i$$

The logit model for the adoption of *parachute* technology by Mahaweli paddy farmers is as follows:

Mahaweli paddy farmer who adopted the *parachute* technology is given the value 1 and who did not adopt is given 0. The predictor variables were derived from the understanding that technology adoption is a function of a range of farmer characteristics –personal, technology related and extension related.

Accordingly, personal characteristics such as total land availability (TLA), owned land availability (OLA), labour source (LS) and farmer skills on the technology (SKL) could have an impact on the adoption of this technology by farmers. Water availability (WA) and input availability (IA) are the technology related characteristics that could have an impact on the technology adoption. Number of extension methods for awareness building (VAW), regularity of contacts with Agricultural Officer (AO), regularity of contacts with Field Assistant (FA) are extension related factors that could have an impact on technology adoption.

The conceptual model of *parachute* technology adoption by Mahaweli paddy farmers is:

$$\ln(Pi/1\text{-}Pi) = \alpha + \beta_1\,TLA + \beta_2\,OLA + \beta_3\,WA + \beta_4\,IA + \beta_5\,LS + \beta_6\,VAW + \beta_7 AO + \beta_8\,FA + \beta_9\,SKL$$

Where,

Total land availability (TLA) in acres

Owned land availability (OLA) in acres

Water availability (WA): Adequate =1, In adequate = 0

Input availability (IA): Yes = 1, No = 0

Labour source (LS): Hired only = 1
Hired & family/hired & *attam* = 2
Family & hired/Family & *attam* & hired = 3
Family only/Family & *attam*/*attam* & family = 4

Number of extension methods for awareness building (VAW):
One method only =1
Two methods only =2
Three or more methods = 3

Regularity of contacts with extension officer (AO):
Occasionally = 1
Once a season = 2
More than once a season = 3
Once or more than once fortnightly = 4

Regularity of contacts with field assistant (FA)
Occasionally= 1
Once a season = 2
More than once a season = 3
Once or more than once fortnightly = 4

Farmer skills on the *parachute* technology (SKL): Unskilled = 1
Semi-skilled = 2
Skilled = 3

Following statistical tests were carried out to select the significance of the model.

Wald Test:
A Wald test is used to test the statistical significance of each co-efficient (β) in the model. A Wald test calculates a *Z* statistic, which is:

$$z = \frac{\hat{B}}{SE}$$

This z value is then squared, yielding a Wald statistic with a chi-square distribution.

Likelihood-Ratio Test:
The likelihood-ratio test uses the ratio of the maximized value of the likelihood function for the full model (L_1) over the maximized value of the likelihood function for the simpler model (L_0). The likelihood-ratio test statistic equals:

$$-2\log\left(\frac{L_0}{L_1}\right) = -2[\log(L_0) - \log(L_1)] = -2(L_0 - L_1)$$

This log transformation of the likelihood functions yields a chi-squared statistic. This is the recommended test statistic to use when building a model through backward stepwise elimination.

Hosmer-Lemshow Goodness of Fit Test:
The Hosmer-Lemshow statistic evaluates the goodness-of-fit by creating 10 ordered groups of subjects and then comparing the number actually in each group (observed) to the number predicted by the logistic regression model (predicted). Thus, the test statistic is a chi-square statistic with a desirable outcome of non-significance, indicating that the model prediction does not significantly differ from the observed. The 10 ordered groups are created based on their estimated probability; those with estimated probability below 0.1 form one group, and so on, up to those with probability 0.9 to 1.0. Each of these categories is further divided into two groups based on the actual observed outcome variable (success, failure). The expected frequencies for each of the cells are obtained from the model. If the model is good, then most of the subjects with success are classified in the higher deciles of risk and those with failure in the lower deciles of risk.

CHAPTER FOUR

Adoption of *Parachute* Technology

4.1 Introduction

This chapter describes factors affecting the adoption of parachute technology in Mahaweli H and Nachchaduwa area. In particular the chapter describes determinants of *parachute* technology adoption by Mahaweli 'H' farmers using logistic regression.

4.2 Adoption of *Parachute* Technology

The sample from Mahaweli 'H' system consisted of 68 farmers of which 34 (50%) have used the *parachute* method and the rest have heard about the method (Table 4.1).

Table 4.1: Distribution of Sample by Awareness and Use of *Parachute* Method

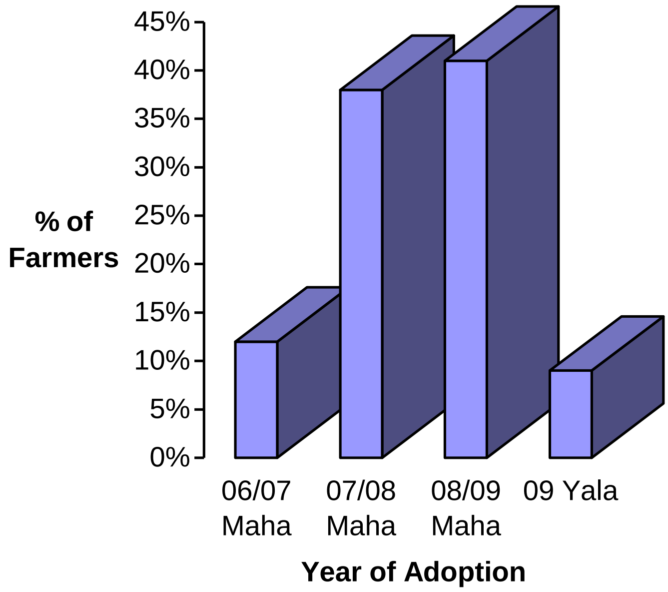
Description	Mahaweli H System		Nachchaduwa Area	
	No.	%	No.	%
Technology used	34	50	10	15
Heard about the technology but not used	34	50	44	67
Not Heard about the technology	-	-	12	18
Total	68	100	66	100

Source: Survey Data, 2009.

This technology has recently been introduced to Nachchaduwa area and therefore only ten farmers were found to be technology adopters. Of the rest the majority was aware of the technology and 18 percent of farmers had not heard about the technology.

