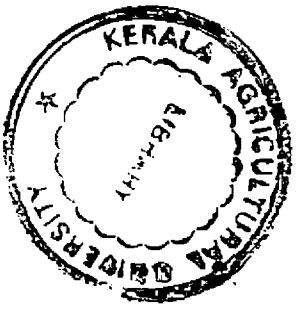
RICE SEED PRODUCTION AND DISTRIBUTION STRATEGIES IN PALAKKAD DISTRICT



By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled **"Rice Seed Production and Distribution Strategies in Palakkad District"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"Rice Seed Production and Distribution Strategies in Palakkad District"** is a record of work done independently by **Mr. Jinesh Jills George,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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20.08.2002.

Jinesh Jills George

Dedicated to the rice farmers of Palakkad

CONTENTS

ABBREVIATIONS

KAU	:	Kerala Agricultural University
TNAU	:	Tamil Nadu Agricultural University
FSS	:	Farmer Sub System
RSS	:	Research Sub System
SSSS	:	Seed Input Sub System
ESS	:	Extension Sub System
MRI	:	Matrix ranking Index
CRI	:	Constraint Ranking Index
ARI	:	Attribute Ranking Index
VRI	:	Varietal Raking Index
MSAI	:	Multi Seasonal Adaptability index
PRA	:	Participatory Rural Appraisal
PLA	:	Participatory Learning and Action
FPR	:	Farmer Participatory Research
PVS	:	Participatory Varietal Selection
PPB	:	Participatory Plant Breeding
ICAR	:	Indian Council of Agricultural Research
IRRI	:	International Rice Research Institute
NARP	:	National Agricultural Research Project
ODI	:	Overseas Development Institute
SWOT	:	Strengths, Weaknesses, Opportunities and Threats
NCAER	:	National Council of Applied Economic Research
FIB	:	Farm Information Bureau
CBD	:	Convention on Biological Diversity
PVP	:	Plant Varieties Farmers'
ADB	:	Agricultural Development Block
KB	:	*Krishibhavan*
MSL	:	Mean Sea Level
AO	:	Agricultural Officer

AA	:	Agricultural Assistant
RARS	:	Regional Agricultural Research Station
RRS	:	Rice Research Station
CRS	:	Crop Research Station
SSF	:	State Seed Farm
FGD	:	Focused Group Discussion
SSI	:	Semi Structured Interview
GPT	:	Group Participatory Technique
SSGI	:	Semi Structured Group Interview
RSGP	:	Registered Seed Growers Programme
PAO	:	Principal Agricultural Officer
NSC	:	National Seed Corporation
HYV	:	High Yielding Variety
DOA	:	Department of Agriculture
CDR	:	Complex, Diverse and Risky
FAMPAR	:	Farmer Managed Participatory Research
SDA	:	State Department of Agriculture
NGO	:	Non Governmental Organisations
PTD	:	Participatory Technology Development
DUS	:	Distinctiveness, Uniformity & Stability

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INTRODUCTION

INTRODUCTION

Listening to users is better because; users know much about
What works and what does not; users ultimately decide about
What to use and what to discard.
Probe into the user's situation; to understand the user's perspective
To prevent users from becoming losers
In the technology generation / adoption game.

-Virginia N. Sandoval

Rice is the staple food for the people of Kerala. However, the recent statistics reveal disturbing trends jeopardizing the prospects of rice cultivation in the State. Though Kerala occupies only less than two per cent (38, 864 km^2) of the total geographical area of India, it has to support a population of 3.44 per cent (2.9 million) of the country. Nationally, out of the total food grain area, 82 per cent is occupied by cereals, in which rice alone accounts for 35.1 per cent. For Kerala, the corresponding figures are 94.4 per cent and 98 per cent respectively, reflecting the importance of rice cultivation in the region. Despite all these, in Kerala, over the last five decades, the gross area under food grains, cereals and rice fell sharply by 49 per cent, 50.1 per cent and 50 per cent respectively. Nationally, the corresponding figures increased by 27 per cent, 29 per cent and 41 per cent respectively (KAU, 2002).

It is quite clear that the other states may not be able to feed the people of Kerala for a long run. Hence, for our own survival rice production has to increase at any cost. Under the present circumstances, bringing more area under rice is not practicable. The productivity of rice in the area available at present should be enhanced substantially.

It is evident that Kerala is seriously deficient in rice production. While the estimated annual requirement is 30 lakh tones, it produces only one-third of its

requirement. This deficit is increasing year after year, primarily due to the reduction in rice area arising out of large-scale conversion of paddy lands for raising cash crops or for non-agricultural purposes. Secondly, majority of rice farmers in the state feel that, rice cultivation has become less remunerative over the years when compared to other perennial cash crops, forcing them to look for other alternatives. It is estimated that in Kerala, 60 to 70 per cent of the total cost of production of rice is accounted for labour and the labour wage rates are one of the highest in the country, making rice production a less attractive enterprise.

Rice seed scenario

The supply of quality seeds by the organized seed industries is still small in majority of the developing countries including India. It is estimated that in Kerala, the public sector is able to satisfy only less than three per cent of farmers' seed requirement. It is in this context, the production and availability of quality seeds of high yielding varieties (HYVs) are gaining importance. Seed is widely accepted as a basic, critical and vital input for enhancing and stabilizing productivity and improving net monetary returns per unit area, besides other inputs and time, in a crop particularly rice. It can act as a catalyst for making other agro- inputs productive and cost effective.

Palakkad district (Kerala)

Palakkad district, the 'rice bowl' of Kerala, occupying 11.3 per cent of the total geographical area of the state, accounts for 30.5 per cent of the total rice production (KAU, 2002). When the total net rice area sown is considered, Palakkad district ranks first (32.6%) among the fourteen districts of the State. Figures from 1975 to 1998 reveal that the declining trend in rice area has been rather low in Palakkad district (34.74%) compared to the state average. Almost a similar trend was observed in rice production also, which recorded a decline of 29.85 per cent and 43.97 per cent, for the district and state respectively. The district's share of the net cultivated rice area

in the state has increased from 31.2 percent in 1975-'78 to 31.2 percent in 1997-'98. This means that the severity of the problem is less pronounced in Palakkad district.

The maximum paddy cultivation is done during *Mundakan* (2nd cropping season - 58,322 ha). Of the net rice area available in the district, about 95 per cent is cultivated during *Virippu* (1st cropping season) and 11.7 per cent during *Puncha* (3rd cropping season). *Virippu* and *Mundakan* (2nd crop) together accounts for more than 94 per cent of the total rice area in the district.

Status of productivity and seed production of rice in Palakkad district

It is a paradox that Palakkad district, the potential rice belt of Kerala, has not yet achieved the expected productivity. Although the district enjoys better soil and irrigation facilities, rice productivity is almost equal to that of the state average. Comparing the season-wise rice productivity in the district, there is not much difference between the two seasons *Virippu* and *Mundakan*. In both the seasons, the difference in productivity over the state average is only 12 to13 percent. At the state level, there has been a steady increase in rice productivity over the past 25 years. The average yield of dry paddy rose from 1542 kg/ha in 1975-76 to about 2061 kg/ha in 1998-99. (an increase by 519 kg/ha). However, in Palakkad district, rice productivity has been almost static over the same period (an increase by 152 kg/ha only).

The extent of High Yielding Variety (HYV) coverage in the district is a matter of controversy. However, the analysis of relevant statistical data proves that HYV coverage is poor in Palakkad district as compared to the state average. At the state level, the HYV coverage during *virippu* and *mundakan* seasons are 43.07 per cent and 36.71 per cent respectively, whereas for Palakkad district, the corresponding figures are rather low (21.0 % and 23.77 % respectively). The gross HYV coverage in Kerala is around 45.74 per cent whereas in Palakkad it is only 21.82 per cent. (FIB, 2000). It is worth mentioning here that our national average is far high (61.84%). Over the past one decade, there has been a slow increase in HYV coverage at the state level.

The rate of increase in HYV coverage in Palakkad district is only half that of the state, (i.e. 25.72 % and 13.78 % respectively). However, it will not be just to conclude that the HYV coverage in the district is very low. Low HYV coverage could be attributed to the non-documentation of many high yielding varieties including the non-descript strains.

Rice seed production scenario of the Palakkad district is rather grim. A study by KAU (1998) revealed that non - availability of sufficient seed material of HYVs was the main reason for the poor coverage of the same in Kerala. Bringing more area under HYVs would be a meaningful strategy for increasing the rice production. To achieve this end, the production and distribution of quality seeds are to be streamlined. Studies by Elsy *et al.* (1994) and Rosamma *et.al.* (1994) suggested that varietal attributes like quality of grain, tolerance to biotic and abiotic stress situations have a definite say on the varietal selection of rice farmers. Hence, an adequate knowledge on the varietal preferences of the rice farmers has to be gathered.

At present, there is a serious deficit of organized seed supply from seed agencies. The seed requirement of the rice farmer is only partly met by Kerala Agricultural University (KAU), State Department of Agriculture (SDA), National Seed Corporation (NSC) and Registered Seed Growers Programme (RSGP). These agencies are able to meet only a negligible portion of the farmers' requirements. Hence, a viable strategy has to be planned and implemented for the production, multiplication and distribution of Breeder, Foundation and Certified seeds in the district.

Since a comprehensive and systematic study of this nature has not been done so far in Kerala, the present investigation was designed with the following specific objectives:

i. To analyze the existing cultivar use pattern, varietal preferences and seed production and distribution status of rice in Palakkad district.

ii. To study the constraints to the production and distribution of rice seeds at different levels in Palakkad district.

iii. To streamline a viable strategy for seed production and distribution of rice cultivars in Palakkad district.

Scope of the Study.

Palakkad district alone accounts for 31 per cent of the total gross rice cropped area in the state. However, the recent rice cultivar use pattern poses several disturbing trends, threatening the scientific varietal release programme in the district. A wide and unwieldy three-dimensional spectrum of cultivars comprising of high yielding, traditional and non-descript strains and cultivars released from the neighbouring state of Tamil Nadu, have a strong hold in the district.

The present study would bring into light, the present status, constraints, quantum of requirements, inadequacies and gaps and *ipso-facto* help to workout a viable strategy for the production, multiplication and distribution of Breeder, Foundation and Certified seeds in Palakkad district. It would also highlight the Strengths, Weakness, Opportunities and Threats (SWOT) to the rice seed production and supply scenario in the district. The study would give the necessary feedback to the various seed production and distribution units namely, the KAU, SDA, NSC, RSGP, Paddy group farming samithies and Panchayat level seed production projects under the 'peoples plan', which may help to frame a better seed production and distribution strategy for the district.

The participatory 'preference evaluation' of rice cultivars included in the present study would provide ample suggestions to the plant breeders for streamlining a research agenda for rice varietal improvement to match the distinct situations, needs and preferences of farmers. It is also expected to re-orient the 'rice-extension

endeavor' to meet the specific demands of the clients, which would help choose and popularize suitable cultivars for the specific socio-economic milieu. The Participatory Rural Appraisal (PRA) / Participatory Learning and Action (PLA) tools like varietal mapping, varietal preference ranking, identification and prioritization of constraints and the qualitative interpretation of data by the stake holders comprising the Farmer Sub System (FSS), Research Sub System (RSS), Seed Input Sub System (SISS) and the Extension Sub System (ESS), is a pioneering effort in Kerala. This approach would provide valuable measuring tools and appropriate indices to analyze the data collected through various PRA techniques.

Based on the results of this study, appropriate policies, recommendations and action plans could be made to overcome the limitations in the production and distribution of quality rice seeds. The research approach and findings could also be extrapolated to other fields of farm research in general and rice growing tracts of the state and the country in particular.

Limitations of the study

This being a pioneering study so far done in Kerala, the important limitation was the dearth of sufficient literature pertaining to the rice seed production and distribution status and varietal preferences of the rice farmers of the state in general and of Palakkad district in particular. Another difficulty was the lack of standardised PRA/PLA methodology and statistical tools for analyzing the data collected through the various PLA tools, especially matrix ranking. Some 'indices' were developed specially for the study.

The present study had the limitation of time, personnel and finance. A study of this nature in much detail would require considerable amount of time, men, material and money for the researcher. However, all efforts have been taken to make the study as objective as possible. In spite of the limitations, it is expected that the findings of the present study would provide a better insight in to the present status,

constraints, quantum of requirements and gaps and *ipso- facto* would help the rice researchers, extension personnel, administrators and the policy makers, to streamline a viable strategy for the production, multiplication and distribution of rice seeds in Palakkad district.

Organisation of the study

The thesis is presented through the chapters namely, introduction, theoretical orientation, methodology, results, discussion and finally the summary and conclusion of the study, followed by reference, appendices and abstract of the thesis.

THEORETICAL ORIENTATION

THEORETICAL ORIENTATION

A review of previous research studies helps in delineating new problem areas and research priorities and provides basis for developing a theoretical framework and the methodology for the present study. In accordance with the specific objectives set, the review of literature is furnished below under the following sub-heads:

2.1 Concept of seed and seed system.

2.2 Concept of varietal preference.

2.3 Concept of varietal replacement.

2.4 Constraints to agricultural production system with special emphasis on rice seed production and distribution.

2.5 Concept of participatory research.

2.6 Concept of participatory crop improvement.

2.7 Conceptual model of the rice varietal preferences of the farmers of Palakkad district- *Virippu*

2.8 Conceptual model of the preferences of the rice varietal preferences of the farmers of Palakkad district – *Mudakan*

2.1 Concept of seed and seed system

Seed contains, in itself, the blueprint for the agrarian prosperity in incipient form. Therefore, in planning for prosperity the significance of quality seeds need no emphasis.

2.1.1 Seed quality

As quoted by Dev (1994) the essential criteria for a quality seed are: i. Trueness of the crop variety ii. Physical purity iii. Freedom from other seeds, inert materials, diseases iv. Capacity to germinate and grow into a vigorous healthy plant.

Nair (1994) defined quality seed as the seed, which is devoid of weed seeds and inert matter with at least 80 per cent moisture content.

2.1.2 Rationale for quality seed production

Joon *et al.* (1970) stated that popularisationof HYVs could be done through releasing varieties with better grain qualities.

According to Kelly (1989) the use of poor quality seed of a new variety had two major ill effects: i) The hoped for improvement in production might not materialize ii) The confidence of the farmer being affected adversely, jeopardizes the future extension of the use of improved varieties.

Girija *et al.* (1994) after citing various examples suggested that Kerala farmers were receptive for quality rice seed.

While commenting on the need for quality seed production, Gopinath (1994) argued that seed quality was a crucial factor in the way of productivity improvement of paddy in Kerala.

Pal (1975) reported that one of the major constraints limiting rice productivity was farmers' difficulty in obtaining quality seeds.

Research findings of Pal *et al.* (2000) revealed that an old rice variety BPT 5204 ('Samba Mashuri') became popular among the rice farmers of Andhra Pradesh because of its superior grain quality.

2.1.3 Seed system

Many scientists have given definitions to seed systems. (Festritzer and Kelly, 1978; Cromwell, 1992). They defined the seed system as the total of the

physical, organizational and institutional components, their actions and interactions that determine seed supply and use, in quantitative terms.

According to Muliokela, (1999) there were two distinctive, but interacting forms of national seed delivery systems in Africa viz., formal and informal seed systems.

Mekhib (1999) identified two seed systems namely, Formal and Informal. The features of the latter were inexpensive and better accessibility to all farmers. It relied more on indigenous knowledge of seed production, quality control, processing and marketing.

Pal *et al.* (2000) discussed the main characteristics of various seed production options for rice in Andhra Pradesh. Accordingly, four of them were in use viz.; Public and Private seed agencies, Seed Co-operatives and Community level Seed Programmes.

2.1.3.1 Rationale for an efficient seed system:

Kunju (1989) opined that farmers were forced to continue with traditional varieties because of the non-availability of sufficient quantity of high yielding variety seeds.

In a report submitted to the Government of Kerala, KAU (1998) pointed out the main reasons for non-adoption of High yielding Varieties (HYVs) in Kerala as: i. Non-availability of sufficient seed material ii) Lack of proper knowledge about new varieties iii) Socio-economic reasons like non-availability and high cost of labour during peak seasons limiting the adoption of HYVs and iv) Limited adaptability of HYVs to specific regions/locations.

2.1.3.2 Limitations of formal seed system

Kelly (1989) observed that in many developing countries, the State farms were not able to grow enough seed to satisfy the requirements of the farming community.

Research findings of Pal *et al.* (2000) suggested that the inefficiency in the delivery of seeds of new varieties and information about these to farmers was a major weakness found in the rice seed system of Andhra Pradesh.

2.1.3.3 Informal seed system:

Informal seed system comprises mainly of on-farm saved seeds and farmer-to-farmer seed exchange. According to Cromwell (1992) local seed sector catered to more than 80 per cent of seed requirements of farmers worldwide.

Studies of Asokan and Singh (1994) in Gujarat and Punjab have revealed that for paddy, most of the farmers used on-farm saved seeds or relied on the fellow farmers for seed supply because of the availability and surety about the quality of the seed.

The public, private and voluntary seed organizations jointly produced only less than 20 per cent of the total amount of seed required and planted in both developing and developed countries. About 60 to 70 per cent of the seed used by the farmers in Complex, Diverse, and Risky (CDR) areas in Africa was saved on-farm. (Cromwell, 1996)

Almekinders and Boef (1999) observed that 80 per cent of the seed used in developing countries were farm-produced, and on-farm production of seeds and farmer-to-farmer seed exchange were the most important means of seed supply in many countries.

2.1.3.4.1 Informal varietal dissemination: popularity of unreleased varieties

Upadhyaya (1998) noticed that some varieties of chickpea and soybean, even though not released formally were popular among the farmers.

Witcombe *et al.* (1998) reported that the potential domain of rice variety Kalinga III was more in Bihar and Madhya Pradesh, whereas in Orissa, its official area of release, its popularity was not very good.

According to Sthapit and Jarvis, (1999) farmer-to-farmer seed exchange mechanism was responsible for the wide scale dissemination of certain varieties that were never officially released. A similar development was noticed in Andhra Pradesh by Pal *et al.* (2000)\ where the seeds distributed as minikits for field-testing became popular and were used for local multiplication and diffusion among the farmers.

2.2 Concept of varietal preference

2.2.1 Importance of farmer-preferred varietal traits:

Johnson *et al.* (1970) opined that in the release of new varieties of crops, better grain quality has to be emphasized.

Ashby *et al.* (1987) found that rice farmers of small production systems have their own varietal selection and preferential criteria based on their limited resources and qualitative, economic, domestic and socio-cultural requirements.

Studies conducted by Elsy *et al.* (1994) and Rosamma *et al.* (1994) have shown that the varietal attributes like the quality of grain, biotic and abiotic stresses, low requirement of purchased inputs, reasonable yield of grain even under stress situations have a significant say on the varietal selection of the rice farmer.

Research findings of Joshi and Witcombe (1996) revealed that the farmers and their families assessed all major parameters relevant to them such as taste,

cooking quality and market value, apart from the traditional limited set of characteristics measured in plant breeder's trials before varieties were ultimately selected.

According to Sthapit *et al.* (1996) the varietal attributes like long compact drooping panicles, good grain setting, density of grain set, tillering ability and cooking and eating quality were considered decisive by farmers in their ultimate selection of varieties. He also added that 'Post harvest evaluation' was the ultimate criterion upon which the farmers either rejected or adopted the varieties.

Ahamed and Remesan (1997) reported 50 desirable varietal attributes to rice cultivars as perceived by the rice farmers and categorized and prioritised them into nine groups as follows: i. Grain yield related attributes ii. Grain quality related attributes iii. Traits related to inputs and cultivation costs iv. Multiple adaptability related attributes v. Straw yield vi. Pest and disease tolerance vii. Traits related to harvest and post harvest operations viii. Straw quality ix. Marketability and price. A comprehensive list of desirable attributes are provided in table 1.

Prema *et al.* (2000) summarized the traits preferred by the Kerala rice farmers as: i. Fast growing habit ii. Ability to withstand water stress in nursery iii. Good tillering iv. Tolerance to pest and diseases in nursery v. Tolerance to pest and diseases in main field vi. Ability to withstand water stress vii. High care not required viii. Optimum duration for first crop ix. Uniform flowering habit x. Strong and long ear head xi. Less chaff content xii. Non-lodging habit xiii. Bold grains xiv. High grain weight xv. Low shedding of grains in the field xvi. Absence of germination on ear head and on staking xvii. Easy to thresh xviii. Good quality and quantity straw xix. Marketability xx. Good taste xxi. High volume expansion xxii. Quick cooking quality

Kent and Mokuwa (2001) reported that the characteristics of farmer-preferred rice varieties were: i. High tillering ability and large panicle formation, ii. Adaptability to various soil conditions, iii High yields, iv. Tolerance/ resistance to iron toxicity,

Table. 1. Desirable varietal traits of rice cultivars as perceived by the farmers

Sl. No.	Varietal traits		
A.	**Grain yield**	**(Rank I)**	**Rank**
1	High grain yield		1
2	Stability of yield		2
3	High percentage of matured grains		3
4	Good tillering		4
5	One year head/tiller		5
6	Uniform plant growth flowering		6
7	More grains/ear head		7
8	Strong and long ear head		8
9	How shedding of grains in the add		9
10	Absence of germination on ear head and on stalking		10
11	More grain filling habit		11
B.	**Grain quality**	**(Rank II)**	**Rank**
12	Grain colour (Red)		1
13	Bold rice		2
14	High grain weight		3
15	Good taste		4
16	High volume expansion		5
17	High protein contents		6
18	Quick cooking quality		7
19	No grain discoloration if caught in rain		8
C.	**Traits related to inputs and cultivation costs**	**(Rank III)**	**Rank**
20	Less water requirement		1
21	Low fertilizer requirement		2
22	Abvailability of pure seeds		3
23	Availability of labour in time		4
24	Availability of tractor in time		5
25	Low requirement of plant protection chemicals		6
D.	**Multiple adaptability**	**(Rank IV)**	**Rank**
26	Ability to withstand water stress		1
27	Adaptability to ill drained conditions		2
28	Adaptability to less intensive management		3
29	Ability to thrive on flood situation		4
30	Short duration		5
31	Multi soil adaptability		6
32	Multi season adaptability		7
33	Adaptability to different systems of sowing and planting		8
34	Adaptability to deep clay soils		9
35	Adaptability to inferior fertile soils		10
36	Fast growing habit during initial stages when there is moisture stress		11

37	Ability to compete weeds		12
38	Tolerance to soil reactions		13
E.	**Straw yield**	**(Rank V)**	**Rank**
39	Adequate straw yield		1
40	Tall plant type		2
F.	**Pest and disease resistance**	**(Rank VI)**	**Rank**
41	Resistance to pests and diseases in all seasons and during weather fluctuations		1
42	Resistance to pests and diseases in all soil conditions		2
G.	**Traits related to harvest and post harvest operations**	**(Rank VII)**	**Rank**
43	Easy to harvest		1
44	Easy to thresh		2
45	Low hulling and milling loss		3
H.	**Straw quality**	**(Rank VIII)**	**Rank**
46	Strong calm		1
47	Non-lodging		2
I.	**Marketability and price**	**(Rank IX)**	**Rank**
48	Assumed market		1
49	High Price		2
50	High consumer preference		3

v. Quick maturity, vi. Palatability, vii. High swelling during cooking, viii. Red attractive grain colour, x. Good storage after cooking.

2.2.2 Varieties: traditional, high yielding and non-descript strains

Ceccarelli (1994) observed that landraces, though usually do not perform well under high - input conditions of research stations, were very difficult to be beaten in low - input marginal conditions.

According to Gopalakrishnan (1994) the main reason for low coverage of high yielding rice varieties in Kerala was due to the inferior milling and cooking qualities of high yielding varieties, when compared to the traditional varieties.

Cromwell (1996) pointed out that high yielding varieties did not always yield well in the Complex, Diverse and Risky (CDR) environments.

Singh (1999) in his study compared the old traditional and high yielding varieties of rice and found that the average yield of many local varieties were significantly higher than that of many high yielding varieties and that the grain-husk ratio of high yielding varieties were significantly less compared to the traditional varieties.

A study conducted by KAU (1996) in the selected villages of Palakkad district revealed that: i) The traditional tall indica varieties had a strong hold in the farmers' varietal preference, which was indicative of their having some specific advantages ii) Some non-descript varieties had overtaken the improved high yielding released genotypes, threatening the scientific varietal programme of the state. These non-descript varieties do not come under the category of traditional varieties as they have only short stature and duration, but since their pedigree was unknown, they could not be classified as high yielding varieties as well.

2.3 Concept of varietal replacement

Silvey (1981) observed that cereal yields in England and Wales increased at the rate of one per cent per annum for barely, oats, and three per cent for wheat because of the introduction of new improved varieties.

Heisey and Brennan (1989) found that the price of seeds purchased by the farmers for sowing was a less important factor when base yields were high and increases in the price of seed for sowing by farmers encouraged higher replacement by stimulating seed production and its marketing.

Byerlee and Heisey (1990) argued that if genetic gains in yield due to breeding were higher than the typical annual average of one per cent, varietal replacement proceeded more quickly.

Cuevas *et al.* (1995) opined that farmers quickly replaced old cultivars when there was a continuous supply of new superior cultivars. This phenomenon was termed as varietal replacement.

Virk (1998) concluded that non-availability of seeds of new varieties was a major constraint in the rapid adoption of new varieties and replacement of old varieties.

It was argued that new varieties of most of the crops failed to replace old ones not because they lacked superiority, but because of very slow replacement rates. As their superiority was demonstrated, new ones replaced older varieties. Witcombe *et al.* (1998) observed that IR 64 and IR 70, two rice varieties, had replaced certain popular cultivars such as IR 36 in some countries.

Delouche (1971) observed that public-private partnerships were more effective than either government seed companies or entirely private ventures in marketing certified seeds to farmers.

Studies conducted by ODI (1990) and Cromwell *et al.* (1993) identified the reasons for low utilization of certified seed by small-scale farmers in developing countries as : i. Seed, though cheap compared to other inputs, has to be bought at the beginning of the season. ii. Modern varieties require more fertilizer for good yields iii. Uncertain crop marketing arrangements and prices iv. Uncertainty in rainfall v. Transport costs for seed distribution to remote areas vi. Relative advantages in yield or quality of new varieties are uncertain or unclear vii. Ineffective extension systems that are not seed focused.

Agnihotri and Tripati (1994) suggested that adequate timely supply of seeds for location specific high yielding varieties/hybrids could be accomplished through: i. Assessing the requirements of high yielding varieties/hybrids with adequate emphasis on the varieties specific for problem areas ii. Planning and marketing arrangements for timely supply of seeds iii. Reporting the demand for the Breeder seed of the specific varieties to the concerned authorities to meet the future requirements of foundation and certified seeds iv. Planning for the production of foundation seed with the breeder seed available/ lifted and ensuring optimum utilization ratio v. Planning for effective delivery system to ensure adequate and timely availability to the farmers vi. Making early stock of the seed of the required varieties at input centres vii. Planning and arranging for the supply of short duration varieties as a contingency measure if need arises.

For streamlining seed production, processing and distribution, Gopalakrishnan (1994) suggested that seeds of location specific varieties should be produced through group farming units in each panchayat, based on the concept of 'Seed Village'.

Jaisani (1998) emphasized the need to establish a system for scientific demand forecast to help plan seed production strategy.

Pal and Joshi (1999) reported that the Indian Council of Agricultural Research had taken measures to foster public - private interface in seed production and distribution such as: i. Mechanisms for sharing resources were developed and operationalised ii. Improved private sector access to the products of public research institutions iii. Public - private joint programmes, involving the private sector's participation in policy making.

