

**INTRODUCING AND EVALUATING SCIENTIFIC STORAGE  
PRACTICES FOR FOOD GRAINS AMONG SELECTED  
RURAL HOUSEHOLDS IN COIMBATORE DISTRICT**

By

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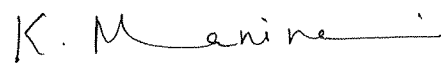
## CERTIFICATE

This is to certify that the thesis entitled “Introducing and Evaluating Scientific Food Grain Storage Practices in Selected Rural Households” submitted to the Avinashilingam Institute for Home Science and Higher Education for Women Deemed University, Coimbatore, for the award of the Degree of Doctor of Philosophy in Family Resource Management, is a record of original research work done by **Tmt.K.Manimozhi M.Sc., (Bharathiar), B.Ed., (Madras), M.Phil., (Avinashilingam)**, during the period of her study in the Department of Family Resource Management, Avinashilingam Institute for Home Science and Higher Education for Women Deemed University, Coimbatore, under my supervision and guidance and the thesis has not formed the basis for the award of any Degree/ Diploma/Associateship/Fellowship or similar title to any candidate of any other University.

  
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## DECLARATION

I hereby declare that the matter embodied in this thesis is the result of investigation carried out by me in the Department of Family Resource Management Avinashilingam Institute for Home Science and Higher Education for Women Deemed University, Coimbatore, under the supervision and guidance of **Dr.Lakshmi Santa Rajagopal, M.S., (Tennessee), Ph.D., (Madras), Vice-Chancellor**, Avinashilingam Institute for Home Science and Higher Education for Women Deemed University and former Professor and Head, Department of Family Resource Management, Faculty of Home Science, and it has not been submitted for the award of any Degree/Diploma/ Associateship/Fellowship or similar title of any other University or Institute.



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## **CONTENTS**

## CONTENTS

CHAPTER NO.		PAGE NO.
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF PLATES	
	LIST OF APPENDICES	
I	INTRODUCTION	1
II	REVIEW OF LITERATURE	7
	A. Role of Agriculture in Indian Economy	7
	B. Importance of Post Harvest Technology	9
	C. Post Harvest Losses of Food Grains	10
	D. Factors Responsible for Food Grain Losses During Storage and Measures to Control the Losses	13
	E. Existing Storage Practices and their Modifications	22
	F. Modern Storage Structures	29
	G. Role of Women in Post Harvest Operations	36
III	DESIGN OF THE STUDY	42
	A. Conduct of the Household Survey	42
	B. Trial on Scientific Storage of Food Grains	78
	C. Educating the Women on Scientific Food Grain Storage	87
	D. Evaluation of the Impact of the Scientific Practices Introduced	93
IV	RESULTS AND DISCUSSION	96
	A. Impact of the Training on Scientific Food Grain Storage on the Women Leaders	96
	B. Impact of the Training on Scientific Food Grain Storage on the Community	107
V	SUMMARY AND CONCLUSION	127
	BIBLIOGRAPHY	
	APPENDICES	

## LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
I	OPTIMUM DOSAGE OF PESTICIDES	15
II	OPTIMUM DOSAGE OF FUMIGANTS	16
III	RECOMMENDED GRAIN MOISTURE CONTENT FOR SAFE STORAGE FOR ONE YEAR	21
IV	CAPACITY, COST AND LIFE SPAN OF STORAGE DEVICES/STRUCTURES	36
V	AGRICULTURAL PROFILE OF THE TWO BLOCKS SELECTED	44
VI	EDUCATIONAL STATUS OF SELECTED HOMEMAKERS AND HEADS OF FAMILIES	49
VII	TYPE OF LANDHOLDING POSSESSED BY THE HOUSEHOLDS	51
VIII	FAMILY INCOME OF THE SELECTED HOUSEHOLDS	52
IX	FOOD CROPS CULTIVATED BY THE SELECTED HOUSEHOLDS	54
X	QUANTITY OF FOOD GRAINS PRODUCED PER CROPPING BY THE SELECTED HOUSEHOLDS	56
XI	INVOLVEMENT OF THE HOMEMAKERS AND HEADS OF FAMILIES IN POST HARVEST OPERATIONS	58
XII	TYPE AND QUANTITY OF FOOD GRAINS STORED	61
XIII	DURATION OF STORAGE OF FOOD GRAINS	63
XIV	GRAIN STORAGE STRUCTURES IN USE BY THE HOUSEHOLDS UNDER STUDY	65
XV	PROBLEMS DURING STORAGE	70
XVI	CAUSES FOR FOOD GRAIN LOSS DURING STORAGE	71
XVII	INDIGENOUS METHODS ADOPTED TO CONTROL INSECTINFESTATION DURING STORAGE	74
XVIII	METHODS ADOPTED TO CONTROL RODENTS	76

XIX	STORAGE DEVICES/STRUCTURES, TREATMENT, TYPE AND QUANTITY OF FOOD GRAINS USED FOR EXPERIMENT	80
XX	MOISTURE, WEEVILIZATION, GERMINATION, ORGANOLEPTIC QUALITY AND NUTRIENT RETENTION OF STORED FOOD GRAINS	84
XXI	COURSE CONTENT FOR THE TRAINING PROGRAMME	89
XXII	THRUST AREAS COVERED IN THE TRAINING CURRICULUM	90
XXIII	SOCIO-ECONOMIC PROFILE OF THE WOMEN LEADERS	97
XXIV	KNOWLEDGE GAINED BY THE LEADERS THROUGH TRAINING EXPOSURE ON SCIENTIFIC STORAGE PRACTICES	99
XXV	ATTITUDES OF THE LEADERS TOWARDS TRAINING PROGRAMME	101
XXVI	ATTRIBUTES OF SCIENTIFIC STORAGE PRACTICES AS PERCEIVED BY THE LEADERS	102
XXVII	EFFECTIVENESS OF TEACHING METHODS AS EXPRESSED BY THE LEADERS	103
XXVIII	PARTICIPATION OF THE COMMUNITY IN THE TRAINING PROGRAMME	107
XXIX	ADOPTION OF SCIENTIFIC STORAGE PRACTICES BY THE COMMUNITY	109
XXX	COMPARITIVE PICTURE ON ADOPTION OF SCIENTIFIC STORAGE PRACTICES BY THE COMMUNITY	115
XXXI	DETAILS OF HOUSEHOLD LEVEL RODENT CONTROL	118
XXXII	DETAILS OF FIELD LEVEL RODENT CONTROL	119
XXXIII	FOOD GRAINS SAVED THROUGH FUMIGATION	120
XXXVI	QUANTITY OF FOOD GRAINS SAVED PER CROPPING PERHOUSE HOLD BY ADOPTION OF SCIENTIFIC STORAGE PRACTICES	121
XXXV	SUGGESTIONS FOR BETTER ADOPTION OF SCIENTIFIC STORAGE PRACTICES	124

## LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO
1.	ANNUAL FOOD GRAIN PRODUCTION (1989-'96)	8
2.	CROSS SECTION OF IMPROVED UNDERGROUND STORAGE STRUCTURE	30
3.	DOUBLE WALLED POLYTHENE LINED BAMBOO BIN	33
4.	DIAGRAM SHOWING THE RESEARCH DESIGN	43
5.	LOCALE OF THE VILLAGES IN ANAIMALAI BLOCK	45
6.	LOCALE OF THE VILLAGES IN THONDAMUTHUR BLOCK	46
7.	INVOLVEMENT OF THE HOMEMAKERS AND HEADS OF FAMILIES IN POST HARVEST OPERATIONS	60
8.	GRAIN STORAGE DEVICES/STRUCTURES IN USE BY THE HOUSEHOLDS UNDER STUDY	66
9.	CAUSES FOR FOOD GRAIN LOSSES DURING STORAGE	72
10.	MOISTURE AND WEEVILIZATION PERCENTAGE OF STORED FOOD GRAINS	85
11.	ADOPTION OF SCIENTIFIC STORAGE PRACTICES BY THE COMMUNITY	110
12.	QUANTITY OF FOOD GRAINS SAVED PER CROPPING PER HOUSEHOLD BY ADOPTION OF SCIENTIFIC STORAGE PRACTICES	122
13.	SUGGESTIONS FOR BETTER ADOPTION OF SCIENTIFIC STORAGE PRACTICES	125

## LIST OF PLATES

PLATE NO.		PAGE NO.
I	EXISTING STORAGE DEVICES/STRUCTURES AND THEIR MODIFICATIONS	
Ia	SERU	25
Ib	KALANGIYAM (PUCCAKOTHI)	25
Ic	PATHAYAM (WOODEN STRUCTURE)	25
Id	THOMBE (BAMBOO STRUCTURE)	28
Ie	MUD KUDIR	28
If	KONI (GUNNY BAG)	28
II	MODERN STORAGE DEVICES/STRUCTURES	
IIa	HAPUR BIN (METAL BIN)	32
IIb	PLASTIC SILO	32
IIc	PLYWOOD BIN	35
IIId	COAL-TAR DRUM BIN	35
III	EXISTING STORAGE DEVICES/STRUCTURES IN THE SELECTED HOUSEHOLDS	
IIIa	KONI	68
IIIb	POLYTHENE BAG	68
IIIc	METAL BIN	68
IIId	KALANGIYAM	69
IIIe	PATHAYAM	69
IIIf	AIR-TIGHT STAINLESS STEEL BIN	69
IV	FOOD GRAINS SELECTED FOR EXPERIMENTS	79
V	METHODS USED FOR COMMUNICATION	
Va	USE OF RAT TRAP TO CONTROL HOUSEHOLD RATS	105
Vb	APPLICATION OF ALUMINIUM PHOSPHIDE TO CONTROL FIELD RATS	105

Vc	FUMIGATION OF STORED FOOD GRAINS IN MUD POT USING CELPHIOSE	105
Vd	WALL PAINTING ON RAT CONTROL	106
Ve	AUDIO VISUAL AIDS USED IN THE TRAINING PROGRAMME	106
Vf	PARTICIPATION OF THE HOMEMAKERS IN THE MEETING	106
VI	ADOPTION OF SCIENTIFIC STORAGE PRACTICES	
Via	POLYTHENE SHEET WITH WOODEN CRATES	112
Vib	POLYTHENE SHEET WITH BAMBOO MATS	112
Vic	USE OF IRON PLANKS	112
Vid	STORING FOOD GRAINS IN A HORIZONTAL POSITION	113
Vie	USE OF MOHAN TRAP	113
Vif	WIRE MESH FITTED WINDOW	113
Vig	FUMIGATED STOCK OF FOOD GRAINS	114
Vih	CHEMICAL CONTROL OF FIELD RATS	114

## LIST OF APPENDICES

APPENDIX NO.	TITLE
I	LIST OF VILLAGES IN THE TWO SELECTED BLOCKS
II	INTERVIEW SCHEDULE TO ELICIT INFORMATION ON STORAGE PRACTICES OF FOOD GRAINS IN THE HOUSEHOLDS
III	SCORECARD PREPARED TO TEST THE ORGANOLEPTIC QUALITY OF STORED FOOD GRAINS
IV	THE DETAILED RESULTS OBTAINED FROM EXPERIMENTS ON MOISTURE, WEEVILIZATION AND GERMINATION PERCENTAGE, ORGANOLEPTIC QUALITY AND PERCENTAGE RETENTION OF NUTRIENTS IN THE STORED FOOD GRAINS
V	READING MATERIALS (Pamphlets) DISTRIBUTED DURING THE TRAINING PROGRAMME
VI	KNOWLEDGE INVENTORY TO TEST THE KNOWLEDGE OF LEADERS BEFORE AND AFTER TRAINING PROGRAMME
VII	ATTITUDE SCALE USED PRIOR TO AND AFTER THE TRAINING PROGRAMME
VIII	SCIENTIFIC STEPS IN COMPUTING THE BEST PERCEIVED ATTRIBUTES IN THE ORDER OF IMPORTANCE

# **INTRODUCTION**

## INTRODUCTION

The agricultural sector in India provides livelihood to about 65 per cent of the labour force. It contributes nearly 29 per cent of the Gross Domestic Product and accounts for a sizeable share of the total value of the country's exports. In addition, it supplies the bulk of wage goods required by the non-agricultural sector and raw materials for a large section of industry (Mehta, 1995; Venkitaramanan, 1996).

The economic regeneration attempted in India through successive Five Year Plans since 1951, has made agriculture a pride of national economy. The Green Revolution and the impetus given by the central and state governments, agricultural universities and other organizations through generation and introduction of numerous hybrid varieties of grains, legumes and vegetables and improved agricultural practices have stepped up food production in the country (Paroda, 1996). The annual food grain production in India has increased from 55 million tonnes in 1947 to 190 million tonnes in 1995-96. The estimated projection of food grain production by 2000 A.D. may reach 220 million tonnes. The overall growth in agricultural production was about five per cent in 1994-95 as against 3 per cent during 1993-94 (Rajagopalan, 1996). As a result, the per capita net availability of food grains went up to a level of 540 grams per day in 1996 as compared to that of 395 grams in the early 50s (Narayanan, 1996; Siddiq, 1996).

However, in spite of the increased food grain production, India has not succeeded in eradicating hunger and malnutrition. Around 10-20 per cent of the population are still unable to obtain sufficient food to meet their basic energy needs. Dharmarajan (1997), Patel (1997) and Tiwari (1997) offer three major reasons for this. First, the population in the country has continued to increase steadily from 361 million in 1951 to 915 million in 1995 and is expected to touch the one billion mark by 2000 A.D. requiring a production level of 240 million tonnes of food grains. Secondly, with increasing population, arable land is diverted for non-agricultural purposes such as industry, housing and public utilities. Out of 142 million hectares of arable land, only 46 million hectares are under agriculture. Further due to population growth, urbanization and industrialization leading to deforestation and climatic changes, the available water for agricultural purpose is on the decline. Thirdly, at least 10 per cent of the food grains produced are lost every year during post harvest operations, particularly during storage. Post harvest losses in quality and quantity occur at all stages from harvesting through threshing, winnowing, processing, transporting, storage, preparation, service and consumption (Parry 1994; Devadas, 1995). Production and protection technology have to go hand in glove for providing sufficient quantities of quality food to the population (Sonelal, 1995; Mosher, 1996).

Of these three major reasons for the insufficiency of food grains to eradicate hunger and malnutrition, the restriction of post harvest losses by adopting suitable measures, might result in adequacy of food grains to a

great extent. The reasons for post harvest losses are either mechanical or biological which are interrelated. Mechanical injury may be due to poor harvesting, handling or processing methods. Biological losses can arise from pest damage (insects, rodents and birds) and the activities of micro-organisms (bacteria, yeast and fungi) during storage (Swaminathan, 1996; Food Corporation of India [FCI], 1997).

Unfortunately, farmers who spend a considerable amount of finance on good seed, fertilizer, pesticides, tractors and other implements, often store their grains only in their traditional storage structures constructed from locally available materials such as straw, split bamboo, mud, brick and wood. These structures are neither moisture or rat proof nor fumigation worthy, resulting in the damage of huge quantities of food grains (Chellappa, 1997; Elangovan, 1997; Maheswari, 1997). As Satyamurthy (1996) points out, India has been losing food grains worth of Rs.350 crores every year due to absence of adequate storage facilities. While it may not be possible to increase the food production level beyond a certain limit, a reduction in losses could lead to substantial increase in food availability to the increasing population, leading to food security.

In recent years a considerable amount of work has been done in the country in the field of post harvest technology at different centres of research and agricultural universities. The Indian Council of Agricultural Research (ICAR) is implementing a programme of All India Coordinated Research Project on Post Harvest Technology and the research findings are being disseminated

to the communities by the Save Grain Campaign (SGC), Government of India (Mahalingam, 1994). However, there is an urgent need to augment the efforts to popularise grain storage management practices among the farming community on a wider scale to arrest the food grain losses.

It is well known that farm women play an indispensable role in agriculture. They are responsible for innumerable activities in the home and farm, including manuring, pre-sowing, sowing, weeding, harvesting, handling grain storage and marketing. However, as Verma et al. (1992) and Manickavasagam (1996) report, in most farm operations, farm women generally play a supporting role with their men counterparts. Their participation is the highest in harvesting and storage of farm products. Women can also be used as effective disseminators and communicators for agricultural technologies particularly those related to post harvest operations. Kim (1991), Devadas (1995), Dubey et al. (1995) and Pokharel (1995) are of the view that agricultural technologies should be tested, keeping in view the roles farm women play.

The association of the investigator with the Food and Agricultural Organisation (FAO) sponsored project on Improvement of Rural Family Storage and Processing of Foods in Selected Blocks in Tamil Nadu, conducted by Sri Avinashilingam Education Trust Institutions during 1988-91, instilled in her a keen interest to probe further into the scientific storage practices which could be adopted by farm households and assess the impact of the new technologies on conservation of grains and retention of their qualities. Therefore, the present study is an attempt in this direction involving

farm women as change agents to foster desirable grain storage practices with the following general and specific objectives :

**General objectives:** to

1. find out the existing food grain storage practices and problems faced during storage and
2. educate farm women on scientific methods of storage through structured training programmes.

**Specific objectives:** to

1. collect information on food crops cultivated in the selected areas
2. study the existing storage practices and their drawbacks
3. assess the extent of losses and determine the factors leading to such losses
4. find out the efficiency of devices/structures used for food grain storage
5. examine the role of women in post harvest operations
6. evolve a training curriculum to impart education to women on scientific storage practices
7. impart skill training to selected farm women
8. evaluate the impact of training programme in terms of knowledge gained, attitudes developed and practices adopted and
9. estimate the quantum of food grains conserved as a result of adoption of scientific storage practices by the selected households.

The hypotheses framed for this study were:

1. Adoption of scientific grain storage practices will have a positive impact on reducing post harvest losses.
2. Women trained on scientific storage methods could contribute greatly towards food grain conservation.

It is hoped that this study will help farmers to improve their storage practices, leading to optimum saving of food grain, which would unquestionably lead the nation to prosperity.

## **REVIEW OF LITERATURE**

## II REVIEW OF LITERATURE

The literature pertaining to the study on “Introducing and Evaluating Scientific Storage Practices for Food Grains among Selected Rural Households in Coimbatore District” is reviewed under the following headings:

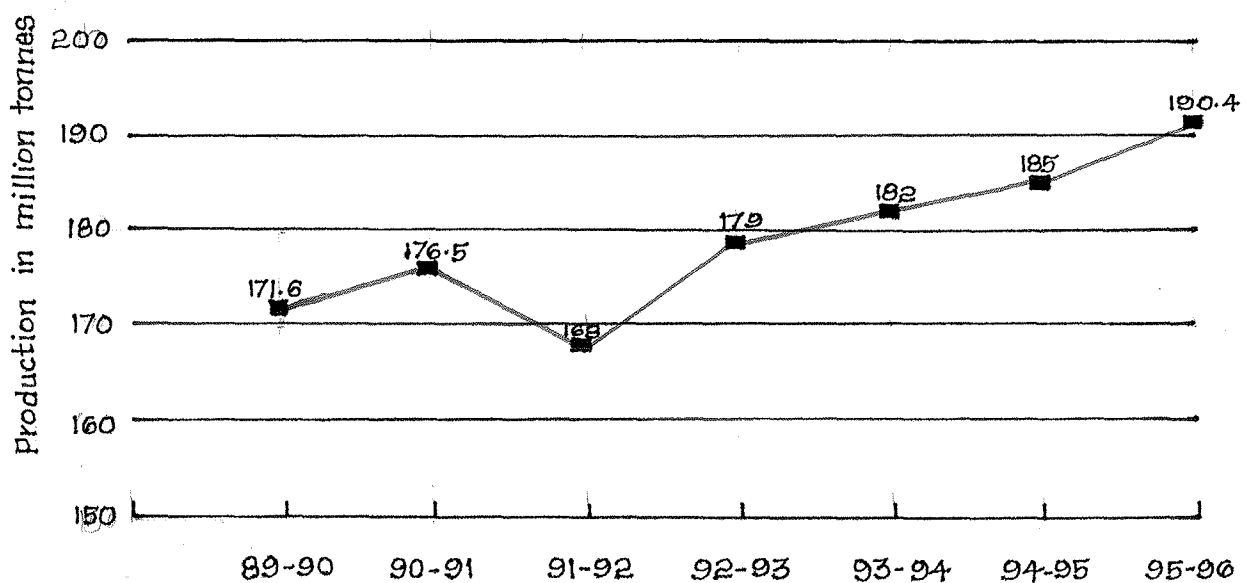
- A. Role of Agriculture in Indian Economy
- B. Importance of Post Harvest Technology
- C. Post Harvest Losses of Food Grains
- D. Factors Responsible for Food Grain Losses During Storage and Measures to Control the Losses
- E. Existing Storage Practices and their Modifications
- F. Modern Storage Structures and
- G. Role of Women in Post Harvest Operations

### **A. Role of Agriculture in Indian Economy**

Agricultural development is an integral part of the nation's general, social and economic development. Agriculture, today, represents a third of India's Gross Domestic Product (GDP) and without doubt, it will continue to be the backbone of the economy for years to come. Tewari and Tewari (1990), Sharma (1991) and Venkataramani (1995) point out that there is a heavy responsibility on the agricultural sector to produce sufficient quantity of quality food to meet the needs of the population and also provide employment to a large section of the population.

According to Kurien (1991) and Chugh (1994) almost 70 per cent of India's population is engaged in agriculture, providing food, clothing and shelter for mankind. Its production, therefore, is the key factor to the lasting solutions to the problems of under-nutrition and hunger (Swaminathan, 1991; Rai, 1994; Grover and Grover, 1996).

The food crops to be handled, processed, transported, distributed and utilized in the country currently include nearly 70-80 million tonnes of paddy, 46 million tonnes of wheat and 40 million tonnes of other cereals and coarse grains. As a result, the country has moved from a position of deficit to a position of surplus food grain production (Padmanaban and Chinnadurai, 1994). The total annual production of food grains over the last seven years from 1989 to 1996 is shown in Figure - I (Mani et al., 1995; Siddiq, 1996).



Annual Food Grain Production (1989-'96)

Figure -1

In spite of the phenomenal increase effected in agricultural production, it is estimated that the country will have to produce 240 million tonnes of food grains by the end of this century to feed a population of over one billion, which means an additional production of 55 million tonnes of food grain in the next five years (Khanna, 1990; Bhatnagar et al., 1995; Mahadevappa, 1995; Chandrasekhar, 1996).

### **B. Importance of Post Harvest Technology**

Girish et al. (1992) explain that harvesting is the single deliberate action to separate the food stuff, with or without associated non edible material, from its growth medium. Reaping cereals, picking fruits, lifting fish from water and all succeeding actions are defined as post harvest actions. According to Devadas (1992) post harvest operations include cutting of crop, stacking, drying, threshing, winnowing, bagging, temporary storage and distribution. Since food cannot stay indefinitely in a natural state after harvesting, it has to be processed and preserved for the required period (Herald, 1994, Ramanuzam, 1995; Kalidurai et al., 1995).

According to Sonelal (1995) post harvest technology is a multi-disciplinary science which has the capability of increasing the agricultural production through scientific conservation, elimination of avoidable losses and making available high value products from low grade raw materials. This can be achieved by proper processing, fortification, packaging, transporting, storage and marketing of agricultural output. Efficiency of these operations makes the post harvest technology an important step in the nation's economy (Shukla, 1988; Dwivedi, 1994). Thet Zin (1986), Rai (1994) and Muir (1994) recommend that the technology involved in these activities be appropriately called as harvesting technology.

Post harvest technology can play a major role in the establishment of agro-industries by producing value added products, assuring financial returns and generating employment opportunities for the farmers and rural poor (Mahalingam, 1994; Paroda, 1996). These technologies also help in systematising the complex system of food marketing, making food available to consumers at all times and saving foreign exchange too (Bani, 1991; Jain, 1996; Venkataramani, 1996).

### **C. Post Harvest Losses of Food Grains**

A variety of factors determine the food grain losses after harvest which vary from commodity to commodity and with the circumstances under which they are grown, harvested, stored, processed and marketed (Melhotra and Yadav, 1983; Chaudhary et al., 1993). The reasons for post harvest losses are either mechanical or biological, often interrelated. Mechanical injury may be due to the result of poor harvesting, handling or processing methods. Biological losses can arise from pest damage (insects, rodents and birds) and the activities of micro-organisms (bacteria, yeast and fungi) (Central Food Technological Research Institute (CFTRI), 1990; Bheemappa, 1994; Thimmaiah and Ravishankar, 1995; FCI, 1997).

According to Renganathan (1988), Chellappa (1997) and FCI (1997) 10 per cent of the total food grains produced are being wasted in various ways in the country. The Food and Agricultural Organization (FAO) (1992), Babhu et al. (1991) and Singh (1996) reveal that the average loss of five per cent of the world production of harvested food stuff was only a conservative figure.

**Post harvest losses at different stages :**

**Threshing:** Separation of the ultimate product from the chaff or straw is known as threshing. Threshing is mostly done by manual tracking, drum beating, bullock trading and by pedal thresher (Miah, 1992). Losses in threshing vary from 0.22 to 1.44 per cent depending upon the different methods and practices adopted. The losses may be accounted as loss of grain in the straw or unthreshed grains and the quantities eaten away by rodents and birds over the threshing yards (Krishnamoorthy, 1984). According to Ahmad (1991) and Narayanan (1996) improper harvesting and threshing of food grains result in losses upto five per cent.

**Drying:** After threshing and cleaning, drying of grains is imperative for the removal of moisture from the grains. Pillaiyar (1996) reports that grains, even with a moisture content of 18 per cent, cannot be kept in storage for more than a day because of its high respiratory rate which leads to loss in dry weight. Drying operation reduces the level of moisture in the harvested crop and enhances its storability, transportability, flavour and texture due to elimination of microbial deterioration. Therefore, the grain should be properly dried and cooled before storage (Kachru and Singh, 1992; Kumar and Chellappa, 1992; Chellappa, 1997 ; FCI, 1997).

**Transport:** Transportation is manually done by carrying the load on either the head or the shoulder or by using bullock carts and tractors. The cut crop is taken from the field to the threshing floor either for stacking or immediate threshing. After threshing, it is taken to the selling or storage place. During these processes, grain loss is possible due to leakage in bags or vehicles . Assessment of grain loss during transport indicates a loss of around 0.15 per cent (Kumar et al., 1992).

**Processing:** The processing operations carried out at home or in mills include cleaning, parboiling, hulling, debranning, grinding and separating. The loss during processing is usually unavoidable (Gomosta et al., 1995). Assessment of grain loss during processing indicates a loss of around 0.92 per cent (FCI, 1997).

**Storage:** Storage is done to meet the food and seed requirements between two harvests and during natural calamities like drought, famine and war (Babhu et al., 1991; Ali and Srivastava, 1993). It has been revealed that many farmers store food grains in poorly designed and constructed storage structures where the grain is attacked by a wide range of insects and pests. According to Satyamurthy (1996), the latest estimate reveals that 10 to 15 per cent of the 191 million tonnes of food grains produced in the country is lost during storage, the cost of which is estimated between Rs.3,000 to 3,500 crores. Sharma and Jain (1983), Gupta (1990), Ahmad (1991) and Kumar and Chellappa (1992) present the break up of losses of 9.33 per cent during the post harvest stages as threshing - 1.68 per cent, transport - 0.15 per cent, processing - 0.92 per cent, rodents - 2.50 per cent, insects - 2.55 per cent, moisture - 0.68 per cent and birds - 0.85 per cent. Although losses through insects and rodents are as high as 25 per cent of the annual losses of food grains stored in godowns in India, losses due to insect infestation alone account for five million tonnes (Krishnamurthy and Girish, 1992; Giraddi, 1992; Chaudhary et al., 1993; Rao, 1996).

## **D.Factors Responsible for Food Grain Losses During Storage and Measures to Control the Losses**

The factors responsible for the losses during storage may be grouped into biological and non-biological (Nagarajan, 1992; Kumar, 1993; Mabbett, 1994).

### **Biological factors**

The biological factors comprise insects, rodents and micro-organisms.

**Insects:** The principal cause of loss in quality and quantity of stored grains is due to the attack of insects such as rice weevil, lesser grain borer, flour beetle, khapra beetle, long headed flour beetle, saw toothed grain beetle, flat grain beetle, grain moth, rice moth and pulse beetle (Gupta et al., 1994; Indian Grain Storage Institute (IGSI), 1996; FCI, 1997). During storage, insects mainly cause quantitative weight losses by directly feeding on the kernels of grains. The losses due to insect infestation vary between 10 to 40 per cent depending upon the type of food grains and condition and period of storage. This loss is highest when compared to the losses caused by other agencies such as rodents, moisture and birds (Agarwal et al., 1992; Prakash and Rao, 1992; Regunathan, 1995; Sachan, 1995).

The following precautions are recommended by IGSI (1996), FCI (1997) and SGC (1997) to save the grains from insects during storage:

Clean the bullock-carts, trucks and wagons in which food grain is transported. Clean and dry used gunny bags for reuse. Avoid storing grains near feed rooms and bins. Spray insecticides inside and outside the storage structures before storing food grains.

Disinfestation of food grains is a method where food grain stocks are preserved from the attack of live insect and rodent population by making use of either permitted chemicals or nature gifted materials and conditions by prophylactic and curative treatments ( Jacob, 1992; Dwivedi, 1994).

Prophylactic treatment to stacks godowns should be done once a fortnight irrespective of the live infestation present. Foodgrain bags (after cleaning and brushing) and godowns are sprayed with the permitted chemicals of required dosage to control cross infestation. Chemicals like Malathion 50% EC and Pyrethrum are commonly used to spray on bags empty space and DDVP (Dimethyl Dichloro Vinyl Phosphate) is used for air charging the empty space only. The spraying may be done by a power sprayer or by foot or hand operated sprayer (Prakash and Rao, 1992). The details of concentration, dosage of these chemicals as recommended by FCI (1997) are given in Table I.