This technology has been first introduced to Mahaweli areas in 2004/2005 *maha* season and an idea of innovativeness of Mahaweli farmers towards taking up the new technology can be obtained from the data in Figure 4.1.

Figure 4.1: Year of Adoption of *Parachute* Method by Mahaweli Farmers



Source: Survey Data, 2009.

4.3 Significance of Technology

Parachute is proven as a high yielding technology and this has compelled the farmers to use it as shown in the Table 4.2. The most prominent reason is that the farmers from both areas have received the message that the *parachute* method is a high yielding technology due to (a) lack of stress on seedling/lack of reduction of seedling vigor (b) increased rate of tillering as a result of adequate space maintained and (c) being a comparatively good method for seed paddy production as a means of income. It is important to mention that the majority of the farmers in Mahaweli 'H' system who have used the *parachute* method (31 – 91.2%) have received high yields as they expected.

Table 4.2: Reasons for Using *Parachute* Method

Reason for Use	Mahaweli 'H' System		Nachchaduwa Area	
	No.	%*	No.	%**
High yield	30	88.2	8	80
Low cost technology	26	76.4	9	90
Encouragement by Extension personnel	8	23.6	2	20

*Percentages out of the total number of farmers who used the technology =34
**Percentages out of the total number of farmers who used the technology =10
Source: Survey Data, 2009.

The results of a paired sample mean comparison of yield between *parachute* method and broadcasting method in Mahaweli 'H' system indicates that there is a significant difference at 95% confidence interval. This indicates a 77.5% yield increase (Table 4.3).

Table 4.3: Yield Comparison between Parachute and Broadcasting Methods

Indicator	*Parachute* method	Broadcasting
Mean	159.78 bushels/ac	90 bushels/ac
SD	44	28

Source: Survey Data, 2009.

Only three farmers have not been able to receive high yields due to over fertilization of nurseries, over spacing due to lack of knowledge, damage caused to nurseries by rainy conditions, poor quality of seed paddy causing diseases and limited skills for broadcasting of seedlings.

Further, they consider *parachute* method as a low cost technology due to: (a) less requirement of labour as labour is not required for uprooting seedlings (b) less requirement of seeds (c) low cost for weed control and as the method is convenient to control weeds and (d) less requirement of labour for land preparation as small drainage channels are not prepared in the field and (e) easy water management.

The encouragement from the extension personnel is another reason for using the technology. As revealed through the discussions with extension personnel, the farmers who show interest to try on new technologies - innovative farmers - are chosen for demonstrations when they require transferring a new technology to the field. These innovators take up new technologies very devotedly and do well in the field. The demonstrational effect helps to diffuse the technology throughout the farming community.

4.4 Determinants of *Parachute* Technology adoption by Mahaweli Paddy Farmers using Logistic Regression

The logit model on *parachute* technology adoption was empirically tested using data collected from Mahaweli paddy farmers to find the factors determining the adoption of *parachute* technology.

The predictor variables tested in the model are total land availability (TLA), owned land availability (OLA), water availability (WA), input availability (IA), labour source (LS), number of extension methods for awareness building (VAW), regularity of contacts with Agricultural Officer (AO), regularity of contacts with Field Assistant (FA) and farmer skills on the technology (SKL).

Logistic regression was performed through backward stepwise elimination and the goodness-of-fit of the model was evaluated by likelihood-ratio test and Hosmer-Lemshow statistics (Tables 4.4 and 4.5).

Table 4.4: Model Test Statistics

-2 Log Likelihood	Cox and Snell R square	Nagelkerke R Square
62.071	.368	.491

Source: Survey Data, 2009.

Table 4.5: Hosmer-Lemshow Test

Chi-square	Df	Sig.
6.44	8	.598

Source: Survey Data, 2009.

Of the predictor variables, owned land availability (OLA), scale of operation (SCL), water availability (WA), number of extension methods for awareness building (VAW) were removed from the best fitted model. The Table 4.6 shows the results of the empirical model.

Table 4.6: Results of the Empirical Model

Variables	**B**	**S E**	**Wald**	**df**	**Sig.**	**Exp (B)**
Input availability (IA)	0.792	0.674	1.382	1	0.240	2.209
Total land availability (TLA)	0.408	0.258	2.497	1	0.114	1.504
Labour sources (LS)	-0.595	0.424	1.971	1	0.160	0.552
Meeting with AO (AO)	-0.338	0.619	0.299	1	0.584	0.713
Meeting with FA (FA)	0.544	0.545	0.996	1	0.318	1.722
Farmer skills (SKL)	2.790	0.737	14.315	1	0.001	16.274
Constant	-7.116	3.155	5.087	1	0.024	0.001

Source: Survey Data, 2009.

4.4.1. Input Availability

Availability of inputs is a factor that triggers the adoption of particular technology by farmers. The model statistics shows that the adoption of *parachute* method has a positive link with input availability.

4.4.2 Total Land Availability

The model describes that the total land availability is a related factor of technology adoption. The variable shows a positive relationship that the adoption of technology increases with the increase of total land availability. This phenomenon can also be understood by examining the land availability data between adopters and non adopters in Mahaweli area. According to the data presented in the Table 4.7 the average total land availability of adopters is higher than that of non-adopters.

Table 4.7: Comparison of Land Availability between Adopters and Non-adopters in Mahaweli 'H' System

Category of Farmers	Own Land (ac)		Total Land (ac)	
	Total	Average	Total	Average
Adopters	81	2.4	112	3.3
Non-adopters	70.75	2.0	87.0	2.6

Source: Survey Data, 2009.

The data reflects the general trend that could be observed in relation to technology dissemination at the grass roots level. There is a category of farmers who shows increased interest to try out new technologies, when the extension personnel work with them. In general, these farmers cultivate more lands either in owned lands or under other ownership patterns and could be termed as progressive farmers who take risks.

4.4.3 Labour Source

Labour availability is a pre-requisite for the adoption of *parachute* method which is a labour intensive technology specially during nursery management. Therefore, the farmers were grouped into four categories in order to explore the effect of labour availability on technology adoption, as described below.

1. Hired only: This category of farmers use only hired labour for paddy cultivation. These farmers are prominently large scale commercial farmers who use hired labour.