While commenting on public- private interface existing in the rice seed system of Andhra Pradesh, Pal *et al.* (2000) pointed out the inadequate attention paid by the private seed companies to promote new rice varieties. Criticism for the 'Seed Village' Programme initiated by the State Department of Agriculture, Andhra Pradesh as summarized by him were: i. Farmers' varietal preferences were not taken care of ii. Due to the lack of adequate funds, farmers were hesitant to store the seed until the next season iii. Even if the seeds were stored, there was no guarantee that all of the produce would be marketed as seeds.

2.4 Constraints to agricultural production system with special emphasis on seed production and distribution

2.4.1 Constraints: definition

Constraints in the production system constitute the basic point in the development and transfer of new technology. According to Webster's Dictionary, to constrain is to check, especially from free or easy indication or expression or to force stricture restriction or limitation imposed by the nature, oneself, circumstances, or exigencies.

Petharam (1985) called the problems and / or limitation as constraints.

According to Pandya and Trivedi (1988) constraints are "those items of difficulties or problems faced by individuals in the adoption of technology".

Gogi and Talukdar (1989) opined that constraints are those factors, which have repressive effects on a desired and / or purposive action.

Nikhade and Bhople (1989) defined constraint as the state or quality of sense of being restricted to a given course of action.

2.4.2 Classification of constraints to agricultural production systems

Classification of constraints helps to gain a comprehensive picture of the diverse problems in the way of transfer of technology and its adoption. Gomez (1977) classified the constraints to rice production as physical/biological/cultural practices: economic, institutional, social and psychological.

Menon (1983) grouped the various Socio-economic, extension and organizational constraints limiting rice production in Kerala into three groups namely. i. Economic constraints ii. Extension constraints iii. Organizational constraints.

According to Librero (1984) production constrains could be classified into biological and socio-economic constraints. The biological constraints included all farm level problems, while the socio-economic constraints comprised of knowledge, institutions, credit, input availability, economic behaviors, traditions and risk aversion.

Swaminathan (1984) classified the production constraints in rice into two categories: the first category included biological, chemical, hydrological, and pedagogical constraints. The second category of constraints was economic and social.

Bembridge (1987) grouped the production constraints in to biological, Socio-economic and institutional. The biological constraints led the farmers either to non-application or poor application of technology, whereas the socio-economic and institutional constraints prevented them from using the improved technology.

The constraints to the adoption of agricultural technology were categorized by Kothicane *et al.* (1987) as: i. Technological constraints ii. Economic constraints iii. Service & supply constraints iv. Information transfer-constraints.

Prasad *et al.* (1987) classified the constraints to agricultural production into: i. Common-basic constraints ii. Technological constraints iii. Organizational and administrative constraints iv. Extension constraints v. Economic constraints vi. Social constraints.

After reviewing the various classifications of constraints to the adoption of improved agricultural technology by Indian farmers, Nikhade and Bhople (1989) came out with a classification, which they called 'Standardized Classification of Constraints' which includes: i. Economic constraints ii. Input constraints iii. Information constraints iv. Technological constraints v. Psychological constraints vi. Infrastructural constraints vii. Situational constraints.

The review of classification of constraints to the agricultural production system indicates that most of the constraints are more or less common in all crop-growing tracts of India and elsewhere. The major groups of constraints emerged from the review could be narrowed down to the following categories. i. Common-basic constraints ii. Input constraints iii. Biological constraints iv. Socio-economic constraints v. Information constraints vi. Infrastructural constraints vii. Technological constraints viii. Psychological constraints ix. Extension constraints.

2.4.3 Constraints to the evolution and spread of new cultivars

According to Kunju (1989) the constraints to the adoption and spread of improved rice varieties as perceived by the different sub-systems were: Input Sub - System: i. Poor cooking quality of improved rice varieties. ii. Low market value of improved rice varieties. Client Sub – System: iii. High cost of labour and other inputs made farmers not to adopt improved rice varieties. iv. Poor cooking quality of

improved rice varieties. v. Under same management conditions, yield of local varieties was better than the improved rice varieties.

2.4.3.1 Research Constraints

According to Kunju (1989) the major constraints faced by the Research Sub-System in evolving and spreading of rice varieties were: i. Lack of infrastructure facilities ii. Insufficient staff strength iii. Lack of facilities to multiply seeds.

In their study Ceccarelli and Grando (1999) distinguished temporal variability, which changed the ranking of genotypes in the same location over time, from the spatial or geographical variability, which consistently changed the ranking of genotypes between different target environments. The majority of plant breeders viewed this phenomenon as a constraint and was mostly interested in avoiding the same.

2.4.3.2 Technological constraints

Agnihotri and Tripathi (1994) identified some of the major technological constraints limiting the rice production in rain fed ecosystems as: i. Lack of wider choice of high yielding varieties to fit into the different land types and growing conditions ii. Non-availability of good quality seeds of promising varieties iii. Lack of the exposure to new and promising varieties iv. Lack of appropriate management techniques.

2.4.3.3 Extension and policy constraints

Surendran (1982) in a study on the impact of operational research project in Kerala found that one of the main problems in TOT was the lack of co-ordination between the Kerala Agricultural University and the State Department of Agriculture.

According to Pal *et al.* (2000) 72 to 86 per cent of the farmers knew about the existing varieties from another farmer and that the extension system responsible for delivering the information on varieties was only less man 25 per cent.

2.4.3.4 Production constraints

Singh and Sharma (1986) identified that high cost and non-availability of high yielding variety seeds were the two important constraints to rice production.

The production constraints of rice based on the studies of various rice researchers of Kerala was summarized by Prakash (1989) which were: i. Drought in *mundakan* ii. Lack of sufficient irrigation facilities iii. Lack of good quality seeds iv. Low coverage of high yielding varieties v. Lack of varieties suited for different agro climatic regions vi. High cost of seeds vii. Non-availability and high cost of organic manures viii. High cost of labour ix. Non-availability of labour in peak seasons x. Lack of efficient input supply system xi. Lack of adequate transport facilities xii. Lack of co-ordination at government level among different departments.

In the NARP status report for the central zone of Kerala, KAU (1992) pointed out that the rice production constraints were: i. Non-availability of quality seed ii. Lack of high yielding varieties suitable for dry sowing and second crop seasons iii. Lack of high yielding varieties suitable for drought and flood prone areas iv. Inadequacy in the availability of organic manures v. Lack of suitable varieties and technology for *'Koottumundakan'* system of rice cultivation and for dry sown and ill-drained areas vi. Scarcity of labour at peak periods of agricultural operation and increasing labour wages.

Research findings of Prakash and Nair (1993) revealed that the rice production constrains faced by the rice farmers in the problem zone of Kerala as:
i. Drought ii. Low adoption of high yielding varieties iii. Non-availability of high yielding variety seeds iv. High cost of high yielding variety seeds v. Non-availability

of farmyard manure vi. High cost of farmyard manure vii. High wage rate of agricultural labour viii. Non-availability of agricultural labour ix. Low labour productivity x. Lack of storage facilities xi. Lack of marketing facilities.

Upadhyaya (1998) opined that lack of sufficient quality of seed and delay in seed supply were the constraints in seed production and dissemination in Maharashtra.

2.5 Concept of participatory research

Biggs (1989) identified the collaborative interface of two equal partners viz., researchers and farmers in participatory research.

There are many arguments that support the contention that farmers are not exposed to increased risk when involved in participatory research (Quist, 1996). This is because the farmers tend to 'test' the new material/variety on small, often inferior plots before fully adopting that particular variety.

2.5.1 Relevance and rationality of participatory approach in data collection

Participatory approaches in scientific investigations and the technique of Participatory Rural Appraisal (PRA)/Participatory Learning and Action was originally propounded and propagated by Chambers (1991). Later on, they were used by workers such as Witcombe *et al.* (1996), Joshi and Witcombe (1996), Sthapit (1996) and the like.

The advantage of PRA is the near truth result as perceived by the most members of the community. The Focused Group Discussions (FGDs), Brainstorming and Semi Structured Interviews (SSIs) could be effectively used to study the rural folks' preferences, attitudes and options. The technique also gives a face lit to the

conventional social science research by removing it from the purely academic and mystical domain into a potential resource for initiating action

According to Ahamed *et al.* (1996) the approach was extremely flexible, meaningful and joyous to the participants and researchers, provided the later believed that the people were store-houses of knowledge and had clear perception of their own needs.

2.5.1.1 Limitations of conventional surveys

Moris (1970) has criticized the formal surveys based on the problems associated with sampling, reaction of the respondents, survey staff, recording inaccuracy and the types of interview errors.

Bardhan (1989) pointed out that in conventional surveys, there could be persistent loss of information in case of ambiguities in the interpretation of terms and categories with overlapping boundaries.

Chambers (1991) opined that data collection in large questionnaire surveys could be costly, time consuming and most of the data collected lay idle without being used by anybody.

Hubert (1991) observed that formal surveys required five to seven times more working days compared to informal surveys and the time needed to publish the results were three times longer for formal surveys.

While reporting on the problems of official statistics based on surveys, Gill (1993) concluded that many of the statistics were characterized by unreality, gaps, over-aggregation, inaccuracies, mutual inconsistencies and untimely reporting and policy formulation based on such incorrect empirical data lead to wrong decision making.

Comparing the cost and time of PRA methods and conventional surveys, NCAER (1993) concluded that the cost incurred for the training of field staff and data collection for the sample survey-based study, were higher by more than one-half of the cost incurred in PRA based data collection.

2.5.1.2 Advantages of participatory approach in data collection

The research findings of Action Aid Nepal (1992), Haddad *et al.* (1993), Rajarathnam *et al.* (1993) and Malik and Richard (1994) suggested that PRA could be applied to a larger scale of inquiry and could be scaled up for large areas under consideration.

According to NCAER (1993), conventional surveys controlled the 'variance' and imparted representative character to the findings of scientific investigations where as, PRA controlled non-sampling errors from interviewer and/or respondent biases.

2.5.2 Role of social scientists in participatory crop improvement programmes

Weltzien *et al.* (2000) after analysing the various reports (Thiele *et al.* 1997; Carrasco *et al.* 1997) categorically established the role played by social science researchers in identifying and prioritizing farmers' criteria in varietal selection to improve targeting of breeding activities.

2.5.3 Need for farmer participation

Some researchers consider Farmer Participatory Approach as an empowering process as "those with a legitimate interest in the outcome of research are able to exert some influence on priorities and decisions" (Harverkort and Zeenw, 1991; Okali *et al.* 1994)

Cooper *et al.* (1992) reported the ability of farmers to carry out controlled crossing successfully.

Studies have given proof of the superiority of farmer participatory research over the conventional researcher based approach, as the technology developed through the farmer participation was better adapted to local conditions (Worade and Mekhib 1993; Prema *et al.* 2000)

ICAR (1995) in its report pointed out the need for developing appropriate research programmes through farmer participation in order to account for complexities of required knowledge involved and the ecology, as well as the social environment in which the farmers work.

Ceccarelli *et al.* (1996) and Kornegay et al. (1996) pointed out that farmers' participation was essential in varietal selection as it solved the problem of fitting a crop to a multitude of diversified target environments and farmers' preferences.

Sthapit *et al.* (1996) noted that there was a good agreement between farmers' perception of the variety and crop harvest results, when the same varieties were grown on the field and tested.

Analyzing the various research findings, Ceccarelli and Grando (1999) summarized that most farmers were significantly more efficient than the breeders in identifying the high yielding varieties, and that farmers were able to formulate suggestions about potential parents for crossing.

Pal *et al.* (2000) opined that private sector's reluctance to promote varieties for fear of rejection by the farmers could be effectively managed by ensuring farmer participation in varietal testing and release.

Weltzien *et al.* (2000), while reporting the results from a bean study in Rwanda, pointed out that the farmers had more knowledge and expertise in identifying varieties with the right trait combinations to match the needs of specific growing conditions.

2.5.4 Need for location specific varieties

Ray (1976) concluded that in West Bengal, lack of suitable varieties was an important reason for the low spread of HYV of paddy during *kharif* season.

In a study, Panikkar (1981) discussed the relevance and importance of breeding new varieties to suit local conditions and constraints.

Ahamed *et al.* (1996) stressed the need for streamlining the rice breeding strategy to evolve varieties to match the preferential traits as perceived by the farmers.

According to Witcombe *et al.* (1996) farmers' preference differed depending upon agro ecological requirements and such regional preferences were to be highlighted as breeders resorted to go for varietal traits.

A study conducted by Song and Manikand (1999) revealed that there was a wide gap between breeders' limited supply of varieties and the diversity of farmers' needs.

Prema *et al* (2000) observed that the reason for farmers not adopting improved rice varieties in Kerala was because of the high complex, diverse and risk-prone and location specific agricultural production system.

2.5.5 Decentralized plant breeding

Many workers have advocated decentralized plant breeding. (Maurya *et al.* 1988; Farrington and Martin, 1988; Galt, 1989; Joshi and Sthapit, 1990; Sperling *et al.*, 1993; Sthapit *et al.* 1994; Joshi and Witcombe, 1996; Witcombe *et al.* 1996)

Tripp *et al.* (1997) recommended a decentralized system of varietal testing with farmers' involvement in the early stages and a regulatory system flexible enough to release varieties on the basis of trials conducted solely or partly with farmer participation.

Weltzien *et al.* (2000) opined that breeding programmes should understand farmers' preferences for specific crop traits and the same information could be brought out through the analysis of varieties that farmers grow.

2.5.5.1 Limitations of centralized/formal breeding

Studies have proved that poor adoption of officially released rice varieties in developing countries was primarily due to a highly centralized formal research system which did not target the problems of resource poor farmers. (Maurya *et al.*, 1988; Joshi and Witcombe, 1996; LARC, 1995 and Chemjong *et al.*, 1995)

Citing the findings of Sperling *et al.* (1993) and Sperling and Scheidegger (1996); Weltzien *et al.* (2000) concluded that differences in varietal preference among closely spared farming communities suggested the need to couple participatory selection with decentralized seed multiplication programmes.

While analyzing the studies of Gomez *et al.* (1995) and Gomez and Smith (1996), Weitzien *et al.* (2000) pointed out that farmers were not adopting improved maize varieties as there were inappropriate breeding objectives became of: i. Inadequate information concerning farmers' varietal needs ii. Inadvertent selection for adaptation to experimental station environments that are not representative of farmers' fields iii. Exclusive variability in varietal needs from farm to farm that could not be well addressed through a centralized breeding system. Accordingly, three alternatives were explored. i. Better understanding of what farmers need in their varieties so that appropriate breeding objectives can be incorporated into selection programmes on experiment stations ii. Use of farmers' fields and expertise, to carry out breeding work

on representative farms iii. Teaching the needed techniques for farmers to select and save their own seed.

Evidences from large-scale screening of rice varieties in Nepal (Joshi *et al.*, 1995) suggested that farmers' varietal choices vary over geographic locations separated by fairly short distances.

Vyas (1995) pointed out that there was a delay of four to six years between the official notification of a variety and its commercial cultivation.

Analysing the various research findings, Joshi and Witcombe (1998) opined that decentralized breeding could be more efficient than centralized breeding in producing cultivars adapted to marginal agricultural environments.

Almekinders and Boef (1999) opined that in most developing countries, the formal institutional plant breeding system has not been very effective where agro-ecological environments were variable and the needs and preferences of the farmers were diverse.

Ceccarelli and Grando (1999) identified that a major factor limiting the centralized breeding programme was its inefficiency to cater to the diversified needs of local farmers.

Pal *et al.* (2000) observed that varietal testing, as release for rice was a lengthy process and took six years for a variety to be released and made available for formal seed production. According to him two years of time gap was there between the placement of indent for breeder seed and the commercial seed ready for the market.

Weltzien *et al.* (2000), found that farmers' criteria for varietal preferences varied widely across a region, according to growing conditions and poverty of farmers.

2.6 Concept of participatory crop improvement

2.6.1 Participatory Varietal Selection (PVS)

PVS is the selection of fixed lines (released, advanced lines or land races) by farmers in their target environments using their own selection criteria. The process of 'selection' could be made from every possible form of material including released/finished, near- finished, advanced lines and products from plant breeding programs and from local landraces.

A successful PVS involves four steps (Joshi and Witcombe 1996; Sthapit *et al.* 1996; Witcombe *et al.* 1996): i. Identification of farmer's needs in cultivars ii. Search for suitable materials (Varieties) iii. Experimentation on its acceptability in farmer's field iv. Wider dissemination of farmer-preferred cultivars.

Joshi and Witcombe (1998) defined Participatory Varietal Selection (PVS) as the selection by farmers on their own fields, fiinished or near finished products from plant breeding programs.

Analyzing the various research findings, Witcombe et al. (1998) summarized that farmer participatory approach such as participatory varietal selection could be used to bring about a higher uptake of modern cultivars and faster rate of replacement of older cultivars in farmers' fields.

Ceccarelli and Grando (1999) observed that there are four strategies in a varietal selection program viz., i. Decentralized participatory selection, which is done by the farmers in their own fields ii. Centralized participatory selection, where the selection is done by the farmers, but in research stations iii. Decentralized non-participatory selection carried out by the breeder in farmers' field iv. Centralized non-participatory selection carried out by the breeder in research stations.

Table 2. Inventory on participatory crop improvement in rice

Sl No	Project Title	Crop (s)	Nature of participation	Researcher(s) involved	Gr. of state/dates country(s)
1.	Project KRIBHCO east	Rice, chickpea, maize, black gram	i. Farmer's need identified (PRA) ii. Farmers testing varieties on their lands iii) Farmers evaluating varieties (Focused group discussions, semi-structured interviews to questionnaire)	A. Joshi, J.R. Witcombe	1992/India
2.	Participatory crop improvement in high potential production systems in India and Nepal	Rice, Chaite Rice, Wheat, Maize etc.	i) Farmers test new varieties in their fields. ii) Varieties evaluated and reported to the (Focussed group discussions, Farm walks)	J.R. Witcombe D.S. Virk, K.D. Joshi B.S. Raghuwanshi	1996/India
3.	High altitude rice breeding in Nepal	Rice	Farmer's selection from F5-bulks and thus they identify, test and modify the varieties at the same time. (Farm walk, varietal ranking, questionnaire)	Bhuwon R. Sthapit, K.D. Joshi J.R. Witcombe	1993-96/ Nepal
4.	Chaite rice in the western hills region of Nepal	Chaite Rice	PVS, but not direct monitoring by Scientists (response cards method)	K.D. Joshi, P.B. Rana, M. Subedi, K.B. Kadayat, B.R. Sthapil	1991/ Nepal
5.	Participatory Rice Improvement and Gender Analysis (PRGIA)	Upland rice, *O. sativa*, *O. glaberrina* Interspecific crosses	Participatory Varietal Selection	Monty P. John Timoty. J. Dalton Nina. K. Lilja, Opoku-Apau Dogbe	1996/West Africa
6.	Strategy for rice breeding in rain fed areas of India	Rainfed rice	Farmers grow and evaluate a trials (farmer visits, informal interviews)	D.M. Maurya	1985/India

2.6.2 Participatory Plant Breeding (PPB)

According to Ceccarelli and Grando (1999), the introduction of varieties bred by breeders in a centralized breeding system did not ensure a satisfactory optimum result and that participatory plant breeding was a promising alternative to a formal institutionalized breeding system. PPB is an advanced step of PVS. Farmers could be involved in selecting segregating material.

2.6.3 Inventory on participatory crop improvement in rice

A global inventory on participatory crop improvement in rice is presented in table 2

2.6.4 Participatory work in other crops

Kornegay *et al.* (1996) carried out a Participatory Plant Breeding Programme for common bean (*Phaseolus vulgaris*) in Columbia with three farmers from one district.

Zimmerman (1996) used farmers' visits early on in a common bean-breeding programme at three researcher-managed locations in Brazil.

2.6.5 Constraints to participatory research

According to Ceccarelli and Grando (1999) one major obstacle to Participatory Plant Breeding was the reluctance of breeders to share with others, the paternity of new varieties.

While commenting on the uses of creating effective intra-institutional linkages for successful participatory crop improvement programmes, Weltzien *et al.* (2000) highlighted the common constraint impeding cross-disciplinary collaboration between the social scientists and plant breeders as rigid institutional organization set

up preventing effective collaboration between the two groups. Effective collaboration and interactions between social scientists and breeders did not occur because of: i. Organizational structures that impede collaboration ii. Divergent professional interests iii. Lack of appreciation for the contributions other disciplines can make iv. Largely divergent expectations for the outcome and the process of joint work v. Lack of professional friendship.

Reports of Martin and Sherrington (1996) revealed that non-governmental organizations were pioneers in initiating Participatory Technology Developmental activities.

Citing the example of a widely popular rice variety IR 40750, a male restorer line of good grain quality, which was preferred well in both seasons in Andhra Pradesh, Pal *et al.* (2000) underscored the niche that existed between decentralized varietal testing and seed production facilities by non-governmental organizations.

2.7 Conceptual model of the rice varietal preferences of the farmers of Palakkad district - *Virippu*

A conceptual model of the varietal preferences of *virippu* rice of the farmers of Palakkad district is presented in fig. 1.

2.8 Conceptual model preferences of the rice varietal preferences of farmers of Palakkad district – *Mudakan*

A conceptual model of the varietal preferences of *mundakan* rice of the farmers of Palakkad district is presented in fig. 2.

Fig. 1. Conceptual model of the rice varietal preference of the farmers of Palakkad district - *virippu*

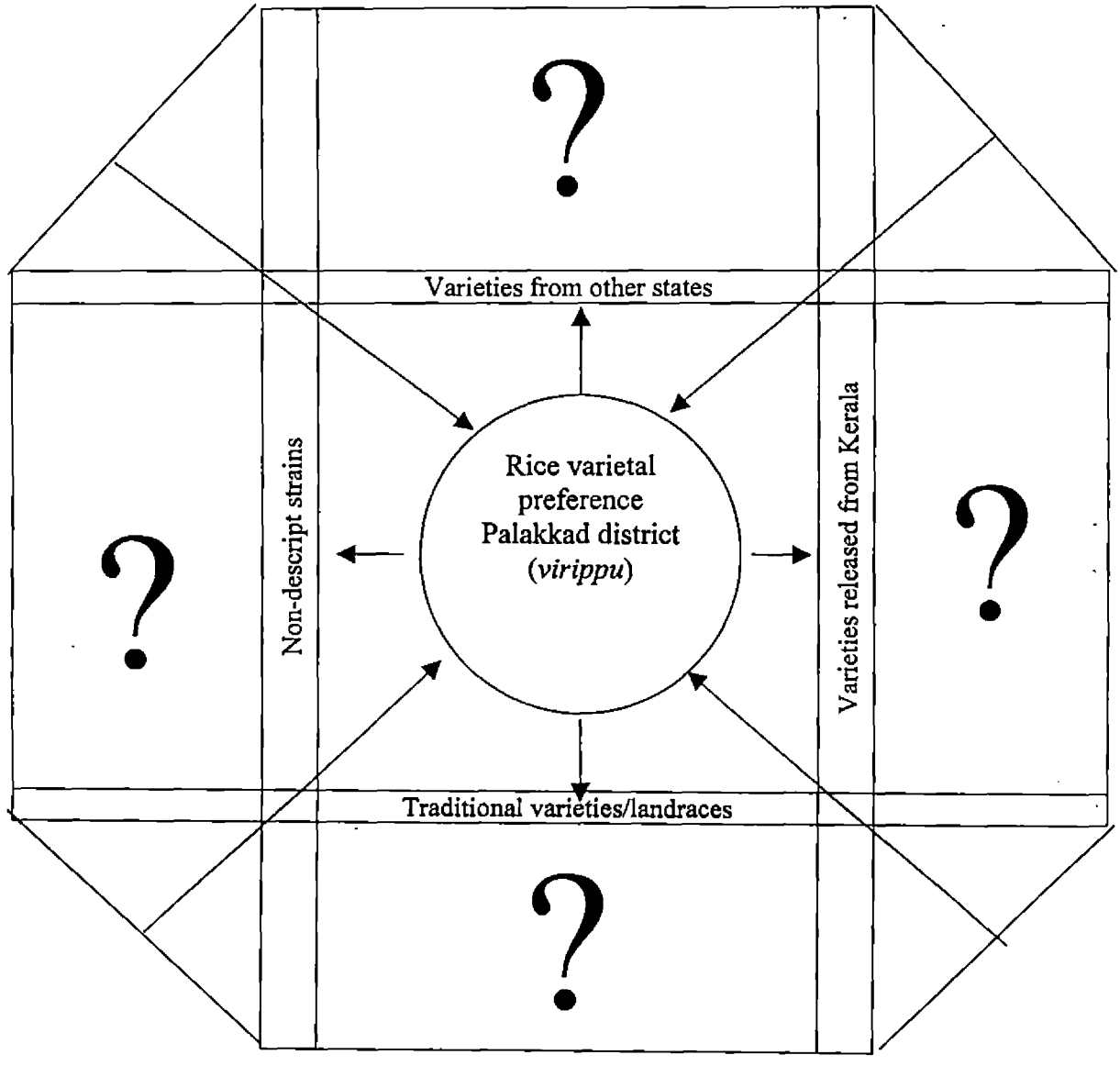
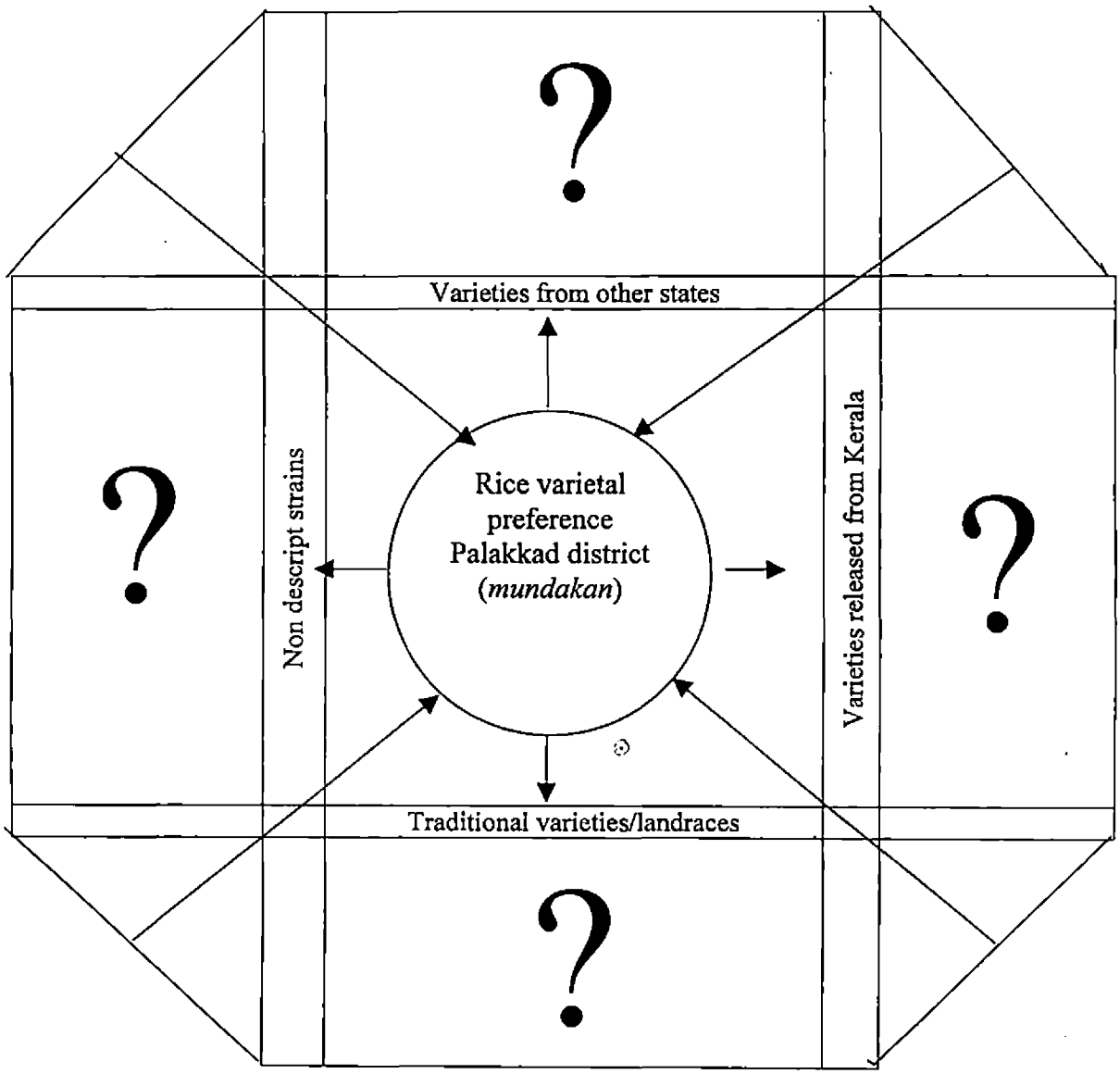


Fig. 2. Conceptual model of the rice varietal preference of the farmers of Palakkad district - *mundakan*



METHODOLOGY

METHODOLOGY

In accordance with the specific objectives, the methodology followed in the study is summarized under the following major heads:

3.1 Profile of the study area

3.2 Sampling design

3.3 Procedure for data collection

3.4 Statistical tools employed

3.5 Operationalisation of concepts and terminologies

3.1 Profile of the study area

3.1.1 Locale of the study

Palakkad district lies between 10°9'57" to 11°14'17" north latitudes and 76°1'36" to 76°54'30" east longitudes and is located in the east central portion of Kerala state. It covers an area of 4,38,947 ha as per the survey of India toposheet. The district is bounded by the high hills of Nilgiris in the north and northeast. The subdued hills and spurs of the Western Ghats in the east and southeast separate the district from the Coimbatore district of Tamil Nadu. The south and southwest portion is partly bounded by high hills and partly by 'Karappara' river, separating it from the Thrissur district. The west and north west is bounded by low ridges separating it from the Malappuram district.