TABLE I  
OPTIMUM DOSAGE OF PESTICIDES

Chemicals	Base	Concentration	Dilution	Dosage of prepared solution	Treatment interval	Remarks
Malathion	Organo phosphorous compound	50% E.C	1:10	3 litres/ 100 sq.mts	Once in two to three weeks	Surface treatment
”	”	”	1:50	3 litres 100 sq.mts.	During infestation by flying moths	Treatment on empty space and for aerial spray
Dimethy dichloro vinyl phosphate	Organo phosphate group	75% E.C	1:300	3 litres/ 100 sq.mts.	At times of flying moths infestation	Treatment on empty space
Pyrethrum	Organic derivative of plant base materials	2.5% of pyrethrum	1:100	3 litres/ 100 sq.mts.	Once in two to three weeks	Surface treatment

These chemicals act as contact poisons by causing irritation, increase of physical and metabolic activity of insects resulting in their destruction (Agarwal et al., 1990; Birwas, 1994; Gupta et al., 1994).

Curative treatment is given to food grain stocks to arrest and control the resident and hidden live infestation completely. This treatment is given depending upon the nature of live insects present and also the degree of infestation in food grain stocks. Fumigation is a process where the insect population

present hidden in food grains are exposed to lethal doses of fumigants for a required period of time to cause cent per cent destruction due to inhaling the poisonous gas emitted by the fumigants. Fumigants are chemical compounds which are volatile at ordinary room temperature and sufficiently toxic to insect population (Agarwal, 1988; Appaiah et al., 1994).

The commonly used fumigants and their dosage are given in Table II.

TABLE II  
OPTIMUM DOSAGE OF FUMIGANTS

Name	Chemical formulae	Availability	Dosage	Type of fumigation	Period of exposure in hours
Aluminium Phosphide (ALP)	ALP	Tablets, pellets in air tight aluminium containers	6-9 g/ Mt of Food grains 2.25 g/cu.m	Cover	96-120
Ethylene Dibromide (EDB)	C <sub>2</sub> H <sub>4</sub> Br <sub>2</sub>	Liquid under pressure in lacquered mild steel drums	22 g/cu.m	Shed	150-170
Methyl Bromide (MBR)	CH <sub>3</sub> Br	Gas at room temp. in seamless cylinders	22 g/cu.m	Cover	12-48

**Rodents:** The rat is one of the most dangerous and expensive pests living and flourishing at man's expense spreading deadly diseases like plague (Gupta et al., 1994). Rats have their own, invisible natural weapons such as ready adaptability, highly developed suspiciousness and the profile reproduction rate (Bhadauria and Mathur, 1994). They constitute one third of the mammalian population and cause extensive damage to both standing crops and stored products. Rodent population in India outnumbers human population by six times. Rat damages are both quantitative and qualitative. One rat consumes on an average 24 g of food per day or about 10 kg per year. It is reported that the quantity contaminated with rodent pellets, urine, hair, carcasses and extraneous debris is equal to ten times the quantity consumed by them (Satyamurthy, 1996). Rat infestation is found in fields, threshing yards, during transit in carts, trucks, wagons, ships, besides human dwellings. It is reported that the loss due to rodent is 2.5 per cent (Neelananarayanan et al., 1995).

Rodent control can be initiated with ecological control measures. It involves removing all sources of food, water and shelter for the rodents, both inside and outside the houses, providing sanitary conditions and removing bushes, shrubbery, trash, garbage and standing water which would reduce the favourable breeding grounds (Rangarajan et al., 1995).

Mechanical control is the second line of measure to be taken which involves use of traps, flooding of rat holes and rat proofing. Biological control entails use of predators. Some farmers keep trained dogs who prey on rats or even

dig out the rats from burrows by smelling them. Snakes, mongoose, weasel and cats are well known predators of rat and contribute to keep the rodent population low (Venkatesha, 1995).

Chemical control forms the backbone of rodent control programmes. Use of poison baits is the quickest way of reducing high rodent population. Chemical materials currently used can be broadly classified into acute toxicants (quick acting), chronic toxicants (slow acting), fumigants, attractants and repellants (Tripathi and Jain, 1994).

Acute toxicants, also known as single dose poisons, are generally used to bring down the rodent population rapidly. They include zinc phosphide, silmurin, vacor or RH 787, strychnin, arsenious trioxide, baricum carbonate norbormide, sodium fluoro acetate and thallium sulphate (Thakre et al., 1990; Bhagwat, 1993). Chronic toxicants which include most of the anticoagulant rodenticides delay blood clotting causing leakage of blood through the capillaries resulting in internal haemorrhage and death. Death occurs after multiple feeding and thus reduces hazards of non-target species.

Fumigation method is used in food godowns and stores. Fumigation of rat burrows with aluminium phosphide is effective under practical conditions. It is prepared in the form of tablets and pellets, which release phosphic gas on exposure to atmospheric or soil moisture.

Repellants are a low-hazard alternative to toxic rodenticides. But there has been little effect in practical application as a single repellent may not be effective universally (Rajamanickam and Lourduraj, 1997).

Sustained rat control campaign on the above lines will help the farmers to keep the rat menace under check.

**Micro-organisms:** Micro-flora can be classified into fungi, bacteria and yeast. Of these, fungi are the most important group responsible for deterioration of food grain (Saxena, 1987; Singh et al., 1992; Verma et al., 1996). During growth, some fungi produce chemicals which can be toxic to human beings and domestic animals and hence mouldy products should not be used for human or animal consumption (Paster et al., 1992; Sudesh et al., 1993; Dwivedi, 1994).

To control micro-organisms the grain must be dried before storage, Micro-flora cause heating of grains and such heating starts in certain pockets or spots. Detecting the heating pockets in time and turning over the grain can stop the heating of grains temporarily (Rao et al., 1991). Excessive moisture from any source such as rain leaks or ground moisture must be prevented.

The temperature of the store must be kept below normal to reduce the activities of micro-organisms. The temperature should be lowered below the optimum (for most fungi it is 23-24°C) as this will reduce the activity of these organisms (Johnes et al., 1993).

### **Non-biological factors**

The non-biological factors are moisture and temperature (Mabett, 1994.)

**Moisture:** Moisture plays an important role in storage of food grains. High moisture content increases storage hazards. Insect infestation tends to increase with increase in moisture content above 10 per cent (Mehrotra and Yadav, 1983). Humidity influences the survival of insects mainly through the effect of their water content. Therefore, to minimize losses, grain must be dried to a safe level of moisture content before storing. Table III shows the safe moisture level for storing different food grains as recommended by Samsher (1991), Ali and Srivastava (1993), Ali and Mohan (1993) and Dash et al. (1994).

TABLE III  
RECOMMENDED GRAIN MOISTURE CONTENT FOR SAFE STORAGE FOR ONE YEAR

S.No.	Commodity	Moisture content (in percent)
1.	Paddy	14
2.	Ragi	12
3.	Wheat	12
4.	Jowar	12
5.	Maize	12
6.	Bajra	12
7.	Barley	13
8.	Oats	13
9.	Soyabean	11
10.	Sorgham	12
11.	Shelled corn	13
12.	Peanuts	13
13.	Pulses	10-12
14.	Oil seeds	8-10

The recommended grain moisture content ranges between eight and 14 per cent.

**Temperature:** Temperature is the most important factor to be considered for safe food grain storage next to moisture content. Initial temperature of stored grain is established by the temperature of grain at harvest or at the end of preliminary

processing. The initial high temperature of freshly harvested grains, encourages rapid deterioration of the stored grains (Miah and Mazed, 1994). The temperature inside the storage should be as low as possible to reduce the activity of micro-organisms and insects. It has been observed that the optimum temperatures for growth of insects and micro-organisms are 35-37°C and 25°-30°C respectively and their activity reduces as temperature decreases. The insects are killed at temperatures below 10°C. Well dried grain will remain reasonably free from insects at temperatures upto 30°C (Cherian, 1992; Kumar, 1993; Dash et al., 1995). Therefore, low temperature can be as effective as low moisture in preventing damage to stored grains.

Post harvest technology in food grain procurement, handling, storage and in overall food grain management has become a great need, first, to prevent physical loss and secondly, to maintain a standard quality acceptable from nutritional as well as commercial point of views. Therefore, minimization of storage loss through improved methods and materials, including efficient storage structures is an urgent need (Laje et al., 1992; Patil and Kalayankar, 1993; Pokharel, 1995).

### **E. Existing Storage Practices and their Modifications**

The most prevalent traditional storage structures in Tamil Nadu are locally known as 'Seru', Kalangiam', (Pucca Kothi) 'Thombè', 'Pathayam', 'Kudir', 'Koni' (gunny bag) and 'Underground Storage Structures'. The method of construction differs from place to place. These structures are made up of either straw, bamboo, reeds or masonry (Shanker et al., 1989; Sudesh et al., 1993).

**'Seru':** It is constructed with paddy straw wound in the form of ropes of diameter varying from 50-100 mm. The structure is a tapered one with a smaller diameter at the bottom and a larger diameter at the top. Usually, dry threshed straw is used for making the ropes and freshly harvested or partly threshed straw is used for inside lining. The cost of construction is low and the materials used are abundantly available with the farmers. This storage structure provides good thermal insulation.

The drawbacks of this structure are as follows: They are not insect proof and are not air tight to carry out disinfestation measures. They are susceptible to rodent attack resulting in heavy losses. They are not free from fire hazards and are protected poorly against theft and damage by animals.

The improvements in the local structure as recommended by Rao et al. (1992) and Kumar, (1993) include introducing water and rodent proof base constructed of brick masonry, RCC ring or cement concrete or metal sheet underneath the structure (Plate -Ia)

**'Kalangiyam' (Pucca Kothi) :** It is a masonry structure for bulk storage of food grains. It is similar to the 'Kotlu' of Andhra Pradesh and 'Kothi' of the northern states of the country. It is usually rectangular or square in shape. This room-like structure is constructed as a part of the house or separately in the middle of one of the rooms of the house or outside the house. This structure does not give adequate protection against rats and moisture (Chellappa, 1997).

The improvement made in this structure is an indoor design constructed of burnt bricks in two compartments of one metric tonne capacity each with reinforced brick at the floor and roof. The inlet opening is provided in the roof and the outlets at the bottom. It has adequate facility for locking. The moisture barrier is provided in the construction to make it damp proof. As such, these improved structures (Plate-Ib) can be used to their full capacity and are found to be sufficiently moisture proof and air tight. Depending upon the space available, the structure can be extended further to have more compartments. Such structures with compartments, facilitate the storage of different varieties of food grains (Ministry of Agriculture and Irrigation, Government of India, 1976; Narasimhan et al., 1978; Rao, 1992).

**'Pathayam '(Wooden structure):** This is an indoor wooden storage structure usually of rectangular shape. Mango wood is commonly used. Use of jackwood and banian wood is also common. The construction of 'pathayam' is in the form of a tray.

The structure is not insect or rodent proof. It is not air-tight in view of the cracks and crevices. The improvement suggested by Kumar (1993) are to fill the cracks or gaps between joints with wood filling materials, to paint the exterior with suitable wood paint to close the pores and to fix a thin galvanised sheet of 30 gauge thickness at the bottom to prevent rats from nibbling (Plate-Ic).



Plate-Ia 'Seru'



Plate-Ib 'Kalangiyam' (Pucca Koth)



Plate-Ic 'Pathayam' (Wooden Structure)

Plate .I. EXISTING STORAGE DEVICES/STRUCTURES AND THEIR  
MODIFICATIONS

**'Kudhir'** : Two types of 'kudhir' are used by farmers. The one which is extensively used in Tamil Nadu is a circular shaped 'Thombe (bamboo kudhir) (Plate-Id). The walls are made of dried red gram stalks interwoven to get a circular shape. They are plastered with mud and cowdung. This structure is not rat proof, water proof and air-tight to carry out disinfestation measures. The improvements suggested include keeping the storage structure on wooden benches and fixing metal cones to the legs of the wooden benches to prevent rats from climbing (Agarwal et al.,1992; Rao, 1992).

The other type is made of burnt clay. Grain meant for seed purposes can be stored in these structures for over a season without any reduction in viability. Being mud structures and fabricated by the local potter, they are economical. But the demerits of the structure are that they are breakable and are not rat proof or air-tight. Improvements suggested for such structures (Plate-Ie) are brick masonry base of sufficient height, fixing suitable outlet to the structure for easy discharge and applying externally two coats of bitumen paint to prevent the entry of moisture (Rao ,1992).

**'Koni' (Gunny bag):** The most commonly used storage structure in Tamil Nadu is 'Koni' which is made out of hessian/jute fabrics. These gunny bags have low tare weight ratio and are easy to handle. It is also easy to measure the quantity of the grain. When empty, they can be rolled and kept in convenient places without occupying much space. Grain kept in bags are well aerated and these are preferred to store seed. .

But 'konis' do not give adequate protection against rats, insects and moisture. Since they are liable to be damaged by rats or by mechanical means, they need frequent replacement which means extra expenditure to the farmer.

The improvements (Plate-If) suggested are :

- a. Keeping bags on a wooden 'dunnage' or on a bench. By this grains will be protected from the ground water/splash water damage
- b. Providing a raised platform which is fitted with metal cones in the legs. This will prevent the rats from getting inside the bags.
- c. Spraying the external surface with a suitable residual insecticidal formulation to prevent cross infestation and
- d. Providing a gas proof sheet to disinfest the grains (FCI, 1997).

**Underground storage structure :** The underground storage structure which is known as 'Pathera' in Andhra Pradesh, 'Khari' in Orissa, 'Havegu' in Karnataka and 'Khatti' in Maharashtra is not common in Tamil Nadu. This is usually a shallow structure for storage of paddy. The depth varies from 21 feet to 31 feet depending upon the water table of the area. The dunnage materials generally provided are paddy straw or palmyrah mat. Paddy straw ropes are placed around the walls to prevent direct contact of the soil and moisture ingress from the soil. The floor is covered with paddy husk and loose straw, on which the grain is loaded. After filling the paddy, they are covered with palm leaves or paddy straw to form a conical shape. Normally the paddy stored in this structure is removed before the onset of monsoon to avoid damage by moisture.

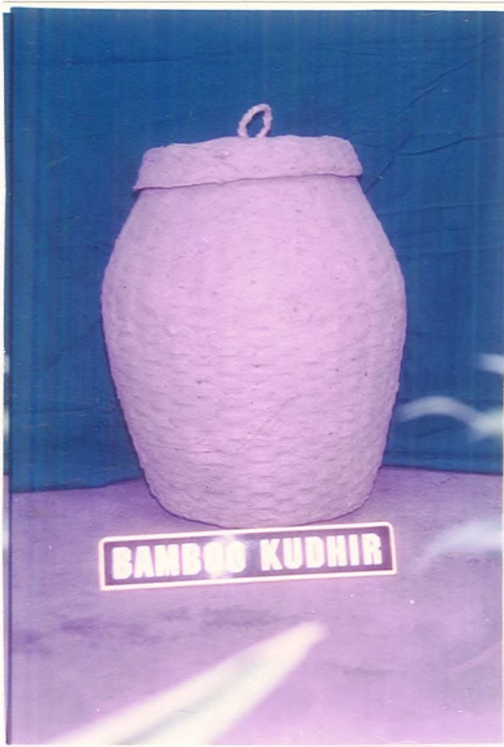


Plate-Id 'Thombe' (Bamboo Structure)



Plate-Ie 'Mudkudir'



Plate-If 'Koni' (Gunny bag)

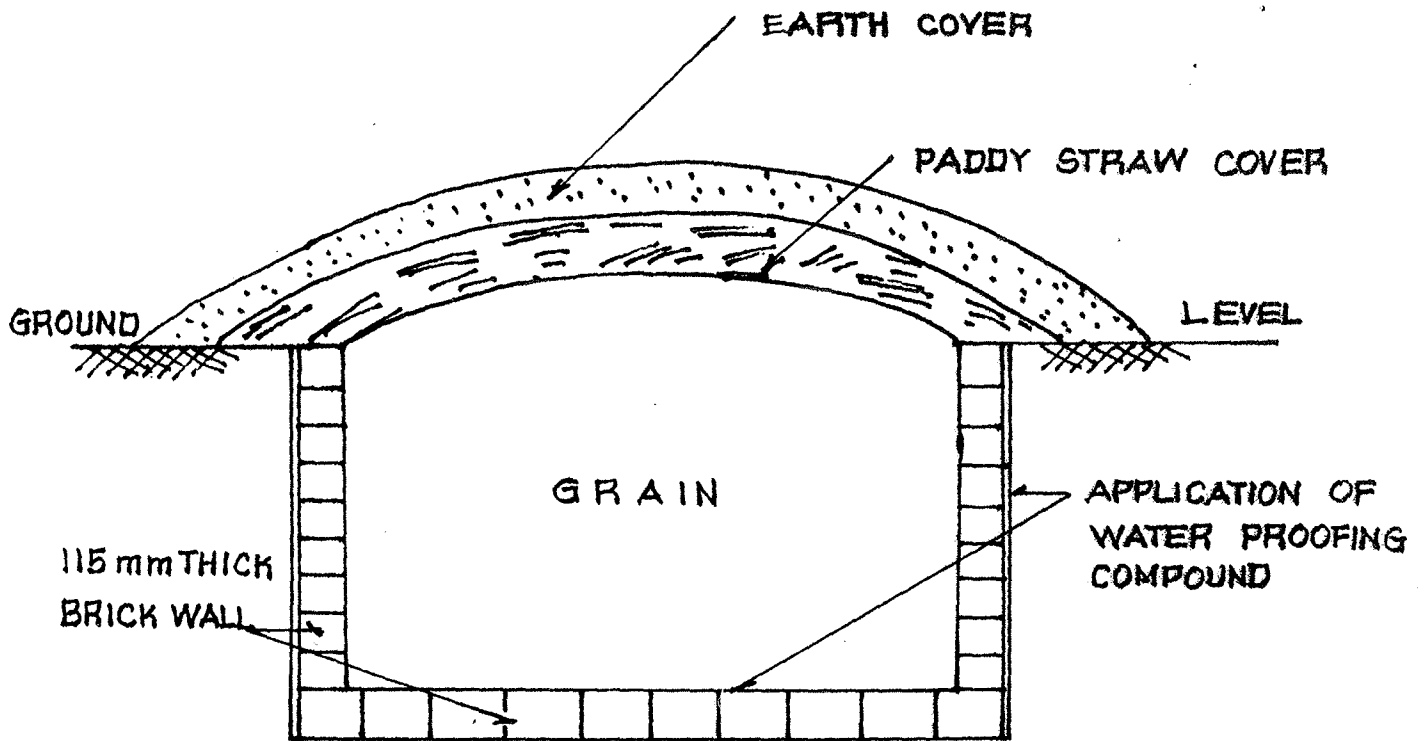
Improvement has been made in the structure by constructing 115 mm thick brick wall with six mm reinforcement at every fourth layer and then concreting the floor or laying solid stone or brick (Figure-2) . Liberal application of tar on floor as well as the exterior of the wall is also suggested (Rao, 1992; Kumar, 1993).

#### **F. Modern Storage Structures**

Storage system have direct relationship with the economy of the nation and therefore, there is always a need for an appropriate and efficient storage system. An improved structure should be free from the attack of rat, mites, pests and moisture-proof and adequately air-tight. It should provide adequate protection against fire and theft and should bring down storage losses and maintenance cost (Birewar, 1990).

Among the several improved storage structures designed Hapur bin (metal bin), plastic silo, polythene-lined double-walled bamboo bin, plywood bin and coal tar drum are of great significance.

**Hapur bin (Metal bin):** Hapur bin (Plate-IIa) is made up of 24 gauge galvanised plain sheet. It is cylindrical in shape, 96 cm in diameter and 98 cm in height. An inlet of 8 cm diameter is fitted at the top of the bin and an outlet of 14 cm diameter is fitted at the bottom, horizontally. The bin is strong and it facilitates easy loading, unloading and transport (Singaravelu et al., 1988; Rao et al., 1991).



CROSS SECTION OF IMPROVED  
UNDER GROUND STORAGE STRUCTURE

Figure - 2

**Plastic silo:** Plastic silo (Plate-IIb) is cylindrical in shape and is fabricated with 3000 guage thick special, flexible plastic material of 84 cm diameter and 147 cm height. After the silo is filled a flat topped cap is inserted over the silo. On the front end of the cap, there is a tape belt by means of which the plastic bin can be hermetically sealed. It is air-tight and moisture proof. It can hold 500 kg. of cereals (Ali and Mohan, 1993).

**Polythene-lined double-walled bamboo bin:** Polythene-lined double-walled bamboo bin (Figure-3) has two layers of bamboo strip mats shaped into a cylindrical form and sandwiched with 700 guage thick polythene sheet. The diameter and height of the bin are 100 cm and 158 cm respectively. Upto a height of 90 cm from the bottom, it is cylindrical and the remaining top portion is in the shape of a frustum of a cone. It is an air tight bin with a low weight of 12.5 kg when empty (Singaravelu et al., 1988).

**Plywood bin:** Plywood bin (Plate -IIc) is designed and developed by Indian Plywood Industries, Bangalore. It is made up of exterior grade plywood made of selected quality veneer using thermo setting synthetic resin. It is cylindrical in shape with 82 cm diameter and 122 cm height. An aggregate, such as sand, glued on the exterior surface of the bin with synthetic resin prevents gnawing by rodents. The loading hatch at the top measures 45 x 45 cm and an unloading chute at the bottom is of size 16 x 12 cm. It is water proof and resistant to decay (Ali and Mohan, 1993).



< - Plate-IIa Hapur Bin (Metal b

Plate-IIb Plastic Silo ->

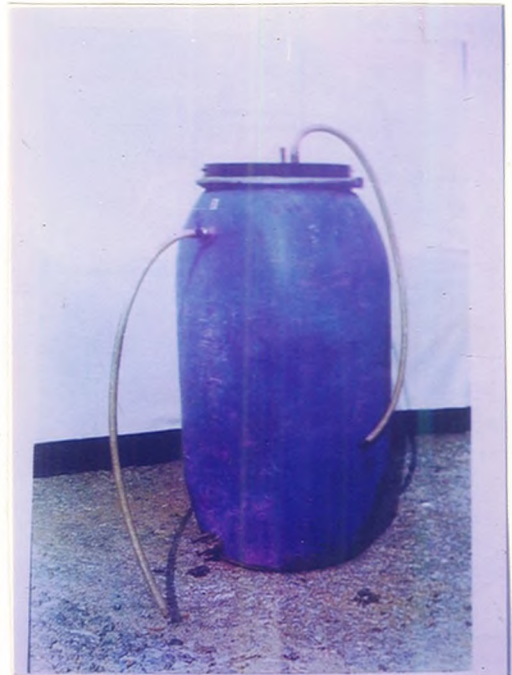
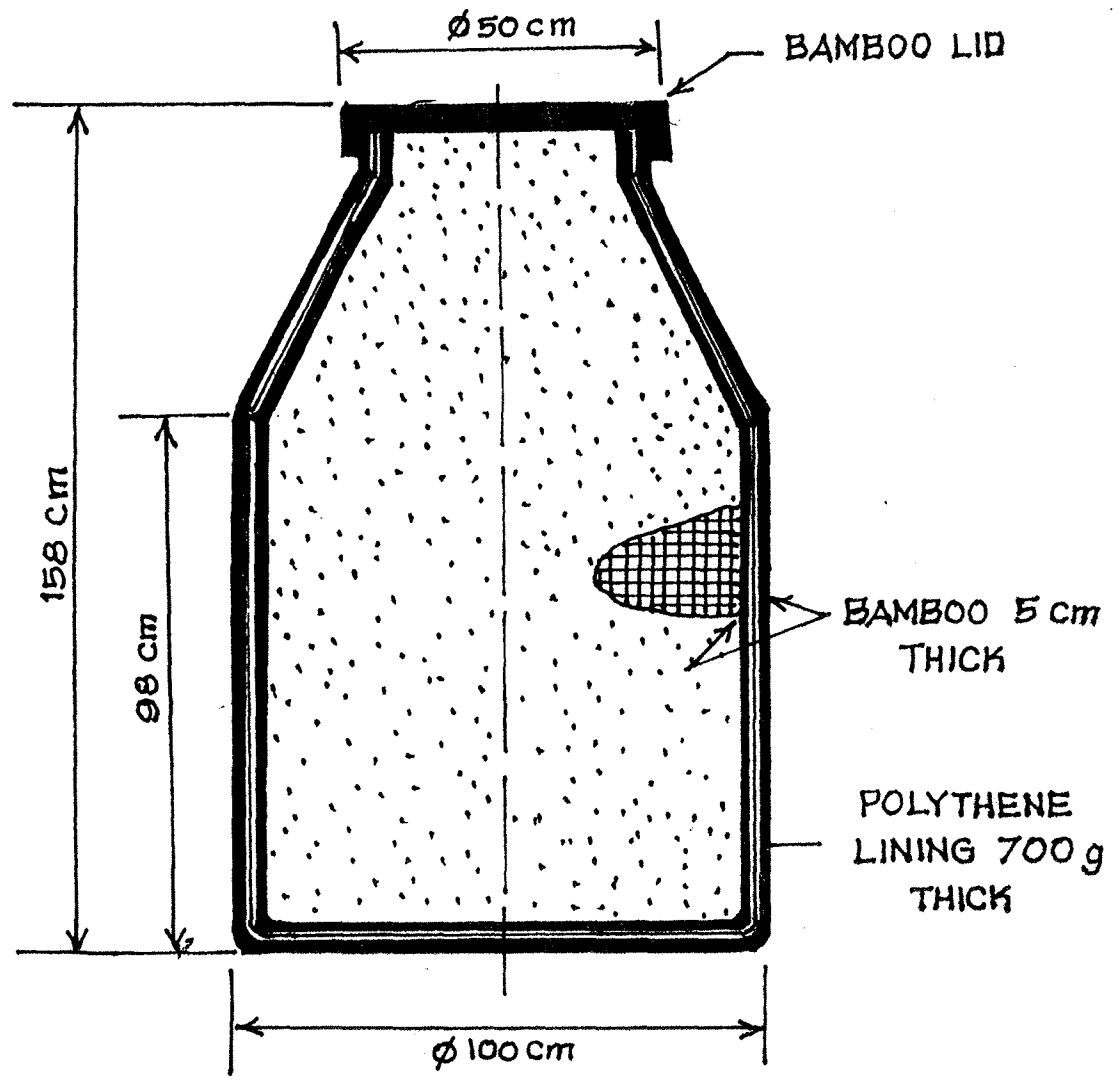


Plate .II. MODERN STORAGE DEVICES/STRUCTURES



SECTIONAL SIDE VIEW

DOUBLE WALLED POLYTHENE LINED  
BAMBOO BIN

Figure - 3

**Coal-tar drum bin:** The used coal-tar drum (Plate -IId) can serve as an efficient storage bin. It is hammered to remove the dents and brought to a cylindrical shape. It is cleaned of tar by heating and by using acetone. It is provided with a cover at the top with M.S. sheet 20 guage and soldered. The diameter of the bin is 50 cm and height 90 cm. In the top cover, provision is made to fill the grain by placing a spout of 20 cm diameter. This spout is provided with a rubber band gasket to make it air tight (Ali and Mohan, 1993). The coal-tar drums developed by the Central Institute of Agricultural Engineering (CIAE), Bhopal, is becoming popular in rural areas. It prevents damage by rats and are more suitable for storage at the processors' and traders' level.

The Udaipur bin is similar to the coal-tar drum bins except for the design of the lid. These are suitable for storing food grains for short duration and can be adopted by small farmers. The capacity, cost and the approximate life span of the above mentioned storage devices/structures are given in Table IV.



<- Plate-IIc Plywood Bin

Plalte-IIId Coal-tar Drum Bin ->



TABLE IV

## CAPACITY, COST AND LIFE SPAN OF STORAGE DEVICES/STRUCTURES

Sl. No.	Name of the bin	Capacity (kg)	Cost (Rs)	Life span (Years)
1.	Hapur bin	500	800	Permanent
2.	Plastic silo	500	400	5
3.	Polythene lined-double-walled bamboo bin	500	325	4
4.	Plywood bin	500	600	10
5.	Coal-tar drum bin	125	220	Permanent

**G. Role of Women in Post Harvest Operations**

Swaminathan (1990) and Dupka (1992) opine that the role of women in agricultural development is one of the important forces towards increasing agricultural production. Therefore, the total intellectual and physical participation of farm women is absolutely essential for economically and ecologically sustainable agriculture.

Rural women spend several hours a day on post harvest handling of samples such as cereals or legume grains, vegetables and fruits for long-home storage or for immediate use. They are engaged in farm operations such as preparation of manure, seed grading, sowing, dibbing, planting, irrigation, fertilizer application, plant protection, weeding, harvesting, threshing, shelling, huddling, winnowing, cleaning, storing grains, feeding the cattle, looking after milch animals, poultry, kitchen gardening and so on (Nandapurkar and Soni, 1988; Girish et al., 1992).

Verma et al. (1992) found that among the major farm operations, rural women participated in a large proportion in winnowing (75 per cent) and grain storage activities (76 per cent). Prasad and Choudari (1991) revealed that 60 to 70 per cent of the labour input in crop production technology was provided by women, the principal activities being manuring, pre-sowing, sowing, weeding, harvesting grain storage and marketing (Majundar, 1991; Sharma, 1992; Bhople and Patki, 1992).

Lale (1988) and Joshi (1989) suggested that agricultural technologies should be tested, keeping in view the requirements of the farm women and they should get attention in national and international development programmes. Though farm women are predominantly involved in all post harvest operations, their participation is most crucial and essential for reduction of losses in food grains at farm level (Kapoor, 1986; Kumar et al., 1992). It is rightly stressed by Devadas (1995) that no national development will be meaningful and thorough without the full involvement of women in the development process. If they are properly trained and made aware of the technological advance, the nation will record high

productivity with a reduction of losses (Singaravadivel, 1992; Singh and Rai, 1993). A survey conducted by Devadas et al. (1988) to assess the aptitude of 196 farm women showed that 96 per cent were interested in learning more about improved seeds, fertiliser use and plant protection measures and 83 per cent in scientific water use and 75 per cent in improved implement. The late Indian Prime Minister Pandit Jawharlal Nehru said that "if the community development movement which aims at changing the whole texture of our society, of our thinking and of our action fails in achieving its objectives, it will not be for lack of money but for the lack of trained personnel".