2. Hired and family/hired and *attam:* This category includes two farmer groups. The prominent labour source for both groups is still hired labour which is supplemented by family labour in one group and *attam* labour in the other group.

3. Family and hired/family, *attam* and hired: This category also includes two farmer groups but the prominent labour source for both groups is family labour supplemented by either hired labour or hired and *attam* labour. Hired labour is the last option.

4. Family only/family and *attam/attam* and family: This category includes three types of farmers. All the farmer groups depend on family labour or *attam* labour. Hired labour use is not reported.

Data in the Table 4.8 indicates that each type of labour plays a vital role in paddy cultivation and depend on three sources of labour,ie; family, *attam* and hired labour.

Table 4.8: Sources of Labour in Mahaweli ‘H’ System

Labour Source Category	Mahaweli ‘H’ System	
	No.	%
1. Hired only	1	1.5
2. Hired & family/hired & *attam*	15	22.4
3. Family & hired/family, *attam* & hired	17	25.4
4. Family only/family & *attam / attam* & family	34	50.7
Total	67	100.0

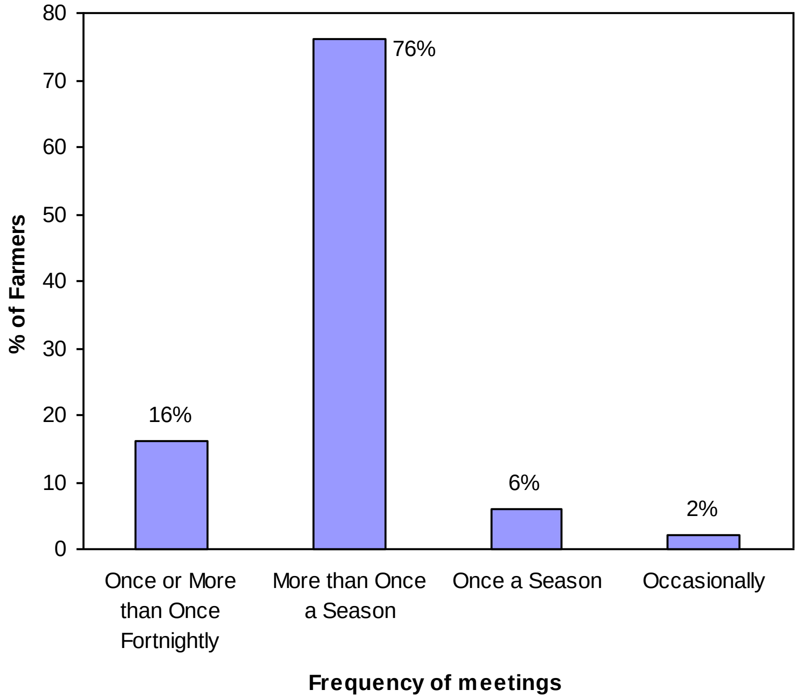
Source: Survey Data, 2009.

It was expected that there would be a positive relationship between adoption and labour source under the given ranking order. In other words, it was expected that the adoption will increase with the availability of unpaid labour - family and *attam* labour - as *parachute* is a labour demanding technology. However, as the model illustrates the farmers with access to hired labour are among the adopters than others with access to unpaid labour. In Mahaweli areas use of hired labour in addition to unpaid labour signifies the affordability of farmers. This again confirms the fact that the large scale commercial farmers who depend on hired labour are the category of farmers who adopt this technology.

4.4.4 Role of Extension in Awareness Creation

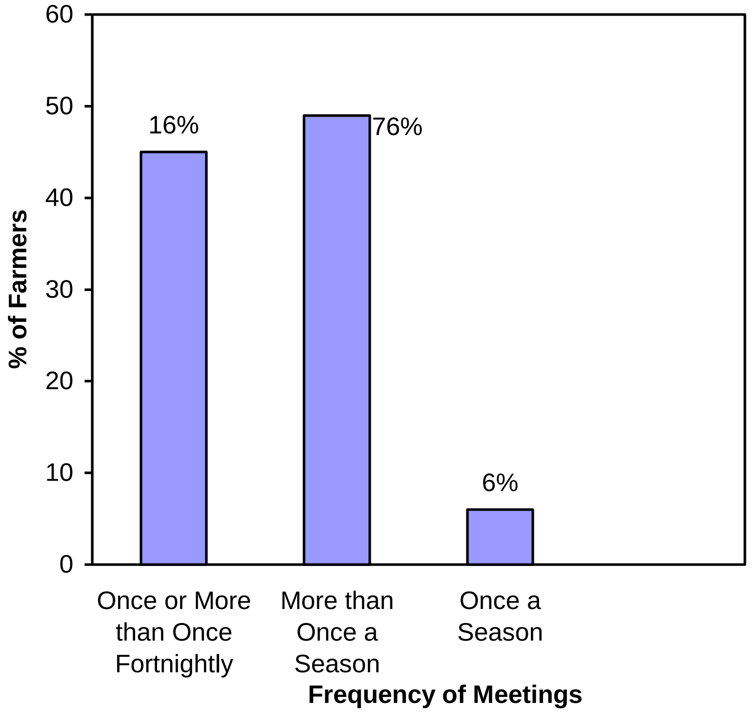
As witnessed by the model, meeting with Extension Officer (AO) has no positive impact on the technology adoption but the meeting with Field Assistant (FA) has a positive relationship. The reason for this difference is that the AO is responsible for overall extension service in the entire zone but the FA is responsible for specific skill development training at unit level. Therefore, the farmers have more frequent contacts with the FA than the AO. Data in Figures 4.2 and 4.3 also confirms this situation. All the farmers from Mahaweli areas stated that initial awareness programmes were conducted at the zonal office of Mahaweli ‘H’ system by the Extension Officer and at the field by the FA respectively. In addition, some farmers have also been exposed to other methods of communication such as leaflets and television programmes.

Figure 4.2: Frequency of Meetings between Farmers and Extension Officers in Mahaweli 'H' System



Source: Survey Data, 2009.