For administrative convenience, the district is divided into five taluks viz., Palakkad, Alathur, Chittur, Ottappalam and Mannarkkad. It has 13 Developmental Blocks (DBs) and 12 Assistant Director of Agriculture Blocks (ADBs), comprising of 93 *Krishibhavans* (Panchayat-level Agricultural Extension Units) (KBs). The names of ADBs are as follows: i) Alathur, ii) Koyalmannam, iii) Nenmara, iv) Kollengode, v) Chittur, vi) Palakkad, vii) Mannarkkad, viii) Sreekrishnapuram, ix) Agali, x) Shoranur, xi) Pattambi and xii) Thrithala.

3.1.2 Physiology and relief

Palakkad district as a whole can be considered as a mid-land dissected plain, being at a higher elevation than the adjoining coastal plains. The district has an undulating topography with a major portion of it falling with in the slope range of less than five per cent. The elevation of the district ranges from 20 m above Mean Sea Level (MSL) in the west central portion to more than 2300 m on the Nilgiri ranges. Several rivers such as 'Tutapuzha', Gayathripuzha', 'Kuntipuzha', 'Kannadi' river, 'Bhavani' river and their tributaries drain through the study area.

3.1.3 Climate and rainfall

The district in general enjoys a dry tropical climate. This is more severe towards the eastern side adjacent to Tamil Nadu. The normal annual rainfall of the district is around 2397 mm. But the east slopping Attappady valley and the eastern region of Kozhinjampara receive only around 915 mm and 1164 mm rainfall respectively. Major portion of the rainfall is received during the southwest monsoon from May to September. Maximum rainy days and rainfall are during June and July months. Palakkad has an oppressive hot season with fairly good seasonal rain. The hot season is from February to March, with the latter as the hottest month.

3.1.4 Irrigation projects

There are seven completed irrigation projects in the district viz., i) Malampuzha, ii) Pothundy, iii) Mangalam, iv) Walayar, v) Gayathri, vi) Chitturpuzha and vii) Kanhirampuzha.

3.2 Sampling design

A multi stage sampling procedure was followed for the purpose of drawing sample for the present investigation. The four rice seed production and distribution subsystems operating in the district were reckoned for the study (Fig.3).

3.2.1 The system concept

Chand (1971) conceptualised that three systems viz., Research, Extension and client systems were involved in an applied research reprocess. Studies of similar nature were conducted by Singh (1975), Jaiswal and Arya (1981), Sen (1984) and Kishore (1986). Though the nomenclature differed slightly, the implied systems were the same in all these works.

Having set the system analysis as the research strategy in this study, it was felt that such an approach would unfold the actions and interactions of the sub systems involved in the rice seed production and distribution system of Palakkad district.

Thus, the respondent groups of the present study comprised of the Farmer Sub System (FSS), the Extension Sub System (ESS), the Seed Input Sub System (SISS) and the Research Sub System (RSS).

3.3 Procedure for data collection

The representative areas under the study were selected following a four-stage sampling method based on the highest net-cropped area of rice during the year 1998-'99. Out of the 12 ADBs, ten having the highest net-cropped area under rice were selected as the first stage units. As the second stage units, from the selected ten ADBs, ten panchayats, one each from every ADB, was selected, again based on the criterion of highest net cropped area under rice. The third stage units comprised of ten *padasekharams* (groups of paddy lands in a village), one from each panchayat, chosen based on the same criterion. Finally, 30 farmers selected from every *padasekharam* following proportionate random sampling formed the last stage units. One more *padasekharam* from Pattanchery panchayat, Chittur block, was included in the present investigation, owing to the distinct unique features revealed during the pilot study. Thus, 11 *padasekharams* were selected for the study.

3.3.1 Selection of respondents

Representatives from all the sub systems identified viz.; FSS, ESS, SISS and RSS were included as respondents for the investigation. (Fig. 3)

3.3.1.1 Farmer Sub System (FSS)

The list of farmers with their net rice cropped area were prepared with the help of Agricultural Assistants (AAs) in charge of the respective *Padasekharams* and Agricultural Officers (AOs) of the concerned *Krishibhavans* (KBs), by referring the secondary sources of data from the registers maintained in KBs as well as that from the concerned *Padasekhara Samithies* (the core group co-ordinating the activities in a *padasekharam*). The 30 farmer respondents from each of the selected *padasekharams* were divided into three equal sized samples viz., 'low', 'medium' and 'high' groups to represent a cross section of farmers based on the net rice cropped area owned by them. The formula used was:

$$\bar{x} \pm Sd, \qquad \text{where } \bar{x} = \frac{\Sigma x}{n}$$

Σx = Total net cropped area under rice in a *padasekharam*

n = number of farmers

Sd = Standard deviation of the net rice cropped area

Altogether 330 farmers formed the FSS.

3.3.1.2 Extension Sub System (ESS)

The Agricultural Officers (AOs) and Agricultural Assistants (AAs) of the 11 panchayats constituted the respondents from the ESS, as detailed in table 3.

Fig. 3. The schematic representation of the sampling design for FSS

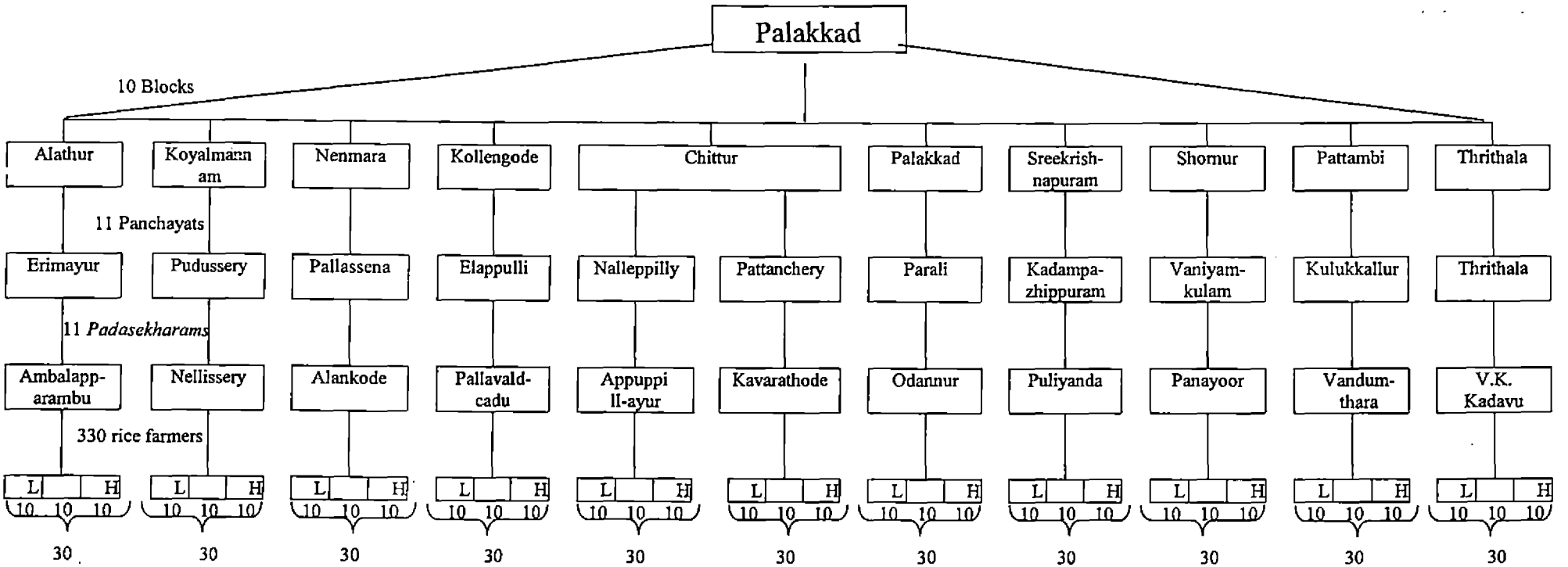


Table 3. The distribution of respondents from the ESS

Sl.No	ADB	Panchayat	Respondents (Nos.)		
			AOs	AAs	Total
1	Chittur	Nalleppilly	1	3	4
		Pattanchery	1	2	3
2	Alathur	Erimayur	1	3	4
3	Koyalmannam	Pudussery	1	3	4
4	Nemmara	Pallassena	1	2	3
5	Kollengode	Elappully	1	3	4
6	Palakkad	Parali	1	3	4
7	Sreekrishnapuram	Kadampazhippuram	1	2	3
8	Shoranur	Vaniyamkulam	1	3	4
9	Pattambi	Kulukkallur	1	3	4
10	Thrithala	Thrithala	1	3	4
				Grand total	41

3.3.1.3 Seed Input Sub System (SISS)

The AOs and three AAs from each of the five State Seed Farms (SSFs) in Palakkad district viz., i) State Seed Farm, Alathur, ii) State Seed Farm, Ananganady, iii) State Seed Farm, Kongad, iv) State Seed Farm, Kunnannur and v) State Seed Farm, Muthalamada, formed the respondents from the SISS. Altogether there were 20 respondents from the SISS.

3.3.1.4 Research Sub System (RSS)

The Rice Researchers (Agronomists & Plant Breeders) from the central zone, mainly from the Regional Agricultural Research Station (RARS), Pattambi constituted the respondents (12 no's) form the RSS.

3.3.2 Data collection

3.3.2.1 Primary data

Primary data were collected from the respondents of the four sub systems included in the study viz., FSS, ESS, SISS and RSS in the form of opinions, preferences, preference rankings, constraint listing and prioritizations and suggestions, using a blend of techniques and tools as explained in the forth coming sections.

3.3.2.2 Secondary data

Perusal of secondary data was done from the registers of 11 KBs, SSFs, RARS, Pattambi, offices of the panchayat, village and Principal Agricultural Officer, Palakkad.

3.3.2.3 Participatory Learning and Action (PLA) tools

Joshi and Witcombe (1996) suggested that PRA/PLA techniques such as 'Matrix Ranking' could be used for assessing different varieties of crop plants by ranking them for multiple traits.

Mukherjee (1995) classified the ranking methods used in PRAs/PLAs into 'preference ranking', 'pair wise ranking', 'direct ranking' and 'wealth ranking'. Preference ranking involved the ranking of a set of problems or priorities by a group or on individual basis on their criteria or perception.

Ipinge (1996), Lechner (1996) and Bidinger (1998), have reported the use of PRA/PLA tools such as 'rank scoring' of a set of traits and 'matrix-ranking' of a set of varieties through group discussions for exploring farmers' choices and preferences in pearl millet varietal evaluation trials.

Plate 1. Researcher as a PLA/PRA facilitator

Plate 2. Learning from their experience was the strength of the study

In a Farmer Participatory Varietal Selection Programme, Joshi and Witcombe (1998) had used 'focused group discussions' and 'matrix ranking' of varieties for data collection and subsequent ranking of varieties by taste.

After analyzing the various research findings, Weltzien *et al.* (2000) summarized the various PRA/PLA tools used in PPB projects as 'matrix ranking' or 'pair wise ranking' of a set of varieties leading to group discussions and rating, scoring and ranking a larger set of genotypes for a standard set of traits.

In the light of the foregoing works, the present study used a blend of PRA/PLA tools for gathering data from different subsystems concerned.

3.3.2.5 Data collection from the FSS

Modified, shortcut PRA/PLA sessions were resorted to elicit the required data for the present investigation. As against the conventional method of survey and interview, Group Participatory Technique (GPT) was employed where farmers could express themselves in an informal conducive atmosphere of participatory learning. In-depth discussions, mental evaluations, instantaneous corrections and healthy debates proceeded before arriving at group consensus. The procedure was free from lengthy questionnaires and schedules. Instead, a combination of Focused Group Discussions (FGD), Brainstorming and Semi-structured Group Interviews (SSGI) were followed. The approach was 'listening to the farmers and learning from them'. The investigator was not an interrogator, but a 'facilitator', 'silent listener' and 'recorder'.

Modified, short cut PRA sessions were conducted at convenient places in the 11 *padasekharams* which included schools, rice mills, houses and shaded premises of homes and likewise. Along with the researcher, for each PRA session, one or two 'recorders' and 'environment controllers' were there. The farmers were briefed about the purpose and *modus operandi* of the PRA. 'Varietal mapping', 'Attribute ranking',

'Matrix ranking' and 'Crop seasonal calendar', were the tools employed in these PRA sessions. The procedure followed is detailed here under:

After a brief introduction and ice-breaking session, the farmers were facilitated to make a list of the then and recent cultivated rice varieties of the respective *padasekharams*, their duration, specific advantages and disadvantages and the like.

3.3.2.5.1 Crop season calendar

A seasonal calendar of rice and rice based cropping systems revealing the seasonality of rice, highlighting sowing, transplanting and harvesting operations over different cropping seasons were prepared by the participants in each PLA session.

3.3.2.5.2 Matrix ranking of rice cultivars

While critically analyzing the methods for collecting farmers' criteria for varietal selection, Weltzien *et al.* (2000) concluded that 'matrix ranking' by groups were the most appropriate when 'forms' used in questionnaires were too cumbersome to fill or process. Researchers switched over to 'preference ranking'/'matrix ranking' in place of 'matrix scoring' for speed and possibility of statistical analysis.

Similarly, in the present study matrix ranks of varieties grown over different seasons were plotted against the prioritized set of attributes derived from the respective *padasekharams*. Along the 'x' axis, each cultivar grown over the concerned season in the *padasekharam* was plotted against the specific varietal attribute given on 'y' axis.

Varietal attributes obtained from the brainstorming sessions were categorized into 'quantitative' and 'qualitative' traits, after the prioritization of the same. Quantitative attributes like 'the optimum duration expected for an ideal variety',

Plate 3. 'Pen and stick' handed over to them

Plate 4. Preparation of crop season calendar

'preferred height' and the like were dropped from the 'matrix ranking' exercises. This was meant to make varietal/matrix ranking reliable and meaningful. Thus those quantitative traits were considered only for 'attribute ranking' and not for 'matrix ranking' exercises.

Taking one attribute at a time, the participants were facilitated to rank the varieties plotted on the 'x' axis according to their relative mental position for that particular attribute on 'y' axis. Thus the most preferred variety for any particular attribute received the highest rank/score which would normally be equal to the total number of varieties considered (need not be always as there could be similar ranks for some of the varieties) whereas, the least preferred variety got the least score possible, which was one.

Whenever the group found it difficult to rank a large number of varieties, the procedure of ranking order was reversed and the participants were asked to spell out the least preferred variety regarding that particular attribute. Places where the same set of varieties were used during different crop seasons yielded only one set of matrix whereas, places where different sets of varieties were grown over different cropping seasons yielded more than one set of matrices.

3.3.2.5.3 Attribute ranking of rice cultivars

The participants were lead to brain storming sessions where they were facilitated to spell out. The 'attractive' and 'desirable' traits of 'liked' rice cultivars of their choice. They were prompted to visualize an apt rice cultivar specifically most adapted to their respective micro-farming situations, needs, priorities and choices, and then state its desirable 'characters'. All the opinions irrespective of rationality and sense were recorded on poster papers as and when they came from the farmers.

The lists of 'preferred varietal attributes' were scrutinized for rationality, repetition and relevance, and irrelevant attributes were removed from the list with

Plate 5. Farmer-preferred attributes : Identification and prioritisation

Plate 6. Participatory matrix ranking of rice cultivars

mutual consensus. These lists were again subjected to prioritization exercises and the rank positions of individual items in the list were agreed upon following several intense arguments, contradictory opinions, in-depth discussions, mental evaluations and instantaneous corrections.

3.3.2.5.4 Identification and prioritization of constraints to rice seed production and distribution

Brainstorming sessions were held to identify the constraints to rice seed production and distribution system existing in the district. The listed constraints were identified as common basic, input related, biological, socio-economic, information, infrastructural, technological, psychological and extension constraints. The list was screened and the final set of constraints were decided and used for participatory prioritization based by way of constraint attributes viz., severity and extent. Suggestions for removal of the constraints were also collected and recorded.

3.3.2.6 Data collection from the ESS

The Agricultural Officers (AOs) and Agricultural Assistants (AAs) of the *Krishibhavans* (KBs) under study were consulted. Semi Structured Group Interviews (SSGI) were conducted to gather data from the ESS. Secondary data on the names and net area under rice in different *padasekharams* were collected from the basic data registers kept in the KBs.

3.3.2.6.1 Matrix ranking of rice cultivars

The methodology followed was similar to that of the one used for collecting data from the FSS. Nevertheless, here the lists of varieties and 'preferred attributes' listed by the FSS were used for ranking by the ESS.

3.3.2.6.2 Attribute ranking of rice cultivars

The preferred varietal attributes identified by the FSS were prioritized by the officials of respective *Krishibhavan.*

Plate 7. Pondering over the constraints to rice seed production and distribution

Plate 8. A 'class room' for the researcher

3.3.2.6.3 Identification and prioritization of constraints to rice seed distribution

The farmers' constraints prioritized by the FSS were indep by the officials of respective *Krishibhavans*. The constraints perce officials in the procurement and distribution of rice seeds and the p them in implementing the Registered Seed Growers Programm collected and prioritized. Suggestions for removing these constraint existing problems were recorded.

3.3.2.7 Data collection from the SISS

The Agricultural Officers and Agricultural Assistants Farms (SSFs) in Palakkad district viz., i. SSF, Alathur ii. SSF, Kongad iv. SSF, Kunnannur and v. SSF, Muthalamada, Officers the office of the Principal Agricultural Officer (PAO); Palakka National Seeds Corporation (NSC) Seed production unit, A respondents from the SISS.

The secondary data on season-wise, variety-wise rice the five years from 1996-1997 to 2000-2001 were collected from the afore-said units. SSGIs were conducted in each of these relevant primary data. Constraints faced by the officials in se distribution were collected and prioritized. Construc suggestion improving the present status were solicited and recor.

3.4 Statistical tools employed

The data collected from the 11 PRA sessi nd the SSIs from the ESS, SISS and RSS were tabulated analysed usin statistical tools:

3.4.1 Categorisation of farmer respondents

Farmers of each of the 11 *padasekharams* were categorised into three groups viz;, 'high', 'medium' and 'low' as follows:

$\bar{x} + 1\ Sd = High$

$\bar{x} \pm 1\ Sd = Medium$

$\bar{x} - 1\ Sd = Low$

Where $\bar{x} = \frac{\Sigma x}{n}$

Σx = Total net cropped area under rice in a *padasekharam*
n = Number of rice farmers in a *padasekharam*
Sd = Standard deviation of the net rice cropped area under consideration

3.4.2 Matrix Ranking Index (MRI)

Padasekharam-based ranking of *virippu* and *mundakan* varieties considering the selected attributes were done by developing a Matrix Ranking Index (MRI) using the data from the two-way matrices obtained from the FSS. Thus the overall ranking was done using the formula,

$$MRI = \frac{\sum_{k=1}^{m} \sum_{j=1}^{n} x_{kj}.w_j}{\sum_{j=1}^{n} w_j}$$

Where $x_{kj} = \frac{r_{kj}}{n}$

r_{kj} = Rank of k^{th} variety with respect to the j^{th} attribute
w_j = Weightage given to the j^{th} attribute
m = Number of varieties
n = Number of attributes

The same index was used to rank the rice cultivars as perceived by the ESS of the concerned panchayat.

3.4.2 Attribute Ranking Index (ARI)

District-based ranking of preferred attributes of rice cultivars was derived from the data elicited through individual PLA sessions with the respondents from the FSS. For this, an Attribute Ranking Index (ARI) was developed, as given below:

$$ARI = \frac{1}{n} \sum_{i=1}^{t} \sum_{j=1}^{n} r_{ij}.p_j$$

Where r_{ij} = Rank of the j^{th} attribute in the i^{th} panchayat
p_j = Proportion of panchayats where j^{th} attribute is considered
n = Total number of attributes considered in all panchayats together
t = Total number of panchayats

Similarly, a district-based ranking of preferred attributes of rice cultivars was obtained from the rankings elicited from the ESS of the district.

3.4.4 Varietal Ranking Index (VRI)

District-based ranking of *Virippu* and *Mundakan* was obtained using the two-way matrices elicited from the FSS of respective panchayats. The Varietal Ranking Index (VRI) was developed for the purpose.

$$VRI = \left[\frac{\sum_{i=1}^{t} \sum_{j=1}^{v} \sum_{k=1}^{u} X_{ijk} x W_{ij}}{\sum_{i=1}^{t} \sum_{j=1}^{v} W_{ij}} \right] . \frac{\sum_{i=1}^{t} m_{pi}}{u} . \frac{\sum_{i=1}^{t} n_{qi}}{v} . pk$$

Where $x_{ijk} = \frac{r_{ijk}}{s_i}$

r_{ijk} = Rank of the k^{th} variety w.r.t the j^{th} attribute in the i^{th} panchayat
s_i = Number of varieties in the i^{th} panchayat
w_{ij} = Weightage given to the j^{th} attribute in the i^{th} panchayat
u = Maximum number of varieties in a panchayat
v = Total number of attributes obtained from all panchayats
t = Total number of panchayats
m_{pi} = Number of varieties in the i^{th} panchayat
n_{qi} = Number of attributes in the i^{th} panchayat
pk = Proportion of panchayat where the k^{th} variety is present

Similarly, district-based rankings of *virippu* and *mundakan* varieties from the ESS of the district were computed from the panchayat based varietal rankings.

3.4.5 Constraint Ranking Index (CRI)

District-based ranking of farmers' constraints to rice seed production and distribution was done using the data elicited through each PLA sessions with respondents from the FSS. For this, a Constraint Ranking Index (CRI) was designed, as given below:

$$CRI = \frac{\sum_{i=1}^{t} \sum_{j=1}^{n_c} r_{ij} \cdot p_j}{n_c}$$

Where r_{ij} = Rank of the j^{th} constraint in the i^{th} panchayat
p_j = Proportion of panchayats where j^{th} constraint is considered
n_c = Number of constraints present in the i^{th} panchayat
f = Total number of panchayats

Similarly, a district-based ranking of farmers' constraints to rice seed production and distribution as perceived by the ESS of the district was also attempted. The same index was used to rank the constraints to rice seed production and distribution as perceived by the SISS of the district.

3.4.6 Multi Seasonal Adaptability Index (MSAI)

Multi Seasonal Adaptability Index (MSAI) was developed to test the adaptability of different rice cultivars to the cropping seasons *virippu* and *mundakan*. Only those cultivars, which were reported to be cultivated in both the seasons, were considered. The most preferred variety in *virippu* and, or *mundakan* (first rank holder by VRI) was given the highest rank value (20). The formula was as follows:

If $n_1 > n_2$

$$MSAI = \frac{\left(\frac{n_1 + n_2}{2}\right)}{\frac{(n_1 - n_2)}{n_1} x100}$$

If $n_2 > n_1$

$$MSAI = \frac{\left(\frac{n_1 + n_2}{2}\right)}{\frac{(n_2 - n_1)}{n_2} x100}$$

Where n_1 = The rank value of a variety in the 1st crop season (*Virippu*)

n_2 = The rank value of the same variety in the 2nd crop season (*Mundakan*)

Final ranking for adaptability was done based on the scores obtained. The most adaptable variety with the highest score was given the rank, one.

3.4.7 Mann-Whitney 'U' test

This was used to test whether there was significant difference between the perception of the FSS and ESS with respects to the district-based varietal ranking for *virippu* and *mundakan* varieties and for district-based farmers' constraint ranking by both the sub systems.

The scores obtained through applying the respective indices were arranged in ascending order of their magnitude and were ranked from the lowest score to the highest, irrespective of the group to which each score belonged.

Let 'U' be the number of times the score in the group precedes the score of the other group. 'U' could be obtained directly using the formula:

$$U = n_1 n_2 + \frac{(n_1 + n_2 + 1)}{2} - R_1$$

Where n_1 = number of scores in group one

n_2 = number of scores in group two

R_1 = sum of the ranks in the group n_1

For large n_1 and n_2, the normal test of significance was applied with the test criterion,

$$Z = \frac{u - (u_1 u_2)/2}{\sqrt{u_1 u_2 (u_1 + u_2 + 1)/12}}$$

3.4.8 Spearman's rank order correlation

The relative perception of the FSS and the ESS regarding the panchayat-based ranking of *virippu* and *mundakan* varieties, preferred varietal attributes and farmer's constraints to rice seed production and distribution, was compared by working out the Spearman's rank order correlation coefficient (r_s). District-based ranking of preferred varietal attributes of the FSS and the ESS was also compared using the same. The formula was as given below:

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)}$$

Where,

r_s = Spearman's rank order correlation coefficient

d = difference between the two sets of values

n = number of ranks

3.5 Operationalisation of concepts and definitions

Temporal variability

Variability caused by 'Genotype-Environment' (GE) interactions that changes the ranking of genotypes in the same location over time.

Phenotype

It is the outward expression of the genotype of a plant.

Spatial/geographical variability

Variability caused by GE interactions that changes the ranking of genotypes between different target environments.

Participatory Varietal Selection (PVS)

PVS is the selection of fixed lines (released, advanced lines or landraces) by farmers in their target environments using their own selection criteria.