As revealed by Verma (1989), problems which hinder the development of improved post harvest systems are lack of communication, co-ordination and co-operation between rural people, government, private sector and the scientific communities. Indifference towards new agricultural technology can be removed by training women in new technology. This would also help in improving their socio-economic status (Kanwari and Korrane, 1988; Nagpal, 1989).

The adoption of modern storage practices through training would help in the prevention of losses in large stocks handled by various agencies. Systematic approach should be established to ensure that enough and good quality of food grains are made available to people especially to poorer section of population at reasonable prices (Pandey, 1990).

Several on going programmes are underway at the governmental level for effective storage of food grains but the most vulnerable area which needs concentrated efforts are the farm level storage, where 60 to 70 per cent of the produce is retained and the maximum losses occur. In order to prevent the losses of this level, systematic extension education programmes are needed. Such programmes must include prevention of storage losses due to insects, pests and rodents, use of chemicals to eradicate the pests, scientific storage practices, improving the existing storage structures and introduction of control measures against rodents (Devadas, 1992).

As explained by Littlezied et al. (1971) and Tara (1985), training is a continuous systematic development of knowledge, skills and attitudes among all levels of employers. According to Kamat (1983) training is the process of helping personnel in an organisation to acquire knowledge, skill and attitude for new and better ways of behaviour needed by an organisation. The general objectives of training are to help participants to widen their perspectives and conceptual abilities, acquaint them with latest social and political environment in the country, familiarize the principles and techniques and help them to develop interpersonal skills. According to Khemmani (1985) and Strayton (1986), training is the consolidation of skill, knowledge, experience which helps trainees in learning the latest development in their specialised profession. Training is the means by which experience is transformed into knowledge and where the knowledge is built up of experience (Melhotra, 1987; Sadasivam, 1988; Swaminathan, 1996).

Indian farmers, a large number of women are illiterate or poorly educated. They play an important role in improving Indian economy. Training of the farmers is one of the most important tools to improve their knowledge to meet their changing needs (Dubey et al., 1995). By improving post harvest technology, the economic standard of the farmers can be improved. Besides, farmers will be encouraged to produce more if they can store the produce safely and get a good price later on (Swaminathan, 1990; Singh and Sharma, 1991).

It is not only the men but also the women play an important role in farming and farm management practices. Disregarding the opinions of women, the men folk will not be able to undertake any activity to improve the farm and home. Therefore, training of farm women is equally as important (Meera and Nair, 1990). Nagarajan (1992) rightly declares that "if you want to plan for a year, plant wheat, if you want to plan for ten years, grow trees but if you want to plan for 100 years educate women". Singh et al. (1987) and Chaudhari and Ganorkar (1992) pointed out that women have been playing and will continue to play a crucial role in farm and rural development and hence the training programmes and extension approaches should concentrate on the special needs of women farmers.

Practical demonstration, wall painting, use of charts, posters and pamphlets are important means to introduce a new idea during the training programmes (Botham, 1967; Saunders, 1979; Jain, 1985) They are the most useful forms of visual aids and an invaluable means of communication.

Field trips help the trainee to study the real picture with evidence (Brown et al., 1979). There is no doubt that women can play a more positive and active role in reducing the post harvest losses if they are imparted education, training and skills (Joshi, 1989).

## **DESIGN OF THE STUDY**

### **III DESIGN OF THE STUDY**

The research design for the study on “Introducing and Evaluating Scientific Storage Practices for Food Grains among Selected Rural Households in Coimbatore District” consisted of the following aspects:

- A. Conduct of the Household Survey
- B. Trial on Scientific Storage of Food Grains
- C. Educating the Women Leaders on Scientific Food Grain Storage Practices and
- D. Evaluation of the Impact of the Scientific Practices Introduced

The research design adopted is given in Figure-4.

#### **A. Conduct of the Household Survey**

Gupta (1996) points out that a survey is a process of collecting data from existing population units with no particular control over factors that may affect the population characteristics and would furnish wide and accurate information. Accordingly, a household survey was conducted to understand the storage practices followed and the related problems faced by the farm households. The household survey included the following steps:

1. Selection of the blocks
2. Selection of the villages
3. Selection of the sample
4. Conduct of the survey and
5. Analysis and interpretation of the data collected

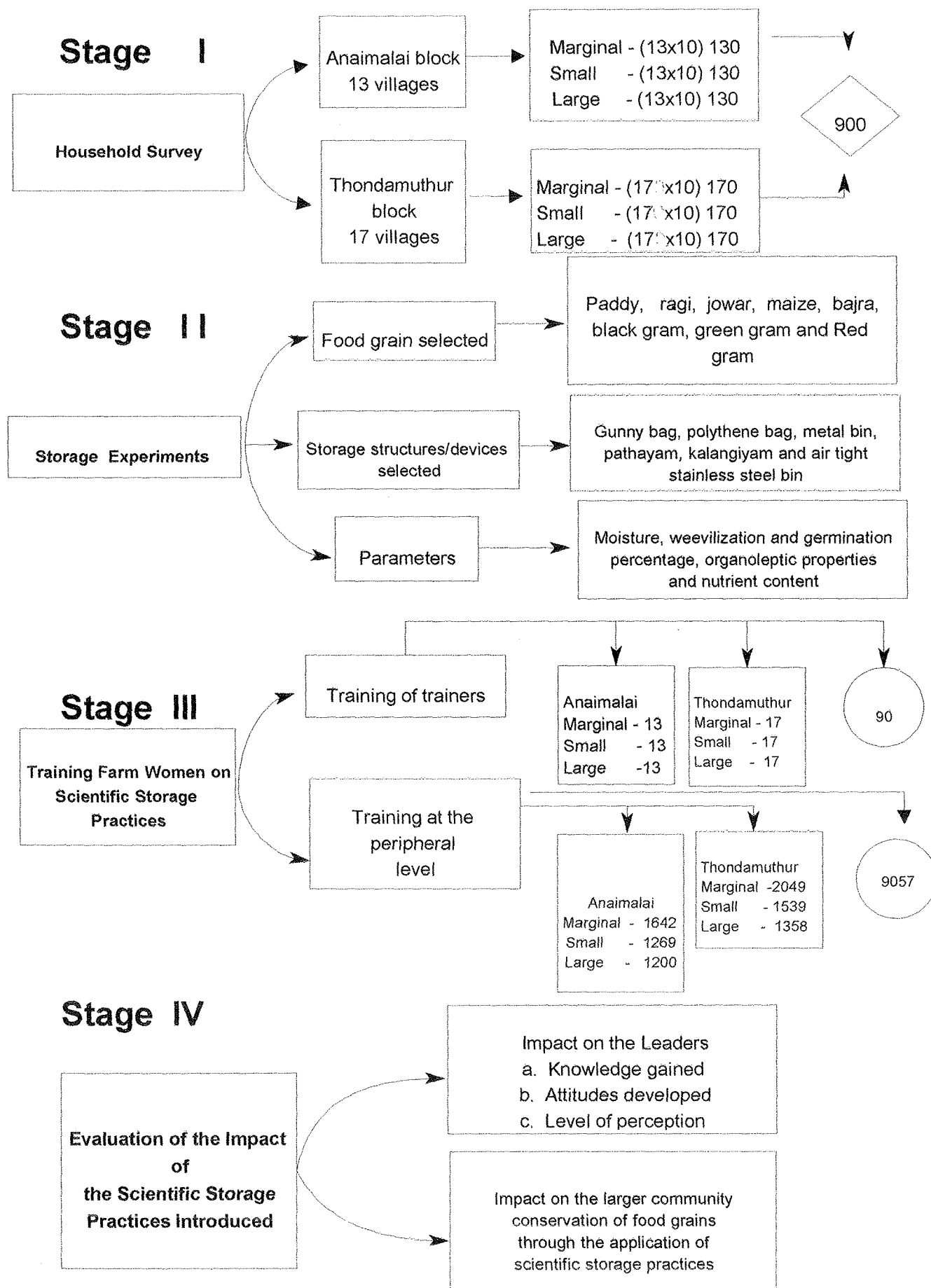


DIAGRAM SHOWING THE RESEARCH DESIGN

Figure - 4

## 1. Selection of the blocks

The study was conducted in Coimbatore district of Tamil Nadu state, as the researcher was acquainted with the area. From the records on food grains production maintained at the District Agricultural Office, Coimbatore, it was noted that out of the 21 blocks in the district, Anaimalai and Thondamuthur blocks had the maximum surplus food grains available for storage and therefore, these two blocks were selected for the study. The agricultural profile of the selected blocks is presented in Table V.

TABLE V  
AGRICULTURAL PROFILE OF THE TWO BLOCKS SELECTED

S.No.	Particulars	Blocks	
		Anaimalai	Thondamuthur
1.	Total number of revenue villages	26	31
2.	<b>Population</b>		
	Male	62,798	41,555
	Female	61,796	41,065
	Total	1,24,594	82,620
3.	Total geographical area (in hectares)	65,750	22,661
4.	Total cultivable area (in hectares)	24,964	20,052
5.	Number and type of farm families		
	Marginal (below 1 hectare)	3,743	3,143
	Small (1 to 2 hectares)	2,247	2,163
	Large (above 2 hectares)	4,046	2,055
	Total	10,036	7,361
6.	Crops generally cultivated	Paddy,bajra, maize,jowar, ragi,pulses, cotton, sugarcane, groundnut, coconut turmeric and soya	Paddy, bajra, maize, jowar,ragi,pulses, chillies,turmeric, sugarcane,fruits, vegetables,groundnut, coconut and sunflower

## 2. Selection of the villages

Scrutiny of the village-wise records maintained in the two blocks showed that 13 villages in Anaimalai block (Figure-5) and 17 villages in Thondamuthur block (Figure-6) produced surplus food grains available for storage. Therefore, these 30 villages were chosen for the study (Appendix I).

## 3. Selection of the sample

Purposive sampling procedure was followed in this study. According to Gupta and Kapoor (1994), purposive sampling is a technique in which a desired number of sample units is selected deliberately or purposely depending upon the object of enquiry. Nine hundred farm households were randomly selected from the 30 villages with equal representation from the three categories of landholdings as detailed below :

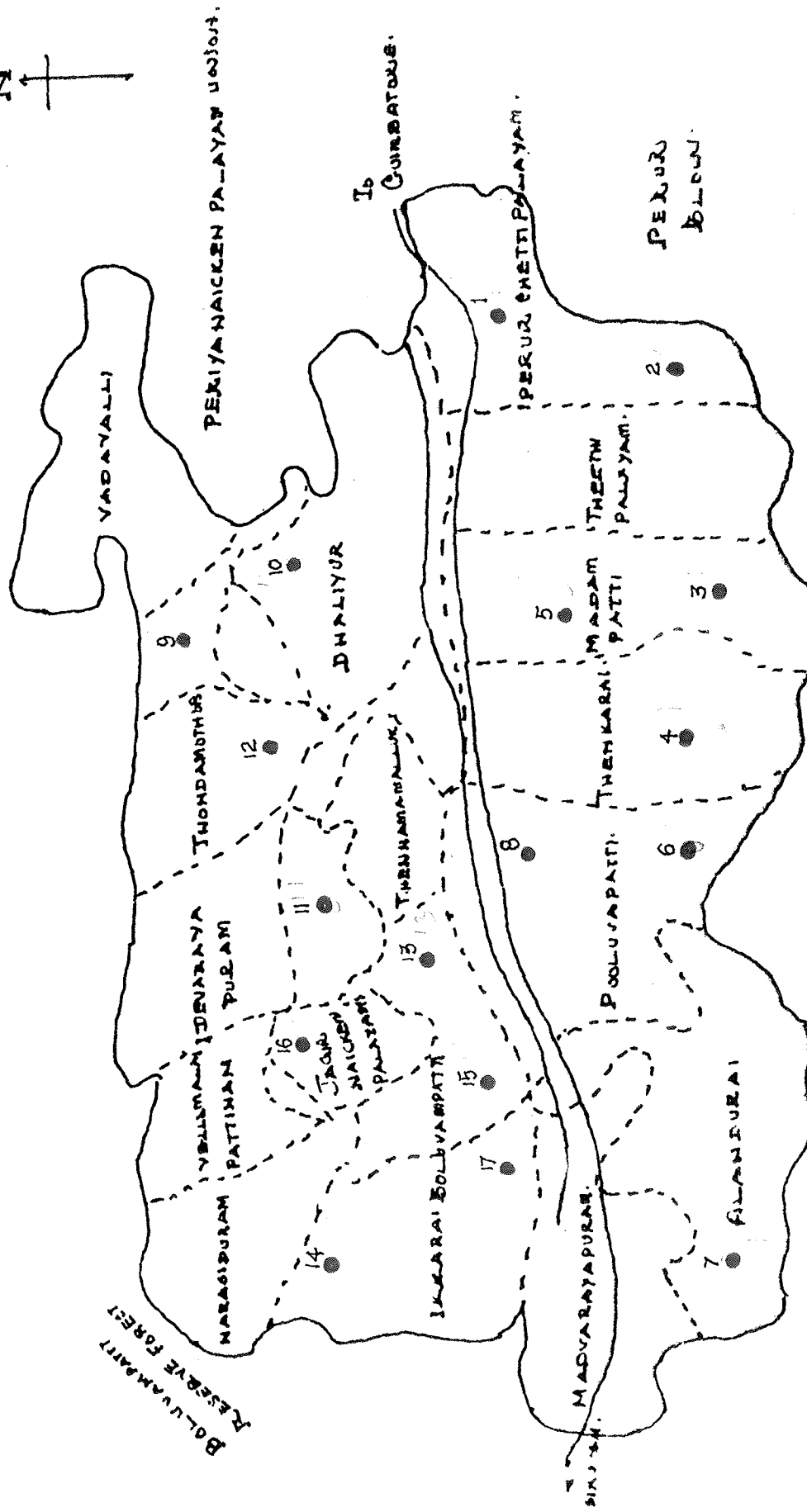
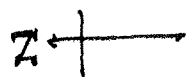
Marginal	10	x	30	=	300
Small	10	x	30	=	300
Large	10	x	30	=	300
Total					900

Since the farm women (homemakers) play a significant role in the storage of food grains, they were selected to be the respondents for the household survey.

## 4. Conduct of the survey

Owing to its suitability, direct personal interview method was selected to collect first hand information from the farm women. The interview schedule





LOCALE OF THE VILLAGES IN THONDAMUTHUR BLOCK

Figure-6

prepared (Appendix II) called for information on the socio-economic profile, type of crops cultivated, the role of women in post harvest operations, storage practices adopted, problems encountered during storage and the measures undertaken to solve the problems. The schedule was finalised after a pilot study conducted in 90 farm households, 30 from each of the three categories. After a couple of informal visits intended to build rapport, the schedule was administered to all the 900 farm homemakers selected for the study.

## **5. Analysis and interpretation of the data collected**

The findings of the household survey are discussed under the following headings:

- a. Socio-economic status of selected households
- b. Pattern of crop cultivation and
- c. Storage practices adopted and problems faced

### **a. Socio-economic status of the selected households**

The educational and occupational status of the homemakers and the heads of families, types of landholding and income of the selected households are discussed under this sub heading.

#### **i. Educational status**

Table VI depicts the educational status of the homemakers and the heads of families in the selected households.

TABLE VI

## EDUCATIONAL STATUS OF SELECTED HOMEMAKERS AND HEADS OF FAMILIES

<u>Percentage of homemakers and heads of families</u>																	
	<u>Anaimalai block</u>								<u>Thondamuthur block</u>								
S. No.	Educational status	<u>Homemakers</u>				<u>Heads of families</u>				<u>Homemakers</u>				<u>Heads of families</u>			
		<u>M</u>	<u>S</u>	<u>L</u>	<u>Total</u>	<u>M</u>	<u>S</u>	<u>L</u>	<u>Total</u>	<u>M</u>	<u>S</u>	<u>L</u>	<u>Total</u>	<u>M</u>	<u>S</u>	<u>L</u>	<u>Total</u>
		n=130	130	130	390	130	130	130	390	170	170	170	510	170	170	170	510
1.	Illiterate	3	1	-	1	-	-	-	-	1	-	-	0.4	-	-	-	-
2.	Primary	11	14	13	13	2	6	2	3	16	8	7	10.3	12	11	4	9
3.	Secondary	31	19	18	23	11	7	8	8	16	21	15	16.8	20	18	8	16
4.	Higher secondary	41	47	39	42	14	11	10	12	46	30	29	34.7	19	13	14	15
5.	Graduate	8	9	15	11	62	54	55	57	12	24	35	24.6	37	39	39	37
6.	Post-graduate	3	5	9	6	5	12	15	11	6	10	6	7.3	4	12	22	13
7.	Diploma	2	2	1	1	2	2	2	2	2	2	1	1.6	6	2	5	5
8.	Professional	1	3	5	3	5	8	8	7	1	5	7	4.3	2	5	8	5

M = Marginal farmers : S = Small farmers : L = Large farmers

It is encouraging to note that only one per cent of homemakers in Anaimalai block and 0.4 per cent in Thondamuthur block (mainly from marginal and small farm households) were illiterate. The heads of families were better educated than their counterparts, with 77 per cent in Anaimalai block and 60 per cent in Thondamuthur block having collegiate level education.

On the basis of land holding, it is evident that in Anaimalai block, irrespective of the type of land holding, 42 per cent of homemakers were educated upto higher secondary level and 55 per cent of heads of families upto graduate level. On the other hand, in Thondamuthur block, 46 per cent of homemakers of marginal and 30 per cent of small land holdings were educated upto higher secondary level whereas 35 per cent of homemakers and 39 per cent of heads of families from large land holding were educated upto graduate level. Professionally qualified members were more (51 per cent) from families of large landholdings when compared to the other two categories -marginal (14 per cent) and small (35 per cent) .

## **ii. Occupational status**

Agriculture was the main occupation for all the large farmers in both the blocks and 88 and 92 per cent of small farmers and 73 and 78 per cent of marginal farmers respectively in Anaimalai and Thondamuthur blocks. In addition, agriculture-related business was the subsidiary occupation for 87 per cent and 82 per cent of large farmers as against 49 and 48 per cent of marginal and 35 and 32 per cent of small farmers respectively, in Anaimalai and Thondamuthur blocks.

All the heads of families in the two blocks with professional education were practising their profession as against only 67 per cent of the homemakers with professional qualification.

### iii. Type of land holding

The type of land possessed by the households under study is presented in Table VII.

TABLE VII  
TYPE OF LANDHOLDING POSSESSED BY THE HOUSEHOLDS

Type	<u>Percentage of households</u>							
	<u>Anaimalai block</u>				<u>Thondamuthur block</u>			
	<u>M</u>	<u>S</u>	<u>L</u>	<u>Total</u>	<u>M</u>	<u>S</u>	<u>L</u>	<u>Total</u>
	n= 130	130	130	390	170	170	170	510
Wet land	68	93	100	87	88	100	100	96
Dry land	85	62	37	62	58	43	24	42
Garden land	32	41	100	57	33	74	100	59

Ninety six per cent of households in Thondamuthur block possessed wet land as against 87 per cent in Anaimalai block. While 62 per cent households in Anaimalai block owned dry land, only 42 per cent had the same in Thondamuthur block. Almost the same percentage in Anaimalai (57 per cent) and Thondamuthur (59 per cent) blocks possessed garden land.

Examined land holdingwise, in Anaimalai block, all the large farmers possessed wet land as well as garden land whereas 85 per cent of marginal farmers owned dry land only. A higher proportion of small farmers when compared to the marginal farmers, possessed wet lands. The same trend was seen in Thondamuthur block also.

#### iv. Family income

Income from agriculture and allied occupations and other sources over a period of one year was taken as the family income. The respondents were categorised into three income groups viz. high, middle and low. following the categorisation adopted by Porchezian (1991) as given below:

- Low - Upto Rs.15,000 per annum
- Middle - Rs.15,001-30,000 per annum
- High - Above Rs.30,000 per annum

Table VIII gives the income level of the selected households.

TABLE VIII  
FAMILY INCOME OF THE SELECTED HOUSEHOLDS

Income category	<u>Percentage of households</u>							
	<u>Anaimalai block</u>				<u>Thondamuthur block</u>			
	M	S	L	Total	M	S	L	Total
	130	130	130	390	170	170	170	510
Low	77	69	3	50	51	46	7	34
Middle	15	12	46	24	30	29	24	28
High	8	19	51	26	19	25	69	38

In Anaimalai block, 50 per cent of families belonged to low income group, while the remaining 50 per cent were distributed almost equally in middle(24 per cent) and high income groups (26 per cent). Marginal and small farmers in

the blocks predominantly belonged to low income groups. On the other hand, more than half of the large farmers of the two blocks belonged to the high income category. In general, the farmers of Thondamuthur block appeared to be financially sound when compared to those in Anaimalai block.

### **b. Pattern of crop cultivation**

The aspects discussed under this head are food crops cultivated, frequency of cultivation, quantity of food grains produced per cropping and involvement of homemakers and heads of families in post harvest operations.

#### **i. Types of crops cultivated**

Table IX presents the food crops cultivated by the selected households.

TABLE IX  
FOOD CROPS CULTIVATED BY THE SELECTED HOUSEHOLDS

Types of food crops	<u>Percentage of households</u>							
	<u>Anaimalai block</u>				<u>Thondamuthur block</u>			
	M n= 130	S 130	L 130	Total 390	M 170	S 170	L 170	Total 510
<b>Cereals</b>								
Paddy	100	100	100	100	100	100	100	100
Ragi	88	63	37	63	31	46	46	41
Jowar	94	92	67	84	79	82	65	75
Maize	71	64	72	69	66	55	46	56
Bajra	41	56	86	61	83	74	82	80
<b>Pulses</b>								
Black gram	100	100	100	100	100	100	100	100
Green gram	93	100	100	98	100	100	100	100
Red gram	85	93	79	89	89	94	100	95
Cow pea	13	29	65	36	28	25	35	29
Bengal gram	60	61	63	61	46	50	65	54

Botanical name of the food crops

Paddy - *Oryza sativa*

Ragi - *Eleusine coracana*

Maize - *Zea mays*

Jowar - *Sorghum vulgare*

Bajra - *Pennisetum typhoideum*

Black gram - *Phaseolus mungo roxb*

Green gram - *Phaseolus aureus roxb*

Red gram - *Cajanus cajan*

All the selected farmers cultivated sufficient paddy for household consumption. More than 60 per cent of farmers cultivated ragi, jowar, maize and bajra in Anaimalai block and jowar and bajra in Thondamuthur block.

Among pulses, black gram was the major crop cultivated by all the households in both the blocks followed by green gram and red gram by 98 per cent and 89 per cent, cent percent and 95 per cent respectively, in Anaimalai and Thondamuthur blocks.

### **iii. Frequency of cultivation**

Irrespective of the category of farmers and blocks, paddy was cultivated twice a year by more than 80 per cent of farmers. Ragi, maize, jowar and bajra were cultivated twice yearly by less than 50 per cent of large farmers in both the blocks. Pulse varieties were cultivated only once a year by all the farmers.

### **iii. Quantity of food grains produced per cropping**

Table X depicts the quantity of food grains produced per cropping.

TABLE X

## QUANTITY OF FOOD GRAINS PRODUCED PER CROPPING BY THE SELECTED HOUSEHOLDS

Food grains	Percentage of households (quantity produced in quintals)																							
	Anaimalai block												Thondamuthur block											
	Marginal(130)				Small (130)				Large (130)				Marginal(170)				Small(170)				Large (170)			
	Upto 10	11-20	21-30	31-40	Upto 10	11-20	21-30	31-40	Upto 10	11-20	21-30	31-40	Upto 10	11-20	21-30	31-40	Upto 10	11-20	21-30	31-40				
Cereals																								
Paddy	8	7	71	14	5	10	22	63	-	5	14	81	18	5	42	35	5	4	13	78	-	-	15	85
Ragi	100	-	-	-	100	-	-	-	83	17	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Jowar	100	-	-	-	100	-	-	-	98	2	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Maize	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Bajra	100	-	-	-	100	-	-	-	83	17	-	-	100	-	-	-	88	12	-	-	77	23	-	-
Pulses																								
Black gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Green gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	96	4	-	-
Red gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Cow pea	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Bengal gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-

One quintal is equal to 100 kg.

The maximum quantity of paddy produced was 20-30 quintals by marginal and 30-40 quintals by small and large farmers in both the blocks. The yearly production of ragi, jowar and bajra was only upto 20 quintals by large farmers in Anaimalai and bajra alone by small and large farmers in Thondamuthur, because these cereals do not find a prominent place in the daily menu. Due to demands, farmers tend to cultivate paddy alone in their wet land. The quantum of production of maize,ragi,jowar and bajra has been declining as the traditional foods prepared using these grains are becoming unpopular.

All the farmers irrespective of the type of land holding and the location produced upto 10 quintals of pulses such as black gram, green gram, red gram, cow pea and Bengal gram. These pulses were used only for family consumption and for use as seed during the next season.

#### **iv. Involvement of the homemakers and heads of families in post harvest operations**

Table XI and Figure 7 provide details on the involvement of homemakers and heads of families in post harvest operations.

TABLE XI  
INVOLVEMENT OF THE HOMEMAKERS AND HEADS OF FAMILIES IN POST  
HARVEST OPERATIONS

Post harvest operations	Percentage of homemakers and heads of families															
	Anaimalai block								Thondamuthur block							
	Homemakers				Heads of families				Homemakers				Heads of families			
	M	S	L	Total	M	S	L	Total	M	S	L	Total	M	S	L	Total
n=130	130	130	390	130	130	130	390	170	170	170	510	170	170	170	510	
Harvesting	96	68	40	68	100	100	100	100	93	34	18	48	89	95	82	89
Threshing	65	60	10	45	86	91	96	91	84	79	16	60	78	77	69	75
Winnowing	72	40	25	45	100	64	65	76	72	28	14	38	84	94	64	80
Drying	95	78	94	89	91	53	35	59	95	99	100	98	64	48	43	52
Transportation	32	29	11	24	88	68	56	71	25	48	7	27	78	69	78	75
Storage	100	100	100	100	55	33	24	37	100	100	100	100	61	64	40	55
Milling	13	37	11	20	100	71	68	80	28	25	8	21	87	89	77	85
Marketing	25	14	9	16	100	100	100	100	31	22	25	26	88	89	100	92
Processing	22	18	25	22	68	71	86	75	19	52	31	34	83	66	70	73

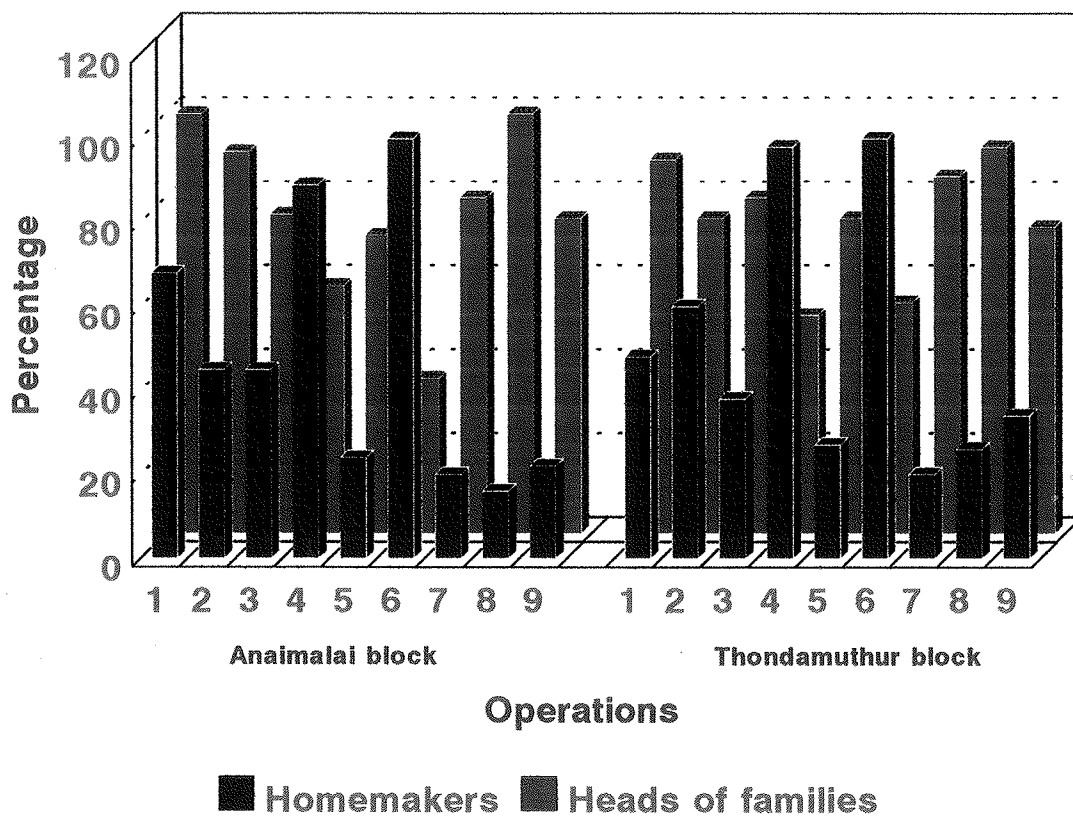
It is interesting to note that all the homemakers of the two blocks were involved in storage of food grains while a large majority of the heads of families were engaged mainly in harvesting and marketing. Only a limited percentage of homemakers in both the blocks were involved in operations such as transportation (24 to 27 per cent), milling (20 to 21 per cent), marketing (16 to 26 per cent) and processing (22 to 34 per cent).

### **c. Storage practices adopted and problems faced**

The aspects discussed under this head are type and quantity of food grains stored, reasons for storage, duration of storage, storage structures in use, problems during storage, causes for food grain losses, quantum of loss during storage, indigenous methods adopted to control infestation and methods adopted to control rodents.