Figure 4.3: Frequency of Meetings between Farmers and Field Assistants in Mahaweli 'H' System



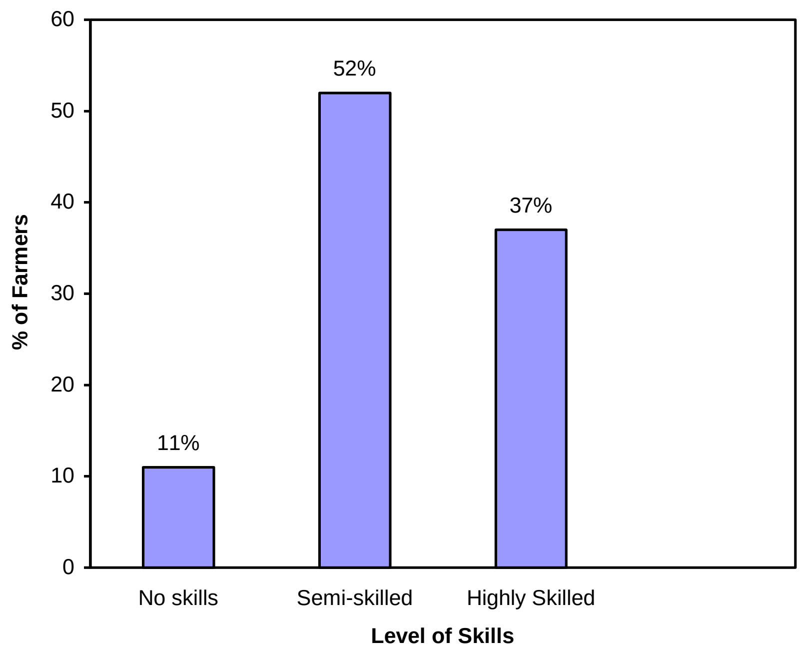
Source: Survey Data, 2009.

Overall, the role of Extension Officer only as an awareness builder of *parachute* technology is insignificant. The justification is that successful adoption of *parachute* technology is not related to only awareness building. The adoption of skilled technologies largely depends on the level of farmer skills and thus, the important factor is training of farmers through demonstrations. *Parachute* method being a skilled technology, just awareness creation is insufficient to attract the farming community. Therefore, it is a pre-requisite to encourage farmers through continuous training and exposure visits to the demonstration fields so as to ensure that the farmers are skilled on the use of new technologies.

4.4.5 Farmer Skills

This variable was expected to positively influence the technology adoption. The basis for this expectation was that for a farmer to adopt the *parachute* technology, he should be well trained on it. As expected, the model describes farmer skills as the highest significant factor for adoption of *parachute* method with a positive coefficient of 2.790. The Figure 4.4 indicates the level of training of the sample farmers in Mahaweli 'H' system. Accordingly, more farmers in Mahaweli 'H' area are highly skilled. Therefore, the role of extension in terms of skill development is a pre-requisite for the adoption of *parachute* technology.

Figure 4.4: Level of Farmer Skills on *Parachute* Methodin Mahaweli 'H' System



Source: Survey Data, 2009.

4.4.6 Water Availability

The *parachute* method is largely recommended for *maha* season in major irrigation areas. Sources revealed that it has been popularized only in the areas where water is assured for paddy cultivation. This is a disadvantage of *parachute* technology compared to broadcasting method, the advantage of which is that whenever water is issued, the cultivation can be completed within a few days after land preparation is done fast. However, the *parachute* method is not such a fast method and it requires nursery preparation and management before field establishment. Therefore, assured water availability is essential for the adoption of *parachute* method.

As revealed by the survey, water availability for paddy cultivation for these farmers slightly varies by season (Table 4.9). However, 98.5% farmers receive sufficient water for cultivation during the *maha* season with the rest of the farmers not receiving adequate water even in the *maha* season. Water availability in the *yala* season appears to be limited as only 31 farmers (45.6%) in Mahaweli had received sufficient water. For the rest, water is a limiting factor.

Table 4.9: Water Availability for Paddy Cultivation in Mahaweli 'H' System

Water Availability in	Farmers	
	No.	%
Yala Season		
1. Inadequate	31	45.6
2. AdequateTotal	37	54.4
	68	100.0
Maha Season		
1. Adequate	67	98.5
2. Inadequate	1	1.5
3. Total	68	100.0

Source: Survey Data, 2009.

4.5 Characteristics of Adopters in Nachchaduwa Area

Due to limited number of adopters in Nachchaduwa area, the statistical models were not used for the analysis. The following characteristics distinguish between adopters and non- adopters.

Land Availability

The Table 4.10 presents the land availability data of both adopters and non-adopters in Nachchaduwa area. Data shows that total land availability of adopters is higher than that of non-adopters as in the case of Mahaweli 'H' system.

Table 4.10: Comparison of Land Availability between Adopters and Non-adopters in Nachchaduwa Area

Category	Own Land (ac)		Total Land (ac)	
	Total	Average	Total	Average
Adopters	37.0	3.7	73	7.3
Non-adopters	143.0	2.6	132	2.4

Source: Survey Data, 2009.

Labour Availability

Parachute method is a labour intensive technology. Thus, labour availability is a pre-requisite for adoption. Data in the Table 4.11 indicates that each type of labour plays a vital role in paddy cultivation in Nachchaduwa area which depend on three sources of labour, family, *attam* and hired labour. All the adopters came under the category 1 and 2 of the Table 4.13 and this shows that the adopters largely rely on hired labour compared to the farmers whose predominant labour source is family or *attam* labour. As in the case of Mahaweli 'H', it appears that large scale commercial farmers who depend on hired labour are the category of farmers who adopt this technology.

Table 4.11: Sources of Labour in Nachchaduwa Area

Labour Source Category	Farmers	
	No.	%
1. Hired only	3	4.6
2. Hired & family/hired & *attam*	34	51.5
3. Family & hired/family, *attam* & hired	20	30.3
4. Family only/family & *attam/attam* & family	9	13.6
Total	66	100.0

Source: Survey Data, 2009.