Participatory Plant Breeding (PPB)

PPB is a breeding process in which farmers and plant breeders, facilitated by social scientists, jointly select achievers from segregating materials under target environments.

Potential parents

Pairs of cultivars identified in participatory selection programmes, which can be utilized for their hybridization.

Cultivar

The term cultivar denotes an assemblage of cultivated plants, which is clearly distinguished by any character, (morphological, physiological, cytological, chemical or others) and which when reproduced (sexually or asexually) retains its distinguishing characters.

Variety

A sub-division of species, defined as "a group of plants with in a species which are uniform in characters". They should be distinct, uniform and stable. In the present study the terms Variety and Cultivars have been used interchangeably in several places.

Character

A morphological, anatomical or physiological feature of a crop variety, usually a product of both genotype and environment.

Farmer-preferred attributes

The positive varietal attributes that a rice farmer will look for in a variety/cultivar.

Genotype

The genetical composition of a crop expressed in terms of genes i.e. the sum total of its genes, both dominant and recessive.

Linkage

Linkage is operationalised as the working relationship between or among the four subsystems namely, the Farmer Sub system (FSS), Extension Sub System (ESS), Seed Input Sub System (SISS) and Research Sub System (RSS).

Farmer Sub System (FSS)

The rice farmers from the selected panchayats/*padasekharams* who formed the respondents of the study constitute the FSS.

Extension Sub System (ESS)

The Agricultural Officers (AOs) and Agricultural Assistants (AAs) of the selected *Krishibhavans* (Grama Panchayat level agricultural offices), under study constitute the ESS

Seed Input Sub System (SISS)

The farm officers (AOs and AAs) of the five State Seed Farms of Palakkad district form the SISS.

High Yielding Varieties (HYVs)

For the purpose of this study HYVs are operationally defined as the high yielding rice varieties evolved and released from research stations presently under Kerala Agricultural University or from any other research stations from India or abroad.

Multi Seasonal Adaptability

In the present study multi seasonal adaptability is defined as the suitability of a rice cultivar to more than one cropping season as evidenced by a uniform performance in every season.

Rice Seed System

It is operationally defined as the genesis, processes and procedures involved in rice varietal development, seed production and distribution including the functional linkages between the component sub systems namely, the Farmer Sub

system (FSS), Extension Sub System (ESS), Seed Input Sub System (SISS) and Research Sub System (RSS).

Non-descript strains

Non-descript strains are operationally defined as the rice varieties whose pedigree is unknown with the available varietal descriptors, which comprise of both high and low yielding strains cultivated by the farmers.

Varietal replacement

Varietal replacement is the phenomenon in which a continuous supply of the seeds of new superior varieties replaces old varieties from farmers' fields.

Landraces/Traditional varieties

Landraces or traditional varieties are the varieties developed by the farmers over many generations of selection without the intervention of formal plant breeding.

RESULTS

RESULTS

The results of the present study are presented under the following subheads:

4.1 Rice production systems of Palakkad district

4.2 Block-based evaluation of crop season calendars, rice varieties and preferred varietal attributes

4.3 District-based evaluation of rice varieties and preferred varietal attributes

4.4 Block-based prioritization of constraints to rice seed production and distribution as perceived by the FSS, ESS, SISS and RSS of Palakkad district

4.5 District-based prioritization of constraints to rice seed production and distribution and the suggestions for improvement as perceived by the FSS, ESS, SISS and RSS of Palakkad district

4.6 District-based ranking of rice varieties based on multi-seasonal adaptability

4.7 Comparative rankings of rice varieties, varietal traits and farmers' constraints to rice seed production and distribution as perceived by the FSS and ESS of Palakkad district

4.8 Rice seed production status of Palakkad district

4.1 Rice production systems of Palakkad district

Exploration of the present situation in Palakkad district revealed that besides the predominant rice production system with the seasons *Virippu* and *Mundakan*, there were three other minor unique traditional systems viz., *Koottumundakan*, *Karingora* and *Poonthal* restricted to certain pockets. The crop establishment systems identified were: i. Dry sowing ii. Transplantation.

4.1.1 *Koottumundakan*

Koottumundakan system of rice cultivation in Palakkad district is confined to the Ottappalam taluk. In this system, a mixture of seeds of a non-photosensitive variety and a photosensitive variety of rice in the proportion 70:30 is sown during virippu season. The non-photosensitive variety will be ready for harvest in August-September and photosensitive long duration variety can be harvested by December – January.

A local variety Chettadi was found predominantly used as the long duration photosensitive variety. Some of the non-photosensitive varieties used along with Chettadi were: Veluthettan, Chenkazhama, Chemban, Arivaakari, Swarnali, Ponnaryan, Aryan, Velutharikazhama and Aiswarya.

4.1.2 Karingora

Karingora system was found confined to some isolated pockets in Sreekrishnapuram, Pattambi and Thrithala blocks of Palakkad district. It is a late *virippu* crop extended to the following *mundakan* season. Extra-long duration, photosensitive varieties like Chettadi and Nila (160 to 180 days) are used. Long duration non – photosensitive varieties like Neeraja or Man. galamashuri (140 – 145 days) are also cultivated by the farmers. There were no second or third crops in *karingora* lands.

In case of extra-long duration photosensitive varieties like Chettadi and Nila, 50 to 60 days old seedlings were reported to be used for transplantation. Nursery is laid by July 15; seedlings transplanted between September 15 to 30 and the crop is harvested by the last week of January.

For non-photosensitive long duration varieties such as Neeraja and Mangalamashuri, 40 to 45 days old seedlings were found used for transplantation. The

transplantation of seedlings is done by first week of October , and would be harvested by mid - January.

4.1.3 *Poonthalpadams*

Poonthalpadams covers around 700 ha in Pattanchery and Muthalamada blocks of Chittur taluk. The black alkaline soil found here is highly deflocculated with excess amounts of sodium and characterized by impeded drainage and slushy soil conditions restrict use of heavy machinery. Based on the elevation and drainage, farmers have classified the *Poonthalpadam* lands into *poonthals* (ill drained low lands) and *mettuppurams* (well drained lands of medium elevation). Rice was found to be cultivated in two cropping seasons.

4.1.3.1 First crop *(Virippu)*

The *virippu* cropping season in *poonthals* starts by the first week of April and ends by the first week of October. In *mettuppurams* cropping season begins with the on-set of southwest monsoon (last weeks of May) and the crop is harvested by the first week of October. Usually 28 to 30 days old seedlings are used for transplantation.

4.1.3.2 Second crop *(Mundakan)*

For *mundakan* (second crop), in both p*oonthals* and *mettuppurams*, the nursery is prepared even before the harvest of the previous crop, i.e. during the first week of October. Generally, 45 days old seedlings are used in *poonthals* and in *mettuppurams* 28 to 30 days old seedlings are transplanted. Harvesting is done by the last week of March in *poonthals,* whereas in *mettuppurams*, harvesting will be over by the second week of February. The popular varieties reported by the farmers were the following:

Virippu: *Poonthals* - i) Bhadra ii) 'Aayirathonnumatta' ii) Mashuri iv) Neeraja. *Mundakan*: *Poonthals* - Ponmani ii) Vellamashuri. *Virippu/Mundakan: mettuppurams* - Jaya ii) Uma iii) IR – 50 iv) 'OTP – 8' v) Kanchana vi) Mattathriveni vii) TKM – 9 viii) Kairali ix) Pranava x) '17 – 27'.

4.2 Block-based evaluation of crop season calendars, rice varieties and preferred varietal attributes

4.2.1 Nemmara Agricultural Development Block

Pallassena panchayat with net rice cropped area of 1356.95 ha and with an estimated gross cropped area of 2507 ha was chosen as the sample. Rice is grown in two seasons: *virippu* and *mundakan.* Out of the 33 *Padasekharams*, Alankode was selected, owing to its highest net cropped area under rice.

4.2.1.1 Crop season calendar

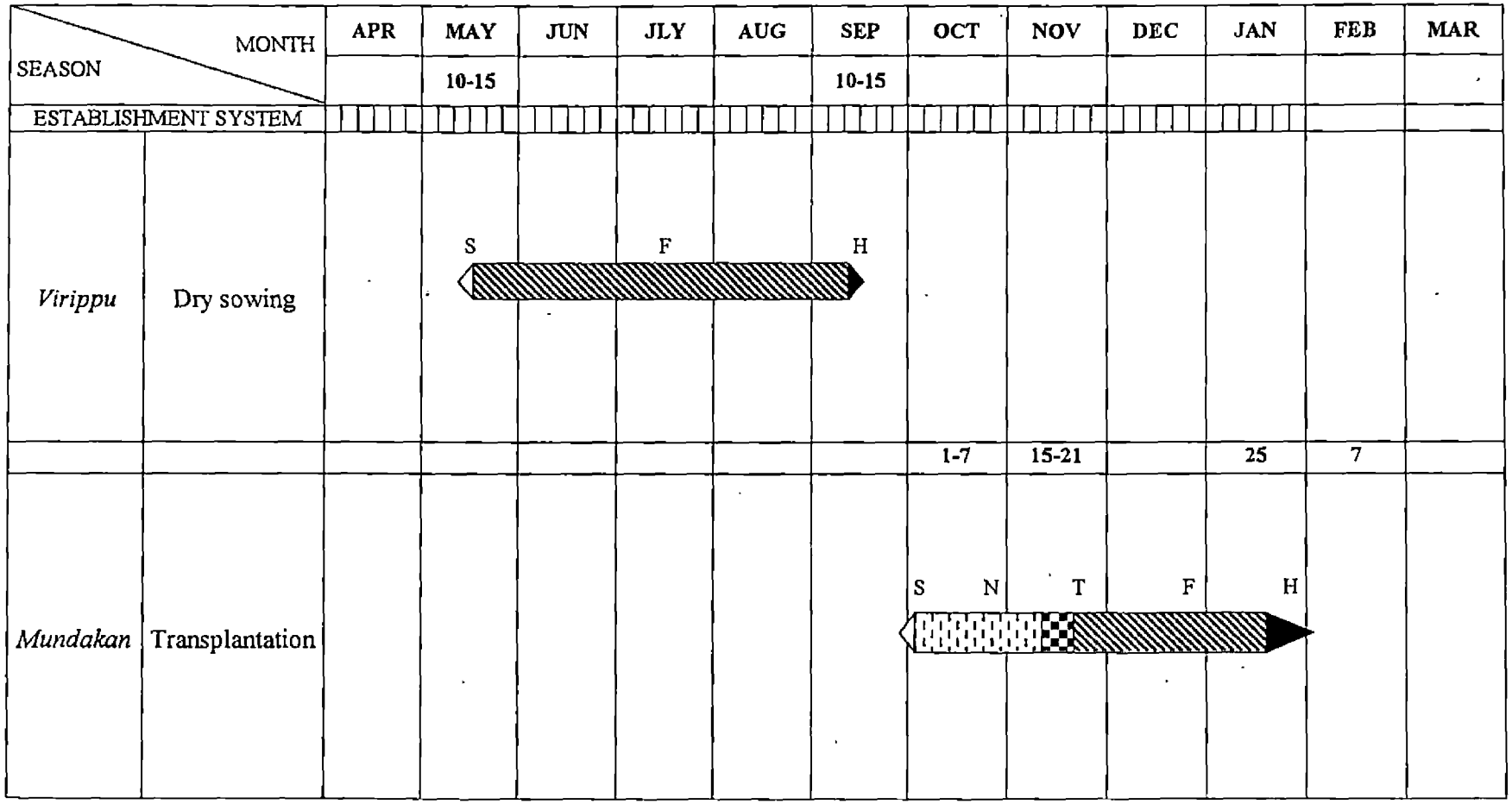
The schedule of important cultural operations in rice followed by the farmers over the cropping seasons is represented as a calendar in fig. 4.

4.2.1.2 Matrix ranking of rice varieties by the FSS and the ESS

Matrix Ranking Index (MRI) was used to rank varieties identified in Alankode *padasekharam,* the results of which are presented in table 4.

As is seen in table 4, during both *virippu* and *mundakan*, the varieties Kanchana, Aiswarya and 'Kunjukunju' were perceived as superior to others by the ESS. But according to the farmers 'Kunjukunju', Aiswarya and Pavizham were the most preferred varieties. According to the *Krishibhavan* officials, ASD-16 was the least preferred variety whereas; 'Lakshmi' was perceived to be the most inferior variety by the farmers of the *padasekharam*.

Fig. 4. Crop season calendar - Nemmara ADB (Pallassena panchayat)



S - Sowing; **N** - Nursery; **T** - Transplantation; **F** - Field; **H** - Harvest

Table 5. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Pallassana panchayat.

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	More productive tillers	2	6	
3	Market preference and demand	3	2	
4	Pest/disease tolerance	4	8	
5	More grains per panicle	5	9	
6	More grain weight	6	10	
7	Long panicle	7	7	
8	Drought tolerance	8	16	
9	Synchronised flowering	9	14	
10	Low grain shattering	10	4	0.645**
11	Less chaff	11	12	
12	High milling percentage	12	3	
13	Non-sticky rice with good keeping quality	13	11	
14	Non-lodging	14	17	
15	Reasonable yield under stress	15	13	
16	Preferred plant height	16	19	
17	Easily threshable	17	5	
18	Correct duration for season	18	20	
19	Low germination in panicle	19	18	
20	Less weight reduction on storage	20	15	

**Significant at 0.01 level

4.2.1 Koyalmannam Agricultural Development Block

Pudussery panchayat with net rice cropped area of 1714 ha was chosen as the sample. *Virippu* and *mundakan* are the two cropping seasons. Among the 17 *padasekharams*, Nellissery with an area of 50 ha was selected for the study.

4.2.2.1 Crop season calendar

The schedule of important cultural operations in rice followed by the farmers of Nellissery *padasekharam* over *virippu* and *mundakan* seasons are presented in fig. 5.

4.2.2.2 Matrix ranking of rice varieties by the FSS and the ESS

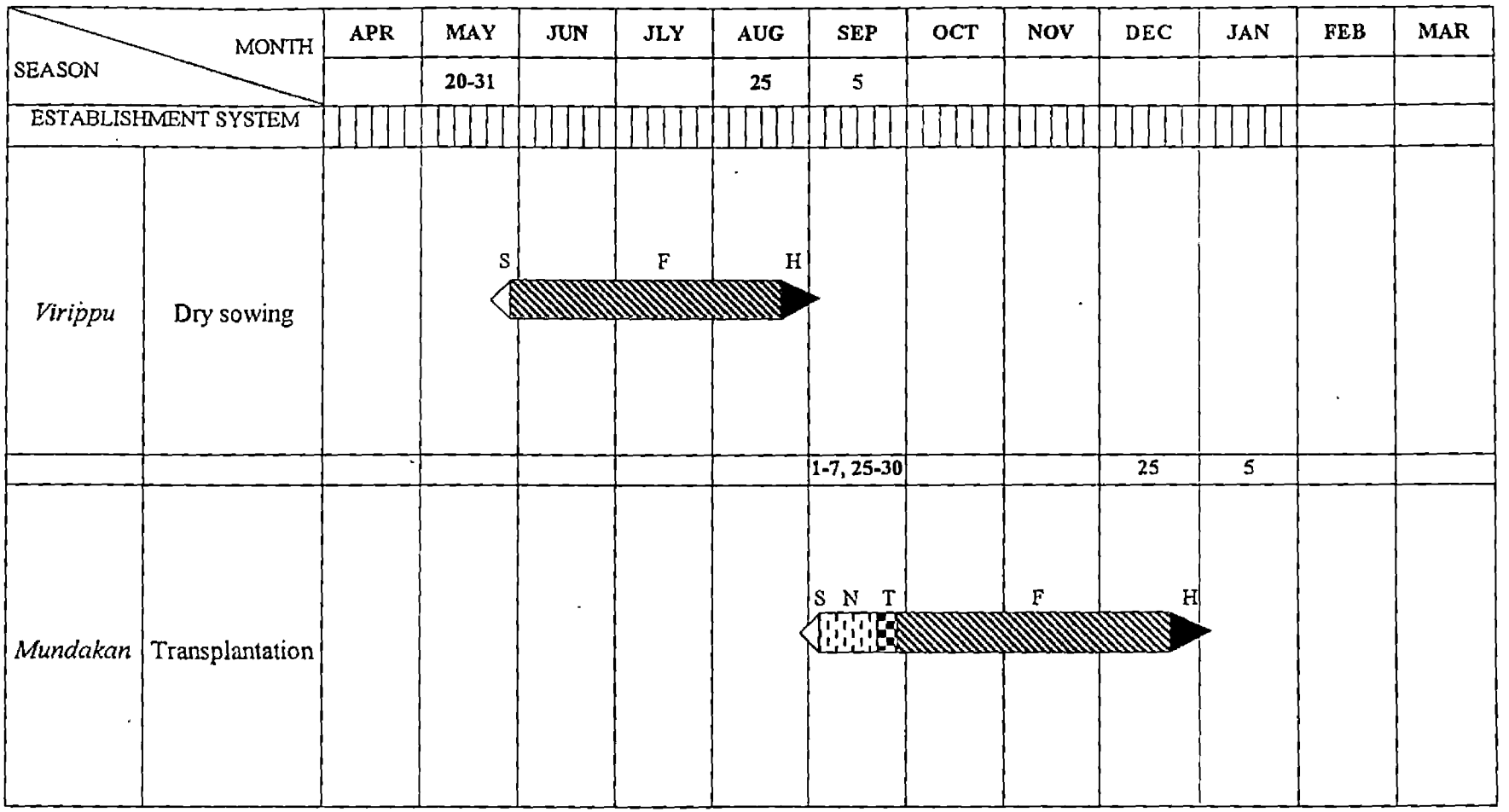
The rice varieties grown in Nellissery *padasekharam* in *virippu* and *mundakan* were ranked separately by the FSS and the ESS, by using the Ranking MRI, the results of which are given in tables 6 and 7 respectively.

Table 6. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Pudussery panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'Kunjukunju'	6.3736	1	4.2967	3	
2	TKM-9	5.4505	2	5.7802	2	
3	Kanchana	4.6264	3	6.0440	1	0.821**
4	Aiswarya	3.6923	4	3.9231	4	
5	'393'	3.1978	5	2.3846	6	
6	Kanakom	3.0220	6	3.3297	5	
7	CO-10	1.9670	7	2.2418	7	

*Significant at 0.01 level

Fig. 5. Crop season calendar - Koyalmannam ADB (Pudussery panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

It could be concluded from table 6 that the varieties Kanchana and TKM-9 were perceived to be superior to all others by the *Krishibhavan* officials. But as to the farmers of Nellissery *padasekharam*, the superior varieties were Kunjukunju, TKM-9, Kanchana, Aiswarya and '393' in the decreasing order of preference.

Table 7. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Pudussery panchayat

Sl.No.	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Ponmani	4.9861	1	4.1528	2	
2	Kanchana	4.2500	2	3.9583	4	
3	TKM-9	3.8750	3	4.2083	1	0.429^{NS}
4	Vellapponni	3.5833	4	3.6250	5	
5	'Vellamashuri'	2.6528	5	2.8333	6	
6	'Undamashuri'	2.0139	6	3.9722	3	

Table 7 revealed that Ponmani, Kanchana and TKM-9 were perceived as superior to the other varieties by the FSS, whereas TKM-9, Ponmani and 'Undamashuri' were considered as superior by the ESS of the panchayat.

4.2.2.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

The attribute rank order provided in table 8 highlights the relative perception of *Krishibhavan* officials and rice farmers of Pudussery Panchayat with respect to the preferred varietal attributes perceived by the FSS.

Table 8. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Pudussery panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	5	
2	More grain weight	2	2	
3	Market preference and demand	3	3	
4	Low grain shattering	4	13	
5	Drought tolerance	5	1	
6	Deep and spreading roots	6	12	0.477*
7	Pest and diseases tolerance	7	4	
8	Bold and red grains for market	8	6	
9	Correct duration for season	9	10	
10	Multi planting system adaptability	10	9	
11	Easily threshable	13	11	
12	Non-lodging	12	7	
13	Secured seed supply	11	14	
14	Less cooking time required	14	8	

*Significant at 0.05 level

Fourteen attributes were perceived as significant in the varietal selection of the rice farmers of the panchayat. The ranking in the decreasing order of their significance as perceived by the ESS is provided in table 8. According to the FSS, 'good yield', 'more grain weight', 'market preference and demand', 'low grain shattering' and 'drought tolerance' were the most significant among the list.

4.2.3 Shoranur Agricultural Development Block

Vaniyamkulam panchayat with net rice cropped area of 489 ha was chosen as the sample. Rice was found to be cultivated in two cropping seasons *virippu* and *mundakan*. Out of the 13 *padasekharams*, Panayoor *padasekharam* with an area of 50.9 ha was selected for the study.

4.2.3.1 Crop season calendar

The schedule of important cultural operations followed by the farmers of Panayoor *padasekharan* over *virippu* and *mundakan* are given in fig. 6.

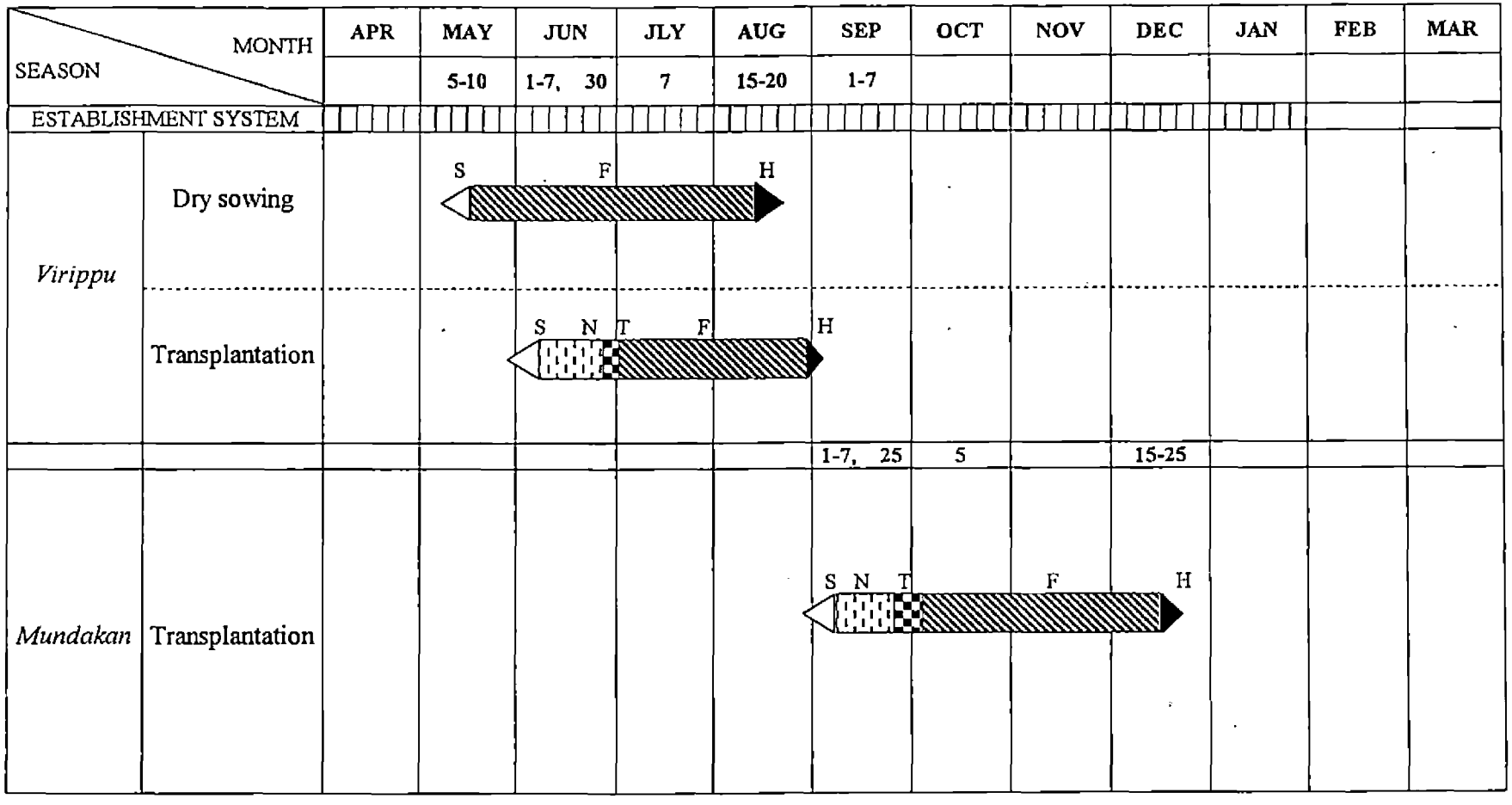
4.2.3.1 Matrix ranking of rice varieties by the FSS and the ESS

The rice varieties grown in Panayoor *padasekharam* in *virippu* and *mundakan* seasons were ranked separately by the ESS and FSS using MRI. The results are given in tables 9 and 10 respectively.

Table 9. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Vaniyamkulam panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'010'	7.9583	1	7.9167	1	0.3714^{NS}
2	Jyothi	6.2292	2	4.6563	3	
3	Athira	4.5937	3	4.1354	5	
4	'Undamashuri'	4.0417	4	3.5208	6	
5	Aiswarya	3.5625	5	4.9271	2	
6	Kanchana	3.3646	6	4.5313	4	

Fig. 6 Crop season calendar - Shoranur ADB (Vaniyamkulam panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

It could be concluded from table 9 that the non-descript strain '010' was perceived as superior to the rest of the *virippu* varieties, by both the FSS and the ESS. For the ESS, the least preferred varieties were Athira and 'Undamashuri', but for the FSS, they were Aiswarya and Kanchana.

Table 10. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Vaniyamkulam panchayat

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Chitteni	5.9632	1	6.0809	2	
2	Vellari	5.5735	2	5.8456	3	
3	Athira	5.5074	3	5.1471	4	
4	CO-10	5.3235	4	4.4118	7	0.560^{NS}
5	Ponmani	5.2426	5	6.2132	1	
6	Aiswarya	5.0441	6	4.9485	5	
7	'Undamashuri'	4.000	7	4.5662	6	
8	Cheera	4.000	7	3.4412	8	

The most preferred varieties for the ESS were Ponmani, Chitteni and Vellari. But Chitteni stood first in the perception of farmers, followed by Vellari, Athira and CO-10. (Table 10)

4.2.3.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

Table 11 highlights the relative perception of *Krishibhavan* officials and rice farmers of Vaniyamkulam panchayat, with respect to the preferred varietal attributes perceived by the FSS.

Table 11. Ranking of preferred attributes of rice varieties by the FSS and the ESS Vaniyamkulam panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	2	
2	Pest/disease tolerance	2	9	
3	Market preference and demand	3	1	
4	More grain weight	4	6	
5	More grains per panicle	5	5	
6	Long panicle	6	4	
7	More productive tillers	7	3	
8	Non-sticky rice with good keeping quality	8	17	
9	Easily threshable	9	15	0.566**
10	Non-lodging	10	11	
11	Good taste	11	18	
12	Low grain shattering	12	14	
13	High milling percentage	13	16	
14	Correct duration for season	14	7	
15	Preferred plant height	15	8	
16	Reasonable yield under stress	16	12	
17	Synchronized flowering	17	10	
18	Drought tolerance	18	13	
19	Awn less grains	19	19	

** Significant at 0.01 level

The analysis of rank orders given in table 11 suggested that, according to the ESS, attributes like market preference and demand, good yield, more productive

tillers, long panicle and more grains per panicle were perceived most decisive in rice varietal selection by the farmers of Vaniyamkulam panchayat. The *Krishibhavan* officials opined that farmers' demand for 'awn less varieties' were mostly insignificant. The FSS also had a similar opinion about the significance of the trait mentioned above. But, they contradicted the opinion of ESS in assigning ranks to the rest of the attributes. According to the FSS, 'good yield', 'pest/disease tolerance', 'market preference and demand', 'more grain weight' and 'more grains per panicle' were the most significant varietal selection criteria followed by the farmers.