#### **i. Type and quantity of food grains stored by the selected households**

Table XII shows the type and quantity of food grains stored by the selected households.



1. Harvesting
2. Threshing
3. Winnowing
4. Drying
5. Transportation

6. Storage
7. Milling
8. Marketing
9. Processing

## INVOLVEMENT OF THE HOMEMAKERS AND HEADS OF FAMILIES IN POST HARVEST OPERATIONS

Figure - 7

TABLE XII

## TYPE AND QUANTITY OF FOOD GRAINS STORED

Percentage of households storing food grains (in quintals)																														
Anaimalai block													Thondamuthur block																	
Marginal(130)					Small (130)				Large (130)				Marginal(170)					Small (170)				Large (170)								
No.of	Quantity				No.of	Quantity			No.of	Quantity			No.of	Quantity				No.of	Quantity			No.of	Quantity							
house	Upto	10-	20-	30-	house	Upto	10-	20-	30-	house	Upto	10-	20-	30-	house	Upto	10-	20-	30-	40	house	Upto	10-	20-	30-	40				
holds	10	20	30	40	holds	10	20	30	40	holds	10	20	30	40	holds	10	20	30	40	holds	10	20	30	40	holds	10	20	30	40	
storing					storing				storing				storing					storing				storing								
<b>Cereals</b>																														
Paddy	100	97	3	-	-	100	3	71	18	8	100	-	13	3	84	100	69	24	7	-	100	12	19	38	31	100	-	11	19	70
Ragi	93	100	-	-	-	68	100	-	-	-	45	100	-	-	-	100	100	-	-	-	76	100	-	-	-	48	100	-	-	-
Jowar	95	100	-	-	-	72	100	-	-	-	63	100	-	-	-	66	100	-	-	-	52	100	-	-	-	51	100	-	-	-
Maize	33	100	-	-	-	48	100	-	-	-	58	100	-	-	-	25	100	-	-	-	36	100	-	-	-	66	100	-	-	-
Bajra	39	100	-	-	-	53	100	-	-	-	55	100	-	-	-	28	100	-	-	-	41	100	-	-	-	69	100	-	-	-
<b>Pulses</b>																														
Black gram	75	100	-	-	-	100	100	-	-	-	100	100	-	-	-	87	100	-	-	-	100	100	-	-	-	100	100	-	-	-
Green gram	67	100	-	-	-	100	100	-	-	-	100	100	-	-	-	100	100	-	-	-	100	100	-	-	-	100	100	-	-	-
Red gram	61	100	-	-	-	86	100	-	-	-	100	100	-	-	-	100	100	-	-	-	100	100	-	-	-	100	100	-	-	-

Except marginal farmers of Anaimalai block, all the other farmers stored upto 40 quintals of paddy annually. With regard to other food grains and pulses, all the households stored only upto 10 quintals per annum. As can be expected, in both the blocks, large farmers had more quantum of paddy for storage.

## **ii. Reasons for storage**

All the small and marginal farmers in the two blocks stored the food grains either for their family consumption or for purposes of seed. On the otherhand, the large farmers in both the blocks stored the food grains also for future marketing.

## **iii. Duration of storage of food grains**

Table XIII gives the duration for which the food grains were stored in the selected households

TABLE XIII  
DURATION OF STORAGE OF FOOD GRAINS

Food grains	<u>Percentage of households</u> <u>Period of storage (months)</u>																							
	<u>Anaimalai block</u>												<u>Thondamuthur block</u>											
	Marginal(130)				Small (130)				Large (130)				Marginal(170)				Small (170)				Large (170)			
	Upto	3-6	6-9	9-12	Upto	3-6	6-9	9-12	Upto	3-6	6-9	9-12	Upto	3-6	6-9	9-12	Upto	3-6	6-9	9-12	Upto	3-6	6-9	9-12
	3				3				3				3				3				3			
<b>Cereals</b>																								
Paddy	35	65	-	-	3	15	68	14	-	80	11	9	32	43	23	2	11	15	8	66	9	15	18	58
Ragi	87	9	4	-	57	35	8	-	14	85	1	-	70	6	24	-	86	3	11	-	92	6	2	-
Jowar	93	7	-	-	94	6	-	-	89	11	-	-	78	22	-	-	10	90	-	-	89	11	-	-
Maize	91	9	-	-	87	13	-	-	79	21	-	-	7	93	-	-	73	27	-	-	89	11	-	-
Bajra	84	16	-	-	87	13	-	-	79	21	-	-	85	15	-	-	88	12	-	-	85	15	-	-
<b>Pulses</b>																								
Black gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Green gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-
Red gram	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-	100	-	-	-

Irrespective of the locale or the category of farmers, food grains other than paddy and ragi were stored only upto three months by over 75 per cent of respondents. Paddy was stored for three to six months by 65 per cent and 80 per cent of marginal and large farmers of Anaimalai block respectively as against six to nine months by 68 per cent of small farmers. In Thondamuthur block, 66 per cent and 58 per cent of small and large farmers respectively stored paddy for nine to twelve months. Those who stored for long periods, did so, due to their preference for rice for family consumption.

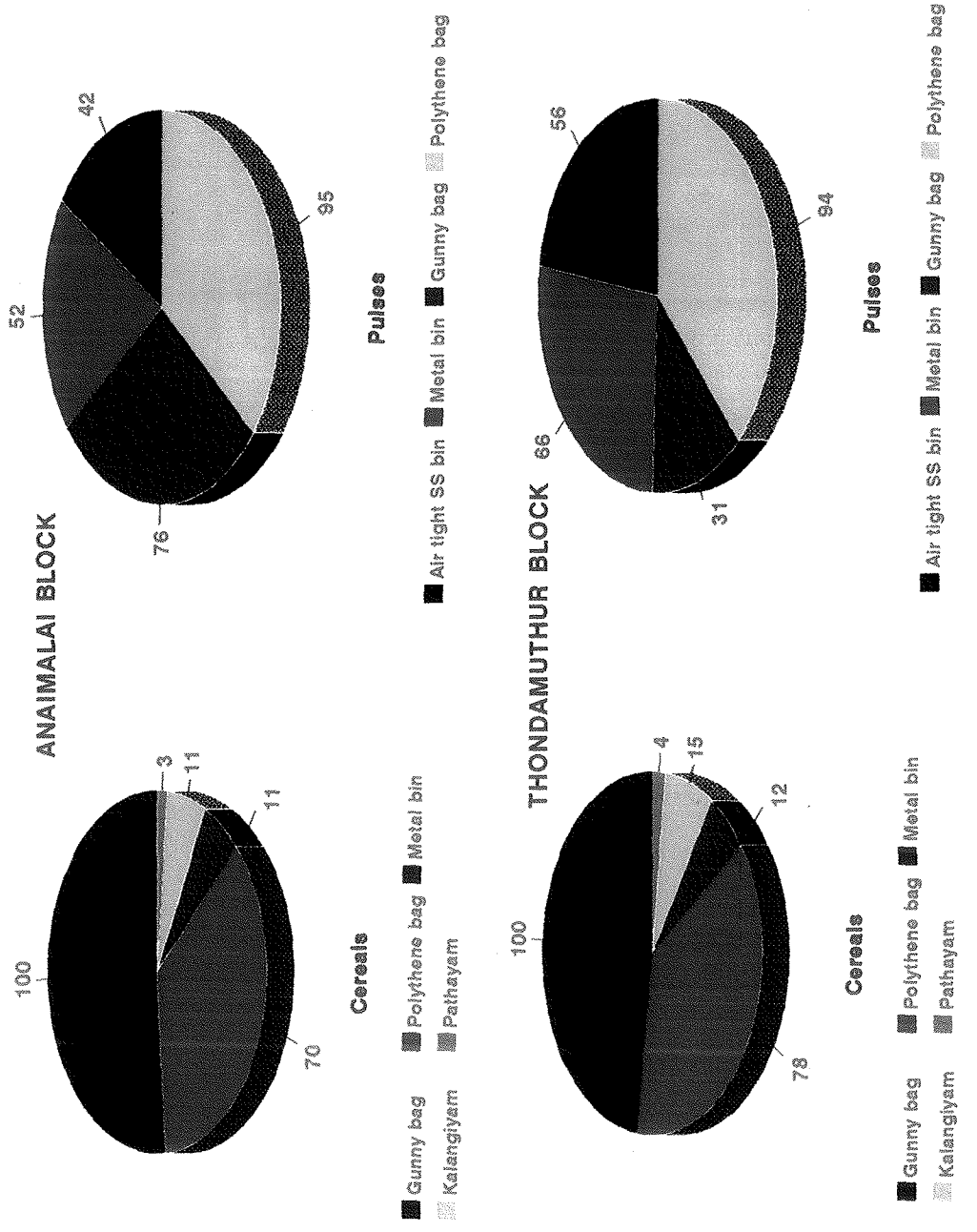
#### **v. Storage structures in use**

Table XIV and Figure 8 reveal the grain storage structures in use by the households under study.

TABLE X IV

## GRAIN STORAGE STRUCTURES IN USE BY THE HOUSEHOLDS UNDER STUDY

Storage structures	<u>Percentage of households</u>								
	n=	<u>Anaimalai block</u>				<u>Thondamuthur block</u>			
		Marginal (130)	Small (130)	Large (130)	Total (390)	Marginal (170)	Small (170)	Large (170)	Total (590)
<b>Cereals</b>									
Gunny bag	100	100	100	100	100	100	100	100	
Polythene bag	40	84	86	70	71	78	86	78	
Metal bin	5	8	18	11	7	10	19	12	
'Kalangiyam'	2	12	19	11	8	11	27	15	
'Pathayam'	2	2	5	3	1	4	8	4	
<b>Pulses</b>									
Air-tight stainless steel bin	28	33	64	42	31	61	76	56	
Metal bin	36	48	71	52	55	69	72	66	
Gunny bag	68	63	96	76	29	31	34	31	
Polythene bag	85	100	100	95	81	100	100	94	



**GRAIN STORAGE DEVICES/STRUCTURES IN USE BY THE HOUSEHOLDS UNDER STUDY**

**Figure 8**

The traditional gunny bag (Plate-IIIa) was used for storage by all the households because of its advantages such as low cost, less weight and ease of handling. As the grains stored in gunny bags are well aerated, they were preferred for storage of seed grains. They were also utilized as a measure of quantity for cereals. Over 70 per cent of the selected households used polythene bags (Plate-IIIb). Only 11 per cent from Anaimalai and 12 per cent from Thondamuthur used metal bin (Plate-IIIc). Traditional 'kalangiyam' (Plate-IIId) and large 'pathayam' (Plate-IIIE) were found to be used only by a small proportion of the farm households, particularly by large farmers.

Pulses were stored in airtight polythene bags by over 90 per cent of the households in both the blocks. Airtight stainless steel bin (Plate-IIIf) was used by 42 and 56 per cent of farmers in Anaimalai and Thondamuthur respectively.

#### **v. Problems during storage**

Table XV indicates the problems during storage.



<- Plate-IIIa Koni

Plate-IIIb Polythene Bag ->



<- Plate-IIIc Metal Bin

Plate .III. EXISTING STORAGE DEVICES/STRUCTURES IN THE  
SELECTED HOUSEHOLDS



<- Plate-III d Kalangiyam

Plate-III e Pathayam ->



<- Plate-III f Air-tight Stain Less Steel bin

TABLE XV  
PROBLEMS DURING STORAGE

Problems	<u>Percentage of households</u>							
	Anaimalai block				Thondamuthur block			
	M n= (130)	S (130)	L (130)	T (390)	M (170)	S (170)	L (170)	T (570)
Inadequate technical guidance	95	78	41	71	83	78	30	64
Insufficient space for storage	71	25	5	34	65	28	7	33
Non-availability of chemicals	87	75	32	64	52	34	23	36
Seasonal variations	35	18	10	21	55	31	9	32

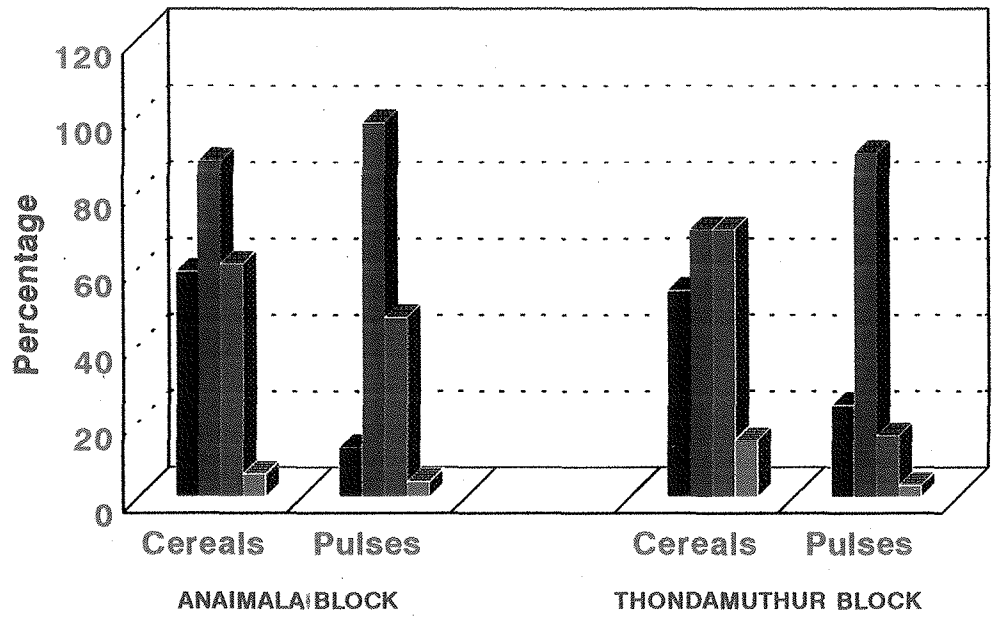
A majority of 71 per cent and 64 per cent in Anaimalai and Thondamuthur blocks respectively, expressed inadequate technical guidance as the most significant problem faced in the storage of food grains. Insufficient storage space, non-availability of chemicals and seasonal variations were the other major problems expressed mainly by the marginal farmers in both the blocks.

#### vi. Causes for food grain losses during storage

Table XVI and Figure 9 indicate the causes for food grain losses during storage as understood by the respondents.

TABLE XVI  
CAUSES FOR FOOD GRAIN LOSSES DURING STORAGE

Causes for food grain losses	Percentage of households															
	Anaimalai block							Thondamuthur block								
	Cereals			Pulses				Cereals			Pulses					
	M	S	L	T	M	S	L	T	M	S	L	T	M	S	L	T
	n= (130)(130) (130) (130) (130) (130) (170) (170) (170) (170) (170) (170) (510) (510) (170) (170) (510)															
Insect infestation	94	86	85	88	100	100	95	98	83	69	58	70	99	89	82	90
Rodents	86	37	61	61	68	40	33	47	66	52	52	70	31	11	7	16
Moulds and fungi	72	61	46	59	17	14	8	13	52	62	48	54	25	35	11	24
Birds	9	8	2	6	6	3	2	4	23	13	11	15	2	2	3	3



**Causes for food grain losses**

■ Moulds and fungi ■ Insect infestation ■ Rodents ■ Birds

**CAUSES FOR FOOD GRAIN LOSSES DURING STORAGE**

**Figure - 9**

Insect infestation was mentioned as the major cause for food grain loss by over 60 per cent of farmers of all categories in both the blocks. Sixty one and 59 per cent of farmers in Anaimalai block and 70 and 54 per cent in Thondamuthur block respectively, complained about the menace by rodents and mould and fungus formation in stored grains. Only ten per cent and 18 per cent from Anaimalai and Thondamuthur blocks respectively, attributed the loss to that caused by birds.

**vii. Indigenous methods adopted to control insect infestation during storage**

Table XVII exhibits the indigenous methods adopted to control insect infestation during storage.

TABLE XVII

## INDIGENOUS METHODS ADOPTED TO CONTROL INSECT INFESTATION DURING STORAGE

Indigenous methods	Percentage of households																	
	Anaimalai block						Thondamuthur block											
	Cereals			Pulses			Cereals				Pulses							
	M	S	L	T	M	S	L	T	M	S	L	T	M	S	L	T		
	n = (130)			(130)			(170)				(170)				(170)			
Sun drying	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Use of 'neem' leaves	95	78	69	80	85	65	33	61	99	100	99	99	95	66	59	73		
Use of 'kattu thulasi'	99	85	61	82	84	64	25	53	96	85	90	90	84	52	36	57		
Use of 'pungam' leaves	94	82	68	81	78	45	9	44	99	93	84	92	54	49	42	48		
Use of boric acid powder	75	78	59	71	85	68	100	84	82	52	42	59	90	66	99	85		
Coating with red soil	-	-	-	-	100	93	87	93	-	-	-	-	95	67	78	80		
Use of red chillies	-	-	-	-	22	24	68	38	-	-	-	-	22	31	65	39		

Botanical name:

Neem - *Azadirachta indica*:Kattu thulasi - *Ocimum gratissimum*Pungam - *Pongauam*

The traditional method of sun drying was used by all the households in the two blocks as a pretreatment for storage of food grains to reduce moisture content. Use of 'neem' leaves 'kattu thulasi' and 'pungam' leaves in storage structure was adopted only for cereals by over 80 per cent of farmers of Anaimalai block and 90 per cent of Thondamuthur block. Over 50 per cent in both the blocks stated spreading of boric acid powder around the storage bags and mixing the same with food grains to minimise insect infestation.

Pulses were coated with moist red soil and ash and then sun dried by over 65 per cent farmers of both the blocks. Mixing pulses with whole red chillies was practised by 38 per cent and 39 per cent of farmers of Anaimalai and Thondamuthur blocks respectively, to reduce insect infestation.

#### **viii. Methods adopted to control rodents**

Table XVIII shows the methods adopted to control rodents in the selected households.

TABLE XVIII  
METHODS ADOPTED TO CONTROL RODENTS

Methods	<u>Percentage of households</u>							
	<u>Anaimalai block</u>				<u>Thondamuthur block</u>			
	<u>M</u>	<u>S</u>	<u>L</u>	<u>T</u>	<u>M</u>	<u>S</u>	<u>L</u>	<u>T</u>
	n = (130)	(130)	(130)	(390)	(170)	(170)	(170)	(510)
Mechanical control	71	58	39	56	65	52	42	53
Chemical control	17	32	53	34	59	71	76	69

In order to control rodents during the post harvest periods, 71 per cent and 58 per cent of marginal and small farmers respectively, of Anaimalai block and 65 per cent and 52 per cent respectively of Thondamuthur block adopted mechanical proofing methods such as wiremeshing the windows, sealing the broken windows and using rat traps, while 53 per cent of large farmers of Anaimalai block and 71 per cent and 76 per cent of small and large farmers respectively, of Thondamuthur block used chemicals methods.

The summary of the findings of the household survey is presented as follows :

- ◆ Paddy, ragi, jowar, maize and bajra, were the cereals and black gram, green gram and red gram were the pulses commonly cultivated.
- ◆ The quantum of production per year was 40 quintals for paddy and upto 10 quintals for all the other cereals and pulses.
- ◆ All the small and marginal farmers stored food grains for food and seed upto six months. The homemakers were mainly responsible for the storage of food grains. .
- ◆ Gunny bags and polythene bags were commonly used for storage of food grains by a majority of the farmers.
- ◆ The grains stored in these devices did not maintain good quality.
- ◆ Inadequate technical guidance, insufficient storage space, non availability of chemicals and seasonal variations were the major storage problems experienced by the farmers.
- ◆ Insect infestation and rodent menace were reported to be the major causes of loss of food grains during storage.

The survey in the farm households thus pointed out the need to enhance the efficiency of the storage devices and the storage methods in use. It was also felt necessary that before introducing the scientific storage practices on a large scale, a trial should be made in the life situation, to assess the feasibility of the storage devices and treatment to be advocated. Therefore, experiments on scientific storage were attempted in the selected households.

## **B. Trial on Scientific Storage of Food Grains :**

This experimental part of the study consisted of the following aspects:

1. Selection of foodgrains for storage
2. Selection of storage devices/structures
3. Conduct of the experiment and
4. Quality analysis of the food grains stored

### **1. Selection of food grains for storage**

The foodgrains stored commonly by all the categories of farmers namely paddy, ragi, jowar, maize, bajra, black gram, green gram and red gram (Plate- IV) were considered for the storage experiments.

### **2. Selection of storage devices/structures**

The household survey revealed that the varied categories of farmers stored cereals in gunny bags, polythene bags, 'pathayam' and 'kalangiyam' and pulses in gunny bags, polythene bags, metal bin and air-tight stainless steel containers.

The maximum capacity of storage devices/structures used in the selected households were 100 kg for gunny bag, polythene bag and metal bin; 50 kg for air tight stainless steel bin and 500 kg each for 'pathayam' and 'kalangiyam'. Therefore, the storage devices/structures with these capacities were selected for conducting the experiments on food grain storage.

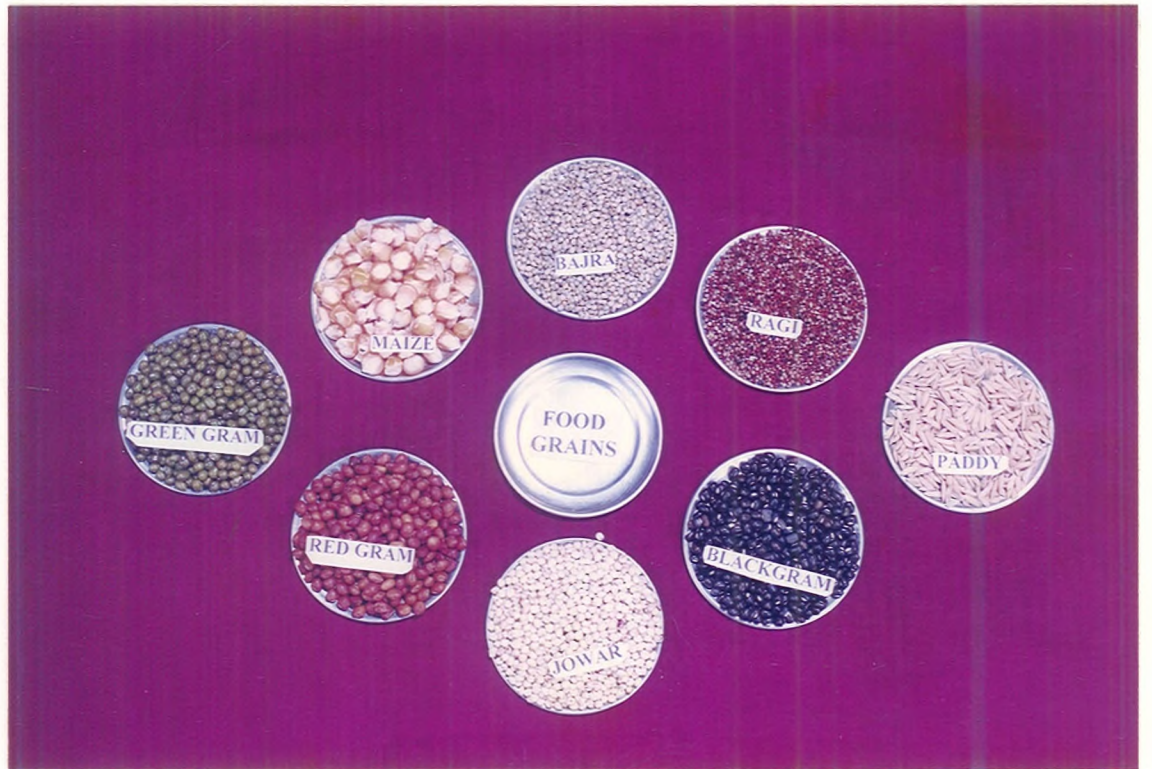


Plate .IV. FOOD GRAINS SELECTED FOR EXPERIMENTS

### 3. Conduct of the experiment

Three farm households representing one each from the marginal, small and large categories which possessed the storage structures were selected to carry out the storage experiments based on the willingness of the clientele and availability of foodgrains. The details of the quantity of food grains stored in the selected storage structures and the scientific storage practices introduced are given in Table XIX.

TABLE XIX

STORAGE DEVICES/STRUCTURES, TREATMENT, TYPE AND QUANTITY OF FOOD GRAINS USED FOR EXPERIMENT

Storage devices/ structures	Pre-storage treatment given	Type and quantity of food grains stored							
		Cereals (in kg)					Pulses (in kg)		
Gunny bag	Dipped in Malathion solution	P 100	R 100	M 100	B 100	J 100	GG 50	BG 50	RG 50
Polythene bag		P 100	R 100	M 100	B 100	J 100	GG 50	BG 50	RG 50
Metal bin		P 100	R 100	M 100	B 100	J 100	GG 50	BG 50	RG 50
Air-tight stainless steel bin		-	-	-	-	-	GG 50	BG 50	RG 50
'Pathayam'	Exterior painted with suitable wood paint	P 500	R 500	M 500	B 500	J 500	-	-	-
'Kalangiyam'	White washed	P 500	R 500	M 500	B 500	J 500	-	-	-

P-Paddy; R-Ragi; M-Maize; B-Bajra; J-Jowar; BG-Black gram; GG-Green gram; RG-Red gram

The experiment was continued for a period of one year. For comparison, the same experiment was conducted with the traditional storage devices/structures without any treatment.

### **Preparing the grains for storage**

Prior to storage in the respective storage devices/structures, the food grains were properly cleaned, graded, dried and cooled. The moisture level of the foodgrains was brought down below the safe level of moisture content - 14 per cent for paddy and 12 per cent for other cereals and pulses.

The cracks and crevices in the room were closed and the walls were white washed. The inside and outside surfaces were sprayed thoroughly with insecticide.

Gunny bags were made pest proof with malathion solution. The exterior of 'pathayam' was painted with suitable wood paint. The inside and outside of 'kalangiyam' were white washed. Wooden crates, black polythene sheets and iron planks were provided as dunnage materials to avoid moisture seepage and to facilitate air circulation.

During the one year period of the experiment, the storage rooms were sprayed with Malathion 50% EC once in 15 days. At the start of insect infestation, the stored grains were fumigated with aluminium phosphide. In addition, Mohan traps which is made of plastic materials were also used to arrest insect infestation in the stored grains. An anticoagulant 'Roban', zinc phosphide and rat trap were used to control rats.

#### **4. Quality analysis of the foodgrains stored**

According to FCI (1996) the quality of foodgrain stored is to be assessed in terms of percentage of moisture, weevilization and germination, organoleptic qualities and nutrient content.

##### **a. Moisture content**

The moisture content of food grains varies during prolonged periods of storage because of the atmospheric changes (Dash et al ., 1995). Therefore, the moisture content of food grains stored in different storage devices/structures was analysed periodically over a period of one year. For analysis, the food grains were collected from different sections (top, bottom, middle and side). Digital Moisture Meter and Thermosampler were used to measure the percentage of moisture and room temperature respectively once in three months for a period of one year. The moisture content recorded was compared with the safe level moisture content for all types of food grains.

##### **b. Weevilization percentage**

For assessing the weevilization percentage, 1000 g of food grain samples were collected from each of the storage structures and kept in polythene bags to avoid spillage. From this, a sub-sample of 100 g was taken and spread in a tray. All the insect infested grains were separated from the sample, counted and weighed and the percentage of infestation was calculated. This was repeated once in three months for a period of one year. On the basis of this data, the percentage of infestation in the respective type of storage structure was determined.

### **c. Germination percentage**

The germination test was conducted using sand medium in a plastic container of 20 x 20 x 20 cm. Four replicates of 25 seeds each were used for this test. The germination percentage for ragi, maize, jowar, bajra, black gram, green gram and red gram was calculated at the end of the seventh day and for paddy, at the end of the tenth day. This was done once in three months for a period of one year. The number of normal seedlings was counted and expressed as percentage of germination.

### **d. Organoleptic quality**

The stored food grains were cooked as part of the daily menu in the traditional method and the organoleptic qualities such as taste, flavour, texture and general appearance were assessed by the homemakers and the head of the family using a score card (Appendix III). This experiment was repeated once in three months.

### **e. Nutrient content**

The nutrient analysis was restricted to protein, fibre, energy and minerals (calcium, phosphorus and iron). This analysis was done at the time of the start of the experiment and at the conclusion, after one year .

The consolidated picture of the results obtained from experiments on moisture content, percentage of weevilization, germination, organoleptic quality and nutrient content is given in Table XX and Figure 10. The detailed results are given in Appendix IV.