Role of Extension in Awareness Creation

Farmers in Nachchaduwa area were categorized based on the intensity of exposure to extension methods as presented in the Table 4.12. According to the data, only a few farmers were properly aware of the *parachute* method though there had been a number of awareness programmes directly conducted by the AI and the DOA. The other methods are mass communication methods including television, radio programs and leaflets. The majority have been made aware through the AI and the other methods. The Table 4.12 demonstrates the nature of technology dissemination process in the Nachchaduwa area. There is a large variation in the intensity of exposure of technology by the farming community.

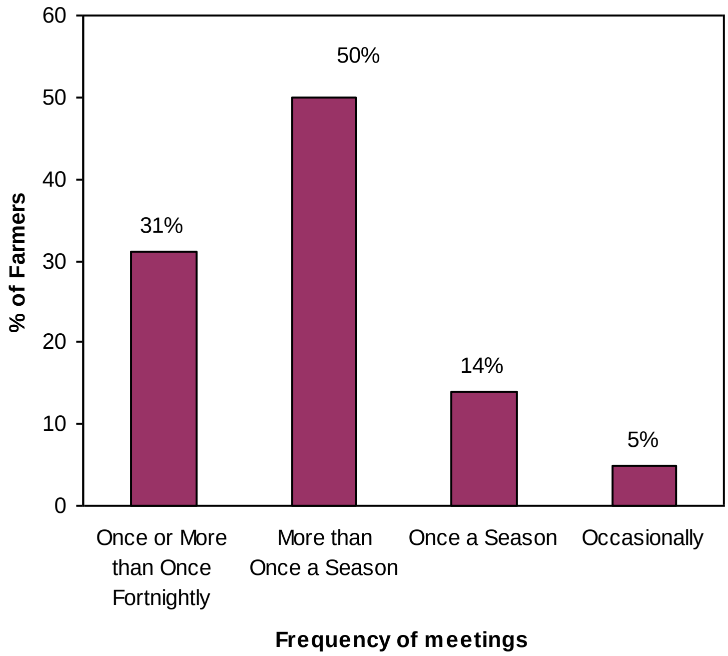
Table 4.12: Farmer Exposure to *Parachute* Method in the Nachchaduwa Area

Method of Awareness Creation	Farmers	
	No.	%
Awareness creation and demonstrations by Agriculture Instructor and other agencies + other methods	4	6.0
Awareness creation by Agriculture Instructor + other methods	32	48.5
Other methods only	18	27.3
No any means	12	18.2
Total	66	100.0

Source: Survey Data, 2009.

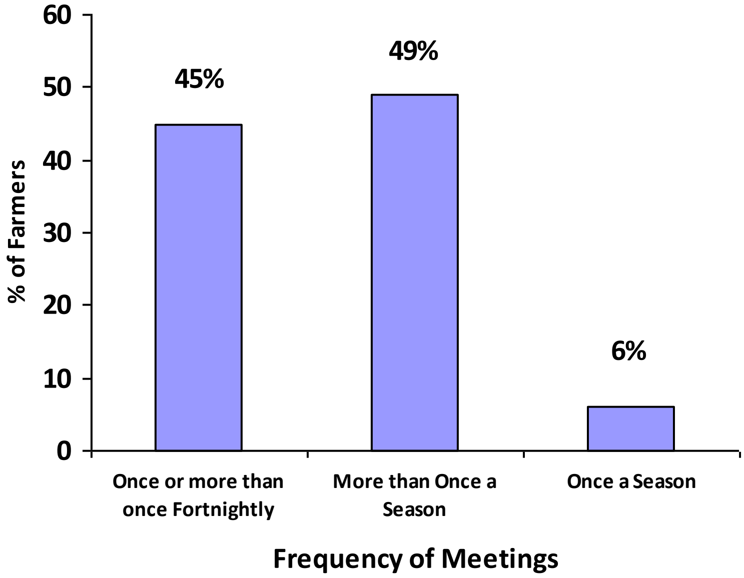
Survey also revealed that the only 31% of farming population had frequent contacts with Agricultural Instructors (Figure 4.5) and Agricultural Research and Production Assistants (Figure 4.6). The findings raise the question whether the present level of contacts between the farmers and the Extension Officers would adequately support the information dissemination process.

Figure 4.5: Frequency of Meetings between Farmers and Agricultural Instructors in Nachchaduwa Area



Source: Survey Data, 2009.

Figure 4.6: Frequency of Meetings between Farmers and Agricultural Research and Production Assistants in Nachchaduwa Area

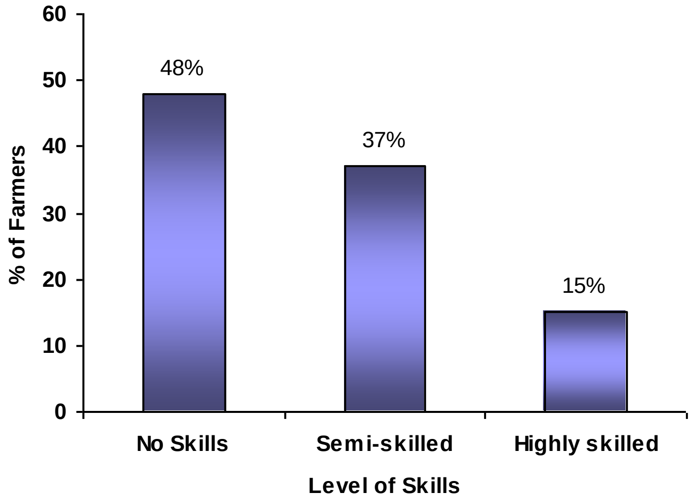


Source: Survey Data, 2009.

Farmer Skills

In Nachchaduwa, all the adopters are skilled farmers and the majority of farmers (48%) lack skills on the use of new technology (Figure 4.7). Therefore, the role of extension in terms of skill development is a pre-requisite for the adoption of *parachute* technology.

Figure 4.7: Level of Farmer Skills on *Parachute* Method in Nachchaduwa Area



Source: Survey Data, 2009.