4.2.4 Palakkad Agricultural Development Block

The total net-cropped area of rice in Parali panchayat is 467 ha and the same was chosen as the sample. Rice is cultivated mainly in *virippu* and *mundakan* seasons. From the 18 *padasekharams* in the panchayat, Odannur was selected for the study.

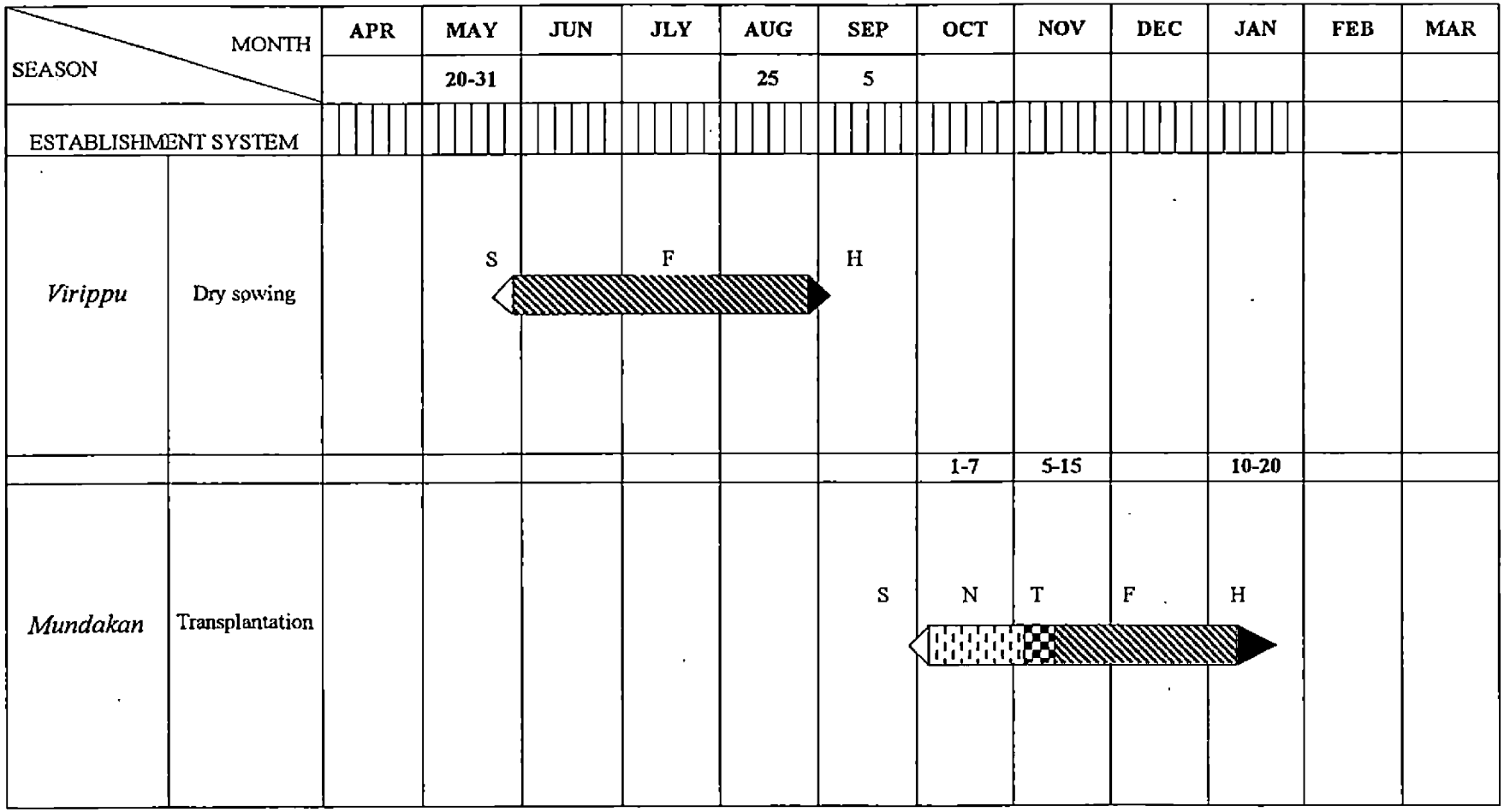
4.2.4.1 Crop season calendar

The schedule of important cultural operations followed by the farmers of Odannur *padasekharan* over *virippu* and *mundakan* seasons are presented in fig. 7.

4.2.4.2 Matrix ranking of rice varieties by the FSS and the ESS

The varieties grown in Odannur *padasekharam* in *virippu* and *mundakan* seasons were ranked independently by the FSS and the ESS using MRI, the results of which are presented in tables 12 and 13 respectively.

Fig. 7. Crop season calendar – Palakkad ADB (Parali panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

Table 12. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Parali panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Pavizham	7.2157	1	7.4216	1	1.00**
2	'Kunjukunju'	6.7451	2	7.3824	2	
3	Aiswarya	5.1569	3	5.1176	3	
4	'Cheriyakanchana'	4.2745	4	4.4510	4	
5	ASD-16	4.0784	5	3.5980	5	
6	Athira	3.2059	6	3.5294	6	

**Perfect correlation

It could be concluded from table 12 that the varietal preferences of the ESS matched exactly with that of the FSS. Pavizham, 'Kunjukunju' and Aiswarya were perceived as superior to 'Cheriyakanchana'; and ASD-16 and Athira for *virippu* season.

Table 13. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Parali panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'Valiyakanchana'	6.3289	1	6.0000	1	0.900**
2	ASD-16	5.5586	2	4.7529	3	
3	Aiswarya	5.5143	3	5.6000	2	
4	Vellapponni	5.1082	4	5.2994	4	
5	Athira	4.3558	5	4.7176	5	

** Significant at 0.01 level

Table 13 revealed that 'Valiyakanchana' and Aiswarya were perceived as superior by the ESS whereas, the respondents from the FSS considered 'Valiyakanchana' and ASD-16 as superior.

4.2.4.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

List of varietal attributes with respective rank positions as perceived by the FSS and the ESS of the panchayat are given in table 14.

Table 14. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Parali panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	Market preference and demand	2	12	
3	More productive tillers	3	3	
4	More grains per panicle	4	5	
5	Long panicle	5	4	
6	Low grain shattering	6	7	
7	More grain weight	7	9	
8	High milling percentage	8	8	
9	Less chaff	9	10	
10	Pest/disease tolerance	10	6	
11	Bold and red grains for market	11	2	0.735**
12	Non-sticky rice with good keeping quality	12	17	
13	Good taste	13	19	
14	Non-lodging	14	11	
15	Easily threshable	15	15	
16	Preferred plant height	16	13	
17	Correct duration for season	17	14	
18	Quality flour	18	18	
19	Quality straw	19	16	

** Significant at 0.01 level

The ranks presented in table 14 revealed that the attributes, 'good yield', 'bold and red grains for market', 'more productive tillers', 'long panicle' and 'more grains per panicle' were perceived as most relevant by the *Krishibhavan* officials while, the FSS considered 'good yield', 'market preference and demand', more productive tillers', 'more grains per panicle' and 'long panicle' as most significant in rice varietal selections.

4.2.5 Kollengode Agriculture Development Block

Elappulli panchayat with net rice cropped area of 1804 ha was chosen as the sample. Rice is cultivated mainly in two seasons, *virippu* and *mundakan*. In Elappulli, there are 18 *padasekharams*, out of which Pallavakkadu *padasekharam* with net rice area of 126 ha was selected for the study.

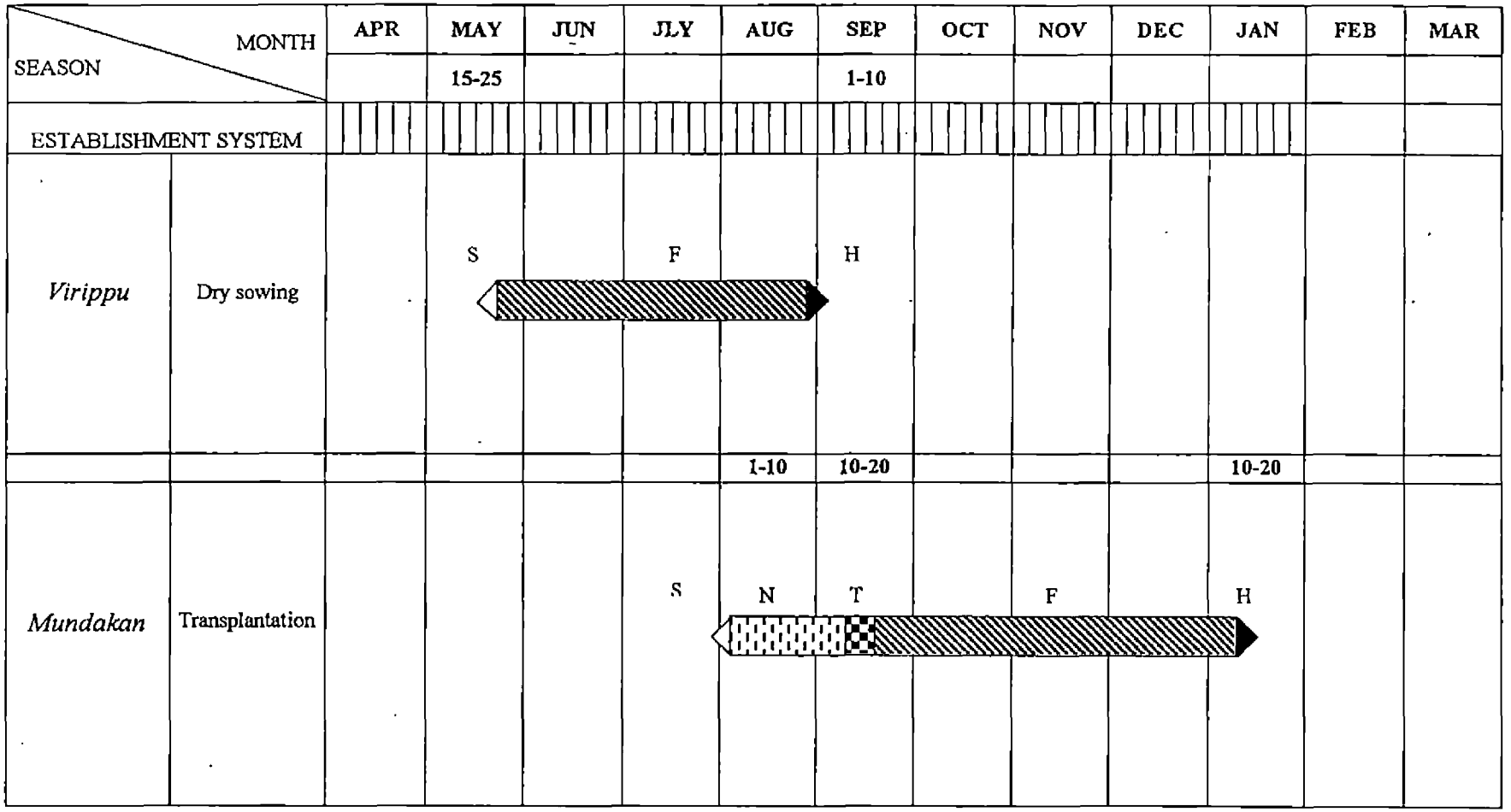
4.2.5.1 Crop season calendar

The schedule of important cultural operations in rice followed by the farmers of the panchayat over the cropping seasons are presented as a calendar in fig. 8.

4.2.5.2 Matrix ranking of rice varieties by the FSS and the ESS

The rice varieties cultivated by the farmers of Pallavakkadu *padasekharam* during *virippu* and *mundakan* were ranked independently by the FSS and the ESS. Later these ranks were summarized employing MRI. The results of the exercises are combined in tables 15 and 16 respectively.

Fig. 8. Crop season calendar – Kollengode ADB (Elappulli panchayat)



S - Sowing; **N** - Nursery; **T** - Transplantation; **F** - Field; **H** - Harvest

Table 15. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Elappulli panchayat

Sl.No.	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'Kunjukunju'	5.6148	1	5.5037	1	0.816**
2	Kanakom	5.3481	2	4.8667	3	
3	ASD-16	5.1259	3	4.9852	2	
4	TKM-9	4.9630	4	4.2074	7	
5	Kanchana	4.2296	5	4.3037	6	
6	Paiyur-1	4.1037	6	4.4444	5	
7	'Lakshmi'	4.0963	7	4.5407	4	
8	Bhadra	3.9259	8	3.9111	8	
9	Bharathi	2.5111	9	3.2370	9	

** Significant at 0.01 level

Table 16. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Elappulli panchayat

Sl.No.	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'Kunjukunju'	6.0000	1	5.5111	2	0.772^{NS}
2	TKM-9	5.6222	2	5.6778	1	
3	Ponmani	5.3444	3	5.2889	3	
4	ASD-16	4.1333	4	3.3778	6	
5	Vellapponni	3.6667	5	4.6000	4	
6	Paiyur-1	3.2333	6	3.5444	5	

It could be concluded from table 15 that the FSS and the ESS perfectly matched in their preference ranking for the most superior and least superior varieties i.e., 'Kunjukunju' and Bharathi respectively.

TKM-9, 'Kunjukunju' and Ponmani were the varieties ranked superior by the ESS, while to the FSS, the rank order was, 'Kunjukunju', TKM-9 and Ponmani. ASD-16 was considered to be the least important variety by the ESS. Farmers were of the view that Payyur-1 was inferior to the all the rest (Table 16).

4.2.5.3 Ranking of preferred attributes of rice varieties by the ESS and FSS

The attribute rank orders given in table 17 reflect the perception of the *Krishibhavan* officials and the farmers of Pallavakkadu *padasekharam* with regard to the preferred varietal attributes.

Table 17. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Elappulli panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	-0.003 NS
2	Market preference and demand	2	6	
3	More productive tillers	3	2	
4	More grains per panicle	4	5	
5	More grain weight	5	4	
6	High milling percentage	6	9	
7	Low grain shattering	7	11	
8	Reasonable yield under stress	8	13	
9	Good taste	9	15	
10	Drought tolerance	10	12	
11	Pest and disease tolerance	11	3	
12	Bold and white grains for home	12	17	
13	Correct duration for season	13	7	
14	Non-lodging	14	8	
15	Easily threshable	15	10	
16	Less weight reduction on storage	16	14	
17	Preferred plant height	17	16	

Table 17 revealed that out of the 17 preferred attributes 'good yield' was considered the most important by both the sub systems. 'Bold and white grains for home' and 'preferred plant height' were perceived to be the least significant varietal selection criteria by the ESS. The attributes 'preferred plant height' and 'less weight reduction on storage of grains' were considered least important by the FSS.

4.2.6 Erimayur panchayat (Alathur block)

Erimayur panchayat with net rice cropped area of 1152 ha and gross cropped area of 2740 ha was chosen as the sample. Cultivation of rice is confined to *virippu* and *mundakan* seasons. It has 26 *padasekharams* from which Ambalapparambu *padasekharam* with a total net sown area of 123.32 ha was selected for the study.

4.2.6.1 Crop season calendar

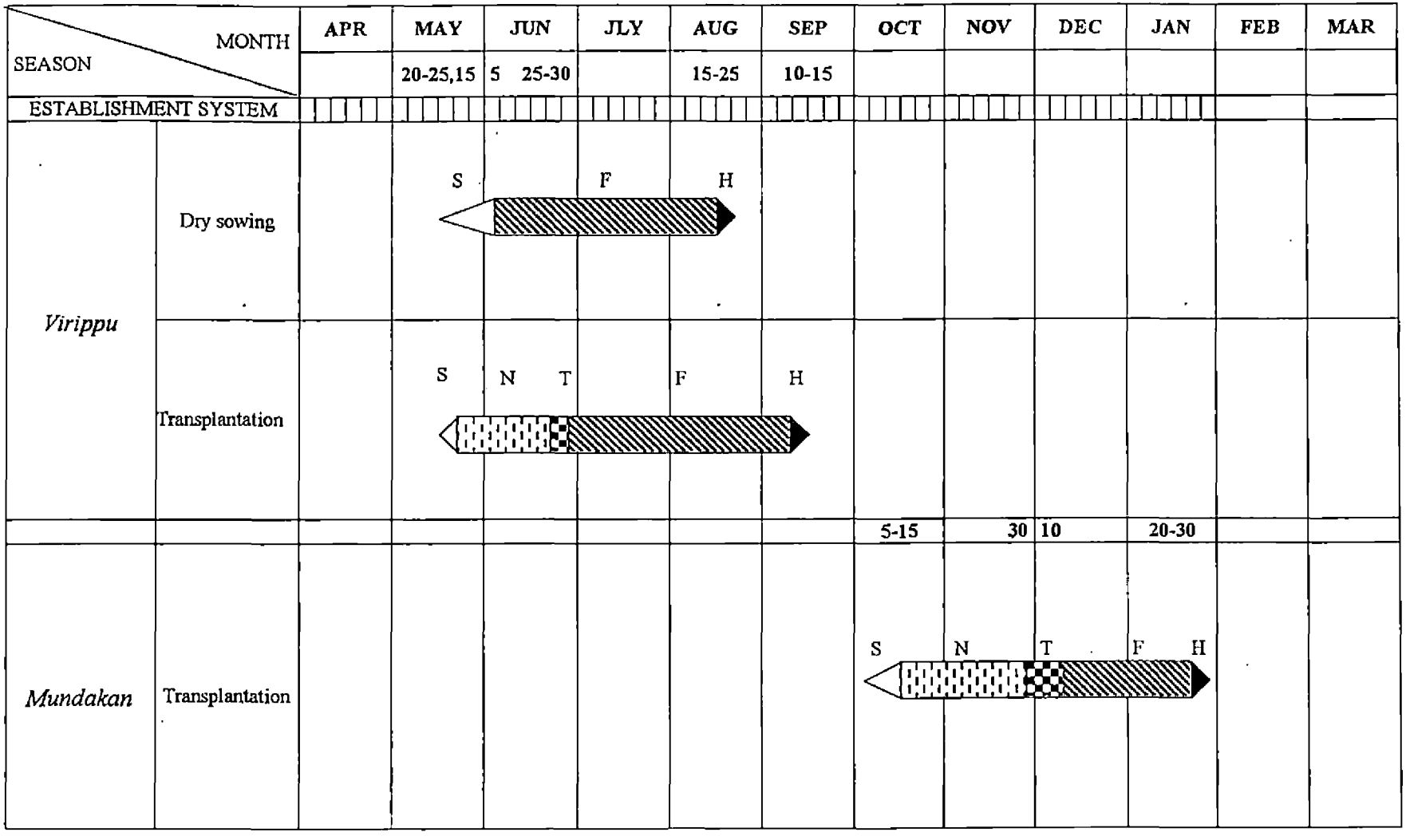
The schedule of important cultural operations followed by the farmers of Ambalapparambu *padasekharam* is given in fig. 9.

4.2.6.2 Matrix ranking of rice varieties by the FSS and the ESS

Matrix ranking index (MRI) was employed to rank varieties in Ambalapparambu *padasekharam* as perceived by the FSS and the ESS. The results of matrix ranking exercise are given in table 18.

It could be concluded from table 18 that both the FSS and the ESS agreed perfectly on ranking the first two preferred varieties viz., 'Kunjukunju' and Kanchana.

Fig. 9. Crop season calendar – Alathur ADB (Erimayur panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

As to the ESS, the least preferred variety was Pranava; whereasf for the FSS, it was ASD-16.

Table 18. Matrix ranking of rice varieties by the FSS and the ESS of Erimayur panchayat

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'Kunjukunju'	5.9340	1	6.6373	1	0.392^{NS}
2	Kanchana	4.6593	2	5.6263	2	
3	Aiswarya	4.0439	3	2.9230	6	
4	Mattathriveni	4.0109	4	3.2857	5	
5	Pranava	3.8681	5	1.7912	7	
6	'Kalyani'	3.1318	6	3.4285	4	
7	ASD-16	2.3516	7	4.3076	3	

4.2.6.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

A comprehensive list of preferred varietal attributes and their respective rank orders are presented in table 19.

The analysis of attribute rank orders provided in table 19 revealed that as for the ESS, varietal attributes like 'good yield', 'market preference and demand', 'pest/disease tolerance', 'drought tolerance' and 'non-lodging nature of the crop' were perceived to be the most important in deciding the varietal choice of the rice farmers. But as far as the FSS is concerned, the preference ranking matched with that of the ESS only in case a few attributes such as 'good yield', 'marketing performance and demand', 'correct duration for season' and 'high milling percentage'.

Table 19. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Erimayur panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	Market preference and demand	2	2	
3	Less chaff	3	7	
4	Easily threshable	4	10	
5	Pest/disease tolerance	5	3	
6	Non-lodging	6	5	
7	Low grain shattering	7	15	
8	Correct duration for season	8	8	0.571*
9	Reasonable yield under stress	9	12	
10	Drought tolerance	10	4	
11	More grain weight	11	6	
12	Preferred plant height	12	14	
13	High milling percentage	13	13	
14	Good taste	14	11	
15	Less weight reduction on storage	15	9	

* Significant at 0.05 level

4.2.7 Pattambi Agricultural Development Block

Kulukkallur panchayat with net rice cropped area of 362 ha was chosen as the sample. Rice is cultivated in both *virippu* and *mundakan*. There are eight *padasekharams* in the panchayat and owing to the highest net cropped area, Vandumthara *padasekharam* was selected for the study.

4.2.7.1 Crop season calendar

The schedule of important cultural operations followed by the farmers of Vandumthara *padasekharan* over different cropping seasons is given in fig. 10.

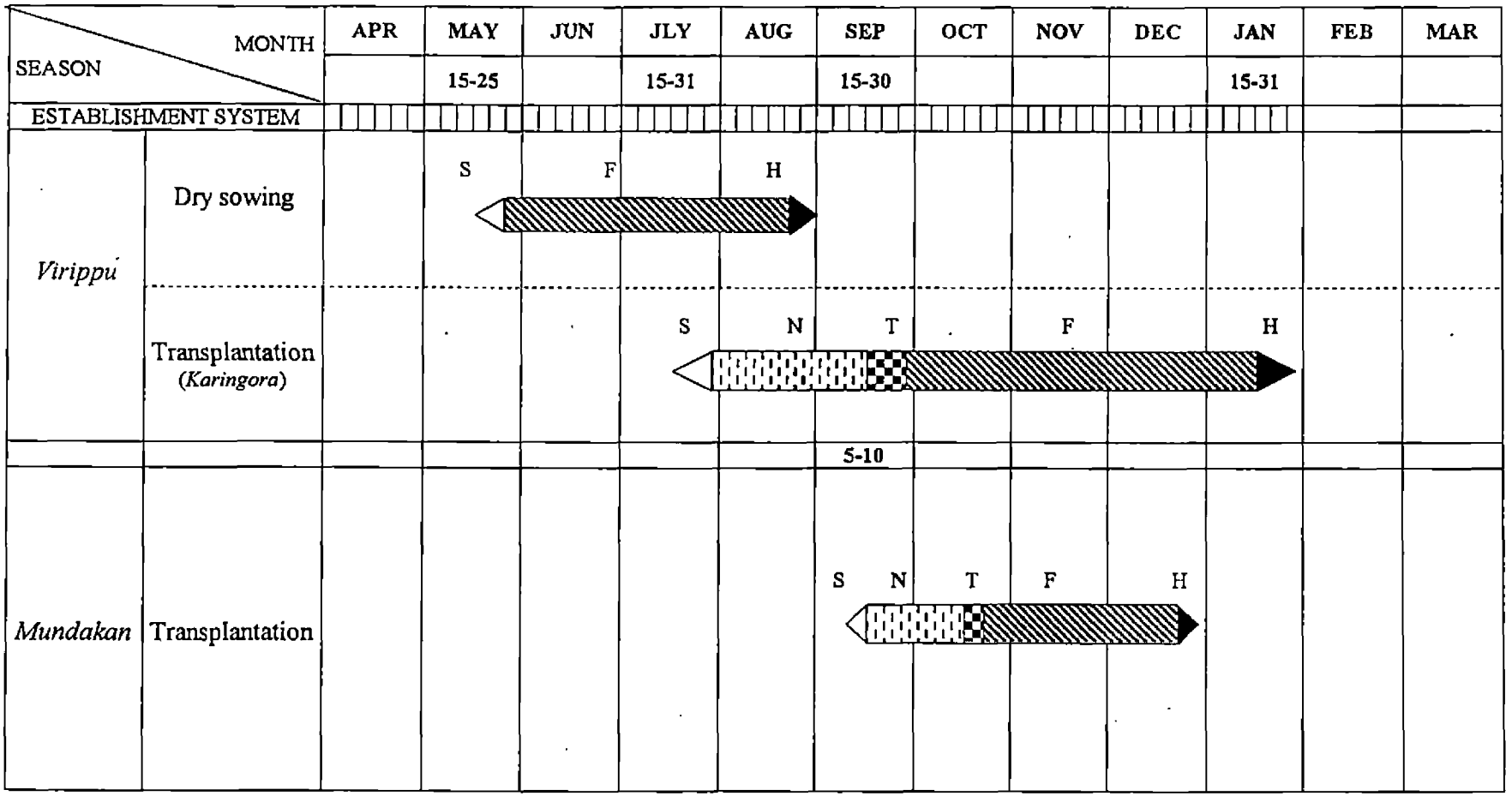
4.2.7.2 Matrix ranking of rice varieties by the FSS and the ESS

MRI was used to rank the varieties cultivated in Vandumthara *padasekharam* over different cropping seasons. The results are provided in tables 20 and 21.

Table 20. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Kulukkallur panchayat

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Aiswarya	4.3000	1	2.5222	7	
2	Veluthettan	3.8667	2	2.9444	6	
3	Athira	3.1444	3	3.2000	5	
4	Jyothi	2.9778	4	3.7333	1	0.200^{NS}
5	Aryan	2.8667	5	3.3333	4	
6	Chenkazhama	2.7889	6	3.3889	3	
7	Jaya	2.7556	7	2.3556	9	
8	'010'	2.5778	8	3.6000	2	
9	Mattathriveni	2.2222	9	2.4222	8	

Fig. 10. Crop season calendar - Pattambi ADB (Kulukkallur panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

Table 21. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Kulukkallur panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Vellachettadi	4.3000	1	4.8200	1	0.200^{NS}
2	'Karna'	3.9600	2	2.6800	5	
3	Neeraja	3.3800	3	2.8600	3	
4	Jaya	2.8400	4	2.6801	4	
5	'Rocket'	2.0200	5	3.4600	2	

It could be summarized from the rank orders given in table 20 that, for *virippu*, varieties such as Jyothi and Athira were perceived to be superior to the rest by the ESS. The FSS considered Aiswarya and 'Veluthettan' as the most preferred varieties.

Table 21 revealed the ranks assigned to the five *mundakan* varieties, as perceived by the farmers of Vandumthara *padasekharam* and by the *Krishibhavan* officials. Both the FSS and the ESS perceived that Vellachettadi was the most superior among the five cultivated varieties. *Krishibhavan* officials were of the opinion that 'Karna' and 'Rocket' were the least preferred rice varieties, but the farmers were of the view that 'Karna' was preferred next to Vellachettadi.