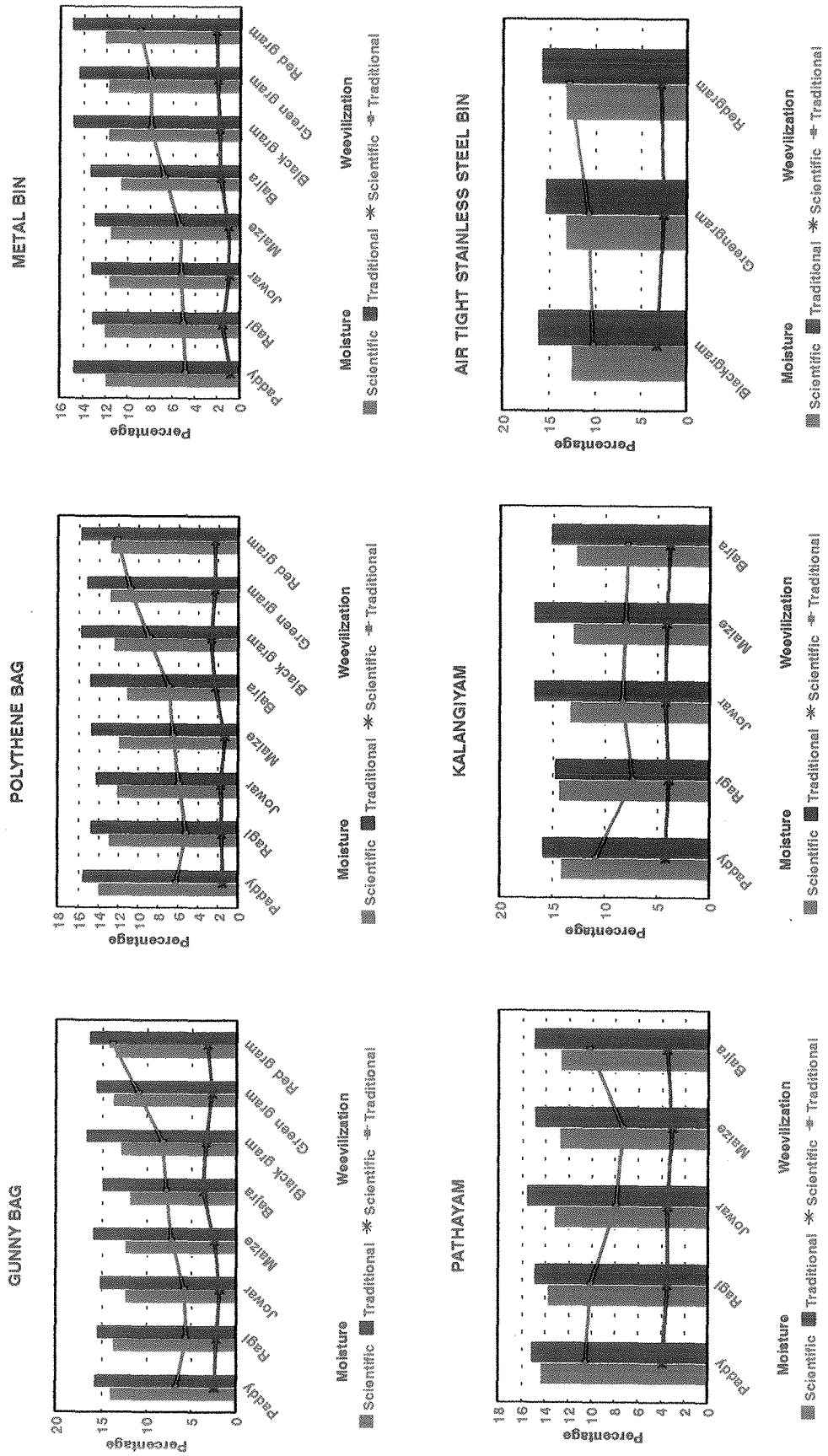
TABLE XX  
MOISTURE, WEEVILIZATION, GERMINATION, ORGANOLEPTIC QUALITY AND NUTRIENT RETENTION OF STORED FOOD GRAINS

Storage structures and grains	Quality analysis of stored food grains																			
	Moisture		Weevili- zation		Germina- tion		Organo- leptic properties*		Percentage retention of nutrients											
	%		%		%				Protein		Fibre		Energy		Iron		Calcium		Phosphorus	
	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T	S	T
<b>Gunny bag</b>																				
Paddy	14.1	15.8	2.4	6.7	99.0	83.3	4	2	99	84	50	50	89	79	90	71	100	92	99	94
Ragi	13.8	15.5	2.2	5.6	82.2	78.1	3	2	100	86	83	28	91	71	87	69	100	91	96	82
Jowar	12.4	15.2	1.8	5.8	87.1	78.2	3	2	99	82	81	63	92	77	71	24	60	56	99	94
Maize	12.4	16.0	2.4	7.2	79.1	62.0	3	2	99	74	81	63	91	73	56	43	100	98	99	92
Bajra	11.9	15.0	3.7	7.8	81.2	71.0	3	2	93	81	100	83	89	72	95	94	79	71	98	98
Black gram	12.9	16.8	3.4	8.2	78.0	73.1	3	3	88	76	44	11	89	79	82	61	84	79	90	78
Green gram	13.8	15.7	2.7	10.9	87.2	69.0	3	2	88	67	56	49	91	78	80	27	98	94	98	94
Red gram	13.5	16.4	3.2	13.8	79.0	78.1	3	3	91	82	67	53	97	71	70	67	97	93	96	90
<b>Polythene bag</b>																				
Paddy	14.0	15.6	1.5	6.2	99.0	82.1	3	2	99	82	50	50	92	83	94	68	100	91	97	91
Ragi	13.0	14.8	1.6	5.2	86.8	83.0	3	2	100	88	81	61	99	89	92	82	100	94	99	75
Jowar	12.2	14.3	1.7	5.9	89.2	87.1	3	2	100	80	100	56	90	81	90	24	88	40	99	94
Maize	12.0	14.8	1.3	6.5	92.2	83.1	4	2	91	79	74	67	95	82	91	78	100	100	99	63
Bajra	11.2	14.9	2.3	6.9	80.1	68.0	3	2	98	84	100	83	92	78	95	94	89	71	98	98
Black gram	12.5	15.8	2.7	8.9	82.2	77.1	3	2	88	79	56	44	95	77	80	66	85	81	92	87
Green gram	12.9	15.2	2.3	10.8	91.1	73.0	3	2	89	70	85	80	93	89	86	41	99	93	100	96
Red gram	12.8	15.8	2.3	12.1	85.0	71.1	3	2	95	85	67	53	91	82	85	70	97	93	96	90
<b>Metal bin</b>																				
Paddy	12.0	14.8	0.8	4.8	99.1	87.5	4	3	100	89	100	55	98	81	97	87	100	95	100	94
Ragi	12.1	13.2	1.5	5.0	90.7	87.0	4	2	100	99	100	53	97	81	100	77	100	99	100	78
Jowar	11.7	13.3	0.9	5.2	89.1	89.2	4	2	99	89	94	75	99	85	100	32	96	68	100	94
Maize	11.6	13.0	1.0	5.3	97.2	84.2	4	2	100	99	96	81	100	82	100	61	100	94	100	95
Bajra	10.7	13.4	1.7	6.7	87.1	72.2	4	2	100	91	100	83	98	81	98	42	100	83	100	100
Black gram	11.8	14.9	1.8	7.9	87.1	79.2	4	2	95	90	89	44	95	82	87	68	84	82	97	87
Green gram	11.8	14.4	2.0	7.9	92.2	77.0	4	2	92	76	93	80	92	89	100	55	100	99	100	98
Red gram	12.1	15.0	2.1	8.9	90.1	73.2	4	2	96	90	67	53	93	88	96	78	98	95	100	98
<b>'Pathayam'</b>																				
Paddy	14.4	15.2	3.9	10.5	85.1	83.3	3	2	84	79	50	50	71	65	68	42	98	91	84	82
Ragi	13.8	14.9	3.5	10.1	82.3	81.0	3	1	85	81	72	47	79	62	62	54	91	81	91	73
Jowar	13.2	15.6	3.5	7.9	82.0	79.0	3	2	82	68	75	50	78	58	54	25	40	36	95	82
Maize	12.8	14.9	3.1	7.3	72.0	79.0	3	2	80	65	59	52	79	61	26	4	100	90	92	88
Bajra	12.7	15.0	3.5	10.2	72.2	67.0	3	1	72	66	75	67	81	68	80	42	67	50	90	88
<b>'Kalangiyam'</b>																				
Paddy	14.2	16.0	4.2	10.9	81.2	79.4	3	2	82	81	50	50	79	71	78	65	100	90	93	82
Ragi	14.4	14.8	3.9	7.3	83.7	82.0	2	1	82	75	72	47	81	62	56	56	80	90	86	62
Jowar	13.4	16.8	4.2	8.3	83.0	80.0	2	1	82	71	75	44	89	61	41	25	32	28	92	87
Maize	13.1	16.8	4.1	8.0	79.1	61.0	3	2	73	60	52	44	71	59	35	22	90	90	85	80
Bajra	12.8	15.2	3.8	7.8	60.1	61.0	2	1	69	63	75	67	77	52	77	42	64	62	93	90
<b>Air-tight stainless steel bin</b>																				
Black gram	12.6	16.2	3.2	10.2	79.1	75.2	3	2	91	86	78	44	90	50	84	71	86	83	98	88
Green gram	13.2	15.4	2.5	10.7	88.1	72.1	4	2	88	74	98	85	91	61	98	73	98	95	98	96
Red gram	13.2	15.9	2.8	12.9	89.1	78	3	2	97	87	67	60	91	72	89	74	92	96	91	84

\*Scores : 4-Very good; 3-Good; 2-Fair; 1- Poor

S-Scientific method

T-Traditional method



**MOISTURE AND WEEVILIZATION PERCENTAGE OF STORED FOOD GRAINS**

**Figure - 10**

From the results of the experiment it was noted that the metal bin maintained a below safe level moisture content for all grains throughout the experiment. Except ragi, the other food grains stored in gunny bags and polythene bags maintained the safe level of moisture content.

The moisture content was maximum in the case of 'pathayam' and 'kalangiyam'. The moisture content was above the maximum level for grains stored in the traditional way with the exception of the metal bin.

As for weevilization, the Bureau of Indian Standards (BIS) has marked the maximum level for paddy as three per cent and for the other food grains as one per cent. In the case of paddy, except that stored in 'pathayam' and 'kalangiyam', the weevilization per cent was maintained below the BIS mark - i.e. metal bin (0.8 per cent) polythene bag (1.5 per cent) and gunny bag (2.4 per cent). The results of the present investigation are also in conformity with the findings of Sonelal (1990) and Doharcy et al. (1992).

Jowar and maize stored in metal bins maintained the standard level of weevilization whereas that stored in other structures had a high percentage of weevilization. A higher percentage in germination was noticed for the food grain stored in the scientific method as against food grains stored in the traditional way. Metal bin followed by polythene bag were found better than the other storage structures with regard to germination rate for all food grains. Girish (1987) reported that food grains stored in metal containers showed the highest germination percentage when compared to other storage structures. According to Wang (1969) storing maize and jowar seeds for longer than six months in polythene bags resulted in retention of germinability compared with other storage structures.

All the dishes prepared out of the food grains stored by the scientific storage method were rated higher for all the organoleptic qualities than those prepared using food grains stored in the traditional way. The rank order was metal bin followed by gunny bag, polythene bag and 'pathyam' and 'kalangiyam'. These findings are in agreement with those of Reddy and Reddy (1987) who reported that scientific treatment did not affect the organoleptic properties of the stored food grains.

The metal bin ranked the highest for retaining the nutrients - protein 92 - 100 per cent, fibre 67 - 100 per cent, energy 92-100 per cent, iron 87-100 per cent, calcium 84-100 per cent and phosphorus 97-100 per cent. The next in order were gunny bag and polythene bag for cereals and polythene bag and airtight stainless steel container for pulses.

From the above results it was confirmed that the application of scientific storage measures definitely maintained the quality of stored food grains throughout the storage period. Metal bin was found to be the best storage device followed by polythene bag and gunny bag treated with scientific methods.

### **C. Educating the Women Leaders on Scientific Food Grain Storage**

After examining the problems experienced in the storage of food grains and after establishing the credibility of the selected storage devices and treatments, it was decided to educate the farm women leaders on scientific storage practices.

Realising the importance of training in minimizing food grain losses during storage, a training programme was organised. The steps included were :

1. Formulation of the training curriculum on scientific storage
2. Selection of women leaders
3. Conduct of the training and
4. Follow up of the training

### **1. Formulation of the training curriculum on scientific storage**

Based on the problems in storage as revealed from the household survey and the efficiency of the storage treatments proven by the experiments conducted in the three households over a one year period, a training curriculum was formulated as shown in Tables XXI and XXII.

TABLE XXI

## COURSE CONTENT FOR THE TRAINING PROGRAMME

Content	Methods/ Aids used
1 Food production scenario in India and Tamil Nadu, need for storage of food grains, loss of food grains due to physical, chemical, biological and mechanical factors	Lectures using charts, booklets
2 Food grain losses due to moisture, temperature, insects, mites and the nature of damage	Lecture using slides and charts
3 Food grain losses due to rodents, nature of damage and its control measures - physical, mechanical, biological and chemical methods	Lecture using charts and pamphlets, demonstration on control of household and field rats using chemical
4 Methods to prevent/control insects and mites, synthetic insecticides, malathion and fumigants	Lecture with pamphlets, demonstration on fumigation of food grains
5 Existing storage practices-defects and improvements suggested, and scientific storage structures	Field visit to see demonstration of fumigation and improved storage practices

The major thrust given in the training programme was on the following scientific storage practices: .

TABLE XXII  
THRUST AREAS COVERED IN THE TRAINING

S.No.	Aspect	Rationale
1.	Pre-storage treatments	The food grains should be properly cleaned dried, graded and cooled before storage. The moisture content of the stored food grains should be brought down below the safe level which is 14 per cent for paddy and 12 per cent for other food grains.
2.	Preparation of storage rooms and structures	<p>The storage room should be properly cleaned and the trash and garbage removed. The walls and ceiling should be white washed and surface inside and outside should be sprayed with insecticides - Malathion 50 % E.C. with the dilution 1:100 once in 15 days (three litres of prepared solution for every square metre). For proper circulation of air, the dunnage (arrangement on the floor to stack grain sacks) can be wooden crates or black polythene sheets. Iron planks can also be used. These should be cleaned and disinfested with Malathion 50% E.C.</p> <p>Gunny bags and polythene bags used for grain storage should be either pest proof with insecticidal formulae Malathion 50% E.C. 'pathayam' used for food grain storage should be painted with suitable wood paint. The inside and outside of the 'kalangiyam' should be white washed.</p> <p>A concrete floor or reinforced brick floor is used to prevent rat-entry from bottom. To avoid rats from crawling or jumping into the structure, a smooth obstruction of 600mm is provided; the obstruction might be of metallic sheet, RCC rings or reinforced brick wall.</p>
3.	<b>Insect control</b>	Mohan trap is made of plastic material to avoid insect infestation. Nine traps per metric tonne can be inserted into the grain and kept for nine days for collection of insects. The insects can be removed from the trap once a fortnight and destroyed.
	Mechanical control	
	Chemical control	Aluminium phosphide three grams of three tablets per metric tonne for cover fumigation, 21 tablets each of three grams or 63 grams per 28 cubic metre for shed fumigation should be used. After five days, the stored food grains should be thoroughly exposed to air atmospheric.

**Rat control**

Mechanical Chemical ↓	Wonder trap, wooden cave trap, snap trap with various baits are used
Household	Single dose anticoagulant - Roban and single dose poison zinc phosphide are used to control rodents in the households
Field	The rat burrows in the field and threshing yards should be fumigated with aluminium phosphide, two tablets (six gms) per burrow.

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Specially prepared pamphlets (Appendix IV) were also distributed during the programme.

**2. Selection of women leaders**

Information obtained from the household survey revealed that all the homemakers were involved in the storage of food grains. Therefore, women were the clientele for the training on scientific storage practices. The training was planned in two stages.

- a. Training of trainers and
- b. Training at the peripheral (village) level

**a. Training of trainers**

A team of three farm women leaders per village representing one each from the marginal, small and large categories, was selected from all the 13 villages of Anaimalai and 17 villages of Thondamuthur block. Thus there were 90 women to be trained as front line workers. The criteria for selection of these 90 front line workers included membership in Mahalir Mandrams and initiative and

willingness to receive knowledge and transfer the same to other women in their own villages.

### **b. Training at the peripheral level**

The training at the peripheral level in the respective villages was planned for the entire farm population.

### **3. Conduct of the training**

In Thondamuthur block which had 51 participants, the training for the front line workers was conducted in two batches with 25/26 members in each batch. The 39 trainees from Anaimalai block were given training in one group. Each group was given intensive training for three days at the block level. With the help of the trained front line women workers, a two day training programme was conducted in each of the 30 villages under study as detailed below.

<u>Number of households</u>							
<u>Anaimalai block</u>				<u>Thondamuthur block</u>			
M	S	L	Total	M	S	L	Total
1642	1269	1200	4111	2049	1539	1358	4946

The village level training covered 4111 farm women in Anaimalai block and 4946 farm women in Thondamuthur block.

### **4. Follow up of the training**

From the large number of women exposed to preliminary training, 15 from each village (consisting of five marginal, five small and five large) who were willing to adopt the scientific storage practices were selected for follow up. Thus 450 farm women from the 30 villages of the two blocks under study were followed up.

Along with the front line workers from the respective villages, the investigator personally visited the selected families once a month for a one year period in order to reiterate the need for safe storage of food grains, clarify any doubts in the procedures to be followed for prolonging the shelflife of food grains and receive their views on the application of scientific storage practices. Efforts were made to ensure services and supplies of equipment and chemicals to these families.

#### **D. Evaluation of the Impact of the Scientific Storage Practices Introduced**

The impact of the training programme was assessed as

1. Impact on the women leaders and
2. Impact on the community

##### **1. Impact on the leaders**

The impact of the training on scientific food grain storage on the leaders was evaluated on the following lines:

- a. Knowledge gained
- b. Attitudes developed and
- c. Level of perception

##### **a. Knowledge gained**

Knowledge was operationalized as the amount of information the women leaders possessed regarding scientific storage practices both prior to and after the training. The extent of knowledge gained was assessed using a knowledge check/inventory comprising questions related to various aspects on scientific storage such as importance of food grains storage, losses during storage and causes

and methods to minimize food grain losses during storage. Appendix VI presents the knowledge check/inventory used.

The mean scores, pre and post, were recorded and the 't' value was calculated to test the significance between the two sets of exposures.

### **b. Attitudes developed**

In order to obtain the right reflection of the leaders' attitude towards scientific storage practices, an attitude scale was developed based on Likert's Summated Rating Scale technique.

Each item in the scale was provided with five response categories. These were strongly favourable, favourable, neutral, unfavourable and strongly unfavourable with scores 5,4,3,2 and 1. Appendix VII gives the attitude scale used prior to and after the training. Based on the responses obtained against each item, they were summated in order to obtain the total attitude scores and 't' test was done to find out any significant differences with regard to the attitude of women leaders at the pre and post training periods.

### **c. Level of perception**

In addition to possessing adequate knowledge and favourable attitudes, it was felt essential that the leaders should have a good perception about the attributes of scientific storage. The perception level of the leaders regarding certain essential attributes of selected scientific storage practices was assessed by paired comparison technique. Shaughnessy (1990) pointed out that paired

comparison is a scaling method in which each stimulus to be measured is paired with another stimulus and the subject is asked to select the number of each pair that has the greater or lesser amount of interest. For this study, the following five attributes of as given by Rogers and Shoemaker (1973) were considered.

Simplicity	Scientific storage practices should be simple
Physical compatibility	There is no inherent health hazard in the practice suggested
Cultural compatibility	The scientific storage practice does contradict the culture and tradition of the community
Profitability	Adoption of the scientific storage practices would result in the reduction of loss of food grains leading to higher returns
Triability	The scientific storage practices can be tried on a smaller scale

## 2. Impact on the community

The quantity of food grains conserved by the families through the adoption of the scientific storage practices was estimated using the quantification formulae given below which were arrived at in consultation with experts and based on the experience of the farmers.

1. Quantum conserved at the household level through rat control : Total no.of dead rats x 4kg of food grains
2. Quantum conserved at the field level through rat control : Total no.of live burrows fumigated x 50 kg of food grains
3. Quantum conserved at the household level through fumigation : 10 per cent of the total quantity fumigated

Chapter IV deals with the findings of this study.

## **RESULTS AND DISCUSSION**

## IV RESULTS AND DISCUSSION

The findings of the study on “Introducing and Evaluating Scientific Storage Practices for Food Grains among Selected Rural Households in Coimbatore District” are discussed as detailed hereunder :

- A. Impact of the Training on Scientific Food Grain Storage on the Leaders
- B. Impact of the Training on Scientific Food Grain Storage on the Community

### **A. Impact of the Training on Scientific Food Grain Storage on the Leaders**

This aspect is discussed on the following heads:

1. Socio-economic profile of the leaders
2. Knowledge gained by the leaders
3. Attitudes of the leaders towards training programme
4. Attributes of scientific storage practices as perceived by the leaders and
5. Effectiveness of teaching methods as expressed by the leaders

#### **1. Socio-economic profile of the leaders**

Table XXIII shows the distribution of the women leaders according to their socio-economic status.

TABLE XXIII  
SOCIO-ECONOMIC PROFILE OF THE WOMEN LEADERS

Characteristics	Details	Percentage of leaders	
		Anaimalai block n:39	Thondamuthur block n:51
Age (in years)	Upto 34	41	51
	35 to 45	49	45
	Above 45	10	4
Education	Primary	28	31
	Higher Secondary	59	53
	Collegiate	13	16
Occupation	Agriculture only	64	76
	Agriculture and allied	28	16
	Agriculture and unrelated jobs	8	8
Marital status	Married	80	94
	Unmarried	15	4
	Widowed	5	2
Family type	Nuclear	89	87
	Joint	11	13
Family size	Small (up to 4 members)	54	45
	Large (>4 members)	46	55
Farming experience (in years)	Low (upto one)	64	25
	Medium (10 to 20)	31	51
	High (above 20)	5	24
Annual family income (in Rs)	Low (Upto 15,000)	31	16
	Middle (15,000-30,000)	36	49
	High (above 30,000)	33	35

A majority of 90 per cent of leaders in Anaimalai block and 96 per cent in Thondamuthur block were below 45 years i.e., in the productive age group appropriate to exercise their leadership traits. More than 50 per cent of them in the two blocks were educated upto higher-secondary level.

Agriculture and agriculture related activities were the main occupations for 92 per cent of the leaders in both the blocks. Over 80 per cent in the two blocks belonged to nuclear families indicating the trend towards disintegration of the joint family system even in the rural areas.

With regard to family size, 54 per cent in Anaimalai block and 55 per cent in Thondamuthur block belonged to small and large families respectively. While a majority of 64 per cent in Anaimalai block had farming experience of less than 10 years, 51 per cent in Thondamuthur had 10-20 years.

An assessment of the family income revealed that in Anaimalai block, the leaders were more or less equally distributed into the three categories low (31 per cent), middle (36 per cent) and high (33 per cent), whereas in Thondamuthur block 49 per cent and 35 per cent belonged to middle and high income groups respectively.

## **2. Knowledge gained by the leaders**

Table XXIV gives a comparative picture of the knowledge scores obtained by the women leaders prior to and after the training.

TABLE XXIV

KNOWLEDGE GAINED\*\*\* BY THE LEADERS THROUGH TRAINING ON  
SCIENTIFIC STORAGE PRACTICES

Aspects	't' values					
	Anaimalaiblock			Thondamuthur block		
	Marginal n = 13	Small 13	Large 13	Marginal 17	Small 17	Large 17
Operations involved in post harvest technology	3.88**	2.70*	4.33**	8.00**	4.02**	2.42*
Causes of grain spoilage	3.67**	6.99**	1.94	3.46**	13.99**	4.15**
Effect of moisture and fungus on grains	4.39**	8.66**	1.73	2.82*	2.32*	3.00**
Safeguarding grains from moisture and fungus	2.44*	2.19*	1.73	1.77	4.89**	1.00
Insect infestation in grain	4.53**	3.01**	2.79*	3.99**	2.40*	2.38*
Insecticides and fumigants	13.38**	8.20**	4.32**	5.47**	3.20**	3.52**
<b>Precautions in using</b>						
i. Insecticides	5.71**	5.11**	2.95**	8.47**	5.04**	2.79*
ii. Fumigants	7.20**	2.75*	1.87	12.82**	2.98**	2.44*
Problems in the use of insecticides and fumigants	4.47**	4.48**	4.80**	4.35**	3.71**	3.71**
Nature of damage by rodents	2.89**	3.14**	3.49**	5.19**	4.15**	2.77*
Methods of controlling rodents	3.46**	4.99**	1.73	10.39**	5.29**	10.39**
Poison used for rodent control	10.24**	4.38**	2.25*	4.16**	3.27**	4.70**
<b>Methods of scientific grain storage</b>						
i. Before storage	4.60**	5.19**	1.41	3.23**	2.19*	1.56
ii. During storage	2.67*	1.87	1.51	2.80*	3.12**	2.27*
iii. After storage	3.46**	3.46**	1.73	2.21*	1.73	1.00
Advantages of scientifically stored grains	3.26**	4.58**	2.12*	6.13**	4.82**	3.57**

\* - Significant at 5 per cent level ;

\*\* - Significant at 1 per cent level

\*\*\* - Calculated on the basis of the mean scores obtained

There was a significant gain in knowledge among the recipients of the training on post harvest technology. All computed 't' values for the gain in knowledge were significant at 5 per cent and 1 per cent of probability for marginal and small farmers in both the blocks except for the aspect methods of scientific grain storage, during storage for small farmers of Anaimalai, and safeguarding grain from moisture and fungus and method of scientific grain storage after storage for marginal and small farmers respectively, in Thondamuthur block.

In the case of large farmers, for aspects such as causes of grain spoilage, effect of moisture and fungus on grains, safeguarding grains from moisture and fungus, precaution in using fumigants and methods of controlling rodents in Anaimalai block and safeguarding grains from moisture and fungus and methods of scientific grain storage, after storage, in Thondamuthur block, the 't' values were not significant, because they were aware of these scientific methods before training but not practicing. The other 't' values were found to be significant at 5 per cent and 1 per cent level of probability.

The significant results obtained might be attributed to the responsibility exhibited by the leaders in playing the leadership roles assigned to them. As a follow up of the training they showed great interest in learning new methods in reducing losses during storage.

### **3. Attitudes of the leaders towards training programme**

Table XXV presents the attitudes developed by the women leaders towards scientific storage practices.

TABLE XXV  
ATTITUDES OF THE LEADERS TOWARDS TRAINING PROGRAMME

Type of leaders	' t' values	
	Anaimalai block	Thondamuthur block
Marginal	6.629**	7.828**
Small	8.978**	10.81**
Large	6.570**	11.82**

\*\* Significant at 1 per cent level

The 't' values calculated to find out the significant differences, if any among the farmers with regard to attitudinal changes were found to be significant at 1 per cent level of probability for all types of farmers in both the blocks. Therefore, it can be inferred that the training programme had a positive impact on the change of attitude of the leaders in the adoption of scientific storage practices.

#### 4. Attributes of scientific storage practices as perceived by the leaders

Table XXVI gives the perception of the women leaders on the attributes of scientific storage practices.

TABLE XXVI  
ATTRIBUTES OF SCIENTIFIC STORAGE PRACTICES AS PERCEIVED BY THE  
LEADERS

Attributes	Anaimalai block			Thondamuthur block		
	Marginal n =	Small	Large	Marginal	Small	Large
	13	13	13	17	17	17
Simplicity	-0.184	-0.226	-0.636	0.108	-0.339	-0.043
Physical compatibility	0.208	-0.043	0.050	0.107	0.025	0.020
Cultural compatibility	0.332	0.061	0.338	0.305	-0.039	0.084
Profitability	0.529	0.242	0.662	0.770	0.772	0.666
Triability	0.764	1.180	0.80	0.512	0.856	0.666

The values obtained in each category of leaders indicated triability as the most important attribute for the acceptance of scientific storage practices followed by profitability by all types of leaders in both the blocks. Cultural compatibility, physical compatibility and simplicity were rated low. The scientific steps in computing the best perceived attributes in the order of importance are furnished in Appendix VIII.

## 5. Effectiveness of teaching methods as expressed by the leaders

Table XXVII explains the effectiveness of teaching methods, as expressed by the women leaders.

TABLE XXVII  
EFFECTIVENESS OF TEACHING METHODS AS EXPRESSED BY THE  
LEADERS

Teaching methods	Percentage of leaders expressing satisfaction															
	<u>Anaimalai block</u>								<u>Thondamuthur block</u>							
	Marginal		Small		Large		Total		Marginal		Small		Large		Total	
n =	13	13	13	39	17	17	17	51	S	NS	S	NS	S	NS	S	NS
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
Lecture	77	23	77	23	92	8	82	18	82	18	88	12	100	-	90	10
Group discussion	92	8	100	-	100	-	97	3	88	12	100	-	100	-	96	4
Demonstration	69	31	92	8	100	-	87	13	71	29	76	24	100	-	82	18
Meeting	54	46	62	38	46	54	54	46	65	35	82	18	59	41	69	31
Exhibition	46	54	62	38	69	31	59	41	59	41	53	47	59	41	57	43
Film and slide show	69	31	69	31	62	38	67	33	53	47	47	53	59	41	53	47
Field visit	92	8	85	15	85	15	87	13	88	12	65	35	76	24	76	24
Wall paintings and posters	85	15	85	15	92	8	87	13	82	18	88	12	82	18	84	16

S = Satisfied NS = Not Satisfied

Over 90 per cent of women leaders in both the blocks were of the opinion that group discussion was the best method to communicate scientific information on post harvest technology, mainly because it placed responsibility on every individual to

think through the process of adoption and clarify doubts and also to contribute towards its solution .

Eighty per cent and above in both the blocks felt that demonstration (Plates - Va, Vb and Vc )and lecture methods were satisfactory mainly because lectures helped them to acquire the background knowledge and demonstration offered a chance for participation/observation.

Over 80 per cent in both the blocks were convinced that wall painting (Plate - Vd) and posters (Plate - Ve) were powerful methods to communicate scientific information directly and visually at a glance in a clear and appealing manner, conveying a lasting impression in the minds of a large majority of the viewers.

Eighty seven per cent and 76 per cent of leaders in both the blocks perceived that field trips provided first hand information and therefore, were useful in acquiring new ideas, in clearing their doubts and in addition, giving them a pleasant and useful break from the normal routine.

Compared to the other methods of teaching, meetings, (Plate - Vf) film and slide shows and exhibitions were rated less effective because the participants being part of the large groups, could not concentrate on the themes.



<- Plate-Va Use of Rat Traps to Control Household Rats

Plate-Vb Application of Aluminium Phosphide to Control Field Rats ->



<- Plate-Vc Fumigation of Stored Food Grains in Mud Pot Using Celphose

Plate .V. METHODS USED FOR COMMUNICATIONS



<Plate-Vd Wall Painting on Rat Control

Plate-Ve Audio Visual Aids Used in the Training -> Programme



<- Plate Vf Participation of the Homemakers in the Meeting

## B. Impact of the Training on Scientific Food Grain Storage on the Community

This aspect is discussed under the following heads:

1. Participation of the community in the awareness programme
2. Extent of adoption of scientific storage practices by the community
3. Estimation of the quantum of food grains saved through scientific storage practices adopted and
4. Suggestions for better adoption of scientific storage practices

### 1. Participation of the community in the awareness programme

Table XXVIII shows the details of participation of the community in the awareness programme.