Water Availability

Assured water availability is a significant factor of adoption of *parachute* technology. As revealed by the survey, the water availability for paddy cultivation in Nachchaduwa area slightly varies by season (Table 4.13) but 98.5% receive sufficient water for cultivation during the *maha* season. Water availability in the *yala* season appears to be limited as only 53 farmers (80.3%) receive sufficient water. For the rest, the water is a limiting factor. Even though the Nachchaduwa scheme is a major irrigation scheme, the time of issuing water to the paddy fields largely depends on the availability of Mahaweli water to the Nachchaduwa tank. Hence, water availability is uncertain. Under such circumstances, the farmers do not wish to bear the risk of investing on this technology which incurs an initial cost of Rs. 8,262/ac at the rate of Rs. 27.00/tray and 306 trays per/acre.

Table 4.13: Water Availability for Paddy Cultivation in Nachchaduwa Area

Water Availability	Farmers	
	No.	%
Yala Season		
3. Adequate	53	80.3
4. Inadequate	13	19.7
5. Total	66	100.0
Maha Season		
4. Adequate	65	98.5
5. Inadequate	1	1.5
6. Total	66	100.0

Source: Survey Data, 2009.

4.6 Non-adopters View on *Parachute* Method

A set of farmers have indicated as to why they have not used the *parachute* method (Table 4.14). Poor knowledge of farmers stemming from poor extension service is the main reason for not using this technology.

Table 4.14: Reasons for not Using *Parachute* Method

Reason for Use	Mahaweli 'H' System		Nachchaduwa Area	
	No.	%*	No.	%**
Lack of knowledge and skills	25	36.8	35	67.3
Technically not feasible	10	14.7	6	11.5
High cost	8	11.8	11	21.2
Low yield	1	1.5	3	5.8

*Percentages out of the total number of farmers who did not use the technology = 34

**Percentages out of the total number of farmers who did not use the technology and responded = 52

Source: Survey Data, 2009.

The majority who had not used the *parachute* method have pointed out many reasons for not adopting the method, among which lack of knowledge and skills predominate. This is attributed to (a) lack of demonstrations at close proximity (b) poor attention paid by farmer organization on awareness creation (c) delay in conducting of awareness creation programmes by extension personnel and (d) lack of knowledge about purchasing of trays. Due to all these, the farmers in both areas have lost interest and are not prone to using the new technology. Therefore, it is necessary to motivate these farmers through skill training.

For some farmers, *parachute* method is not a feasible technology as the time of water availability is uncertain more particularly in Nachchaduwa area. This is also not an appropriate technology for paddy lands without a deep layer of top soil which makes finer land preparation difficult. During rainy days, seeds are washed away due to rain drops in nurseries. Observations have been made on all the difficulties faced by the technology users in nursery management particularly during rainy *maha* season. Further, this technology is not appropriate for *yala* season in which water is rationed and released for which the broadcasting method is only suited.

For some farmers *parachute* method is a high cost technology as the nursery management process consumes more labour. The nursery has to be maintained for about 12-18 days and when family labour is not available, it involves a cost. This also happens when the farmers are involved in other occupations as the primary source of income. Purchase of trays is essentially an additional cost item in the farm budget.

In some occasions, the *parachute* method has failed due to damage of nurseries as a result of over fertilization and heavy rains leading to low yield. Those who have observed failures of *parachute* methods have been discouraged to try out the new technology.

4.7 Scale of Operation of *Parachute* Method

All the above difficulties have limited the area sown under the *parachute* technology. During the period of practice of *parachute* method, only 4 farmers (11.8%) out of 34 *parachute* practitioners in Mahaweli area have used their total land area under this method. Of them, two have cultivated 5 ac each and the other two have cultivated 2.5 ac each.

The majority of farmers (88.2% farmers in Mahaweli area) have not brought the total land area under this technology for many reasons as shown in the Table 4.15. Use of this technology involves an additional cost but the farmer would lose unless weather conditions are favourable. Water scarcity at the initial stages enhances the weed competition, especially during *yala* season.

Table 4.15: Reasons for not Cultivating more Lands under *Parachute* Method

Reason	Mahaweli 'H' System		Nachchaduwa Area	
	No.	%*	No.	%**
Risky	21	61.8	1	10
Non-availability of trays	13	38.2	7	70
Scarcity of labour	3	8.8	6	60
Other	-	-	3	30

*Percentages out of the total number of farmers who used the technology = 34
** Percentages out of the total number of farmers who used the technology = 10
Source: Survey Data, 2009.

In addition, there has been a shortage of trays which can be attributed to both non-availability and less affordability. The Mahaweli authority has distributed a limited number of trays which had been sufficient for cultivation of 0.5 ac of paddy land by each recipient. Those who took up the technology on trial basis have utilized a small piece of land. However, in Nachchaduwa area most of the farmers had not been able to find the required number of trays.

As already discussed, the nursery management is difficult when labour is a scarce resource and therefore large scale cultivation under *parachute* method is impractical. Even though it is claimed that labour requirement is low in *parachute* method the real situation is somewhat different. *Parachute* method is a skilled technology but most farmers are not yet used to nursery management and broadcasting of seedlings. Therefore, skilled farmers in Mahaweli area had a considerable demand from outside areas at the time of survey.

Further, *parachute* method requires finer land preparation. In the Nachchaduwa area, this is not possible in some fields which are situated on comparatively highlands. In addition, there are some other reasons for not cultivating a large area under the *parachute* method such as;

a. Difficult in finding a suitable place for the nursery
b. Damages by animals to nurseries
c. Long distance between nursery and the paddy field.
d. Delay in supply of fertilizer subsidy.

4.8 Reasons for Poor Dissemination of *Parachute* Method

All sample farmers were inquired about the reasons for lack of widespread adoption of the *parachute* method by a large majority of farmers. According to Table 4.16, it is due to four main reasons.

Table 4.16: Reasons for Non-adoption of *Parachute* Method by Farmers

Reason	Mahaweli 'H' System		Nachchaduwa Area	
	No.	%*	No.	%**
Weak communication process	32	47.1	54	81.8
Negative attitudes	39	57.4	22	33.8
Technically not feasible	30	44.1	20	28.8
Technology not profitable	12	17.6	7	10.6

*Percentages out of the total number of farmers = 68
**Percentages out of the total number of farmers = 66
Source: Survey Data, 2009.