4.2.7.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

A list of 12 preferred varietal attributes was prepared by the rice farmers of Vandumthara *padasekharam*, which was then ranked according to their importance by the respondents from both the FSS and the ESS. The results are summarized in table 22.

Varietal attributes such as 'good yield', and 'pest/disease tolerance' were perceived to be highly decisive in farmers' varietal selection by both the FSS and the ESS. The attribute, 'preferred plant height' was considered least significant by the FSS while, the attribute, 'more grains per panicle' was perceived to be of least relevance by the ESS (Table 22).

4.2.8 Thrithala Agricultural Development Block

Thrithala panchayat with net rice cropped area of 302 ha was chosen as the sample. Rice is grown in two seasons: *virippu* and *mundakan*. Out of the 15 *padasekharams*, V.K. Kadavu was selected, owing to its highest net-cropped area under rice.

Table 22. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Kulukkallur panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	Pest/disease tolerance	2	2	
3	More grain weight	3	10	
4	More grains per panicle	4	12	
5	High milling percentage	5	11	
6	More productive tillers	6	5	0.147^{NS}
7	Non-lodging	7	3	
8	Good taste	8	7	
9	Low germination in panicle	9	8	
10	Correct duration for season	10	4	
11	Drought tolerance	11	9	
12	Preferred plant height	12	6	

Table 23. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Thrithala panchayat

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Jyothi	6.2917	1	6.8125	1	0.942*
2	Aiswarya	5.7188	2	6.5625	2	
3	Kanchana	5.6354	3	6.3854	3	
4	Jaya	5.1667	4	4.6145	5	
5	Mattathriveni	4.4688	5	4.7292	4	
6	Aannapoorna	2.4688	6	2.8333	6	

* Significant at 0.05 level

4.2.8.1 Crop season calendar

The schedule of important cultural operations in rice followed by the farmers over different cropping seasons is presented as a calendar in fig. 11.

4.2.8.2 Matrix ranking of rice varieties by the FSS and the ESS

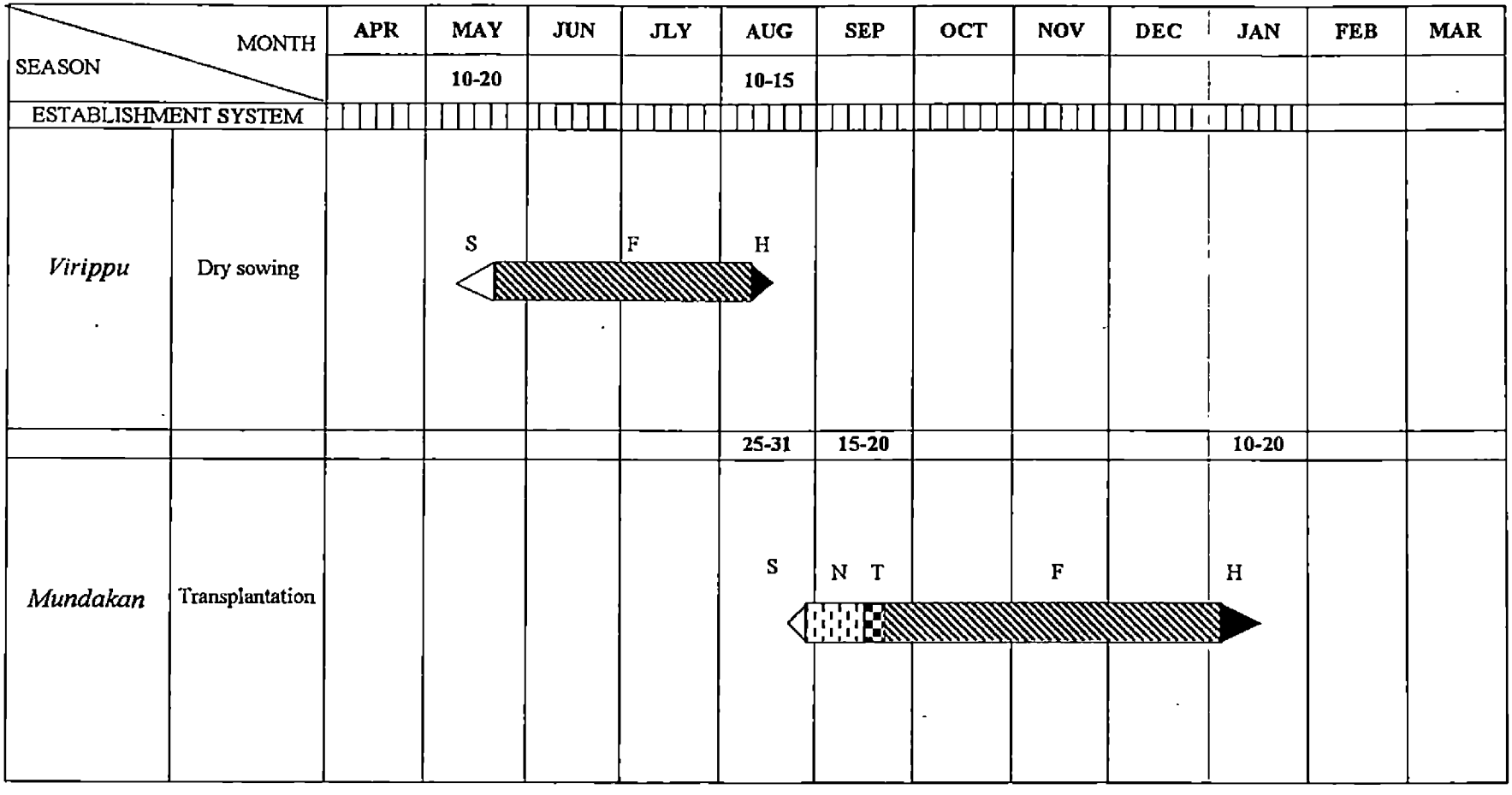
MRI was used to rank the varieties identified in V.K. Kadavu *padasekharam* during *virippu* and *mundakan*. The results are presented in tables 23 and 24 respectively.

It is clear from the rank orders given in table 23 that both the FSS and the ESS preferred Jyothi, Aiswarya and Kanchana to the other varieties. Similarly, least preference was given to the variety Aannapoorna by both the subsystems.

Table 24. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Thrithala panchayat

Sl No.	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
	Aiswaraya	5.5375	1	5.7625	2	0.400^{NS}
	Kanchana	5.3125	2	5.6000	3	
		5.3000	3	5.1250	4	
		5.1125	4	5.9000	1	
		4.2375	5	3.1125	5	

Fig. 11. Crop season calendar – Thrithala ADB (Thrithala panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

Chitteni and Aiswarya were ranked superior to the other varieties by the FSS and the ESS respectively, while Mattathriveni was considered most inferior by both the subsystems (Table 24).

4.2.8.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

The varietal attributes rank order presented in table 25 reflects the relative perception of *Krishibhavan* officials and rice farmers of Thrithala panchayat.

Table 25. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Thrithala panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	More productive tillers	2	6	
3	Market preference and demand	3	2	
4	Pest/disease tolerance	4	8	
5	More grains per panicle	5	9	
6	More grain weight	6	10	
7	Long panicle	7	7	
8	Synchronised flowering	8	12	
9	Low grain shattering	9	4	
10	High milling percentage	10	3	
11	Non sticky rice with good cooking quality	11	11	0.690**
12	Non-lodging	12	15	
13	Taste	13	14	
14	Reasonable yield under stress	14	13	
15	Correct duration for season	15	18	
16	Easily threshable	16	5	
17	Preferred plant height	17	17	
18	Less cooking time required	18	16	

** Significant at 0.01 level

According to the respondents from the ESS, 'good yield', 'market preference and demand', 'high milling percentage', 'low grain shattering' and 'easily threshable' grains were the most important from farmers' point of view. But, according to the farmers, 'good yield', 'long panicle', 'market preference and demand', 'pest/disease tolerance' and 'more grains per panicle' was the most preferred varietal attributes (Table 25).

4.2.9 Chittur Agricultural Development Block (*Poonthalpadams*)

Pattanchery panchayat with net rice cropped area of 1627.28 ha with an estimated gross cropped area of 3255 ha, was chosen as the sample for the *Poonthalpadams* rice production system. Rice is cultivated in '*mettuppurams*' and '*poonthals*' mainly in two seasons, *virippu* and *mundakan*. Out of the 24 *padasekharams*, Kavarathode was selected owing to the presence of a sizeable area of *'Poonthalpadams'*.

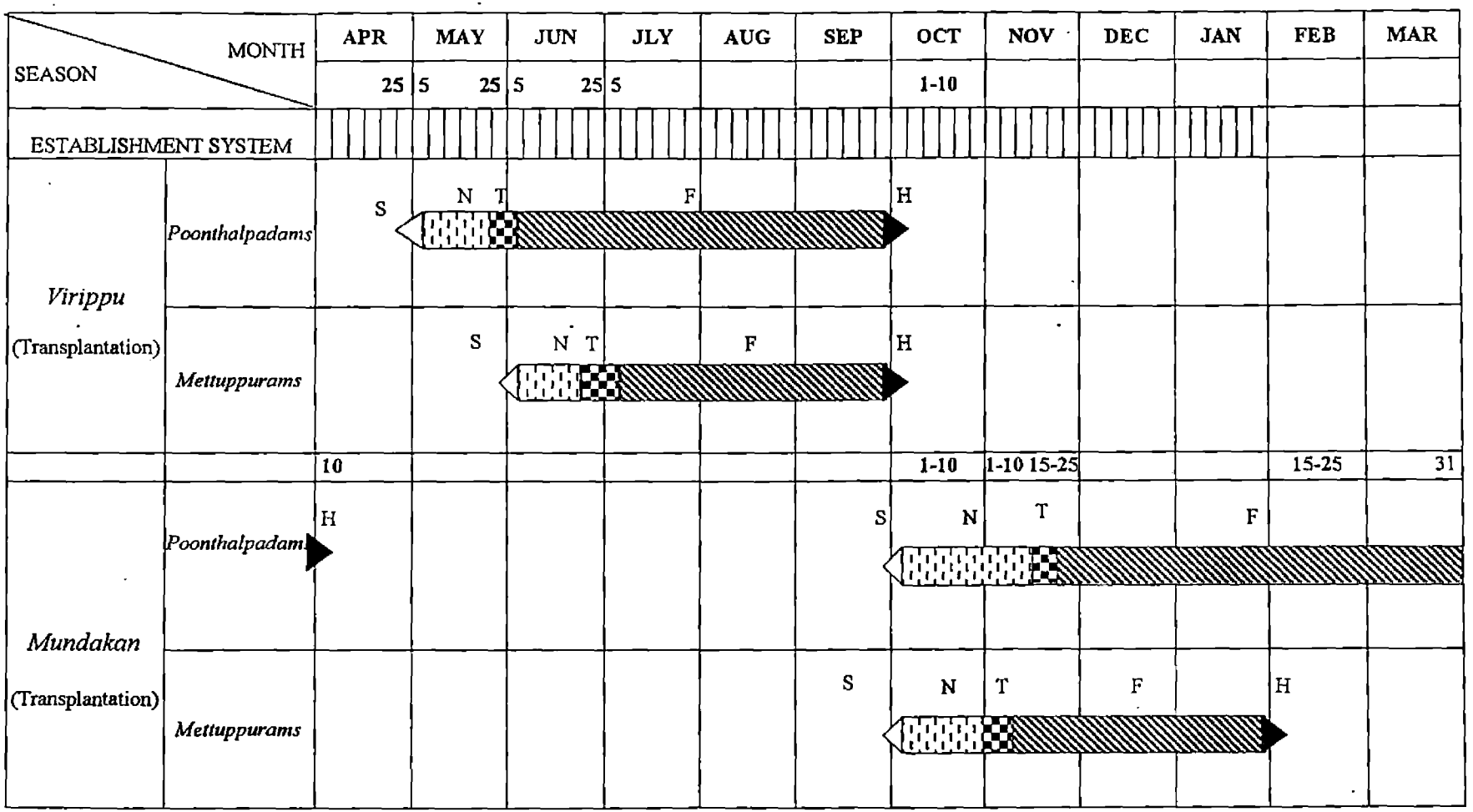
4.2.9.1 Crop season calendar

The schedule of important cultural operations in rice followed by the farmers over different cropping seasons under different systems is presented as a calendar in fig. 12.

4.2.9.2 Matrix ranking of rice varieties by the FSS and the ESS

MRI was used to rank the varieties identified in Kavarathode *padasekharam*. Matrices for varieties grown in *mettuppurams* and *poonthals* were prepared separately by both the FSS and the ESS. The results of these exercises are presented in tables 26, 27and 28.

Fig. 12. Crop season calendar – Chittur ADB (Pattanchery panchayat) - ***Poonthalpadams***



S - Sowing; N - Nursery; T - Transplantation; F - Field; H – Harvest

Table 26. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Pattanchery panchayat (*mettuppuram*)

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Uma	7.2900	1	3.6950	9	
2	TKM-9	7.4650	2	7.4850	2	
3	'17-27'	6.6650	3	7.4100	3	
4	Kanchana	5.3750	4	4.9650	8	
5	IR-50	5.3200	5	5.5250	6	0.072^{NS}
6	Jaya	5.2650	6	6.1250	4	
7	Pranava	5.2000	7	7.8550	1	
8	'OTP-8'	5.1100	8	3.5350	10	
9	Mattathriveni	5.0300	9	5.8850	5	
10	Kairali	5.0300	9	5.2700	7	

Pranava, TKM-9 and '17-27' were perceived to be superior to the other varieties by the ESS while the first preference was given to Uma by the FSS (Table 26).

Table 27. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Pattanchery panchayat (*poonthals*)

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Mashuri	8.4625	1	6.4625	2	
2	'Aayirathonnumatta'	6.7000	2	8.8500	1	0.600^{NS}
3	Neeraja	6.1250	3	5.1750	4	
4	Bhadra	4.9625	4	5.7625	3	

Out of the four varieties identified and ranked, 'Aayirathonnumatta' and Mashuri were perceived to be superior by the ESS. But farmers preferred Mashuri to 'Aayirathonnumatta' (Table 27).

Table 28. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Pattanchery panchayat (*poonthals*)

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Ponmani	9.6667	1	9.5952	1	1.00**
2	'Vellamashuri'	6.8333	2	6.9048	2	

**Perfect correlation

Analysis of table 28 revealed that Ponmani was considered superior to 'Vellamashuri' by both the subsystems.

4.2.9.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

The comprehensive list of preferred varietal attributes and their respective rank orders as perceived by the ESS and FSS are presented in table 29.

It could be concluded from table 29 that 'good yield', 'market preference and demand', 'high milling percentage', 'more grain weight' and 'pest/disease tolerance' were decisive in farmers' varietal selection as perceived by the ESS. According to the farmers, 'good yield', 'more grains per panicle', 'pest and disease tolerance', 'tolerance to yellowing' and 'high milling percentage' were the most significant varietal attributes.

Table 29. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Pattanchery panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	More grains per panicle	2	7	
3	Pest/disease tolerance	3	5	
4	Tolerance to yellowing	4	22	
5	High milling percentage	5	3	
6	More grain weight	6	4	
7	More productive tillers	7	9	
8	Synchronised flowering	8	10	
9	Long panicle	9	19	
10	Low grain shattering	10	6	
11	Market preference and demand	11	2	0.594**
12	Quality flour	12	12	
13	Good taste	13	8	
14	Less chaff	14	13	
15	Non-lodging	15	14	
16	Tolerance to poor drainage	16	20	
17	Shade tolerance	17	15	
18	Correct duration for season	18	23	
19	Low germination in panicle	19	21	
20	Good stem girth	20	17	
21	Preferred plant height	21	16	
22	Easily threshable	22	11	
23	Non-sticky rice with good keeping quality	23	18	

** Significant at 0.01 level

4.2.10 Chittur Agricultural development Block

Nalleppilly panchayat with net rice cropped area of 2151 ha was chosen as the sample for representing the whole of Chittur ADB. Rice is cultivated in *virippu* and *mundakan*. Out of the 27 *padasekharams* identified in the panchayat, Appuppillayur was selected for the study.

4.2.10.1 Crop season calendar

The schedule of important cultural operations in rice followed by the farmers over different cropping seasons is presented in a calendar (Figure 13).

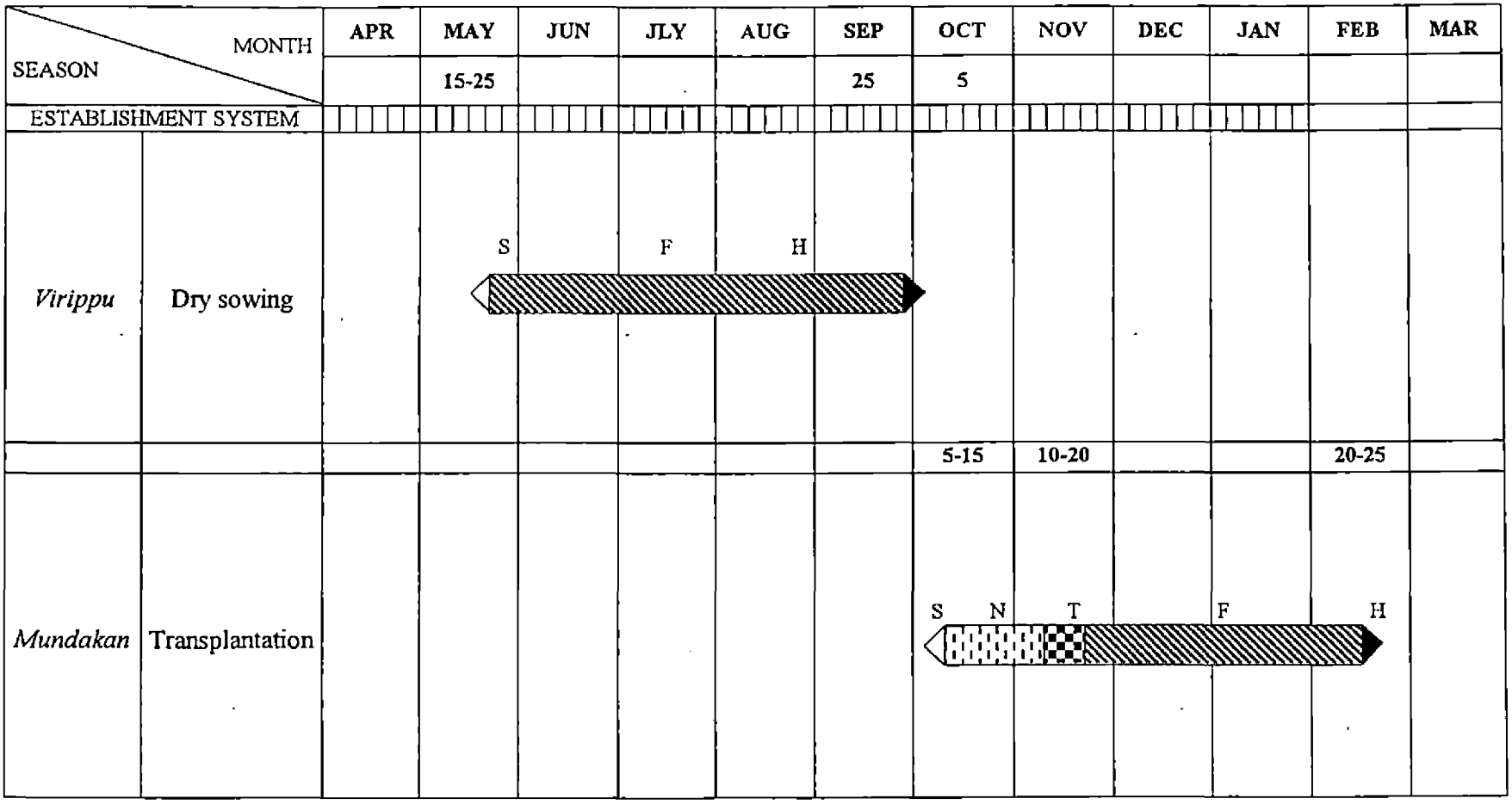
4.2.10.2 Matrix ranking of rice varieties by the FSS and the ESS

MRI was used to rank the varieties identified in Appuppillayur *padasekharam*. The results are presented in table 30.

Table 30. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Nalleppilly panchayat

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	'Kunjukunju'	6.0306	1	4.0204	4	
2	Kanakom	5.5510	2	3.5714	5	
3	TKM-9	4.9388	3	5.3163	2	-0.25^{NS}
4	Bhadra	4.0000	4	3.2449	7	
5	Vellapponni	3.7143	5	3.2653	6	
6	Jaya	2.9490	6	5.8469	1	
7	Chamban	2.8163	7	4.9490	3	

Fig. 13. Crop season calendar – Chittur ADB (Nalleppilly panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

The rank orders presented in table 30 revealed that Jaya, TKM-9 and Chamban were ranked superior to other varieties by the ESS whereas 'Kunjukunju', Kanakom and TKM-9 were preferred to others by the FSS. There was a high degree of disagreement between them on this.

Table 31. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Nalleppilly panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Ponmani	6.2143	1	5.3333	1	1.00**
2	ASD-16	4.5476	2	5.2143	2	
3	Mashuri	4.2381	3	4.0238	3	

**Perfect correlation

Table 31 revealed that both the FSS and the ESS preferred Ponmani to ASD-16 and Mashuri.

4.2.10.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

The varietal attributes rank order presented in table 32 revealed the relative perception of *Krishibhavan* officials and rice farmers of Nalleppilly panchayat.

The analysis of rank orders presented in table 32 revealed that 'good yield' and 'market preference and demand' were perceived to be the important varietal attributes determining farmers' varietal selection. 'Good taste' and 'preferred plant height' were the least significant attributes according to the FSS and the ESS respectively.

Table 32. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Nalleppilly panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Good yield	1	1	
2	Market preference and demand	2	2	
3	More productive tillers	3	7	
4	More grains per panicle	4	6	
5	More grain weight	5	4	
6	Pest/disease tolerance	6	9	
7	High milling percentage	7	3	0.847**
8	Low grain shattering	8	8	
9	Non-lodging	9	5	
10	Drought tolerance	10	15	
11	Correct duration for season	11	11	
12	Easily threshable	12	10	
13	Non-sticky rice with good keeping quality	13	12	
14	Good taste	14	16	
15	Quality flour	15	13	
16	Preferred plant height	16	14	

** Significant at 0.01 level

4.2.11 Sreekrishnapuram Agricultural Development Block

Kadampazhippuram panchayat with net rice cropped area of 1194.42 ha and with an estimated gross cropped area of 1944.72 ha was chosen as the sample. Rice is grown in two seasons *virippu* and *mundakan*. There are 45 *padasekharams*

under Kadampazhippuram *Krishibhavan.* Puliyanda was selected for the study owing to its highest net-cropped rice area under rice.

4.2.11.1 Crop season calendar

The schedule of important cultural operations in rice followed by the farmers over different cropping seasons is presented as a calendar in fig. 14.

4.2.11.2 Matrix ranking of rice varieties by the FSS and the ESS

MRI was used to rank the varieties identified in Puliyanda *padasekharam.* The results are presented in table 33.

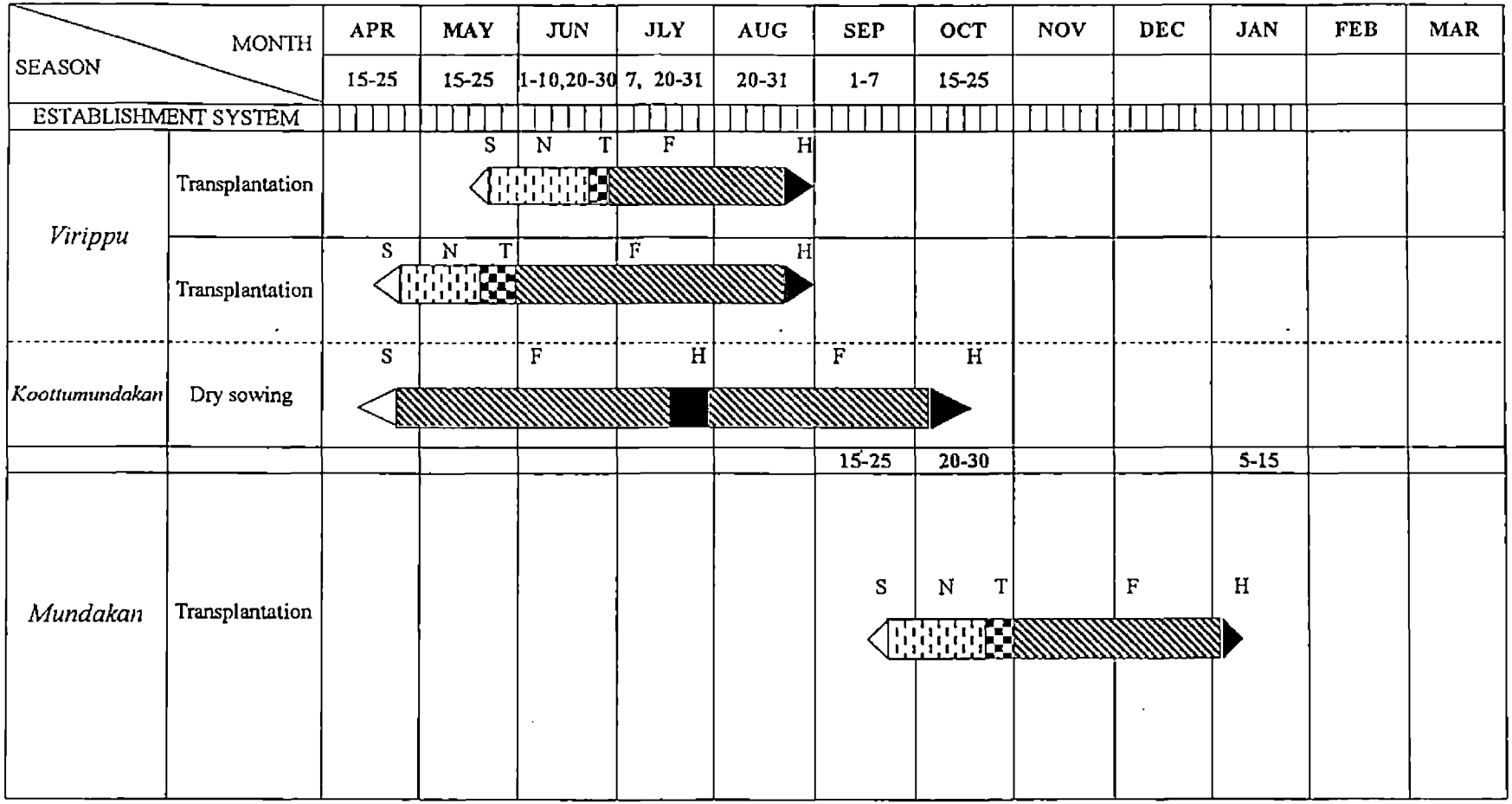
Table 33. Matrix ranking of *virippu* rice varieties by the FSS and the ESS of Kadampazhippuram panchayat

Sl.No	Varieties/Cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Thavalakkannan	6.5079	1	6.6587	2	
2	Velutharikazhama	6.2857	2	6.9524	1	
3	Chenkazhama	6.0397	3	5.1984	3	
4	Aiswarya	5.4365	4	5.1349	5	0.893**
5	Arivakaari	4.6667	5	5.1508	4	
6	Kanchana	4.5952	6	4.3889	7	
7	Chamban	4.4683	7	4.5159	6	

** Significant at 0.01 level

The data in table 33 showed that Velutharikazhama, Thavalakkannan and Chenkazhama were the three most preferred varieties as perceived by the ESS. Thavalakkannan, Velutharikazhama and Chengazhama were ranked superior to the rest by the FSS.