TABLE XXVIII

#### PARTICIPATION OF THE COMMUNITY IN THE TRAINING PROGRAMME

Components	Number of participants																	
	Anaimalai block								Thondamuthur block									
	Marginal		Small		Large		Total		Total	Marginal		Small		Large		Total		Total
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Demonstration	234	227	196	169	166	137	596	533	1129	335	240	239	212	201	182	775	634	1409
Meeting	192	290	164	159	132	175	488	624	1112	278	303	169	224	171	148	618	675	1293
Exhibition	118	63	82	75	77	64	277	202	479	175	103	156	87	121	90	452	280	732
Film and slide shows	194	162	171	153	162	146	527	461	988	217	229	152	172	84	248	453	649	1102
Field visit	120	42	59	41	61	80	240	163	403	130	39	88	40	73	40	291	119	410
Total	858	784	672	597	598	602	2128	1983	4111	1135	914	804	735	650	708	2589	2357	4946

F = Female; M = Male ;

Demonstration attracted the largest number of participants, 1129 from Anaimalai block and 1409 from Thondamuthur block, followed by general meeting attended by 1112 in Anaimalai block and 1293 in Thondamuthur block. The next in the order were film and slide shows (988 and 1102), exhibition (479 and 732) and field visit (403 and 410) in Anaimalai block and Thondamuthur block respectively. The participation level was higher in Thondamuthur block with 4,946 participants against 4,111 in Anaimalai block. Categorywise analysis revealed that participation level was high among marginal farmers followed by small and large farmers in both the blocks.

Women's participation was found to be higher for demonstration, exhibition and conducted field trips. Men appeared to have participated in greater measure in public meetings and film and slide shows put up in public places. This reflects the cultural settings in which Indian rural folk live.

## **2. Extent of adoption of scientific storage practices by the community**

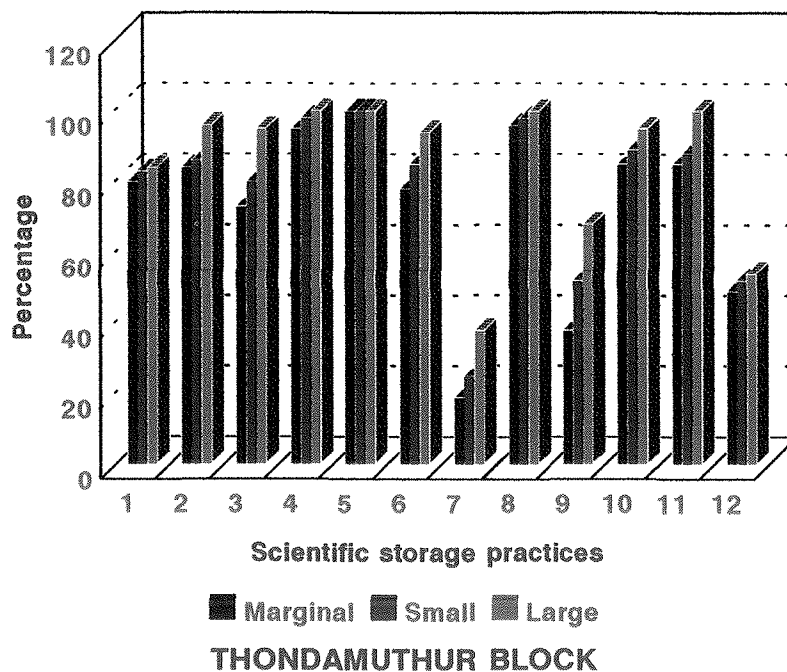
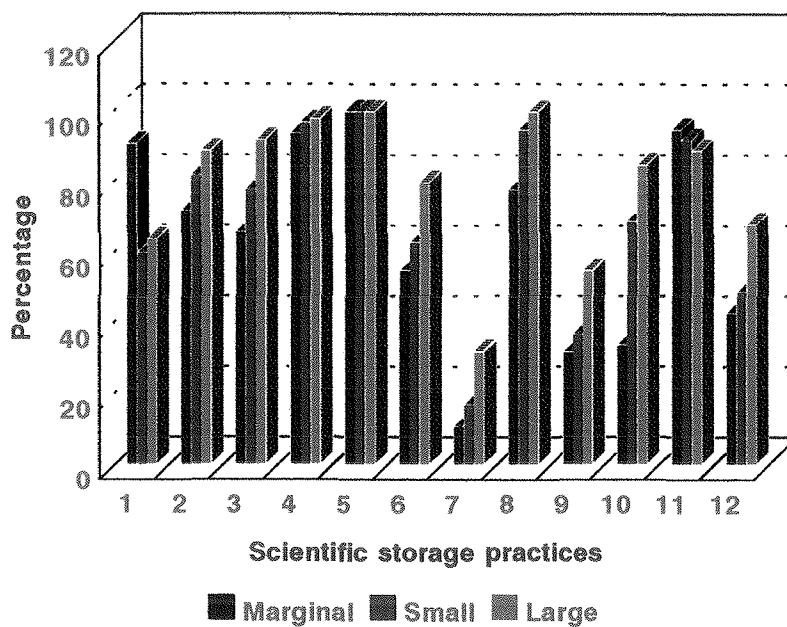
Tables XXIX, XXX and Figure 11 show the extent of adoption of scientific storage practices introduced by the community.

TABLE XXIX

## ADOPTION OF SCIENTIFIC STORAGE PRACTICES BY THE COMMUNITY

Scientific storage practices	Percentage of households							
	Anaimalai block				Thondamuthur block			
	Marginal n = 65	Small 65	Large 65	Total 195	Marginal 85	Small 85	Large 85	Total 255
Drying grains before storage	91	<b>92</b>	<b>98</b>	94	<b>94</b>	<b>98</b>	<b>99</b>	97
Pre treating storage devices/ structures	72	82	89	81	84	86	96	89
Using intact bags	66	78	92	79	73	80	95	83
Using dunnage	94	97	98	96	95	98	100	98
Placing bags horizontally	100	100	100	100	100	100	100	100
Using polythene lined bags	55	63	80	66	78	85	94	85
Using metal bins	11	17	32	20	19	25	38	27
Using Mohan trap	78	95	100	91	96	98	100	98
Fumigating food grains	32	37	55	42	38	52	68	53
Rat proofing	34	69	85	63	85	89	95	90
Using rat trap	95	92	89	92	85	88	100	91
Applying chemicals to control rats	43	49	68	53	49	52	54	54

Of the 12 scientific storage practices introduced, five practices namely drying the grains before storage, using dunnage ( Plates - VIa, VIb and VIc) placing bags horizontally (Plate - VI d), using Mohan trap (Plate - VI e) and rat trap were adopted by more than 90 per cent of the selected farm households in both the blocks irrespective of the category of farmers.



- |   |  |
|---|--|
| 1. Drying grains before storage             | 7. Using metal bins                    |
| 2. Pre treating storage devices/ structures | 8. Using mohan trap                    |
| 3. Using intact bags                        | 9. Fumigating                          |
| 4. Using dunnage                            | 10. Rat proofing                       |
| 5. Placing bags in horizontal position      | 11. Using rat trap                     |
| 6. Using polythene lined bags               | 12. Applying chemicals to control rats |

**ADOPTION OF SCIENTIFIC STORAGE PRACTICES BY THE COMMUNITY**

Figure 11

Using polythene lined bags, intact bags, rat proofing (Plates- VI f ) and pre treatment of storage devices/structures were adopted by more than 60 per cent of the farm households in both the blocks. A high proportion of the small and large farmers appeared to have adopted these practices, compared to marginal farmers, which may perhaps be due to the cost factor involved in the purchase of polythene bags and pretreatment of storage structures.

As for the use of fumigants (Plate - VI g), 37 per cent and 51 per cent of small farmers and 55 per cent and 68 per cent of large farmers of Anaimalai and Thondamuthur blocks respectively, adopted the practice. Chemical control of rats (Plate- VI h) was adopted by 49 per cent and 52 per cent of small and 68 per cent and 54 per cent of large farmers of Anaimalai and Thondamuthur blocks respectively. Marginal farmers in both the blocks showed less interest in following the above practices and the causes were found to be non-availability of sprayers and high cost of chemicals.

Metal storage bins were used only by less than 40 per cent in both the blocks, mainly by large farmers. Only less than 28 per cent of the small farmers and less than 20 per cent of the marginal farmers could adopt the metal bin. Affordability was the major criterion for this situation.

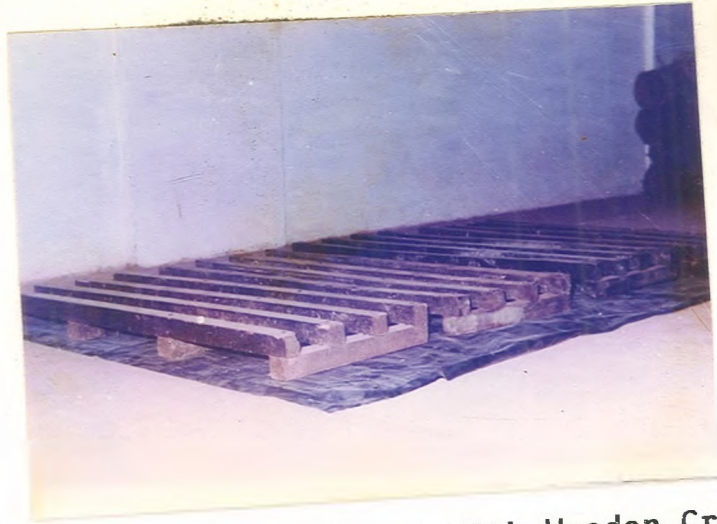


Plate-VIa Polythene Sheet With Wooden Crates



Plate-VIb Polythene Sheet with Bamboo Mats



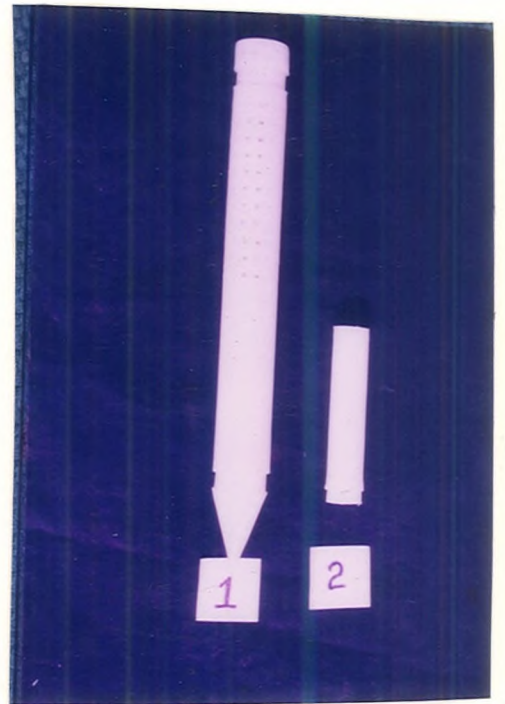
Plate-VIc Use of Iron Planks

Plate .VI. ADOPTION OF SCIENTIFIC STORAGE PRACTICES



<- Plate-VId Storing Foo  
Grains in a Horizontal  
Position

Plate-VIe Use of Mohan Trap



<- Plate VI f Wire Mesh Fi  
Window



**Plate-VIg Fumigated Stock of Food Grains**



**Plate-VIh Chemical Control of Field Rats**

**TABLE XXX**  
**COMPARATIVE PICTURE ON ADOPTION OF SCIENTIFIC STORAGE PRACTICES BY THE**  
**COMMUNITY**

Practices	<u>x<sup>2</sup> values</u>							
	Anaimalai block				Thondamuthur block			
	Marginal and small	Small and large	Large and marginal	Marginal small and large	Marginal and small	Small and large	Large and marginal	Maginal small and large
Drying grains before storage	0.099	2.705	3.774	3.729	1.340	0.339	2.764	3.355
Pre-treating storage/ devices/structures	1.560	1.541	5.992*	6.070*	0.044	6.899**	7.908**	8.014*
Using intact bag	2.458	4.992*	13.509**	3.403	1.176	9.181**	15.894**	15.546**
Using dunnage	0.6989	0.341	1.872	2.074	0.691	-	4.096*	4.096
Using polythene lined bags	0.790	4.571*	9.004**	9.207**	1.385	3.976*	9.509**	9.357**
Using metal bins	1.031	4.145*	8.921**	10.000**	0.863	3.317	7.431**	7.987*
Using Mohan trap	8.188**	3.070	15.689**	21.007**	0.206	2.023	0.053	1.856
Fumigating	0.305	4.457*	7.029**	11.099**	3.426	4.803*	15.901**	5.978*
Rat proofing	16.292**	4.333*	34.690**	37.616**	0.835	2.082	5.294*	5.225
Using rat traps	0.532	0.367	1.733	1.733	0.452	10.625**	14.076**	13.285**
Applying chemicals to control rats	0.094	0.094	0.376	8.571*	0.561	0.561	7.969**	0.3769

\*\* Significant at 1 per cent level

\* Significant at 5 per cent level

The Chi square values were calculated to find out the significant differences, if any, among the farmers in the adoption of scientific storage practices. The computed Chi square values were found to be significant at 1 per cent level for large and marginal farmers in the aspects of using intact bags, polythene lined bags, metal bins, Mohan trap, fumigants and rat proofing in Anaimalai block and pre-treatment of storage structures/devices, using intact bags, polythene lined bags metal bins, fumigants, rat traps and chemical control of rats in Thondamuthur block. The reasons for the differences in the adoption of such practices may be due to the cost involved and difficulties in applying the methods.

The Chi square values were found to be significant at 5 per cent level for small and large farmers in the aspects of using intact bags, polythene lined bags, using metal bins, fumigants and rat proofing by small and large farmers in Anaimalai block and using polythene lined bags, and fumigants in Thondamuthur block..

No significant difference was observed among the marginal and small farmers in both the blocks except for using Mohan trap and rat proofing in Anaimalai block. This may be due to the cost factor involved in the purchase of metal bin and chemicals.

Blockwise analysis revealed significant differences at 1 per cent level in the adoption of polythene lined bags, metal bins, Mohan trap, fumigants and rat proofing in Anaimalai block and intact bags, polythene lined bags and rat traps in Thondamuthur block.

In the adoption of pre-treatment of storage devices/structures, and chemical control of rats in Anaimalai block and pre-treatment of storage devices/structures, using metal bins and fumigants in Thondamuthur block the chi square values were significant at 5 per cent level.

No significant difference was observed regarding the drying of the grain before storage in both the blocks or in using intact bag, dunnage and rat traps in Anaimalai block and dunnage, Mohan trap, rat proofing and chemical control of rats in Thondamuthur block. By and large, high costs of the inputs featured as the main barrier in the adoption of scientific storage practices.

In general, the adoption level of all the practices was higher in Thondamuthur block compared to Anaimalai block, which may perhaps be due to the higher socio-economic status along with higher educational level of the community.

### 3. Estimation of the quantum of food grains saved through scientific storage practices adopted

The aspects discussed under this heading are:

- a. Details of household level rodent control
- b. Details of field level rodent control
- c. Food grains saved through fumigation and
- d. Quantity of food grains saved per cropping per household by adoption of scientific storage practices

#### a. Details of household level rodent control

Table XXXI gives the details of control of rats in the households by using the anticoagulant 'Roban'

TABLE XXXI

#### DETAILS OF HOUSEHOLD LEVEL RODENT CONTROL

Details	Anaimalai block n=195	Thondamuthur block n=255	Total
Number of dead rats found by the application of 'Roban'	626	675	1301
Estimated saving of foodgrains (in kg)	2504	2700	5204
Saving of food grains per household per cropping (in kg)	13	11	12

Over a period of six months, around 1301 rats were killed. The estimated saving of food grains was found to be 5204 kg in the community and approximately 12 kg/ household. This confirms the beneficial effects of anticoagulant 'Roban' which in turn had reduced the loss of food grains due to rodents ultimately resulting in monetary benefits.

#### b. Details of field level rodent control

The details of the field level rodent control through fumigation is given in Table XXXII.

TABLE XXXII

DETAILS OF FIELD LEVEL RODENT CONTROL

Details	Anaimalai	Thondamuthur	Total
	block n=195	block n=255	
Number of burrows fumigated	223	287	510
Estimated saving of food grains (in kg)	11150	14350	25500
Saving of food grains per household per cropping (in kg)	57	56	57

There were more burrows in the lands owned by large farmers, owing to the large size and difficulty in maintaining and mending the land after each cropping and during the cropping period. Totally, 510 burrows were fumigated with aluminium phosphide during one cropping period which in turn saved 25,000 kg of food grains. On an average, 57 Kg of food grains were saved per household per cropping.

### c. Food grains saved through fumigation

The food grains saved through fumigation in the selected households is given in Table XXXIII.

TABLE XXXIII  
FOOD GRAINS SAVED THROUGH FUMIGATION

Details	Anaimalai block	Thondamuthur block
	n=195	n=255
Quantity of food grains fumigated (in kg)	92,700	2,17,000
Estimated saving of food grains (in kg)	9,270	21,700
Saving of food grains per household per cropping (in kg)	48	85

The Table values imply that owing to fumigation, 9,270 kg of food grains in Anaimalai block and 21,700 kg of food grains in Thondamuthur block were saved per cropping by fumigating 92,700 Kg and 2,17,000 of Kg food grains in Anaimalai and Thondamuthur blocks respectively. The saving of food grains per household was around 48 kg in Anaimalai block and 85 kg in Thondamuthur block.

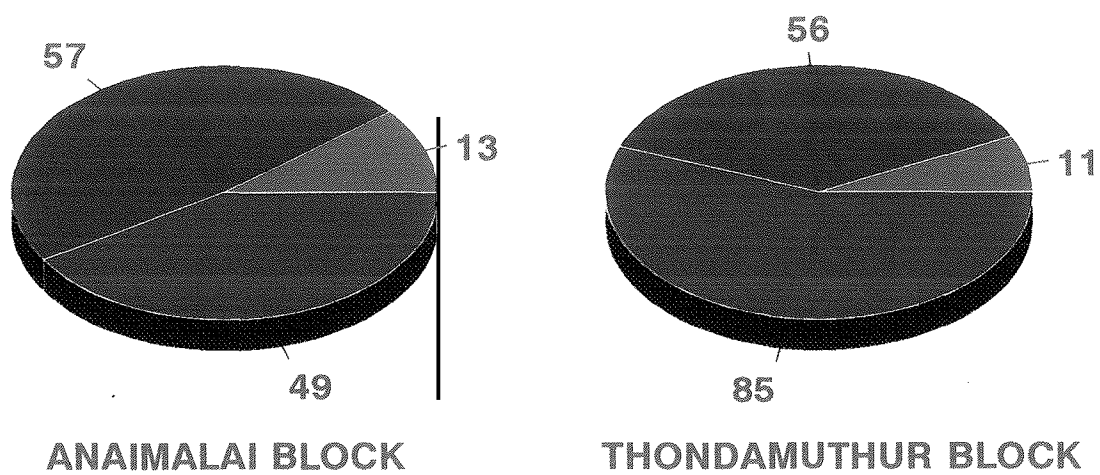
**d.Quantity of food grains saved per cropping per household by adoption of scientific storage practices**

The total quantity of food grains saved through the adoption of scientific storage practices was calculated and is presented in Table XXXIV and Figure 12.

TABLE XXXIV  
QUANTITY OF FOOD GRAIN SAVED PER CROPPING PER HOUSEHOLD  
BY ADOPTION OF SCIENTIFIC STORAGE PRACTICES

Practices	Anaimalai block	Thondamuthur block
	n=195	n=255
	(in Kg)	
I. Rodent control		
a. Household level	13	11
b. Field level	57	56
II. Fumigation	48	85
	118	152

All the selected households were supplied with 'Roban' and aluminium phosphide to control rats in the households and fields respectively and fumigant celphose to control insects in stored food grains. For supplying these chemicals, a sum of Rs.8150 was required per cropping which on an average amounted to Rs.18 per household.



**Practices**

■ Rodent control (HHL) ■ Rodent control (FL) ■ Fumigation

Household level (HHL); Field level (FL)

**QUANTITY OF FOOD GRAINS SAVED PER CROPPING PER HOUSEHOLD BY ADOPTION OF SCIENTIFIC STORAGE PRACTICES (in kg)**

**Figure - 12**

As a result of the adoption of scientific storage practices, on an average, a saving of 118 kg of food grains worth Rs.475 per household per cropping had accrued in Anaimalai block as against 152 kg worth Rs.620 in Thondamuthur block. The final results of the adoption of scientific storage practices emphasized that the marginal, small and large farmers of Anaimalai block could bring down the losses averaging between 10.8 to 5.5 per cent, 10.0 to 4.2 per cent and 6.5 to 3.2 per cent of food grains, while in Thondamuthur block it was reduced to the extent of 10.2 to 4.8 per cent, 9.5 to 4.1 per cent and 5.5 to 3 per cent respectively.

The reduction of food grain loss could be attributed mainly by adoption of simple scientific storage practices followed by the farmers, such as proper drying of grains, use of dunnage, proper stacking of bags, use of fumigants and rodent control. If farmers continue to adopt these scientific practices, quite a significant amount of grains could be saved.

#### **4.Suggestions for better adoption of scientific storage practices**

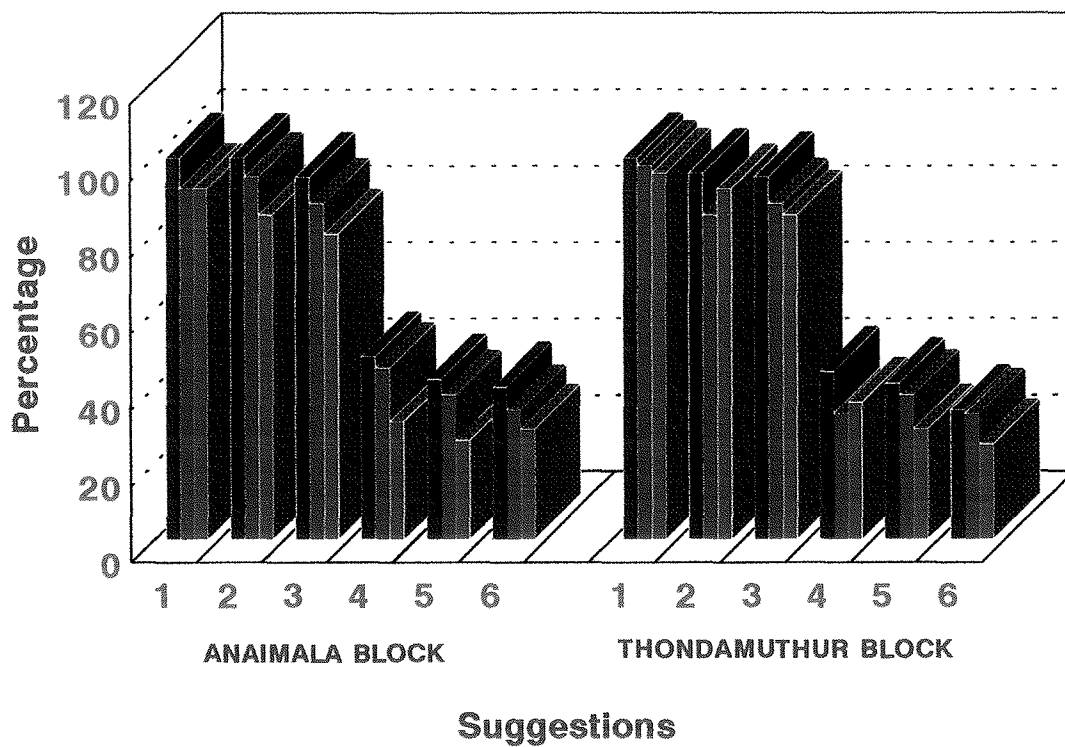
Table XXXV and figure 13 give the suggestions put forth by the farmers to overcome the problems faced in the adoption of scientific storage practices.

TABLE XXXV

## SUGGESTIONS FOR BETTER ADOPTION OF SCIENTIFIC STORAGE PRACTICES

Suggestions	Percentage of households								
	n =	Anaimalai block				Thondamuthur block			
		Marginal	Small	Large	Total	Marginal	Small	Large	Total
	65	65	65	195	85	85	85	255	
Credit support	100	92	92	95	100	98	96	98	
Provisions of subsidy	100	95	85	93	96	85	92	95	
Regular supplies/ services	95	88	80	88	95	88	85	89	
Storage devices at low cost	48	45	31	41	44	33	36	38	
Educational campaigns	42	38	26	35	41	38	29	36	
Technical guidance	40	34	29	34	34	33	25	31	

Over 95 per cent of the respondents in both the blocks requested financial assistance in terms of credit support by government for purchase of scientific storage devices\structures. Provision of subsidy was also suggested by a majority of 90 per cent of farmers in both the blocks. More than 85 per cent in both the blocks suggested ensuring timely and adequate supply of inputs such as anticoagulant, zinc phosphide, Malathion and Mohan trap.



■ Marginal ■ Small ■ Large

1. Credit support
2. Provision of subsidy
3. Regular supplies / services
4. Storage devices at low cost
5. Educational campaigns
6. Technical guidance

**SUGGESTIONS FOR BETTER ADOPTION OF SCIENTIFIC STORAGE PRACTICES**

**Figure - 13**

Forty one per cent of farmers in Anaimalai and 38 per cent in Thondamuthur block suggested developing low cost storage devices/structures. One third of the farmers in both the blocks (35 per cent) requested technical guidance and educational campaigns to disseminate information.

All these suggestions are worth implementation by scientists, government and extension agencies.

## **SUMMARY AND CONCLUSION**

## V SUMMARY AND CONCLUSION

The study on “Introducing and Evaluating Scientific Storage Practices for Food Grains among Selected Rural Households in Coimbatore District” was undertaken with the main objective of eliciting the participation of rural women in minimizing food grain losses during storage and improving the quality of food leading ultimately to food security.

Based on the availability of surplus food grains for storage, 30 villages (13 from Anaimalai and 17 from Thondamuthur blocks of Coimbatore District) were selected for this action research which was conducted in three phases.

### **A. Household Survey**

A household survey was conducted among 900 households from the 30 villages with equal distribution from marginal, small and large categories of the farming community, using an interview schedule to elicit the food grain storage practices in vogue and the problems encountered. The survey pointed out the need for adoption of scientific storage practices, through enhancing the efficiency of the storage devices/structures.

## **B. Trial on Scientific Storage of Food Grains**

It was felt necessary to have trials on storage experiments in the life situation with practising farmers before introducing the scientific storage practices on a large scale. Accordingly, three households were selected for the storage experiments for a period of one year. The efficacy of the storage devices and treatment were analysed in terms of moisture content, weevilization and germination percentage, organoleptic characteristics and percentage of nutrient retention. Comparisons were made with control.

## **C. Training Women Leaders**

Based on the results of the experiment, a training curriculum was formulated to impart knowledge on scientific storage practices. In the first phase, a three day training was given to 90 women leaders (39 from Anaimalai and 51 from Thondamuthur blocks) who were willing to act as frontline workers and deliver the messages learnt to fellow members - both men and women. In the second phase, training was given for a period of two weeks for the entire community, utilising the front line leaders. The training programmes included lectures, participatory discussions, demonstrations, meetings, exhibitions and field visits. The visual aids used were charts, posters, pamphlets, booklets film and slide shows.

## **Evaluation of the Impact of the Scientific Practices Introduced**

The impact of the training programme was evaluated in terms of the knowledge gained by the leaders, attitudes developed and their level of perception and the quantum of food grains conserved by the selected households.

The major findings of the study are summarised hereunder :

### **Household Survey**

- \* All except one per cent of the homemakers in Anaimalai block and 0.4 per cent in Thondamuthur block (mainly from marginal and small farm households) were literate.
- \* Agriculture was the main occupation of all the large farmers of the two blocks; 88 and 92 per cent of small farmers and 73 and 78 per cent of marginal farmers respectively, in Anaimalai and Thondamuthur blocks. In addition, agricultural business was the subsidiary occupation among 87 per cent and 82 per cent of large farmers as against 49 and 48 per cent of marginal and 35 and 32 per cent of small farmers respectively, in Anaimalai and Thondamuthur blocks.
- \* Ninety six per cent of the households in Thondamuthur possessed wet land as against 87 per cent in Anaimalai. While 62 per cent households in Anaimalai owned dry land, only 42 per cent had dry land in Thondamuthur. Almost the same percentage in Anaimalai (57 per cent) and Thondamuthur (59 per cent) block possessed garden land.

- \* Marginal and small farmers in the two blocks predominantly belonged to low income groups, on the otherhand, more than half of the large farmers of the two blocks belonged to high income category. In general, the farmers of Thondamuthur block appeared to be financially better when compared to those in Anaimalai block.
- \* All the selected households cultivated sufficient paddy for household consumption. More than 60 per cent of farmers cultivated jowar, maize and ragi in Anaimalai block and bajra and jowar in Thondamuthur block . Among pulses, black gram was the major crop cultivated by all the households in both the blocks, followed by green gram and red gram.
- \*. Irrespective of the category of farmers and blocks, paddy was cultivated twice a year by more than 80 per cent of farmers. Ragi, maize, jowar and bajra were also cultivated twice by less than 50 per cent of large farmers in both the blocks. Pulse varieties were cultivated once a year by all the farmers.
- \* The maximum annual production of paddy was 20-30 quintals by marginal and 30-40 quintals by small and large farmers in both the blocks. The quantum of production of maize, ragi, jowar and bajra has been declining, as the traditional foods prepared using these grains are becoming unpopular. All the farmers, irrespective of the type of land holding and blocks, annually produced upto 10 quintals of pulses such as black gram, green gram, red gram, cow pea and Bengal gram.