The role of extension service in technology transfer as the SENDER of message is very vital. However, a considerable proportion of farmers have pointed out the weakness of the present communication process as one of the reasons for non-adoption of the particular technology. This situation has been described by the farming community in different forms as summarized below:

a. Even though the *parachute* method was introduced to both areas, the farmers were not exposed to further training on field application.
b. There is only one Agricultural Instructor to provide the extension service to a large number of farmers but he is unable to reach the whole farming community.
c. Demonstrations were limited to only certain areas of the village and/or the number of demonstrations was inadequate.
d. Lack of/inadequate training programs for awareness building.
e. Lack of/less attention to make farmers aware of training/demonstrations.
f. Attention was paid only to a selected group of farmers.
g. Lack of attention on small scale farmers.
h. Lack of attention on continuous training and monitoring.
i. Conflicts between farmer organizations and officials.
j. Poor road network that discourage visiting remote areas by extension personnel.
k. Poor involvement by Agricultural Research and Production Assistants (ARPAs).
l. Weak status of farmer to farmer extension.

Extension service to be effective, the RECEIVER of the message, the farmer, should be prepared to take up the message or the technology disseminated by the SENDER. However, the negative attitudes of the RECEIVER have constrained the technology transfer process. According to farmers this includes several aspects both general and specific to the *parachute* technology and general to the extension service such as:

a. Lack of farmer interest to participate in the training programmes/training classes as they consider it a waste of time.
b. Unwillingness to try out new technologies/lethargic.
c. The belief that broadcasting is the best method and the perception that it was difficult to obtain high yield with a lesser amount of seed paddy by *parachute* technology.

d. Requirement of more labour for the new technology.
e. Fear of uncertain weather conditions due to time taken for field establishment in *parachute* method after nursery management.
f. The belief that the technology does not suit to some of the paddy fields with shallow soil layers.
g. Negative thoughts that 'I should not follow what others have followed'.
h. Willingness to use only if incentives are provided with the new method.

In addition to sender and receiver of the MESSAGE, the technology should be appropriate to be taken up by the receiver or the end user. In the case of the *parachute*, the MESSAGE should be appropriate in social, technical, environmental and economic terms. As revealed by the farmers, the *parachute* method has several shortcomings in technical and financial terms.

Technically:

a. Non-availability and less durability of trays.
b. Difficulty in nursery management during heavy rains.
c. More time and labour requirement for nursery management.
d. Inconvenience in nursery management. When high-land nurseries are established trays with seedlings should be transported to the paddy field. When mud nurseries are established, it is inconvenient and time consuming to take care of the nurseries particularly when there is a considerable distance between residence and the nursery.

When compared with broadcasting method, the farmers need to invest on trays for *parachute* technology which is an additional cost. Also nursery management requires more labour so that it increases the cost in real terms.

4.9 Suggestions to Promote *Parachute* Method

Table 4.17 illustrates suggestions made by the farmers from both locations. Accordingly awareness building is the most important aspect whereas the farmers have also suggested some other issues required to be addressed.

4.9.1 Awareness Creation and Skill Training

Farmers have proposed several suggestions regarding awareness creation and skill training:

a. Increase the number of initial awareness creation programs.
b. Conduct timely awareness programs/group training aiming at *maha* season cultivation.
c. Give priority for innovative, successful and dedicated farmers in extension programmes.
d. Train more farmers/include small scale farmers/ landless farmers as well.

Table 4.17: Suggestions to Promote *Parachute* Method

Reason	Mahaweli 'H' System		Nachchaduwa Area	
	No.	%*	No.	%**
Awareness creation and skill training	49	72.1	63	95.5
Farmer incentives	35	51.5	20	30.3
Address water needs	7	10.3	-	-
Improve tray quality	4	5.9	1	.1.5
Make it compulsory	3	4.4	2	3.0

*Percentages out of the total number of farmers = 68
** Percentages out of the total number of farmers = 66
Source: Survey Data, 2009.

e. Adopt attractive means of information dissemination such as banners, leaflets, loud speakers, television, and video through farmer organizations and cyber extension units.
f. Demonstrate in each village/*yaya*/for each farmer organization/common places which are accessible to everyone.
g. Supervise of training of new persons by AO/AI
h. Make frequent field visits to successful fields specially at harvesting time and develop interest among farmers.
i. Educate the farmers about income and expenditure of *parachute* method and change their negative attitudes toward new technologies.
j. Promote farmer to farmer extension through strengthening farmer organization which maintains close contacts with extension personnel.
k. Supervise technology usage of farmers by extension personnel continuously.
l. Maintain frequent contacts between farmer and extension personnel.

4.9.2 Incentives for Farmers

As usual, the farmers suggested providing trays free of charge or at subsidized rates. This will be practicable while introducing the technology into new areas. Further, they expected the government involvement on price determination of trays and subsidies for purchasing trays.

4.9.3 Address Water Issues

Farmers expect timely supply of water for *parachute* fields and increase the frequency of water releases. Some issues relating to water management require attention of water management experts.

4.9.4 Improve Tray Quality and Availability

There was a considerable request from the farmers to provide information on where they could obtain the trays. Some experienced farmers suggested that the tray quality should be improved so that they could use them for several years. At the moment, trays are used for 3-4 seasons only. Trays do not last long as they are much heavy at the time of transportation with seedlings and are damaged during the process. Therefore, the farmers request ensuring timely availability of low cost, durable trays made of light materials.

4.9.5 Compulsory Use of New Technologies

It is obvious that a higher yield can be obtained through the *parachute* method. Therefore, it should be popularized to achieve agricultural production targets.

4.10 Farmers View on Overall Extension System in the Area

Farmers were interviewed about the present situation of extension service and they pointed out several weaknesses as presented in Table 4.18.

The table indicates that lack of individual contact by extension staff with farming community is the main weakness in the present extension service. The situation is worse in Nachchaduwa area. This is a result of a number of factors ranging from:

- Limited field visits by extension personnel
- Inadequate extension staff/larger coverage by one officer/lack of transport facilities.
- Communication only with a limited group/omission of small scale/landlless farmers
- Poor level of knowledge of officers
- Lack of continuation/*ad hoc* knowledge dissemination process.