Fig. 14. Crop season calendar - Sreekrishnapuram ADB (Kadampazhippuram panchayat)



S - Sowing; N - Nursery; T - Transplantation; F - Field; H - Harvest

Table 34. Matrix ranking of *mundakan* rice varieties by the FSS and the ESS of Kadampazhippuram panchayat

Sl.No	Varieties/cultivars	FSS		ESS		(r_s)
		MRI	Ranking	MRI	Ranking	
1	Chuvannachettadi	7.9167	1	7.8519	1	0.886*
2	Cheruvellari	6.7222	2	6.5833	2	
3	Aiswarya	5.2130	3	5.2314	4	
4	Paramchitteni	5.0926	4	5.3148	3	
5	Thekkencheera	4.4167	5	3.9815	6	
6	Kanchana	3.8889	6	4.2870	5	

*Significant at 0.05 level

Chuvannachettadi and Cheruvellari were considered to be the most superior varieties by both the FSS and the ESS (Table 34).

4.2.11.3 Ranking of preferred attributes of rice varieties by the FSS and the ESS

The varietal attributes rank order presented in table 35 revealed the relative perception of *Krishibhavan* officials and rice farmers of Kadampazhippuram panchayat.

The analysis of preferential rank orders presented in table 35 revealed that 'good yield', 'long panicle', 'high milling percentage', 'more grain weight' and 'pest/disease tolerance' were perceived to be the most important attributes determining the varietal selection of the farmers as perceived by the ESS. Farmers considered 'pest/disease tolerance', 'good yield', 'more grain weight', 'non-lodging' crop and 'more number of tillers' as the most preferred varietal attributes.

Table 35. Ranking of preferred attributes of rice varieties by the FSS and the ESS of Kadampazhippuram panchayat

Sl.No	Attributes	Ranking		(r_s)
		FSS	ESS	
1	Pest/disease tolerance	1	5	
2	Good yield	2	1	
3	More grain weight	3	4	
4	Non-lodging	4	10	
5	More productive tillers	5	6	
6	Low grain shattering	6	9	
7	Drought tolerance	7	12	
8	Easily threshable	8	14	
9	Good taste	9	15	0.701**
10	Long panicle	10	2	
11	More grains per panicle	11	7	
12	Market preference and demand	12	8	
13	High milling percentage	13	3	
14	Low germination in panicle	14	11	
15	Deep and spreading roots	15	18	
16	Good stem girth	16	17	
17	Non-sticky rice with good keeping quality	17	13	
18	Quality flour	18	16	
19	Preferred plant height	19	20	
20	Correct duration for season	20	19	

** Significant at 0.01 level

4.3 District-based evaluation of rice varieties and preferred varietal attributes

Results obtained by pooling the data of the 11 panchayats representing 10 ADBs formed the basis for the district-based evaluation of rice varieties and preferred varietal attributes as perceived by the rice farmers and *Krishibhavan* officials of Palakkad district, which is presented hereunder:

4.3.1 District-based ranking of *virippu* varieties by the FSS and the ESS

Varietal Ranking Index (VRI) was used to rank the 41 *virippu* varieties identified in 11 *padasekharams* representing 10 ADBs of the district. District-based varietal ranking was obtained by pooling the results of the matrix ranking exercises done by the farmers and extension personnel of the 11 panchayats under consideration. The results are presented in table 36.

Table 36. District-based ranking of *virippu* varieties by the FSS and the ESS

Sl.No	Varieties/cultivars	FSS		ESS	
		VRI	Ranking	VRI	Ranking
1	Aiswarya	18.9617	1	17.9437	2
2	Kanchana	18.7063	2	22.0791	1
3	'Kunjukunju'	14.3658	3	13.0532	3
4	TKM-9	6.4014	4	6.3464	4
5	Jaya	4.3031	5	5.0356	5
6	ASD-16	4.2133	6	4.3425	7
7	Mattathriveni	4.1730	7	4.4008	6
8	Kanakom	2.7036	8	2.3027	9
9	Jyothi	2.5481	9	2.5603	8
10	Bhadra	2.0796	10	2.0241	10
11	Athira	1.8774	11	1.8697	11
12	Pavizham	1.6410	12	1.6922	12

13	Pranava	1.3179	13	1.5181	14
14	'Lakshmi'	1.2256	14	1.5601	13
15	'010'	1.1825	15	1.3317	15
16	'Kalyani'	1.1524	16	1.1259	16
17	Chenkazhama	1.1230	17	1.1148	17
18	Chamban	0.8499	18	1.1042	18
19	Uma	0.6075	19	0.3079	26
20	'17-27'	0.5554	20	0.6175	19
21	IR-50	0.4433	21	0.4604	20
22	'OTP-8'	0.4258	22	0.2946	29
23	Kairali	0.4192	23	0.4392	21
24	'Vanitha'	0.4032	24	0.2940	30
25	Thavalakkannan	0.3796	25	0.3884	24
26	Velutharikazhama	0.3667	26	0.4056	22
27	'Sulochana'	0.3139	27	0.4009	23
28	Paiyur-1	0.3078	28	0.3333	25
29	Veluthettan	0.2900	29	0.2208	34
30	Mashuri	0.2821	30	0.2154	35
31	Arivakaari	0.2722	31	0.3005	27
32	'Aayirathonnumatta'	0.2233	32	0.2950	28
33	Vellapponni	0.2167	33	0.1905	36
34	Aryan	0.2150	34	0.2500	31
35	'Cheriyakanchana'	0.2137	35	0.2225	33
36	Neeraja	0.2042	36	0.1725	38
37	'Undamashuri'	0.2021	37	0.1760	37
38	Bharathi	0.1883	38	0.2428	32
39	'393'	0.1865	39	0.1391	40
40	Annapoorna	0.1234	40	0.1417	39
41	CO-10	0.1147	41	0.1308	41

Detailed matrices presented in Appendices III (a) & III (b)

The data in table 36 revealed that Aiswarya, Kanchana, 'Kunjukunju', TKM-9, Jaya and ASD-16 were ranked superior to others by the ESS, while the respondents from the FSS perceived that Kanchana, Aiswarya, 'Kunjukunju', TKM-9, Jaya and Mattathriveni were the most preferred varieties. Both the subsystems opined that CO-10 was the least preferred variety.

4.3.2 District-based ranking of *mundakan* varieties by the FSS and the ESS

Varietal Ranking Index (VRI) was used to rank the 33 *mundakan* varieties identified in 11 *padasekharams* representing 10 ADBs of the district. The results are presented in table 37.

Table 37. District-based ranking of *mundakan* varieties by the FSS and the ESS

Sl.No	Varieties/Cultivars	FSS		ESS	
		VRI	Ranking	VRI	Ranking
1	Aiswarya	13.4598	1	12.5573	1
2	Kanchana	7.3547	2	9.1791	2
3	Ponmani	7.1667	3	7.1488	3
4	ASD-16	6.1632	4	6.0856	4
5	'Kunjukunju'	4.4086	5	4.3056	5
6	Vellapponni	2.0921	6	2.3635	6
7	Chitteni	1.5810	7	1.6270	7
8	'Kalyani'	1.3969	8	1.3648	8
9	Athira	1.3301	9	1.2680	9
10	TKM-9	1.1512	10	1.1983	11
11	Mattathriveni	0.9952	11	0.7790	13
12	'Undamashuri'	0.8905	12	1.2194	10
13	Jaya	0.8033	13	0.7884	12
14	'Vellamashuri'	0.5976	14	0.6224	14

15	Pavizham	0.5572	15	0.5758	15
16	'Vanitha'	0.4888	16	0.3563	22
17	Chuvanna Chettadi	0.4798	17	0.4759	18
18	Vellari	0.4504	18	0.4724	19
19	CO-10	0.4302	19	0.3565	21
20	Cheruvellari	0.4074	20	0.3990	20
21	'Sulochana'	0.3805	21	0.4860	17
22	'Lakshmi'	0.3704	22	0.5000	16
23	Cheera	0.3232	23	0.2781	24
24	'Valiyakanchana'	0.3196	24	0.2525	25
25	Pranava	0.2735	25	0.1267	32
26	Paramchitteni	0.2678	26	0.2980	23
27	Thekkencheera	0.2677	27	0.2413	27
28	Vellachetadi	0.2172	28	0.2434	26
29	'Karna'	0.2000	29	0.1354	31
30	Paiyur-1	0.1960	30	0.2148	28
31	Neeraja	0.1707	31	0.1444	30
32	Mashuri	0.1284	32	0.1219	33
33	'Rocket'	0.1020	33	0.1747	29

Detailed matrix presented in Appendices III (c) & III (d)

It could be concluded from table 37 that varieties such as Aiswarya, Kanchana, Ponmani, ASD-16, 'Kunjukunju', Vellapponni, Chitteni, 'Kalyani' and Athira were perceived to be superior by both the subsystems. Mashuri, Pranava, 'Karna', Neeraja and 'Rocket' were the least preferred varieties cited by the ESS, while the farmers of Palakkad district reported 'Rocket', Mashuri, Neeraja, Paiyur-1 and 'Karna' as inferior.

4.3.3 District-based ranking of preferred attributes by the FSS and the ESS

Attribute Ranking Index (ARI) was employed to rank the 34 preferential attributes of rice varieties identified and elicited from the farmers of Palakkad district. Both the subsystems namely, the FSS and the ESS were facilitated to prepare prioritised lists of varietal attributes (table 38).

Table 38. District-based ranking of preferred attributes by the FSS and the ESS

Sl.No	Attributes	FSS		ESS	
		ARI	Ranking	ARI	Ranking
1	Good yield	5.6471	1	5.5294	1
2	More grain weight	4.3441	2	3.4412	4
3	Pest/disease tolerance	4.3274	3	4.2353	2
4	Market preference and demand	4.2059	4	3.9034	3
5	More productive tillers	3.1933	5	2.7914	7
6	Low grain shattering	3.0973	6	2.7273	8
7	More grains per panicle	2.9823	7	2.5508	9
8	High milling percentage	2.6583	8	3.0749	5
9	Non-lodging	2.5753	9	2.9118	6
10	Easily threshable	1.9334	10	2.5133	10
11	Good taste	1.6627	11	1.2754	13
12	Correct duration for season	1.3803	12	2.0294	11
13	Drought tolerance	1.3765	13	1.2620	14
14	Long panicle	1.1421	14	1.2834	12
15	Non-sticky rice with good keeping quality	0.9330	15	0.7112	17
16	Preferred plant height	0.8664	16	1.0962	16
17	Less chaff	0.7267	17	1.1257	15
18	Reasonable yield under stress	0.5424	18	0.4144	20

19	Synchronised flowering	0.4283	19	0.4492	19
20	Quality flour	0.2046	20	0.2460	21
21	Low germination in panicle	0.1706	21	0.7086	18
22	Secured seed supply	0.1194	22	0.0027	32
23	Bold and red grains for market	0.0831	23	0.1444	22
24	Good stem girth	0.0636	24	0.0695	24
25	Less weight reduction on storage	0.0553	25	0.1364	23
26	Deep and spreading roots	0.0400	26	0.0321	27
27	Multi-planting system adaptability	0.0270	27	0.0160	31
28	Shade tolerance	0.0240	28	0.0267	28
29	Bold and white grains for home	0.0159	29	0.0027	32
30	Less cooking time required	0.0110	30	0.0535	25
31	Tolerance to poor drainage	0.0105	31	0.0187	29
32	Tolerance to yellowing	0.0055	32	0.0348	26
33	Quality straw	0.0025	33	0.0107	30
34	Awn less grains	0.0025	33	0.0027	32

Detailed matrices presented in Appendices IV (a) & IV (b)

Perusal of table 38 revealed that according to the ESS 'good yield', 'pest/disease tolerance', 'market preference and demand', 'more grain weight' and 'high milling percentage' were perceived to be the most significant attributes deciding the rice varietal choice of the farmers of Palakkad district. According to the farmers, 'good yield', 'more grain weight', 'pest/disease tolerance', 'market preference and demand' and 'more productive tillers' were decisive in determining their varietal choice.

4.4 Block-based prioritization of constraints to rice seed production and distribution as perceived by the FSS, ESS, SISS and RSS of Palakkad district

The constraints to rice seed production and distribution faced by the FSS, ESS, SISS and RSS in each ADB were analyzed:

4.4.1 Block-based prioritization of constraints to rice seed production and distribution as perceived by the FSS and the ESS of Palakkad district

4.4.1.1 Nemmara Agricultural Development Block

Pallassena was chosen as the sample panchayat for study owing to its largest net-cropped rice area in the Nemmara ADB.

4.4.1.1.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The farmers' constraints as ranked by the FSS and the ESS are presented in table 39.

Table 39. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Pallassena panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Non availability of Malampuzha dam water	1	1	0.697*
2	Drought towards the end of *mundakan*	2	2	
3	Untimely availability of *Krishibhavan* seeds	3	4	
4	Non-availability of preferred varieties from *Krishibhavan*	4	5	
5	Low physical purity of *Krishibhavan* seeds	5	8	
6	Lack of assured irrigation	6	3	
7	Labour shortage during peak season	7	10	
8	Low genetic purity of *Krishibhavan* seeds	8	9	
9	Poor germination of *Krishibhavan* seeds	9	7	
10	Difficulty in processing *virippu* seeds	10	6	

*Significant at 0.05 level

Non-availability of Malampuzha dam water in time during *mundakan* and drought towards the end of *mundakan* were the two major constraints cited by both the FSS and the ESS. Labour shortage during peak seasons was the least important constraint according to the *Krishibhavan* officials, while the farmers opined that difficulty in processing *virippu* seed was the least significant constraint faced by them. (Table. 39)

4.4.1.1.2 Constraints to rice seed distribution as perceived by the ESS

The KB officials were facilitated to prepare a prioritized list of constraints faced by them in rice seed distribution (Table 40).

Table 40. Constraints to rice seed distribution as perceived by the ESS of Pallassena panchayat

Sl.No	Constraints	Ranking ESS
1	Inadequate staff	1
2	Service Co-operative banks not willing to procure seeds from farmers	2
3	Inadequate storage facilities for inputs	3
4	Reduced demand for seeds	4
5	High work load for staff	5

For the ESS, inadequate staff, service co-operative bank's failure to procure seeds and inadequate storage facilities were the most important constraints. High work load for staff and reduced demand for seeds were the other constraints perceived by them. (Table 40)

4.4.1.2 Koyalmannam Agricultural Development Block

Nellissery was chosen the sample panchayat for study owing to its largest net-cropped rice area in the Koyalmannam ADB.

4.4.1.2.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the farmers of the panchayat in rice seed production and distribution were listed and prioritized by the farmers of the Nellissery *pdadasekharam* and were again ranked independently by the officials of Pudussery *Krishibhavan.* (Table 41.)

Table 41. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Pudussery panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Drought towards the end of *Mundakan*	1	1	
2	Untimely availability of *Krishibhavan* seeds	2	3	
3	Non-availability of preferred varieties from *Krishibhavan*	3	2	
4	Non-availability of *Krishibhavan* seeds in adequate quantities	4	10	
5	Delayed payment for seeds procured through RSGP	5	5	0.797*
6	Inadequacy of Walayar irrigation project	6	6	
7	Insufficient procurement of RSGP seed	7	7	
8	Complex procedure for seed testing in RSGP	8	8	
9	Difficulty in processing *virippu* seed	9	11	
10	Lack of facilities for seed storage	10	12	
11	Low physical purity of *Krishibhavan* seeds	11	4	
12	Poor germination of *Krishibhavan* seeds	12	14	
13	Inconvenient seed bag size/quantity	13	16	
14	High cost of seeds from public seed agencies	14	9	
15	Inaccessibility of seed production agencies	15	13	
16	Lack of awareness about quality seed production	16	15	

**Significant at 0.01 level

It could be seen from table 41 that 'drought towards the end of *mundakan*' was considered to be the most serious constraint faced by the FSS according to both the FSS and the ESS. 'Inconvenient seed bag size/quantity', 'lack of awareness about quality seed production', 'poor germination of *Krishibhavan* seeds' were considered least significant by the ESS whereas, the respondents from the FSS opined that 'lack of awareness about quality seed production', 'inaccessibility of seed production /distribution agencies', 'high cost of seeds from public seed agencies' were the least important constraints faced by them in rice seed production and distribution in Pudussery panchayat.

4.4.1.2.2 Constraints to rice seed distribution as perceived by the ESS

The officials of Pudussery *Krishibhavan* were asked to name and rank various constraints faced by them in rice seed distribution. The results are shown in table 42.

Table 42. Constraints to rice seed distribution as perceived by the ESS of Pudussery panchayat

Sl.No	Constraints	Ranking
1	Untimely availability of SISS seeds	1
2	Non-availability of farmer preferred varieties	2
3	Accumulation of seeds	3
4	High work load for staff	4
5	Inadequate staff	5

Table 42 revealed that 'untimely availability of SISS seeds', 'non-availability of farmer preferred varieties', and 'accumulation of seeds' were the important problems faced by the ESS in rice seed distribution in the panchayat.

4.4.1.3 Shoranur Agricultural Development Block

Vaniyamkulam was chosen the sample panchayat for study owing to its largest net-cropped rice area in the Shoranur ADB.

4.4.1.3.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the rice farmers in Vaniyamkulam panchayat were listed and prioritized by the respondents from the FSS. Then the officials of the concerned *Krishibhavan* ranked them independently. The results are summarized in table 43.

Table 43. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Vaniyamkulam panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	
2	Non-availability of *Krishibhavan* seeds in adequate quantities	2	3	
3	Non-availability of preferred varieties from *Krishibhavan*	3	2	
4	Drought towards the end of *mundakan*	4	4	
5	Varietal mixing and genetic impurity in farmer produced seeds	5	9	0.800**
6	Conveyance inaccessibility of remote fields	6	5	
7	Difficulty in processing of *Krishibhavan* seeds	7	7	
8	High cost of seeds from public seed agencies	8	6	
9	Poor germination of *Krishibhavan* seeds	9	8	

** Significant at 0.01 level

Both the FSS and the ESS were of the view that 'untimely availability of *Krishibhavan* seeds' was the most serious constraint faced by the FSS in rice seed production and distribution (Table 43). 'Non-availability of preferred varieties from *Krishibhavan*', 'non-availability of *Krishibhavan* seeds in adequate quantities', 'drought towards the end of *mundakan*', 'conveyance inaccessibility of remote fields' was perceived to be the next important constraints by the ESS. The rank order given by the FSS to the rest of the constraints started with the 'non-availability of *Krishibhavan* seeds in adequate quantities' followed by 'non availability of performed varieties from *Krishibhavan*', and 'drought towards the end of *mundakan*'.

4.4.1.3.2 Constraints to rice seed distribution as perceived by the ESS

Constraints faced by the *Krishibhavan* officials and their rank orders are given in table 44.

Table 44. Constraints to rice seed distribution as perceived by the ESS of Vaniyamkulam panchayat

Sl.No	Constraints	Ranking
1	Monitoring of RSGP difficult	1
2	Inadequate staff	2
3	Inadequate storage facilities of inputs	3
4	High work load for staff	4
5	Accumulation of seeds	5

It could be concluded from table 44 that, 'difficulty in monitoring RSGP', 'inadequate staff' and 'inadequate storage facilities for inputs' were perceived to be the most important constraints faced by the ESS.

4.4.1.4 Palakkad Agricultural Development Block

Parali was chosen the sample panchayat for study owing to its largest net-cropped rice area in the Palakkad ADB.

4.4.1.4.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the rice farmers in Parali panchayat were listed and prioritised by the farmer respondents from Odannur *padasekharam*. The Parali *Krishibhavan* officials then ranked these constraints independently. The results are presented in table 45.

Table 45. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Parali panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	
2	Non-availability of preferred varieties from *Krishibhavan*	2	2	
3	Lack of assured irrigation	3	7	
4	Conveyance inaccessability of remote fields	4	3	0.750*
5	High labour charge	5	6	
6	Labour shortage during peak seasons	6	5	
7	Low tillering in sandy soil	7	4	
8	Lack of co-operation among farmers during critical farm operations	8	9	
9	Poor germination of *Krishibhavan* seeds	9	8	

* Significant at 0.05 level

It could be concluded from table 45 that both the FSS and the ESS considered 'untimely availability of *Krishibhavan* seeds' and 'non-availability of preferred varieties from *Krishibhavan*', as the two most important constraints faced by the FSS in the panchayat. 'Conveyance inaccessibility of remote fields', 'low tillering in sandy soil', 'labour shortage during peak seasons' were reckoned as the next important constraints, in the decreasing order of importance by the ESS. The ranks for the rest of the constraints as perceived by the FSS were in the order, 'lack of assured irrigation', 'conveyance inaccessibility of remote fields and 'high labour charge'.

4.4.1.4.2 Constraints to rice seed distribution as perceived by the ESS

Constraints faced by the *Krishibhavan* officials and their respective ranks are given in table 46.

Table 46. Constraints to rice seed distribution as perceived by the ESS of Parali panchayat

Sl.No	Constraints	Ranking
1	Service co-operative banks' unwillingness to procure seeds from farmers	1
2	Inadequate storage facilities for inputs	2
3	High work load for staff	3
4	Reduced demand for seeds	4
5	Inadequate staff	5

The rank orders presented in table 46 concluded that 'service co-operative banks' 'unwillingness to procure seeds from the farmers', 'inadequate storage facilities for inputs' and 'high work load for *Krishibhavan* officials' were the major constraints faced by the ESS.

4.4.1.5 Kollengode Agricultural Development Block

Elappulli was chosen the sample panchayat for study owing to its largest net-cropped rice area in the Kollengode ADB.

4.4.1.5.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the rice farmers of Elappulli panchayat were listed and then prioritized by the farmer respondents from Pallakkadavu *padasekharam*. The

officials of Elappulli *Krishibhavan* again ranked these constraints independently. The results of both the exercises are combined in table 47.

Table 47. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Elappulli panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	0.007^{NS}
2	Non-availability of preferred varieties from the *Krishibhavan*	2	3	
3	Non-availability of *Krishibhavan* seeds in adequate quantities	3	2	
4	Drought towards the end of *mundakan*	4	12	
5	BLB menace during *virippu*	5	7	
6	Poor germination of *Krishibhavan* seeds	6	11	
7	Delayed payment for seeds procured through RSGP	7	4	
8	Insufficient procurement of RSGP seeds	8	6	
9	Complex procedure for seed testing in RSGP	9	5	
10	Difficulty in processing *virippu* seed	10	10	
11	Varietal mixing and genetic impurity in farmer-produced seeds	11	8	
12	Conveyance inaccessability of remote fields	12	9	

According to the ESS the most serious constraints faced by the farmers in rice seed production and distribution were 'untimely availability of *Krishibhavan* seeds', 'non-availability of *Krishibhavan* seeds inadequate quantities', 'non-availability of preferred varieties from *Krishibhavan'* and 'delayed payment for seeds procured through RSGP'. But to the FSS the rank order was slightly modified. 'Untimely availability of *Krishibhavan* seeds' was perceived to be the major constraint, followed by 'non-availability of preferred varieties from *Krishibhavan'*, 'non-availability of *Krishibhavan* seeds in adequate quantities' and drought towards the end of *mundakan* (Table 47).

4.4.1.5.2 Constraints to rice seed distribution as perceived by the ESS

The officials of Elappulli *Krishibhavan* were asked to name and prioritize the various constraints faced by them in rice seed distribution in the panchayat. The result of the exercise is given in table 48.

Table 48. Constraints to rice seed distribution as perceived by the ESS of Elappulli panchayat

Sl.No	Constraints	Ranking
1	Inadequate storage facilities for inputs	1
2	Monitoring of RSGP difficult	2
3	Untimely availability of SISS seeds	3
4	Non-availability of farmer-preferred varieties	4
5	Non-availability of SISS seeds in adequate quantities	5
6	High work load for staff	6

'Inadequate storage facilities for inputs', 'difficulty in monitoring RSGP', and 'untimely availability of SISS seeds' were perceived to be the major constraints faced by the ESS in the panchayat (Table 48).

4.4.1.6 Alathur Agricultural development Block

Erimayur was chosen the sample panchayat for study owing to its largest net-cropped rice area under Alathur ADB.

4.4.1.6.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the rice farmers in Erimayur panchayat were identified and ranked by the farmer respondents from Ambalapparambu *padasekharam*. The officials of Erimayur *Krishibhavan* ranked these constraints independently. The results of both the exercises are given in table 49.

Table 49. Farmers' constraints to rice seed production and distribution as perceived by the ESS and FSS of Erimayur panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Non-availability of *Krishibhavan* seeds in adequate quantities	1	1	
2	Delayed payment for seed procured through RSGP	2	2	
3	Complex procedure for seed testing in RSGP	3	3	
4	Insufficient procurement of RSGP seeds	4	4	
5	Extra payment for seed bags	5	5	1.00**
6	Lack of awareness about quality seed production	6	6	

**Perfect correlation

It is evident from table 49 that the constraint ranking by the FSS and the ESS perfectly matched each other. 'Non-availability of *Krishibhavan* seeds in adequate quantities', 'delayed payment for seeds procured through RSGP', and 'complex procedures for seed testing in RSGP' were perceived as the major constraints.

4.4.1.6.2 Constraints to rice seed distribution as perceived by the ESS

The constraints faced by Erimayur *Krishibhavan* officials in rice seed distribution are summarized and ranked in table 50.

Table 50. Constraints to rice seed distribution as perceived by the ESS of Erimayur panchayat

Sl.No	Constraints	Ranking
1	Untimely availability of SISS seeds	1
2	Monitoring of RSGP difficult	2
3	Inadequate staff	3
4	Non-availability of SISS seeds in adequate quantities	4
5	Poor genetic purity of SISS seeds	5
6	Poor germination of SISS seeds	6

'Untimely availability of SISS seeds', 'accumulation of seeds in *Krishibhavan* due to low demand' and 'inadequate staff strength' were the most important constraints faced by the *Krishibhavan* officials of Erimayur panchayat (Table 50).

4.4.1.7 Pattambi Agricultural Development Block

Kulukkallur was chosen as the sample panchayat for study owing to its largest net-cropped rice area under Pattambi ADB.

4.4.1.7.1 Farmers' constraints to rice seed production and distribution, as perceived by the FSS and the ESS of Kulukkallur panchayat.

The constraints to rice seed production and distribution faced by the farmers of Kulukkallur panchayat were listed and ranked by the farmer respondents from Vandumthara *padasekharam.* The officials of Kulukkallur *Krishibhavan* again ranked these constraints independently. The results of both the exercises are summarized in table 51.

Table 51. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Kulukkallur panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	0.666*
2	Non-availability of preferred varieties from *Krishibhavan*	2	2	
3	High cost of seeds from public seed agencies	3	8	
4	Difficulty in processing *virippu* seeds	4	3	
5	Labour shortage during peak seasons	5	4	
6	High labour charge	6	5	
7	Poor germination of *Krishibhavan* seeds	7	9	
8	Lack of facilities for seed storage	8	6	
9	Inconvenient seed bag size/quantity	9	7	

* Significant at 0.05 level

The data given in table 51 revealed that the constraints such as 'untimely availability of *Krishibhavan* seeds' and 'non availability of preferred varieties from *Krishibhavan*' were assigned the highest rank by both the FSS and the ESS. 'Poor germination of *Krishibhavan* seeds' and 'inconvenient seed bag size/quantity', were perceived to be the least significant constraints faced by the rice farmers, as perceived by the *Krishibhavan* officials and the farmer respondents respectively.