- \* All the homemakers of the two blocks were involved in the storage of food grains while a large majority of the heads of families were engaged mainly in harvesting and marketing.
- \* Except the marginal farmers of Anaimalai block, all the other farmers stored upto 40 quintals of paddy annually. With regard to other food grains and pulses, the maximum amount stored was upto 10 quintals per annum.
- \* All the small and marginal farmers in the two blocks stored food grains either for their family consumption or for seed. On the otherhand, the large farmers in both the blocks stored food grains for marketing purposes also.
- \* Irrespective of the locale or the category of farmers, food grains other than paddy and ragi were stored only upto three months by over 75 per cent . Paddy was stored for three to six months by 65 per cent of marginal and 80 per cent of large farmers as against six to nine months by 68 per cent of small farmers in Anaimalai block. In Thondamuthur block, 66 per cent and 58 per cent of small and large farmers respectively, stored paddy for nine to twelve months.
- \* All the households surveyed stored their food grains in gunny bags. Traditional 'kalangiyam' and 'pathayam' were found to be used only by a small proportion of the farm households, particularly by large

farmers. Pulses were reported to be stored in polythene bags by over 90 per cent.

- \* Seventy one per cent and 64 per cent in Anaimalai and Thondamuthur blocks respectively, expressed inadequate technical guidance as the most significant problem faced in the storage of food grains. Insufficient storage space, non-availability of chemicals and adverse climatic conditions were the other major problems expressed by over 50 per cent of the marginal farmers in both the blocks.
- \* Insect infestation was mentioned as the major cause for food grain losses by over 60 per cent of farmers of all categories in both the blocks. Sixty one and 59 per cent of farmers in Anaimalai block and 70 and 54 per cent in Thondamuthur block respectively complained about the menace by rodents and mould and fungi formation in stored grains.
- \* Sun drying was the popular method used by all categories of farmers in both the blocks to reduce moisture content of food grains prior to storage. Traditional storage treatments such as use of leaves of 'neem' 'kattu thulasi' and 'pungam' were prevalent among 80 per cent in Anaimalai block and 90 per cent in Thondamuthur block to reduce insect infestation. Pulses were coated with moist red soil and ash and then sun dried by over 65 per cent farmers of both the blocks. Mixing pulses with whole red chillies was practised by 38 per cent and 39 per cent of farmers in Anaimalai and Thondamuthur respectively, to reduce insect infestation.

- \* Seventy one per cent and 58 per cent of the marginal and small farmers in Anaimalai and 65 per cent and 52 per cent in Thondamuthur blocks respectively adopted mechanical proofing methods.

### **Trial on Scientific Storage of Food Grains**

- \* From the results of the experiment, it was noted that metal bin maintained moisture content below the safe level for all grains throughout the experiment. Except ragi, the other food grains stored in gunny bags and polythene bags maintained the safe level of moisture content. The moisture content was maximum in the case of food grains in traditional 'pathayam' and 'kalangiyam'.
- \* In the case of paddy, except that stored in 'pathayam' and 'kalangiyam', the percentage of weevilization was maintained below the BIS mark - i.e., metal bin 0.8 per cent, polythene bag 1.5 per cent and gunny bag 2.4 per cent. Jowar and maize stored in metal bin maintained the standard level of weevilization whereas that stored in other structures had recorded a higher percentage of weevilization.
- \* A higher percentage in germination was noticed in food grains stored using scientific methods as against those stored in the traditional way. As for storage structures, metal bin followed by polythene bag were considered better with regard to germination rate for all the food grains.

- \* All the dishes prepared out of the food grains stored in the scientific storage methods were rated higher for all the organoleptic qualities than those prepared using food grains stored in the traditional way. Ranking was high for metal bin followed by gunny bag, polythene bag, 'pathayam' and 'kalangiyam'.
- \* The metal bin ranked the highest for retaining the nutrients in cereals as well as pulses - 92-100 per cent for protein, 67-100 per cent for fibre, 92-100 per cent for energy, 87-100 per cent for iron, 84-100 per cent for calcium and 97-100 per cent for phosphorus . The next in order were gunny bag and polythene bag for cereals and polythene bag and airtight stainless steel container for pulses. From the above results it was confirmed that the metal bin is the best storage device followed by polythene bag and gunny bag treated with scientific methods.

#### **Impact of Training on the Leaders:**

- \* A majority of 90 per cent of leaders in Anaimalai and 96 per cent in Thondamuthur were below 45 years, i.e., in the productive age group appropriate to exercise their leadership traits. More than 50 per cent of the leaders in the two blocks were educated upto higher secondary level.

Agriculture and agriculture-related activities were the main occupations for 92 per cent of the leaders in both the blocks.

An assessment of the family income revealed that in Anaimalai block, the leaders were more or less equally distributed into the three categories - low (31 per cent), middle (36 per cent) and high (33 per cent) whereas in Thondamuthur block 49 per cent and 35 per cent belonged to middle and high income groups respectively.

- \* Significant gain in knowledge was observed in the leaders who had received the training on scientific storage practices. All computed 't' values for the gain in knowledge were significant at 5 per cent and 1 per cent of probability for marginal and small farmers in both the blocks except for the aspect methods of scientific grain storage, during storage, for small farmers of Anaimalai and safeguarding grain from moisture and fungus and methods of scientific grain storage, after storage, by marginal and small farmers respectively in Thondamuthur block.
- \* For the attitude of leaders towards scientific storage practices, the calculated 't' values were found to be at 1 per cent level of probability, irrespective of the type of farmers and blocks. It may, therefore, be inferred that the training programme had a positive impact on the attitudinal changes of leaders towards the adoption of scientific storage practices.

- \* As for the perception of the leaders about the attributes of scientific storage practices, the scale values obtained in each category of leaders indicated triability as the most crucial attribute for the acceptance of scientific storage practices followed by profitability by all types of farmers in both the blocks. Cultural compatibility, physical compatibility and simplicity scaled low.
- \* Over 90 per cent of women leaders in both the blocks expressed that group discussion was the best method to communicate scientific information on post harvest technology. Eighty per cent and above in both the blocks felt that demonstration and lecture methods were satisfactory, mainly because lectures helped to receive the background knowledge and demonstration offered a chance for participation. Compared to other methods of teaching, meetings, film and slide shows and exhibitions were rated less effective because the participants, being part of the large groups attending the programmes, could not concentrate on the themes.

### **Impact of Training on the Community**

- \* Both men and women showed a great deal of interest in attending the demonstrations, meetings, exhibitions, film and slide shows. The participation level was higher in Thondamuthur block with 4,946 participants against 4,111 in Anaimalai block. Categorywise analysis revealed that participation level was higher among marginal farmers followed by small and large farmers in both the blocks.

- \* Scientific storage practices such as drying the grains before storage, using dunnage, placing bags in horizontal position, using Mohan trap and rat trap were adopted by more than 90 per cent of the selected farm households in both the blocks irrespective of the category of farmers . This may be due to the fact that these practices did not involve much skill or cost. Polythene lined bag, intact bag, rat proofing and pre treatment of storage devices/structures were adopted by more than 60 per cent of the farmers.
- \* Use of fumigants and chemical control of rats were found to be moderately adopted by small and large farmers when compared to marginal farmers in both the blocks. This may be due to the cost factor.
- \* Eighty nine and 81 per cent of the marginal farmers, 83 and 75 per cent of the small farmers and 68 and 62 per cent of the large farmers respectively, of Anaimalai and Thondamuthur blocks did not use metal bin for storage because of the high cost involved.
- \* Blockwise analysis revealed significant differences at 1 per cent level in the adoption of polythene lined bags, metal bins, Mohan trap, fumigants and rat proofing in Anaimalai block and intact bags, polythene lined bags, and rat traps in Thondamuthur block.
- \* In the adoption of pre-treatment of storage devices/structures, and chemical control of rats in Anaimalai block and pre-treatment of storage devices/structures, using metal bins and fumigants in Thondamuthur block the Chi square values were significant at 5 per cent level.

- \* No significant difference was observed for the aspect of drying the grain before storage in both the blocks and using intact bag, dunnage and rat traps in Anaimalai block and using dunnage, Mohan trap, rat proofing and chemical control of rats in Thondamuthur block.
- \* In general, the adoption level of all the practices was higher in Thondamuthur block compared to Anaimalai block, which may perhaps be due to the higher socio-economic status along with higher educational level of the community.
- \* All the selected households were supplied with Roban and aluminium phosphide to control rats in the households and fields respectively, and fumigants celphose to control insects in stored food grains. For supplying these chemicals a sum of Rs.8,150 was required per cropping which, on an average amounted to Rs.18 per household.
- \* The saving of food grains per household per cropping resulting from the adoption of scientific storage practices amounted to 118 kg of food grains worth Rs. 475 in Anaimalai block as against 152 kg worth Rs.620 in Thondamuthur block. The final results for the adoption of scientific storage practices emphasized that the marginal, small and large farmers of Anaimalai block could bring down the losses averaging between 10.8 to 5.5 per cent, 10.0 to 4.2 per cent and 6.5 to 3.2 per cent of food grains while in Thondamuthur block it was reduced to the extent of 10.2 to 4.8 per cent, 9.5 to 4.1 per cent and 5.5 to 3 per cent respectively. If farmers continue to adopt these scientific practices quite a significant amount of grains and money could be saved.

- \* Over 95 per cent of the farmers in both the blocks expressed the need for financial assistance in terms of credit support by the government for the purchase of scientific storage devices/structures. Ninety per cent in both the blocks suggested provision of subsidy also. Over 85 per cent in both the blocks suggested timely and adequate supply of inputs like anti-coagulant, zinc phosphide, Malathion and Mohan trap. Forty one per cent in Anaimalai and 38 per cent in Thondamuthur block suggested intensified research for developing low cost storage structures to prevent grain losses through infestation. One third of the farmers in both the blocks (35 per cent) in general, suggested provision of adequate technical guidance on scientific storage practices of food grains through educational campaigns.

It may be concluded that the village-wide programme launched to educate, motivate and persuade the farmers to adopt scientific food grain storage practices was successful with a majority understanding and following the techniques which resulted in saving of food grains and money.

For the continuation of the programme, the following recommendations are suggested :

**Recommendations emerging from this study:**

1. At least one storage centre for storing food grain in each village or panchayat union could be developed where all the storage operations can be done. All essential requirements like small size dryers, cleaning machine, weighing scale, 'dunnage', polythene covers, insecticides and temporary storage can be provided in this storage centre which could be of great help to the marginal and small farmers.
2. Short term training courses on 'scientific storage practices' could be organised for the benefit of the local farmers in all the panchayat unions by trained agriculturists.
3. Improved storage structures need to be popularized through wider publicity by the concerned extension agencies. The government can help the marginal farmers by providing 50 per cent subsidy for buying improved storage structures.
4. The control of rats should have an integral approach in the whole village.
5. Research on improved scientific storage practices so as to minimize the food grain losses should be encouraged.
6. There is need for further investigation on reducing the losses in farm harvesting, threshing, drying and processing. A similar type of training on scientific practices in each stage could be conducted in other villages

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## **APPENDICES**

## APPENDIX - 1

### LIST OF VILLAGES IN THE TWO SELECTED BLOCKS

#### ANAIMALAI BLOCK

1. Suppugundenpudur
2. Devipattinam
3. Kaliapp agoundenpurdur
4. Manakadavu
5. Ganpathipalayam
6. Minorpathi
7. Arasur
8. Kullegoundanur
9. Narikkalpathi
10. Vepparaipathi
11. Marappagoundenpudur
12. Kuppichipudur
13. M. G. Pudur

#### THONDAMUTHUR BLOCK

1. Pechettipalayam
2. Kondayampalayam
3. Vellarugampalayam
4. Karamarathur
5. Madhampatti
6. Palaniandavanpudur
7. Alandurai
8. Methipalayam
9. Karadimadai
10. Kaliannanpudur
11. Palanigoundanpudur
12. Kalveeramapalayam
13. Santhegoundanpalayam
14. Kalamapalayam
15. Puthur
16. Jaginaickenpalayam
17. Pullagoundenpudur

## APPENDIX II

**AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND  
HIGHER EDUCATION FOR WOMEN  
(DEEMED UNIVERSITY)  
COIMBATORE - 641 043**

**INTERVIEW SCHEDULE TO ELICIT INFORMATION ON STORAGE  
PRACTICES OF FOOD GRAINS IN THE HOUSEHOLDS**

- I.
1. Name of the Panchayat :
  2. Name of the village :
  3. Name of the interviewee :
  4. Name of the head of the family

II. Educational status

S.No.	Educational status	Homemakers	Head of the family
1.	Illiterate		
2.	Primary		
3.	Middle		
4.	Higher Secondary		
5.	Graduate		
6.	Post Graduate		
7.	Diploma		
8.	Professional		

III. Occupational status

S.No.	Occupational status	Homemakers	Head of the family
1.	Agriculture		
2.	Business		
3.	Teacher		
4.	Clerk		
5.	Professional		
6.	Any other		

#### IV. Size of land holding

S.No.	Type of land	Size in hectares
1.	Dry land	
2.	Wet land	
3.	Garden land	

#### V. Family Income

S.No.	Income Category
1.	Low
2.	Middle
3.	High

#### VI. Types of crops cultivated

##### **a. Cereals**

Paddy

Ragi

Jowar

Barja

Maize

Others

##### **b. Pulses**

Black gram

Green gram

Red gram

Cow pea

Bengal gram

Others

##### **c. Nuts and oils seeds**

Groundnut

Gingelly seeds

Coconut

Others

##### **d. Tubers**

Turmeric

Tobacco

Others

##### **Frequency of cultivations**



b. Sources of information gained?

- a. Training
- b. Demonstration by experts
- c. Radio
- d. Television
- e. News paper
- f. Others

c. Do you put them in practice?      Yes                                  No

If yes in what way have you been practising it?

Scientific storage practices

- 1. Dunnage
- 2. White washing
- 3. Dark painting
- 4. Metal bin
- 5. Chemical treatment

- a. Pesticides
- b. Insecticides
- c. Fumigants

IX. Have you undergone any training programme in storage practices?

Yes    No

XII. If such training is conducted in your village would you like to participate and benefit from it?

Yes    No



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**Scientific Practices****Traditional Practices**

Preparation	Scientific Practices					Traditional Practices								
	Gunny bag	Polythene bag	Metal bin	Pathayam	Kalangiyam	Airtight Stain less steel bin	Gunny bag	Polythene bag	Metal bin	Pathayam	Kalangiyam	Airtight Stain less steel bin		
	HM	HF	HM	HF	HM	HF	HM	HF	HM	HF	HM	HF	HM	HF

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**Black gram dhal vadai**

Appearance

Taste

Texture

Flavour

Acceptability

**Green gram dhal sundal**

Appearance

Taste

Texture

Flavour

Acceptability

**Red gram dhal****Sambar**

Appearance

Taste

Texture

Flavour

Acceptability

## **APPENDIX IV**

**THE DETAILED RESULTS OBTAINED FROM EXPERIMENT ON MOISTURE,  
WEEVILIZATION AND GERMINATION PERCENTAGE AND ORGANOLEPTIC  
QUALITY AND PERCENTAGE RETENTION OF NUTRIENTS IN THE STORED  
FOOD GRAINS**

MOISTURE CONTENT

S. No.	Name of the Food grains	Initial moisture	Three Months January March *55-60 **26-30 C		Six Months April -June 40-60 28-30 C		Nine Months July-September 65-75 16-18 C		One year Octo-Decb. 60-70 20-21 C		Driage gain/loss of food grain	
			Adop- tion of scienti- fic method	Non Adop- tion of scienti- fic method	Adop- tion of scienti- fic method	Non Adop- tion of scienti- fic method	Adop- tion of scienti- fic method	Non Adop- tion of scienti- fic method	Adop- tion of scienti- fic method	Non Adop- tion of scienti- fic method	Adop- tion of scienti- fic method	Non Adop- tion of scienti- fic method
<b>Paddy</b>												
1.	Gunny bag	10.9	12.2	14	13	15	14.0	15.6	14.1	15.8	3.7	5.8
2.	Polythene bag		12.8	13.8	13.6	14.2	13.8	15.2	14.0	15.6	3.6	5.6
3.	Metal bin		12.2	13	13.2	13.9	12.8	14.0	12.0	14.8	1.2	4.6
4.	Pathayam		13.2	13.8	13.8	14.0	14.0	14.7	14.4	15.2	4.0	5.2
5.	Kalangiyam		13.0	13.9	13.9	14.8	14.0	15.2	14.2	16	3.8	6.1
<b>Ragi</b>												
1.	Gunny bag	9.3	11.4	13.3	12	14.6	13	14.8	13.8	15.5	5.2	7.3
2.	Polythene bag		12	12.8	12.4	14.2	12.6	14.6	13.0	14.8	4.3	6.4
3.	Metal bin		11.0	12.2	11.8	12.8	12.0	13	12.1	13.2	3.2	4.5
4.	Pathayam		12	12.3	13.4	14.2	13.5	14	13.8	14.9	5.2	6.5
5.	Kalangiyam		11.8	12.4	12.3	13.8	13.4	14	14.4	14.8	5.9	6.4
<b>Maize</b>												
1.	Gunny bag	9.7	11	12.3	12.1	14.2	12.3	15.8	12.4	16	3.0	7.5
2.	Polythene bag		11	12.1	12.2	3.2	12.2	14.8	12.4	15.1	3.0	6.4
3.	Metal bin		10.5	11.0	11.1	12.1	11.4	12.9	11.6	13.0	2.1	3.0
4.	Pathayam		11.2	12.1	11.4	13.0	11.9	14.1	12.8	14.9	3.5	6.1
5.	Kalangiyam		12.2	12.3	14.0	14.3	12.6	15.6	13.1	16.8	3.9	8.5
<b>Jowar</b>												
1.	Gunny bag	10.1	10.5	12.3	11.8	13.6	12.1	14.2	12.4	15.8	2.6	6.8
2.	Polythene bag		10.5	12.0	11.7	12.5	12.0	13.8	12.2	14.3	2.3	4.9
3.	Metal bin		10.2	11.8	10.8	12.1	11.2	12.9	11.7	13.3	1.6	3.6
4.	Pathayam		12	12.9	12.9	13.2	13.0	14.8	13.2	15.6	3.5	6.5
5.	Kalangiyam		11.5	12.1	12.1	14.3	13.3	15.6	13.4	16.8	3.8	8.0
<b>Bajra</b>												
1.	Gunny bag	11.1	12	12.3	12.1	13.2	12.1	14.8	11.9	15.0	0.9	4.5
2.	Polythene bag		11.2	11.7	11.0	13.1	11.0	13.7	11.2	14.9	0.1	4.4
3.	Metal bin		11.2	11.3	10.9	12.2	11.3	12.9	10.7	13.2	-0.4	2.4
4.	Pathayam		11.8	12.2	12.8	13.8	12.2	14.5	12.7	15.0	1.8	4.5
5.	Kalangiyam		11.1	12.0	12.4	13.4	12.0	14.9	12.8	15.2	1.9	4.8
<b>Pulses</b>												
<b>Black gram</b>												
1.	Gunny bag	10.2	10.1	11.5	11.1	13.8	12	16.2	12.9	16.8	3.1	7.4
2.	Polythene bag		12.1	11.1	11.7	12.4	11.2	13.9	12.5	15.8	2.6	6.0
3.	Metal bin		10.7	11.0	10.8	12.3	11.5	12.8	11.8	14.9	1.8	5.5
4.	Stainless steel air tight container		10.1	11.9	10.9	13.4	11.8	16.8	12.6	16.2	2.7	7.2
<b>Green gram</b>												
1.	Gunny bag	10.9	12.1	12.0	13.2	13.8	13.4	14.2	13.8	15.7	3.3	5.6
2.	Polythene bag		11.0	11.2	11.2	12.7	12.2	14.4	12.9	15.2	2.2	5.1
3.	Metal bin		10.9	11.9	10.7	12.8	11.7	13.2	11.8	14.7	1.0	4.4
4.	Stainless steel air tight container		11.2	12	11.8	12.9	12.7	14.3	13.2	15.4	2.6	5.3
<b>Red gram</b>												
1.	Gunny bag	11.2	11.9	13.2	12.3	14.1	12.5	15.9	13.5	16.4	2.6	6.2
2.	Polythehe bag		11.7	12.1	11.9	13.7	12.1	14.8	12.8	15.8	1.8	5.5
3.	Metal bin		11.2	11.9	11.2	13.2	11.9	14.7	12.1	15.0	1.0	4.4
4.	Stainless steel airtight container		11.7	12.0	12.0	14.7	12.2	15.0	13.2	15.9	2.3	5.5

\* Room Relative humidity

\*\* Room Temperatu

PERCENTAGE OF WEEVILIZATION

S. No.	Name of the food grains	Percentage of weevilization							
		Scientific storage practices				Traditional storage practices			
		3 month	6 month	9 month	one year	3 month	6 month	9 month	one year
<b>Paddy</b>									
1.	Gunny bag	Nil	Nil	0.2	2.4	0.8	2.3	3.2	6.7
2.	Polythene bag	Nil	Nil	0.2	1.5	0.1	1.8	3.4	6.2
3.	Metal bin	Nil	Nil	0.05	0.8	1.9	2.5	2.8	4.8
4.	Pathayam	1.2	1.7	2.0	3.9	4.3	6.5	7.2	10.5
5.	Kalangiyam	1.5	1.8	2.1	4.2	2.1	3.4	5.2	10.9
<b>Ragi</b>									
1.	Gunny bag	Nil	Nil	0.3	2.2	2.0	3.0	3.8	5.6
2.	Polythene bag	Nil	Nil	0.1	1.6	1.9	2.3	3.5	5.2
3.	Metal bin	Nil	Nil	0.1	1.5	1.8	3.2	3.5	5.0
4.	Pathayam	1.0	1.8	2.2	3.5	5.8	7.0	8.0	10.1
5.	Kalangiyam	1.8	2.2	3.1	3.9	2.3	3.3	4.8	7.3
<b>Jowar</b>									
1.	Gunny bag	Nil	Nil	0.2	1.8	3.0	3.2	3.9	5.8
2.	Polythene bag	Nil	Nil	0.2	1.7	2.2	4.0	4.8	5.9
3.	Metal bin	Nil	Nil	0.1	0.9	1.5	4.0	4.8	5.2
4.	Pathayam	1.7	1.9	2.1	0.5	3.1	4.2	5.6	7.9
5.	Kalangiyam	1.2	2.1	3.0	4.2	2.4	3.2	4.3	8.3
<b>Maize</b>									
1.	Gunny bag	Nil	Nil	0.4	2.4	4.0	4.0	5.0	7.2
2.	Polythene bag	Nil	Nil	0.1	1.3	1.8	4.3	5.9	6.5
3.	Metal bin	Nil	Nil	0.1	1.0	2.0	3.8	4.5	5.3
4.	Pathayam	1.4	1.8	1.9	3.1	2.2	4.2	5.9	7.3
5.	Kalangiyam	1.1	1.8	2.8	4.1	2.2	3.1	4.1	8.0
<b>Bajra</b>									
1.	Gunny bag	Nil	Nil	0.2	3.7	5.0	5.0	6.0	7.8
2.	Polythene bag	Nil	Nil	1.2	2.3	1.8	5.3	5.9	6.9
3.	Metal bin	Nil	Nil	0.15	1.7	1.9	4.2	5.4	6.7
4.	Pathayam	1.2	1.3	1.5	3.5	4.8	6.1	7.1	10.2
5.	Kalangiyam'	1.5	1.9	2.5	3.8	2.9	3.9	6.0	.8
<b>Black gram</b>									
1.	Gunny bag	0.1	1.2	1.6	3.4	3.8	4	4.2	8.2
2.	Polythene bag	0.4	0.9	2.0	2.7	4.5	5.2	5.8	8.9
3.	Metal bin	0.3	0.4	1.0	1.8	2.0	3.8	4.8	7.9
4.	Stainless steel air tight container	0.9	1.2	1.6	3.2	4.3	5.8	7.2	10.2
<b>Green gram</b>									
1.	Gunny bag	0.4	1.7	2.0	2.7	6.5	7	7.8	10.9
2.	Polythene bag	Nil	0.3	1.8	2.3	2.8	4.2	7.2	10.8
3.	Metal bin	Nil	1.0	1.5	2.0	1.9	5.8	6.8	7.9
4.	Stainless steel air tight container	0.1	0.3	1.8	2.5	2.7	3.8	5.8	10.7
<b>Red gram</b>									
1.	Gunny bag	0.3	1.4	1.9	3.2	4.0	4.8	5.0	13.8
2.	Polythene bag	0.4	1.2	1.3	2.3	1.8	3.0	4.7	12.1
3.	Metal bin	Nil	1.0	1.2	2.1	1.2	3.0	4.2	8.9
4.	Stainless steel air tight container	0.4	1.0	1.4	2.8	3.9	4.7	5.2	12.9

GERMINATION PERCENTAGE

S No.	Name of the food grains	Percentage of germination							
		With adop- tion of scientific storage method Germination after 3 months	Without adoption scientific storage method	With adop- tion of scientific storage method Germination after 6 months	Without adoption scientific storage method	With adop- tion of scientific storage method Germination after 9 months	Without adoption scientific storage method	With adop- tion of scientific storage method Germination after One year	Without adoption o scientific storage method
<u>Pady</u>									
	Gunny bag	93.7	90.1	95.8	92.0	92.1	90.1	99.0	85.3
	Polythene bag	94.3	91.1	94.9	89.0	94.0	89.2	90.0	82.1
	Metal bin	98.0	94.0	98.9	92.1	96.0	91.0	93.1	87.5
	Pathayam	92.7	92.2	90.0	90.9	89.2	87.0	85.1	82.3
	Kalangiyam	94.6	91.4	91.8	89.7	90.2	87.0	81.2	79.4
<u>Ragi</u>									
	Gunny bag	91.8	90.1	90.1	87.2	87.7	85.0	82.2	78.1
	Polythene bag	92.7	92.0	92.0	91.0	91.1	90.1	86.8	83.0
	Metal bin	95.0	90.0	94.0	90.0	92.8	90.0	90.7	87.0
	Pathayam	90.9	89.0	97.2	87.1	85.2	85.4	82.3	81.0
	Kalangiyam	92.3	91.2	92.1	90.5	89.3	87.0	80.7	82.0
<u>Jowar</u>									
	Gunny bag	92.7	90.1	92.3	87.3	90.1	85.0	87.1	78.2
	Polythene bag	96.6	92.2	96.2	91.1	96.0	91.0	89.2	87.1
	Metal bin	97.8	95.4	96.5	92.3	96.0	92.0	89.1	89.2
	Pathayam	92.9	90.9	90.3	90.4	90.1	86	82.0	79.0
	Kalangiyam	93.0	91.2	92.1	90.2	90.1	87.0	83.0	80.0
<u>Maize</u>									
	Gunny bag	92.0	89.1	90.9	87.1	90.5	80.0	79.1	62.0
	Polythene bag	95.3	92.3	95.5	92.3	95.1	92.0	82.2	83.1
	Metal bin	96.2	93.0	96.5	92.1	96.3	92.5	87.2	84.2
	Pathayam	92.0	92.0	90.6	90.0	87.1	86.0	72.0	79.0
	Kalangiyam	91.0	90.0	90.2	90.0	91.2	80.7	79.1	61.0
<u>Bajra</u>									
	Gunny bag	93.2	92.2	93.8	91.1	93.1	90.0	81.2	71.0
	Polythene bag	95.3	90.4	94.7	87.1	94.0	85.0	79.1	68.0
	Metal bin	97.0	96.0	96.6	92.2	95.0	90.2	87.1	72.2
	Pathayam	90.7	87.0	87.7	86.0	85.0	80.1	72.2	67.0
	Kalangiyam	90.5	90.5	88.2	87.0	82.1	73.0	60.1	61.0
<u>Pulses - Black gram</u>									
	Gunny bag	89.2	87.1	89.1	87.1	84.7	80.0	78.0	73.1
	Polythene bag	87.3	85.3	86.0	85.2	85.0	82.0	82.2	77.1
	Metal bin	90.0	84.0	90.0	83.0	90.0	83.0	87.1	79.2
	Stainless steel air tight container	90.0	81.0	87.2	80.0	85.1	80.2	79.1	75.2
<u>Green gram</u>									
	Gunny bag	92.0	83.0	90.1	81.2	91.1	80.1	87.2	69.0
	Polythene bag	93.3	87.0	93.2	85.3	93.0	82.0	91.1	73.0
	Metal bin	95.2	92.2	95.0	90.0	94.1	89.0	92.2	77.0
	Stainless steel air tight container	92.1	87.1	92.0	85.0	91.0	83.2	88.1	72.1
<u>Red gram</u>									
	Gunny bag	99.2	84.2	85.0	84.2	82.0	81.2	79.0	68.1
	Polythene bag	87.3	83.3	87.0	80.3	87.1	80.1	85.0	71.1
	Metal bin	92.5	87.1	92.0	85.0	92.2	82.3	90.1	73.2
	Stainless steel air tight container	92.0	93.0	91.0	81.0	90.1	80.1	89.1	78