Table 4.18: Major Weaknesses of Present Extension Service: From the Farmers Viewpoint

Weakness	Mahaweli 'H'		Nachchaduwa area	
	No.	%*	No.	%**
Weak farmer- extension personnel linkage	21	65.6	49	86.0
Weak group and mass communication methods	10	31.3	31	54.4
Shortage of information on inputs and implements	16	50.0	3	5.3
Lack of dissemination of new technologies	3	9.4	9	15.8

* No. responded in Mahaweli = 32 (47%)
** No. responded in Nachchaduwa area = 59 (86%)
***No. responded in provincial area = 66 (100%)
Source: Survey Data, 2009.

Farmers have also voiced their opinion regarding group and mass communication methods. According to them, agriculture related programmes in electronic media are not available at the appropriate time. They have also pointed out weaknesses of cyber extension units and access to field training programmes and demonstrations.

Even though some technologies are known to the farmers, the number of implements and inputs relating to such technologies are not easily accessible at the market. There is also the problem of unavailability of such implements and inputs in time.

Other problems are lack of dissemination of new knowledge and technologies relating to control of pests and diseases, new high yielding varieties, resistant varieties, knowledge on selection of pesticides and eco-friendly agriculture.

CHAPTER FIVE

Conclusions and Recommendations

5.1 Summary of Findings

- The adoption of *parachute* technology by Mahaweli farmers is satisfactory. The binary logistic analysis used to find the impact of various factors on adoption decision shows that, of the six variables used for the analysis, farmer skills, labour source, total land availability and input availability have a significant effect on adoption of *parachute* technology.

- Availability of inputs, plastic trays, is a pre-requisite for the adoption of this technology. Therefore, attention should be paid to popularize the technology among the farmers who could afford to purchase the trays.

- Only awareness creation is insufficient for widespread adoption of *parachute* technology which demands skills for nursery management as skill training is critical before field application.

- Operators with access to sufficient labour tend to adopt the *parachute* method. Farmers perceive that *parachute* method is a labour demanding technology as it also involves nursery management.

- Water availability is an essential factor for *parachute* method which demands water during nursery period. Water is not a problem for Mahaweli areas where water is abundantly available but in Nachchaduwa area water scarcity was reported as a key constraint for the adoption of *parachute* technology.

- Total land availability becomes a significant determinant of the adoption of *parachute* technology. This means that large scale operators appear to be progressive and innovative so that they show increased interest to take up new technologies.

- Awareness creation and skill training on *parachute* technology in the Mahaweli system is very effective. In the Nachchaduwa area, the level of awareness creation is higher but skill training on the technology is insufficient. This indicates only awareness is insufficient to create an interest among the large majority of farmers to adopt the technology.

- Seedling vigour, increased tillering and high yield are the favored characteristics of the technology. In the Mahaweli area there is a significant yield difference at 95% confidence interval compared to broadcasting method. Yield increase is 77.5%.

- From the non-adopters point of view, lack of knowledge and skills is one of the reasons for not adopting the *parachute* technology. As reported from

Nachchaduwa area, drawbacks in the dissemination process of *parachute* technology are; inadequacy of demonstrations, lack of broader outlook on awareness creation programs, delays in conducting awareness programs, lack of information on obtaining inputs and raw materials, staff shortages, inadequacy of Extension Officers leading to limited farm visits, lack of regular training on field application of technologies, and obtaining feedback.

- Wherever water is a scarce resource and a limiting factor and when soil is sandy, the technology has been rejected. Heavy rainfall also constraints nursery management.

- Whilst the technology requires special skills and when the farmers are not adequately skilled, they have not adopted the technology. Additional cost of trays is another drawback for technology adoption.

- Negative attitudes of the end-user both general and specific to the *parachute* technology have also constrained the dissemination of technology. These attitudes are; lack of interest for participating in training programs, or training classes which are considered as a waste of time, lethargic attitude of farmers towards new technologies, fixed attitudes such as broadcasting is the best method and high yield cannot be obtained with a lesser quantity of seeds and other reasons such as unnecessary fear of weather conditions and dependent nature of seeking incentives. Non durability of trays, more time and labour needs for nursery management and inconvenience of nursery management are other constraints of *parachute* technology.

- All the above factors determine the area to be cultivated under the *parachute* technology. Given the situation *parachute* technology suits a small land area around 0.5 ac.

- Proper awareness building followed by skill training, and solving problems relating to input needs are required to promote the adoption of the *parachute* method. Water availability is a critical factor in this technology and therefore attempts to introduce the technology should be limited to cultivation seasons and areas where water availability is assured.

- In general, the demonstrations are conducted in the fields of progressive farmers who adopt the technology with minimum failures. Survey findings uncover this as a successful process for dissemination of technologies in the farming community.

- Overall, the weak extension services in educating farmers through individual, group and mass methods, poor availability of information on inputs and output markets, lack of dissemination of new technologies are the major constraints in the present extension system.

5.2 Conclusions

The dissemination process of *parachute* technology should be a well-planned process which needs regular awareness creation and skill development programs that result in attitudinal and behavioural changes among the farmers. Knowledge, skills, inputs and market needs should be timely and adequately ensured so that the farmer is well equipped with all the elements of the technological package at the time he is ready to use the new technology. The entire technology dissemination process should seek a constructive change in the knowledge management system. With the changed management system, the technologies should rapidly penetrate the farming locations enabling farmers to self realization of the feasibility of such technologies with limited time and effort by the extension personnel.

5.3 Recommendations

- Introduction of *parachute* method to other areas where timely availability of water is assured.

- Awareness building followed by skill training/demonstrations in the fields of innovative farmers to promote the adoption of the *parachute* method.

- Ensure timely availability of trays in the areas of introduction of the technology.

- Action to promote the production or imports of durable and low cost trays used for parachute method.

- Reorganization and strengthening of entire technology transfer process through an innovative approach of knowledge management.

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