## PROTIEN, FIBER AND ENERGY CONTENT OF STORED FOOD GRAINS

Storage devices	Initial	ST	Protein (g)			Fibre (g)					Energy (K.cals)				
			P	T	P	Initial	ST	P	T	P	Initial	ST	P	T	P
<b>Gunny bag</b>															
Paddy	7.3	7.2	99	6.1	84	0.2	0.1	50	0.1	50	344	306	89	272	79
Ragi	7.3	7.3	100	6.3	86	3.6	3.0	83	1.0	28	326	297	91	231	71
Jowar	10.4	10.3	99	8.5	82	1.6	1.3	81	1.0	63	347	319	92	267	77
Maize	11.1	10.8	99	8.2	74	2.7	2.2	81	1.7	63	343	312	91	250	73
Bajra	11.6	10.8	93	9.4	81	1.2	1.2	100	1.0	83	360	320	89	259	72
Blackgram	24.0	21.0	88	18.2	76	0.9	0.4	44	0.1	11	346	308	89	273	79
Greengram	24.0	21.0	88	16.0	67	4.1	2.3	56	2.0	49	333	303	91	260	78
Redgram	22.6	20.6	91	18.6	82	1.5	1.0	67	0.8	53	330	320	97	234	71
<b>Polythene bag</b>															
Paddy	7.3	7.2	99	6.0	82	0.2	0.1	50	0.1	50	344	316	92	286	83
Ragi	7.3	7.3	100	6.4	88	3.6	2.9	81	2.2	61	326	323	99	290	89
Jowar	10.4	10.4	100	8.3	80	1.6	1.6	100	0.9	56	347	312	90	281	81
Maize	11.1	10.1	100	8.8	79	2.7	2.0	74	1.8	67	343	326	95	281	82
Bajra	11.6	11.4	98	9.8	84	1.2	1.2	100	1.0	83	360	331	92	281	78
Blackgram	24.0	21.2	88	19.0	79	0.9	0.5	56	0.4	44	346	329	95	266	77
Greengram	24.0	21.3	89	16.8	70	4.1	3.5	85	3.3	80	333	310	93	296	89
Redgram	22.6	21.4	95	19.4	85	1.5	1.0	67	0.8	53	330	300	01	281	82
<b>Metalbin</b>															
Paddy	7.3	7.3	100	6.5	89	0.2	0.2	100	0.1	55	344	337	98	279	81
Ragi	7.3	7.3	100	7.2	99	3.6	3.6	100	1.9	53	326	316	97	264	81
Jowar	10.4	10.3	99	9.3	89	1.6	1.5	94	1.2	75	347	344	99	295	85
Maize	11.1	11.1	100	11.0	99	2.7	2.6	96	2.2	81	343	100	100	281	82
Bajra	11.6	11.6	100	10.6	91	1.2	1.2	100	1.0	83	360	353	98	392	81
Blackgram	24.0	22.2	95	21.5	90	0.9	0.8	89	0.4	44	346	329	95	392	81
Greengram	24.0	22.0	92	18.2	76	4.1	3.8	93	3.3	80	333	309	92	296	89
Redgram	22.6	21.6	96	20.4	90	1.5	1.0	67	0.8	53	330	307	93	290	88
<b>Pathayam</b>															
Paddy	7.3	6.1	84	5.8	79	0.2	0.1	50	0.1	50	344	244	71	224	65
Ragi	7.3	6.2	85	5.9	81	3.6	2.6	72	1.7	47	326	258	79	202	62
Jowar	10.4	8.5	82	7.1	68	1.6	1.2	75	0.8	50	347	271	78	201	58
Maize	11.1	8.9	80	7.2	65	2.7	1.6	59	1.4	52	343	271	79	209	61
Bajra	11.6	8.4	72	7.6	66	1.2	0.9	75	0.8	67	360	292	81	245	68
<b>Kalangiyam</b>															
Paddy	7.3	6.0	82	5.9	81	0.2	0.1	50	0.1	50	344	272	79	244	71
Ragi	7.3	6.0	82	5.5	75	3.6	2.6	72	1.7	47	326	264	81	202	62
Jowar	10.4	8.5	82	7.4	71	1.6	1.2	75	0.7	44	347	309	89	212	61
Maize	11.1	8.1	73	6.7	60	2.7	1.4	52	1.2	44	343	244	71	202	59
Bajra	11.6	8.0	69	7.3	63	1.2	0.9	75	0.8	67	360	277	77	187	52
<b>Airtight stainlesssteelbin</b>															
Blackgram	24.0	21.8	91	20.7	86	0.9	0.7	78	0.4	44	346	311	90	173	50
Greengram	24.0	21.0	88	17.7	74	4.1	4.0	98	3.5	85	336	306	91	205	61
Redgram	22.6	21.9	97	19.6	87	1.5	1.0	67	0.9	60	330	300	91	238	72

## IRON, CALCIUM AND PHOSPHORUS CONTENT OF STORED FOODS GRAINS

Storage devices	Iron (mg)					Calcium (mg)					Phosphorus (mg)				
	Initial	Adoption	Percentage	Non-adoption	Percentage	Initial	Adoption	Percentage	Non-adoption	Percentage	Initial	Adoption	Percentage	Non-adoption	Percentage
<b>Gunny bag</b>															
Paddy	3.8	2.8	90	2.2	71	10	10	100	9.2	92	160	158	99	150	94
Ragi	3.9	3.4	87	2.7	69	344	344	100	314	91	283	273	96	231	82
Jowar	4.1	2.9	71	1.0	24	25	15	60	14	56	222	220	99	209	94
Maize	2.3	1.3	56	1.0	43	10	10	100	9.8	98	248	344	99	320	92
Bajra	12.8	12.2	95	12	94	42	33	79	30	71	296	291	98	291	98
Black gram	3.8	3.1	82	2.3	61	154	130	84	121	79	385	348	90	300	78
Green gram	4.4	3.5	80	1.2	27	124	122	98	117	94	326	321	98	308	94
Red gram	2.7	1.9	70	1.8	67	73	71	97	68	93	304	293	96	274	90
<b>Polythenbag</b>															
Paddy	3.1	2.9	94	2.1	68	10	10	100	9.1	91	160	155	97	145	91
Ragi	3.9	3.6	92	2.8	82	344	344	100	327	94	283	281	99	213	75
Jowar	4.1	3.7	90	1.0	24	25	22	88	10	40	222	220	99	208	94
Maize	2.3	2.1	91	1.8	78	10	10	100	9.7	100	348	345	99	218	63
Bajra	12.8	12.2	95	12.0	94	42	33	79	30	71	296	291	98	291	98
Black gram	3.8	3.0	79	2.5	66	154	131	85	124	81	385	365	92	335	87
Green gram	4.4	3.8	86	1.8	41	124	123	99	115	93	326	326	100	314	96
Red gram	2.7	2.3	85	1.9	70	73	71	97	68	93	304	293	96	274	90
<b>Metalbin</b>															
Paddy	3.1	3.0	97	2.7	87	10	10	100	9.5	95	160	160	100	151	94
Ragi	3.9	3.9	100	3.0	77	344	344	100	342	99	283	283	100	220	78
Jowar	4.1	4.1	100	1.3	32	25	24	96	17	68	222	222	100	210	94
Maize	2.3	2.3	100	1.4	61	10	19	100	9.4	94	348	348	100	330	95
Bajra	12.8	12.6	98	12	94	42	42	100	35	83	296	296	100	296	100
Black gram	3.8	3.0	87	2.6	68	154	130	84	126	82	385	375	97	334	87
Green gram	4.4	4.4	100	2.4	55	124	124	100	123	99	326	325	100	321	98
Red gram	2.7	2.6	96	2.1	78	73	72	98	69	95	304	304	100	297	98
<b>Pathayam</b>															
Paddy	3.1	2.1	68	1.3	42	10	9.8	98	9.1	91	160	134	84	131	82
Ragi	3.9	2.4	62	2.1	54	344	314	91	279	81	283	258	91	208	73
Jowar	4.1	2.2	54	0.9	22	25	10	40	9.0	36	222	210	95	183	82
Maize	2.3	0.6	26	0.1	4	10	10	100	9.0	90	348	320	92	305	88
Bajra	12.8	10.3	80	10.2	80	42	28	67	21	50	296	265	90	260	88
<b>Kalangiyam</b>															
Paddy	3.1	2.1	68	2.0	65	10	10	100	9.0	90	160	148	93	131	82
Ragi	3.9	2.2	56	2.2	56	344	311	90	285	83	283	243	86	196	62
Jowar	4.1	1.7	41	0.7	17	25	8.0	32	7.0	28	222	205	92	194	87
Maize	2.3	0.8	35	0.5	22	10	7.0	70	7.0	70	348	295	85	280	80
Bajra	12.8	9.8	77	9.7	76	42	27	64	26	62	296	276	93	267	90
<b>Airtight stainless steel bin</b>															
Black gram	3.8	3.2	84	2.7	71	154	132	86	128	83	385	377	98	339	88
Green gram	4.4	4.3	98	3.2	73	124	122	98	118	95	326	320	98	318	98
Red gram	2.7	2.4	89	2.0	74	73	71	92	70	96	304	277	91	255	84

## GIST OF ENGLISH VERSION OF THE PAMPHLET DISTRIBUTED DURING

### THE TRAINING PROGRAMME

#### REDUCING POST HARVEST GRAIN LOSSES

Food grain production in the world is not keeping pace with the increase in human population. The food grain problem will become more acute by the end of the current century when double of the present population may have to be fed in the world. During the last four decades, the agricultural production in India has increased from 50.8 million tonnes to 190 million tonnes.

#### Post Harvest Grain Losses

Eventhough the Food Grain production has increased, there were still lossess during storage, processing, transportation etc., and these losses amount to the following figures.

Threshing yards	1.68%
Transportation	0.15%
Processing	0.92%
Rodents	2.55%
Insects	2.55%
Moisture	0.68%
Birds	0.85%
Total	9.33%

The degree and extent of post harvest food grain losses is now a matter of great concern throughout the world including India. In villages, these food grain losses are much more where 70 per cent of total production of food grains are stored by farmers in their traditional grain storage structures. These traditional storage structures are made of locally available materials like bamboo, paddy straw, burnt clay, mud and reeds. Huge quantities of food grains are damaged by moisture, rats, insects and miro-organisms (storage fungi). These are neither moisture or rat proof nor fumigation worthy. Besides this, farmers are not aware about the simple techiques on scientific storage of food grains.

#### Factors Causing Post Harvest Grain Losses

The various causes of post harvest food grain losses are physical factors (temperature and relative humidity, mechanical factors (more of storage and transportation) and biological factors (insects, rats, birds and storage fungi). Temperature and moisture are two importance factors which play an important role in storage of food grains. High temperature and high humidity are deterrmental to stotred food grains.

## **Reducing Post Harvest Food Grain Losses**

Multi dimensional approaches are required to be made to minimise post harvest food grain losses.

Post harvest loss of food grain is highest in storage (7 to 10%) hence great emphasis has been given to prevent storage losses.

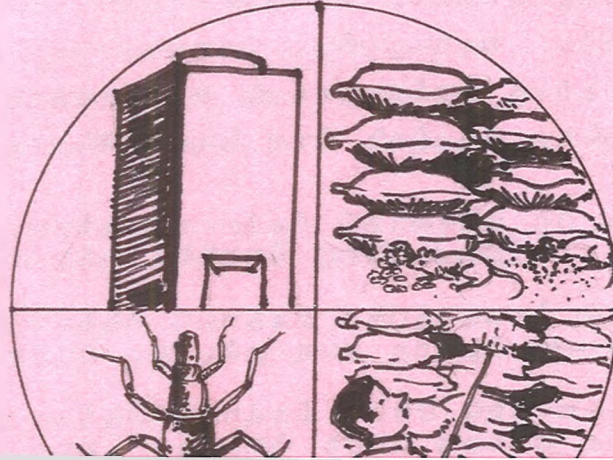
Five golden rules to prevent grain losses during storage are as follows:

- a. Drying of food grains upto 12% moisture content and proper cleaning of grains to remove inner materials.
- b. Proper maintenance, cleaning and disinfecting the storage structures and godowns.
- c. Preventing moisture absorption by grains by placing storage structures and godowns.
- d. Preventing heat formation in storage structures and godowns, by storing food grains in dry, cool and well ventilated place.
- e. Preventing stored grains from insects and rodent attacks by using fumigants.

வயலில் எலிகளின் தொல்லை யா  
ஏ.எல்.பி. மாத்திரை  
உபயோகியுங்கள்

APPENDIX - V  
READING MATERIALS (PAMPHLETS) DISTRIBUTED DURING  
THE TRAINING PROGRAMME

விளைந்த தானியத்தை வீணாகாமல்  
பாதுகாப்போம்



## APPENDIX -VI

### KNOWLEDGE INVENTORY TO TEST THE KNOWLEDGE OF LEADERS BEFORE AND AFTER TRAINING

Before  
Training

Knowledge Statement

After Training

#### A. Operations involved in post harvest technology

What are the operations involved in P.H.T.?

1. Threshing
2. Winnowing
3. Drying
4. Bagging or placing threshed grain in other containers or just keeping inside the room
5. Transport from field to storage structure
6. Storage

#### Causes of grain spoilage

7. Moisture and fungus
8. Insects-pests
9. Rodents

#### EFFECT OF MOISTURE AND FUNGUS ON GRAINS

10. Reduce quantity
11. Change in taste and flavour
12. Reduce marketability of grains
13. Make the grain unhygienic

#### SAFEGUARDING GRAINS FROM MOISTURE AND FUNGUS

14. Dry the grains properly before storing it
15. Floor of the store house should be pucca and there should no leakage during rainy season
16. Spread the bamboo mats or polythene sheet iron plank on the floor, while storing grains in the gunny bag
17. Grains spoiled due to water should not be stored with other grains

## INSECTS INFESTATION ON GRAINS

18. Lesser grain borer
19. Pulse beetle (Dhora)
20. Khapra beetle
21. Flour beetle
22. Rice weevil
23. Rice moth
24. Any other

NAMES OF INSECTICIDES AND FUMIGANTS  
FOR CONTROLLING THESE INSECTS**Insecticides:**

25. Emulsion melathion
26. B.H.C. dust

**Fumigants:**

27. Celphos tablet
28. Ethyle dibromide ampules
29. Emulsion malathion

WELL CLEANED STORE SHOULD BE DISINFEST WITH 0.5 PER CENT MELATHION EMULSION. (ONE PART MELATHION 50 E.C. IN 100 PER CENT OF WATER

30. Old gunny bags should be disinfest by dipping them into 0.1 per cent melathion for 10 minutes and then dry them in shade before use
31. Mix 5 per cent melathion in 250 gms/quintal grain meant for seed. DDT or BHC dust should never be mixed with grains to be used as seed.

**Celphose tablet**

32. Use one tablet of celphose for one ton grains. After applying the fumigants keep the store closed for 7 days. Use this tablet in those store which are air tight
33. **Ethylene Dipromide Ampole:**

Break the ampoul slightly in the storage structures. After that stores kuthir as and metal bins should be air tight atleast for 7 days after fumigation

PRECAUTIONS TO BE TAKEN WHILE USING THESE INSECTICIDE AND FUMIGANTS?

**Insecticides:**

34. Keep the insecticides at the time when it is to be used
35. Always mix the insecticide with wooden spoon
36. Deep burry the utensils in which insecticides are prepared
37. Wash the hands with soap after using these insecticides
38. Wash the grains before consumption

Before  
training

Knowledge Statement

After training

**Fumigants:**

- 39. Break the ampoule slightly so that it may not come in contact with body parts
- 40. Avoid fumigation in living rooms because it may be dangerous
- 41. Handle all these fumigants carefully as these are deadly poisonous
- 42. Fumigants grains should be aired properly before using it

**PROBLEMS IN THE USE OF INSECTICIDES AND FUMIGANTS**

- 43. Lack of technical know-how
- 44. Non-availability of insecticides and fumigants
- 45. It is very difficult to keep the store air tight as there is no separate storage structure
- 46. Every time washing of grains is required before consumption
- 47. There is no tradition of using these insecticides and fumigants

**NATURE OF DAMAGE BY RODENTS**

- 48. Makes the grain unhygienic
- 49. Reduces the quantity
- 50. Reduces the marketability
- 51. Reduces the germination power

**METHODS OF CONTROLLING RODENTS**

- 52. Proofing
- 53. Trapping
- 54. Poison

**PLEASE NAME THE POISON USED FOR RODENT CONTROL:**

- 55. Aluminium phosphide
- 56. Anticoagulants (Roban)
- 57. Zinc phosphide (for 100 gm feed).
- 58. Do you know the method of using of all these poison

**METHODS OF SCIENTIFIC GRAIN STORAGE**

**Before storage**

- 59. Stores are white washed before storage
- 60. Cleaning and plastering of stores
- 61. All the cracks, crevice, holes, existing in the floors, walls, ceiling are closed with cement and levelled permanently
- 62. Disinfest the stores by spraying malathion on walls, floor and ceiling (one part of malathion 50 EL in 500 part of water).

Before  
training

Knowledge Statement

After training

During storage:

63. Proper stocking of bags, as it helps in grain protection
64. Stores are kept rat proof and moisture proof
65. Use new bags. Disinfest old bags by dipping in malathion emulsion for 10 minutes and dry in shade. (One part of malathion . 0 parts of water).
66. Never store old grains with new grains. As far as possible process the old grains into flour
  
67. Mixed sand/Ash
  
68. Mixing of neem leaves

**After storage**

69. Doors and windows of godowns are kept closed during rainy season
70. Treating the grains with insecticides in case of spoilage
71. Making the store air tight

**Do you know the advantage os safe grain storage?**

72. Quality is good
73. No loss in quantity
74. Better seed for next sowing
75. No change in taste and flavour
76. Nutritive value cannot be degraded
77. Income is increased
78. Time saving
79. Energy saving
80. Money saving

## KNOWLEDGE GAINED BY THE LEADERS THROUGH TRAINING ON SCIENTIFIC STORAGE PRACTICES

Aspects	Anaimalaiblock									Thondamuthur block								
	Marginal (13)			Small (13)			Large (13)			Marginal (13)			Small (13)			Large (13)		
	B	A	t	B	A	t	B	A	t	B	A	t	B	A	t	B	A	t
Operations involved in post harvest technology	8.50+	23.84+	3.88	10.00+	12.66+	2.70	10.33+	13.00+	4.33	10.83+	16.16+	8.00	13.16+	16.00+	4.02	15.00+	16.50+	2.42
Causes of grain spoilage	2.94	0.40		2.28	0.51		1.50	0		1.94	1.16		2.04	0.84		2.09	0.83	
Effect of moisture and fungus on grains	7.33+	12.66+	3.67	7.66	12.33+	6.99	10.33+	12.66+	1.94	12.66+	16.66+	3.46	12.00+	16.66+	13.99	13.00+	16.66+	4.15
Safeguarding grains from moisture and fungus	2.51	0.57		1.52	0.57		2.30	0.57		1.52	0.57		1.00	0.57		1.00	0.57	
Insect infestation in grain	9.00+	12.75+	4.39	10.25+	12.75+	8.66	12.50+	13.00+	1.73	15.00+	17.00+	2.82	15.50+	17.00+	2.32	14.75+	17.00+	3.00
Insecticides and fumigants	1.41	0.50		0.50	0.50		0.57	0		1.41	0		1.29	0		1.50	0	
Precautions in using i. Insecticides	9.50+	12.50+	2.44	11.00+	13.00+	2.19	11.50+	13.00+	1.73	14.25+	17.00+	1.77	15.00+	17.00+	4.89	16.75+	17.00+	1.00
ii. Fumigants	2.88	0.57		1.82	0		1.73	0		3.09	0		0.81	0		0.50	0	
Problems in the use of insecticides and fumigants	7.71+	12.00+	4.53	8.71+	12.71+	3.01	10.57+	13.00+	2.79	13.17+	16.42+	3.99	13.71+	16.42+	2.40	14.42+	16.85+	2.38
Nature of damage by rodents	3.77	1.41		3.98	0.48		2.29	0		2.07	1.11		3.25	0.53		2.99	0.37	
Methods of controlling rodents	4.12+	12.12+	13.38	6.75+	12.50+	8.20	9.00+	12.87+	4.32	9.37+	16.00+	5.47	13.37+	16.62+	3.20	13.25+	17.00+	3.52
Poison used for rodent control	1.45	0.64		2.31	0.53		2.67	0.35		4.13	1.19		3.15	0.74		3.01	0	
Advantages of scientifically stored grains	5.33+	12.66+	5.71	5.83+	13.00+	5.11	8.00+	13.00+	2.95	8.33+	15.83+	8.47	10.66+	17.00+	5.04	11.66+	16.83+	2.79
Before storage	3.20	0.51		3.43	0		4.14	0		3.38	1.85		3.07	0		4.67	0.40	
During storage	8.20+	12.40+	7.20	9.80+	12.00+	2.75	11.40+	12.80+	1.87	11.40+	16.20+	12.82	14.00+	16.00+	2.98	14.80+	16.60+	2.44
After storage	1.92	0.89		2.16	0.83		1.51	0.44		1.14	0.83		2.12	0.54		1.48	0.54	
Scientific storage	6.20+	12.20+	4.47	4.20+	12.40+	4.48	10.00+	12.80+	4.80	12.80+	16.00+	4.35	13.40+	16.60+	3.71	13.20+	16.40+	3.71
Before storage	3.34	0.83		4.38	0.89		1.58	0.44		0.83	1.73		2.07	0.54		2.16	0.54	
During storage	5.33+	11.66+	2.89	5.33+	12.66+	3.14	9.66+	12.00+	3.49	13.00+	16.00+	5.19	12.00+	15.66+	4.15	13.33+	16.66+	2.77
After storage	4.93	1.52		4.16	0.57		0.57	1.00		1.00	1.73		1.00	1.54		2.30	0.57	
Advantages of scientifically stored grains	11.00+	13.00+	3.46	11.33+	13.00+	4.99	12.00+	13.00+	1.73	11.00+	17.00+	10.39	12.33	17.00+	5.29	11.00+	17.00+	10.39
Before storage	1.00	0		0.57	0		1.00	0		1.00	0		1.52	0		1.00	0	
During storage	3.49+	11.60+	10.24	7.60+	12.60+	4.38	9.40+	13.00+	2.25	10.60+	17.00+	4.16	11.20+	17.00+	3.27	12.20+	17.00+	4.70
After storage	1.94	1.51		3.54	0.54		3.57	0		3.43	0		3.96	0		2.28	0	
Advantages of scientifically stored grains	8.00+	12.75+	4.60	11.25+	12.75+	5.19	11.75+	12.75+	1.41	12.50+	16.75+	3.23	15.00+	17.00+	2.19	16.25+	17.00+	1.56
Before storage	2.16	0.56		0.50	0.50		1.89	0.50		2.38	0.50		1.82	0		0.95	0	
During storage	9.00+	12.28+	2.67	10.57+	12.71+	1.87	11.28+	13.00+	1.51	12.14+	15.42+	2.80	12.42+	16.14+	3.12	13.71+	16.28+	2.27
After storage	3.69	1.11		3.15	0.48		2.98	0		4.29	2.07		3.99	1.46		3.45	1.25	
Advantages of scientifically stored grains	8.66+	12.66+	3.46	11.00+	13.00+	3.46	12.00+	13.00+	1.73	14.00+	16.66+	2.21	16.00+	17.00+	1.73	16.66+	17.00+	1.00
Before storage	2.48	0.57		1.00	0		1.00	0		2.00	0.57		1.00	0		0.57	0	
During storage	11.14+	12.71+	3.26	12.00+	13.00+	4.58	12.57+	13.00+	2.12	13.57+	16.85+	6.13	14.71+	17.00+	4.82	15.71+	17.00+	3.57
After storage	1.34	0.48		0.57	0		0.53	0		1.51	0.37		1.25	0		0.95	0	

## APPENDIX VII

### ATTITUDE SCALE USED PRIOR TO AND AFTER THE TRAINING PROGRAMME

S.No	Statements	SF	F	N	UF	SU
1	One should continue using traditional procedure of storage as cost involved is very low	1	2	3	4	5
2.	One should continue using traditional procedure of strage as their application is easy	1	2	3	4	5
3.	One should use traditional procedure of storage is locally available	1	2	3	4	5
4.	One should continue using traditional procedure of storage as their application effect the health of children	1	2	3	4	5
5.	Traditional storage procedures demands excessive labour for the purpose of periodical cleaning of the grains	5	4	3	2	1
6.	Traditional storage procedures demands excessive time for the purpose of storing the grains	5	4	3	2	1
7.	Traditional storage methods leads to more loss of food grains	5	4	3	2	1
8.	Scientific storage fetches attractive prices in the market	5	4	3	2	1
9.	Scientific storage practices maintain the quality of the grain	5	4	3	2	1
10.	For safe and longer storage improved grain storage structures are ensured	5	4	3	2	1
11.	We should follow the scientific storage methods, the nutritive values of grains is increased	5	4	3	2	1
12.	The food grain can be damaged due to insects and would cause acute loss of food grain	5	4	3	2	1
13.	The use of chemicals deteriorates the taste of food grain thus not good for consumption purpose	1	2	3	4	5
14.	Scientific storage practices ensure the protection of grains from rodents	5	4	3	2	1
15.	Scientific storage practices ensure the protection of grains from insects and pests	5	4	3	2	1
16.	The use of chemicals helps to reduce insects infestation	5	4	3	2	1
17.	Scientific storage procedures are helpful in safe grain storage	5	4	3	2	1
18.	Scientific storage procedures ensures good quality seeds for next season	5	4	3	2	1

SF- Strongly Favourable, F-Favourable, N-Neutral, UF- Unfavourable, SU- Strongly unfavourable

VALUES OF THE STATEMENTS ON POST HARVEST TECHNOLOGY  
ANAIMALAI BLOCK

Statement	B	A	Ed	
			A-B	Ed <sup>2</sup>
		<sup>q</sup> Marginal N		
1	18	58	40	1600
2	19	61	42	1764
3	13	58	45	2025
4	58	49	-9	81
5	32	51	19	361
6	31	58	27	729
7	47	60	13	169
8	48	64	16	256
9	36	58	22	484
10	21	62	41	1681
11	56	61	5	25
12	59	65	6	36
13	15	59	44	1936
14	40	63	23	529
15	32	58	26	676
16	51	63	12	144
17	22	62	40	1600
18	16	55	39	1521
		t=6.629		
		Small		
1	25	60	35	1225
2	17	62	45	2025
3	19	63	44	1936
4	38	60	38	1444
5	36	62	26	676
6	35	52	17	284

7	49	62	13	169
8	36	60	24	576
9	38	64	26	676
10	28	63	25	625
11	58	64	6	36
12	60	65	5	25
13	17	61	44	1936
14	41	62	21	441
15	33	62	29	841
16	48	63	15	225
17	28	65	37	1369
18	18	61	43	1849

t = 8.978

**Large**

1	22	62	40	1600
2	19	64	45	2025
3	19	65	46	2116
4	30	58	28	784
5	38	55	17	289
6	40	63	23	529
7	44	63	19	361
8	42	64	22	484
9	49	63	14	196
10	30	63	14	196
11	60	65	5	25
12	62	65	3	9
13	18	62	44	1936
14	38	63	25	625
15	34	65	31	961
16	40	65	25	625
17	30	65	30	900
18	14	63	49	2401

t = 6.570

## THONDAMUTHUR BLOCK

### Marginal

1	28	76	48	2304
2	29	81	52	2704
3	18	69	51	2601
4	62	41	-21	441
5	46	81	35	1225
6	51	88	37	1369
7	56	80	24	576
8	58	82	24	576
9	46	68	22	484
10	46	72	35	1225
11	51	90	39	1521
12	51	89	38	1444
13	25	89	64	4096
14	30	66	36	1296
15	32	66	34	1156
16	61	73	12	144
17	32	84	52	2704
18	21	65	44	1936

t = 7.828

### Small

1	22	84	62	3844
2	27	82	55	3025
3	21	81	60	3600
4	38	81	43	1849
5	46	82	36	1296
6	65	90	25	625
7	52	82	30	900
8	56	80	24	576
9	58	84	26	676
10	38	73	35	1225
11	52	90	38	1444

11	52	90	38	1444
12	49	80	31	961
13	27	87	60	3600
14	28	49	21	441
15	35	72	37	1369
16	58	73	15	225
17	38	89	51	2601
18	28	74	46	2116

t = 10.81

**Large**

1	28	85	57	3249
2	28	84	56	3136
3	22	86	64	4096
4	30	88	58	3364
5	48	90	42	1764
6	58	83	25	625
7	59	83	24	576
8	52	84	32	1024
9	69	83	14	196
10	40	85	45	2025
11	51	90	39	1521
12	48	89	41	1681
13	28	88	60	3600
14	36	76	40	1600
15	38	75	37	1369
16	50	75	25	625
17	36	90	54	2916
18	22	89	67	4489

t = 11.82

APPENDIX VIII

SCIENTIFIC STEPS IN COMPUTING THE BEST PERCEIVED ATTRIBUTES  
IN THE ORDER OF IMPORTANCE

- F. Matrix:- after calculating the preferred statements the frequency table was prepared which is known as 'F' matrix. Considering rows as (i) and columns as (j) Note than (i) should greater than (j)
- P. Matrix - After F- matrix, P-matrix formula  
(P/N)was used
- Z. Matrix - Note than Z-values from the table of normal deviates Z-corresponding to proportions P of a dichotomized unit normal distribution.

**Anaimalai block**

**Marginal**

F - Matrix

	SC	PC	CC	Pr	TR
SC	13	8	7	9	10
PC	5	13	9	8	6
CC	6	4	13	7	9
PR	7	5	6	13	8
TR	3	7	4	5	13

**P.Matrix**

	SC	PC	CC	Pr	TR
SC	0.00	0.61	0.54	0.69	0.76
PC	0.39	0.00	0.69	0.61	0.46
CC	0.46	0.31	0.00	0.54	0.59
PR	0.31	0.39	0.46	0.00	0.61
TR	0.21	0.54	0.31	0.39	0.00

Mean  $\bar{X} = 0.4000$

SD = 0.2394

### Z Matrix

	SC	PC	CC	PR	TR
SC	0.00	0.87	0.58	1.20	1.50
PC	-0.04	0.00	1.20	0.91	0.25
CC	0.25	-0.37	0.00	0.58	1.20
PR	-0.37	0.04	0.25	0.00	0.87
TR	-0.66	0.58	-0.37	-0.04	0.00
Sum	-0.92	1.04	1.66	2.64	3.82
n	5	5	5	5	5
Mean	-0.164	0.208	0.332	0.529	0.764

### Small F-Matrix

SC	PC	CC	PR	TR	
SC	13	9	4	11	12
PC	4	13	8	9	11
CC	9	5	13	5	11
PR	2	4	8	13	12
TR	1	2	2	1	13

### P-Matrix

	SC	PC	CC	PR	TR
SC	0.00	0.69	0.31	0.85	0.92
PC	0.31	0.00	0.62	0.69	0.85
CC	0.69	0.38	0.00	0.38	0.85
PR	0.15	0.31	0.62	0.00	0.92
TR	0.08	0.15	0.15	0.08	0.00

Mean X = 0.4000

S.D = 0.3270