4.4.1.7.2 Constraints to rice seed distribution as perceived by the ESS

The constraints faced by Kulukkallur *Krishibhavan* officials in rice seed distribution in the panchayat were ranked and the same is furnished in table 52.

Table 52. Constraints to rice seed distribution as perceived by the ESS of Kulukkallur panchayat

Sl.No	Constraints	Ranking
1	Inadequate storage facilities for inputs	1
2	Inadequate staff	2
3	Untimely availability of SISS seeds	3
4	High work load for staff	4
5	Undue interference of local bodies	5

'Inadequate storage facilities for inputs', 'inadequate staff' and 'untimely availability of the SISS seed' were considered to be the most serious problems faced by the ESS (Table 52).

4.4.1.8 Thrithala Agricultural Development Block

Thrithala was chosen as the sample panchayat for the study owing to its largest net-cropped rice area under Thrithala ADB.

4.4.1.8.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by rice farmers were identified and ranked by the farmer respondents from V.K. Kadavu *padasekharam*. The officials of Thrithala Krishibhavan again ranked these independently. The results of both the exercises are combined in table 53.

Table 53. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Thrithala panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	
2	Non-availability of preferred varieties from *Krishibhavan*	2	3	
3	Non-availability of *Krishibhavan* seeds inadequate quantities	3	2	0.952**
4	High Labour charge	4	4	
5	Labour shortage during peak season	5	5	
6	Conveyance inaccessibility remote fields	6	6	
7	Poor germination of *Krishibhavan* seeds	7	8	
8	Difficulty in processing *virippu* seed	8	7	

** Significant at 0.01 level

It could be concluded from table 53 that 'untimely availability of *Krishibhavan* seeds' was the most important constraint faced by the farmers as perceived by both the FSS and the ESS.

4.4.1.8.2 Constraints to rice seed distribution as perceived by the ESS

The *Krishibhavan* officials were asked to prepare a prioritised list of constraints faced by them in rice seed distribution (Table 54).

Table 54. Constraints to rice seed distribution as perceived by the ESS of Thrithala panchayat

Sl.No	Constraints	Ranking
1	Reduced demand for *Krishibhavan* seeds	1
2	Accumulation of seeds	2
3	High work load for staff	3
4	Inadequate staff	4
5	*Krishibhavan* officials compelled to dispose previous seed stock	5

The rank orders presented in table 54 revealed that 'reduced demand for *Krishibhavan* seeds', 'accumulation of seeds' and 'high work load for staff' were the serious constraints faced by the ESS.

4.4.1.9 Chittur Agricultural Development Block (*poonthalpadams*)

Pattanchery was chosen as the sample panchayat for the study in *Poonthalpadams* under Chittur ADB.

4.4.1.9.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the rice farmers of the panchayat were identified and prioritised by the farmer respondents from Karavathode *padasekharam*. The officials of Pattanchery Krishibhavan again ranked these constraints independently. The results of both the exercises are presented in table 55.

Table 55. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Pattanchery panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	
2	Non-availability of *Krishibhavan* seeds inadequate quantities	2	10	
3	Lack of suitable varieties for *Poonthal mundakan*	3	3	
4	Difficulty in processing *virippu* seed	4	9	
5	Germination of seeds in panicle	5	6	0.273^{NS}
6	Poor germination of *Krishibhavan* seeds	6	4	
7	Low grain filling	7	2	
8	High incidence of yellowing	8	8	
9	Ill drained soil conditions	9	7	
10	Difficulty in cultural operations in *Poonthals*	10	11	
11	Deterioration of seed quality in poly bags	11	5	

'Untimely availability of *Krishibhavan* seeds' was the major constraint perceived by both the FSS and the ESS. The least important constraints were 'difficulty in cultural operations in *Poonthals*' and 'deterioration of seed quality in poly bags' to the FSS and the ESS respectively (Table 55).

4.4.1.9.2 Constraints to rice seed distribution as perceived by the ESS

Pattanchery *Krishibhavan* officials were asked to prepare a prioritised list of constraints faced by them in rice seed distribution (Table 56).

Table 56. Constraints to rice seed distribution as perceived by the ESS of Pattanchery panchayat

Sl.No	Constraints	Ranking
1	Non-availability of farmer preferred varieties	1
2	Accumulation of seeds	2
3	High work load for staff	3
4	Monitoring of RSGP difficult	4
5	Inadequate staff	5

Table 56 revealed that 'non-availability of farmer preferred varieties', 'accumulation of seeds' and 'high work load for staff' were the most significant constraints faced by the ESS in rice seed distribution in the panchayat.

4.4.1.10 Chittur Agricultural Development Block

Erimayur was chosen as the sample panchayat for study owing to its largest net-cropped rice area under Alathur ADB.

4.4.1.10.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by rice farmers of the panchayat in rice seed production and distribution were listed and prioritised by the farmers of Appuppillayur *padasekharam*, which were again ranked independently by the officials of the *Krishibhavan*. The results of the exercises are presented in table 57.

Table 57. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Nalleppilly panchyat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	2	
2	Non-availability of preferred varieties from *Krishibhavan*	2	1	
3	Non-availability of *Krishibhavan* seeds in adequate quantities	3	7	
4	Drought towards the end of *mundakan*	4	4	
5	High labour charge	5	9	
6	Difficulty in processing *virippu* seed	6	10	0.294^{NS}
7	Conveyance inaccessibility of remote fields	7	12	
8	Absence of marketing arrangements for farmer-produced seeds	8	8	
9	Low price for farmer produced seeds	9	11	
10	Inadequate and untimely service from Chitturpuzha irrigation project	10	5	
11	Poor germination of *Krishibhavan* seeds	11	3	
12	Labour shortage during peak seasons	12	6	

It could be concluded from table 57 that 'non-availability of preferred varieties from *Krishibhavan*', 'untimely availability of *Krishibhavan* seeds' and 'poor germination of *Krishibhavan* seeds' were considered to be the most important constraints faced by the FSS as perceived by the ESS. 'Untimely availability of *Krishibhavan* seeds', 'non-availability of preferred varieties from *Krishibhavan* ' and 'non- availability of *Krishibhavan* seeds in adequate quantities'were perceived to be the major problems faced by the rice farmers of the panchayat.

4.4.1.10.2 Constraints to rice seed distribution as perceived by the ESS

The *Krishibhavan* officials of Nalleppilly panchayat were asked to prepare a prioritized list of constraints faced by them in rice seed distribution (Table 58).

Table 58. Constraints to rice seed distribution as perceived by the ESS of Nalleppilly panchayat

Sl.No	Constraints	Ranking
1	Inadequate storage facilities for inputs	1
2	Inadequate staff	2
3	Non-availability of farmer preferred varieties	3
4	Accumulation of seeds	4
5	Poor germination of SISS seeds	5

Table 58 revealed that 'inadequate storage facilities' in *Krishibhavans*, 'inadequate staff' and 'non-availability of farmer preferred varieties', were the most important constraints faced by the ESS in rice seed distribution.

4.4.1.11.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS

The constraints faced by the FSS were identified and prioritised by the farmer respondents from Puliyanda *padasekharan.* The officials of Kadampazhippuram Krishibhavan again prioritised these constraints independently. The results of both the exercises are combined in table 59.

Table 59. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Kadampazhippuram panchayat

Sl.No	Constraints	Ranking		(r_s)
		FSS	ESS	
1	Untimely availability of *Krishibhavan* seeds	1	1	0.576*
2	Non-availability of preferred varieties from *Krishibhavan*	2	3	
3	Difficulty in processing *virippu* seed	3	5	
4	Poor germination of *Krishibhavan* seeds	4	6	
5	Low genetic impurity of *Krishibhavan* seeds	5	7	
6	Conveyance inaccessibility of remote fields	6	4	
7	Labour shortage during peak seasons	7	9	
8	Small and fragmented holdings unsuitable for mechanisation	8	8	
9	Non-availability of *Krishibhavan* seeds in adequate quantities	9	2	
10	Low tillering in sandy soil	10	10	

*Significant at 0.05 level

The rank orders in table 59 revealed that 'untimely availability of *Krishibhavan* seeds', 'non-availability of *Krishibhavan* seeds in adequate quantities' and 'non-availability of preferred varieties from *Krishibhavan* were the important constraints to the rice farmers according the ESS. According to the FSS, 'untimely availability of *Krishibhavan* seeds', 'non-availability of preferred varieties from *Krishibhavan*' and 'difficulty in processing *virippu* seeds' were perceived to be the major constraints faced by the rice farmers of Kadampazhippuram panchayat.

4.4.1.11.2 Constraints to rice seed distribution as perceived by the ESS

The *Krishibhavan* officials of Kadampazhippuram panchayat were asked to prepare a prioritised list of constraints faced by them in rice seed distribution (Table 60).

Table 60. Constraints to rice seed distribution as perceived by the ESS of Kadampazhippuram panchayat

Sl.No	Constraints	Ranking
1	Inadequate storage facilities for inputs	1
2	Reduced demand for *Krishibhavan* seeds	2
3	Monitoring of RSGP difficult	3
4	High work load for staff	4
5	Inadequate staff	5

'Inadequate storage facilities for inputs', 'reduced demand for *Krishibhavan* seeds' and 'monitoring of RSGP difficult' were the most important constraints faced by the ESS (Table 60).

4.4.2 Constraints to rice seed production and distribution as perceived by the SISS of Palakkad district

The officials of five State Seed Farms (SSFs) in the district were interviewed in groups (GSSIs) and were facilitated to prepare a prioritised list of constraints faced by them in rice seed production and distribution. The results are presented hereunder:

4.4.2.1 State Seed Farm – Alathur

The total area under the SSF is 7.192 ha.

4.4.2.1.1 Constraints to rice seed production and distribution as perceived by the officials of SSF Alathur

Comprehensive prioritised list of constraints faced by the officials of SSF, Alathur is presented in table 61.

Table 61. Constraints to rice seed production and distribution as perceived by the officials of SSF, Alathur

Sl.No	Constraints	Ranking
1	Absence of skill training to SSF labourers regarding quality seed production	1
2	Drought towards the end of *mundakan*	2
3	Labour shortage	3
4	Pest/disease menace in *mundakan*	4
5	Untimely availability of RSS seeds	5
6	Poor work efficiency of aged labourers	6
7	Inadequate seed processing and storage facilities	7
8	Inadequate farm mechanisation	8
9	Inadequate transportation and communication facilities for SSFs	9
10	Inadequate feedback about farmer's varietal performances	10
11	Excess of inputs required for seed production	11
12	Weed menace	12

The analysis of rank orders given in table 61 revealed that 'absence of skill training to SSF labourers regarding quality seed production' was perceived as the most important constraint, followed by 'drought towards the end of *mundakan*', 'labour shortage', 'pest/disease menace in *mundakan*' and 'untimely availability of RSS seeds'.

4.4.2.2 State Seed Farm -Ananganady

The total area coming under the farm is 7.162 ha. It has rice cropped area of 5.5 ha in *virippu* and 4.5 ha in *mundakan*.

4.4.2.2.1 Constraints to rice seed production and distribution as perceived by the officials of SSF, Ananganady

A comprehensive prioritised list of constraints faced by the officials of SSF, Ananganady is presented in table 62.

Table 62. Constraints to rice seed production and distribution as perceived by the officials of SSF, Ananganady

Sl.No	Constraints	Ranking
1	General apathy of SSF labourers towards work	1
2	Inadequate farm mechanisation	2
3	Inadequate facilities for drying *virippu* seed	3
4	Poor work efficiency of aged labourers	4
5	Poor co-ordination between RSS and SISS	5
6	Untimely availability of RSS seeds	6
7	Excess of inputs required for seed production	7
8	Drought towards the end of *mundakan*	8
9	Labour shortage	9
10	Inadequate seed processing and storage facilities	10
11	Small and fragmented paddy lands	11
12	Inadequate farm mechanisation	1
13	Inadequate transportation and communication facilities for SSFs	13

The analysis of rank orders given in table 62 showed that 'general apathy of SSF labourers towards work', 'inadequate farm mechanisation', 'inadequate facilities for drying *virippu* seed', 'poor work efficiency of aged labourers' and 'poor co-ordination between RSS and SISS' were perceived to be the most important constraints faced by the officials of SSF Ananganady.

4.4.2.3 State Seed Farm -Kongad

The total area of the farm is 7.15 ha, with rice in 3.76 ha in *virippu* and 4.5 ha in *mundakan.*

4.4.2.3.1 Constraints to rice seed production and distribution as perceived by the officials of SSF, Kongad

A comprehensive, prioritised list of constraints faced by the officials of SSF, Kongad is presented in table 63.

Table 63. Constraints to rice seed production and distribution as perceived by the officials of SSF, Kongad

Sl.No	Constraints	Ranking
1	Financial constraints	1
2	Untimely availability of RSS seeds	2
3	Gab menace in *virippu*	3
4	Drought towards the end of *mundakan*	4
5	Labour shortage	5
6	Excess of inputs required for seed production	6
7	Poor work efficiency of aged labourers	7
8	Wild boer menace	8
9	Inadequate facilities for drying *virippu* seed	9
10	Small and fragmented paddy lands	10
11	Inadequate transportation and communication facilities of SSFs	11
12	Inadequate seed processing and storage facilities	12

The analysis of rank orders given table 63 revealed that 'financial constraints' was perceived as the most important one, faced by the SISS, followed by 'untimely availability of RSS seeds', 'crab menace in *virippu*', 'drought towards the end of *mundakan*' and 'labour shortage'.

4.4.2.4 State Seed Farm -Kunnannur

The total area of the farm is 18.8 ha.

4.4.2.4.1 Constraints to rice seed production and distribution as perceived by the officials of SSF, Kunnannur

A comprehensive, prioritised list of constraints faced by the officials of SSF, Kunnannur is presented in table 64.

Table 64. Constraints to rice seed production and distribution as perceived by the officials of SSF, Kunnannur

Sl.No	Constraints	Ranking
1	Drought towards the end of *mundakan*	1
2	Financial constraints	2
3	Labour shortage	3
4	Lesser work norms of SSF labourers	4
5	Poor work efficiency of aged labourers	5
6	Absence of skill training to SSF labourers regarding quality seed production	6
7	Inadequate seed processing and storage facilities	7
8	Pest/disease menace in *mundakan*	8
9	Excess inputs required for seed production	9

Table 64 revealed that according to SSF officials of Kunnannur, 'drought towards the end of *mundakan*', 'financial constraints', 'labour shortage', 'lesser work norms of SSF labourers', and 'poor work efficiency of aged labourers' were the most important constraints faced by them in rice seed production and distribution.

4.4.2.5 State Seed Farm -Muthalamada

The total geographic area of the farm is 22.44 ha in which 11.5 ha are cultivated in *virippu* and 7 ha in *mundakan*. The rest of the area is demarcated as garden land.

4.4.2.5.1 Constraints to rice seed production and distribution as perceived by the officials of SSF, Muthalamada

A comprehensive, prioritised list of constraints faced by the officials of SSF, Muthalamada is presented in table 65.

Table 65. Constraints to rice seed production and distribution as perceived by the officials of SSF, Muthalamada

Sl.No	Constraints	Ranking
1	Financial constraints	1
2	Untimely availability of RSS seeds	2
3	Drought towards the end of *mundakan*	3
4	Crab menace in *virippu*	4
5	High work load for staff	5
6	Insufficient supporting staff	6
7	General apathy of SSF labourers towards work	7
8	Inconsistent viability of RSS seeds	8
9	Inadequate transportation and communication facilities	9
10	BLB menace in *virippu*	10

According to the officials of SSF Muthalamada, 'financial constraints', 'untimely availability of RSS seeds' and 'drought towards the end of *mundakan*' were the most important constraints to rice production and distribution. (Table 65)

4.5 District-based prioritisation of constraints to rice seed production and distribution and the suggestions for improvement as perceived by the FSS, ESS, SISS and RSS of Palakkad district

The district-based prioritisation of constraints to rice seed production and distribution and the suggestions for improvement as perceived by the FSS, ESS, SISS and RSS of Palakkad district are presented hereunder:

4.5.1 Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Palakkad district

Through GSSIs with the respondents from the ESS representing 11 panchayats under study, prioritised lists of constraints faced by them in rice seed production and distrbution were obtained. The same lists were presented before the respective *Krishibhavan* officials and were ranked independently. A district-based list of constraints was prepared and prioritised employing Constraint Ranking Index (CRI). The results of the exercise are presented in table 66.

It could be concluded from table 66 that 'untimely availability of *Krishibhavan* seeds', 'non-availability of preferred varieties from *Krishibhavan*', 'poor germination of *Krishibhavan* seeds', 'difficulty in processing *virippu* seed' and 'non-availability of *Krishibhavan* seeds in adequate quantities' were identified as the major constraints faced by the farmers of the district, as perceived the ESS. But farmers opined that, 'untimely availability of *Krishibhavan* seeds', 'non-availability of preferred varieties from *Krishibhavan*', 'non- availability of *Krishibhavan* seeds in adequate quantities', 'difficulty in processing *virippu* seed' and 'poor germination of *Krishibhavan* seeds' were the major problems faced by the rice farming community.

Table 66. Farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Palakkad district

Sl.No	Constraints	FSS		ESS	
		CRI	Rank	CRI	Rank
1	Untimely availability of *Krishibhavan* seeds	8.9400	1	8.3900	1
2	Non-availability of preferred varieties from *Krishibhavan*	7.8600	2	7.0900	2
3	Non-availability of *Krishibhavan* seeds in adequate quantities	3.2900	3	3.0100	5
4	Difficulty in processing *virippu* seed	2.9400	4	3.0600	4
5	Poor germination of *Krishibhavan* seeds	2.6900	5	3.1800	3
6	Drought towards the end of *mundakan*	1.8600	6	1.5800	6
7	Labour shortage during peak seasons	1.4800	7	1.4400	7
8	Conveyance inaccessibility of remote fields	1.4400	8	1.3200	8
9	High labour charge	0.8000	9	0.7400	9
10	Delayed payment of seeds procured through RSGP	0.5800	10	0.6200	10
11	Insufficient procurement of RSGP seeds	0.4400	11	0.4200	12
12	Complex procedure for seed testing in RSGP	0.4400	11	0.4700	11
13	Low genetic purity of *Krishibhavan* seeds	0.3500	12	0.3600	13
14	High cost of seeds from public seed agencies	0.3200	13	0.3200	14
15	Lack of assured irrigation	0.2400	14	0.2200	16
16	Varietal mixing and genetic impurity in farmer- produced seeds	0.1300	15	0.2600	15
17	Lack of facilities for seed storage	0.1200	16	0.1400	17
18	Inconvenient seed bag size/quantity	0.0700	17	0.0700	18
19	Low physical purity of *Krishibhavan* seeds	0.0600	18	0.0300	22
20	Germination of seeds in panicle	0.0500	19	0.0400	21
21	Lack of awareness about quality seed production	0.0400	20	0.0500	20
22	Extra payment for seed bags	0.0300	21	0.0600	19
23	Absence of marketing arrangements for farmer- produced seeds	0.0300	21	0.0400	21

24	Low price for farmer-produced seeds	0.0200	22	0.0100	24
25	Small and fragmented holdings unsuitable for mechanisation	0.0200	22	0.0200	23
26	Deterioration of seed quality in polybags	0.0200	22	0.0600	19
27	Lack of co-operation among farmers during critical farm operations	0.0200	22	0.0100	24
28	Inaccessibility of seed production/distribution agencies	0.0100	23	0.0200	23

Detailed matrices presented in Appendices V (a) & V (b)

4.5.2 Constraints to rice seed production and distribution as perceived by the ESS of Palakkad district

Through GSSIs with the officials of the ESS, a prioritised list of constraints faced by them in rice seed distribution was obtained from each of the 11 KBs under consideration. A district-based prioritised list of constraints was computed from them, employing Constraint Ranking Index (CRI). The result of the exercise is presented in table 67.

Table 67. Constraints to rice seed production and distribution as perceived by the ESS of Palakkad district

Sl.No	Constraints	CRI	Ranking
1	Inadequate staff	4.7900	1
2	Inadequate storage facilities for inputs	3.8300	2
3	High work load for staff	3.0900	3
4	Accumulation of seeds	1.9900	4
5	Untimely availability of SISS seeds	1.1800	5
6	Non-availability of farmer-preferred varieties	1.0500	6
7	Monitoring of RSGP difficult	1.0300	7
8	Reduced demand for *Krishibhavan* seeds	0.9500	8
9	Service co-operative banks' unwillingness to procure seeds from farmers	0.3300	9
10	Non-availability of SISS seeds in adequate quantities	0.1500	10
11	Poor germination of SISS seeds	0.0700	11
12	*Krishibhavan* officials compelled to dispose previous seed stock	0.0300	12
13	Undue interference of local bodies	0.0200	13
14	Poor genetic purity of SISS seeds	0.0200	13

Detailed matrix presented in Appendix VI

4.5.3 Constraints to rice seed production and distribution as perceived by the SISS of Palakkad district

Through GSSIs with the officials of five SSFs in the district, prioritised lists of constraints faced by them in rice seed production and distribution were prepared employing CRI. The results of the exercise are presented in table 68.

It could be concluded from table 68 that 'drought towards the end of *mundakan*', 'untimely availability of RSS seeds', 'labour shortage' and 'poor work efficiency of aged labourers' were perceived to be the most significant constraints faced by SISS. 'Weed menace' and 'BLB menace' were the least important among them.

4.5.4 Constraints to rice seed production and distribution as perceived by the RSS of Palakkad district

The rice researchers of RARS, Pattambi were interviewed and constraints to the development, maintenance, production and distribution of rice varieties were collected. These constraints were again classified into 'Research', 'Production' and 'Extension' constraints and ranked separately.

4.5.4.1 Research constraints

'Developmental variation' of rice varieties due to temporal and geographic variation and 'evolution of minor diseases such as Brown spot into major diseases' making it difficult for the breeder to fix research priorities were the two problems categorized as research constraints.

Table 68. Constraints to rice seed production and distribution as perceived by the SISS of Palakkad district

Sl.No	Constraints	CRI	Ranking
1	Drought towards the end of *mundakan*	3.9300	1
2	Untimely availability of RSS seeds	2.4700	2
3	Labour shortage	2.1300	3
4	Poor work efficiency of aged labourers	1.9300	4
5	Financial constraints	1.7300	5
6	Excess of inputs required for seed production	1.1200	6
7	Small and fragmented paddy lands	1.0200	7
8	Inadequate seed processing and storage facilities	0.9900	8
9	Lack of transportation and communication facilities	0.6200	9
10	Crab menace in *virippu*	0.6100	10
11	Absence of skill training to SSF labourers regarding quality seed production	0.5800	11
12	General apathy of SSF labourers towards work	0.5600	12
13	Inadequate farm mechanisation	0.5400	13
14	Inadequate facilities for drying *virippu* seed	0.4700	14
15	Pest/disease menace in *mundakan*	0.3900	15
16	Inconsistent viability of RSS seeds	0.1800	16
17	Poor co-ordination between RSS and SISS	0.1400	17
18	Lesser work norms of SISS labourers	0.1300	18
19	High work load for staff	0.1200	19
20	Insufficient supporting staff	0.1000	20
21	Wild boer menace	0.0800	21
22	Inadequate feed back about farmers' varietal preferences	0.0500	22
23	Weed menace	0.0200	23
24	BLB menace in *virippu*	0.0200	23

Detailed matrix presented in Appendix VIII

4.5.4.2 Production constraints

The constraints identified and prioritised under this category are given in table 69.

Table 69. Rice production constraints as perceived by the RSS, Pattambi

Sl.No	Constraints	Ranking
1	Water scarcity during *mundakan*	1
2	Late indent for seeds from SISS	2
3	Labour shortage due to partial overlapping of *virippu* and *mundakan*	3
4	High seed production cost	4
5	Labour shortage in the farms of RSS	5
6	Crab menace	6
7	Reduced demand for seeds from the farmers	7
8	Varietal mixing during post production stages	8
9	Varietal mixing in flood prone plots	9

It could be concluded from table 69 that 'water scarcity during *mundakan*', 'late indent for seeds from SSIS' and 'labour shortage due to partial overlapping of *virippu* and *mundakan*' were perceived as the most serious production constraints by the RSS.

4.5.4.3 Extension constraints

'Apprehension of the SISS towards 'new' varieties', 'inadequate knowledge of the ESS and the SISS personal on the recent varieties' and 'lack of their knowledge on specific varietal adaptability' were the extension constraints perceived by the RSS.

Table 70. Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the FSS

Constraint No.*	Suggestions
1	Better linkage between SISS & ESS; local seed production in panchayats
2	Breeding farmer-preferred varieties
3	Decentralized community level seed production; More SSFs to be established
4	Farm mechanization in the form of artificial seed driers
5	Quality seeds to be supplied; delayed distribution should be avoided
6	Water release from Malampuzha dam to be properly monitored with farmer participation;Short duration HYVs suitable to *mundakan* should be released
7	Perceived social status of farm labour should be enhanced for attracting youth
8	Farm roads
9	Nil
10	Prompt payment needs should be assured
11	The entire seed produced should be procured
12	Local seed testing with the help of AOs should be practiced
13	Proper care to be maintained while seed production, processing and storage
14	Cost should be reduced
15	Dig common ponds in *padasekharams* & desilt the existing ones
16	Proper rouging should be practiced
17	Infrastructural facilities for seed storage should be provided to *Krishibhavans*
18	Seeds should be made available in 10 kg bags
19	Proper care to be maintained while seed production, processing and storage
20	Varieties with seed dormancy should be developed
21	Seed fares, exhibitions and trainings on quality seed production should be conducted
22	Payment for sacks should be avoided
23	Farmers' cooperatives should be established
24	Seed produce should be procured at a higher price
25	Group farming should be encouraged
26	Linen Bags should utilized to pack seeds
27	Subsidies should be restricted to collective farming groups
28	Local seed multiplication

*Refer table 66

4.5.5 Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the FSS, ESS, SISS and RSS

The suggestions for countering the constraints each subsystem faced, were also elicited from the respondents of the study, which are presented in tables 70 to 73

4.5.5.1 Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the FSS

4.5.5.2 Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the ESS

Table 71. Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the ESS

Constraint No.*	Suggestions
1	Adequate clerical staff and Junior Agricultural Officer should be posted in KBs
2	Adequate storage facilities should be allotted
3	KB staff should be responsible for agricultural related services only
4	Seeds of farmer-preferred varieties should be made available
5	Better communication should be ensured between ESS and SISS
6	Farmer participation should be ensured in future breeding programmes
7	Adequate clerical staff and Junior Agricultural Officer should posted in KB
8	Farmer participation should be ensured in future breeding programmes
9	Adequate storage facilities should be given to service co-operative banks
10	Local seed production should be encouraged
11	Delayed supply of seeds should be discouraged
12	Seeds of farmer-preferred varieties should be made available
13	Undue interference of local bodies should be avoided
14	Proper care to be maintained while seed production, processing and storage

*Refer table 67

4.5.5.3 Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the SISS

Table 72. Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the SISS

Constraint No.*	Suggestions
1	Additional water sources such as bore wells need to be dug
2	Effective communication between the SISS and the RSS should be facilitated
3	New recruitment of temporary hands
4	Labourers should be substituted at the age of fifty
5	The State Seed Farms should be assured with adequate and timely funding
6	Nil
7	Nil
8	Adequate seed processing and storage facilities should be ensured
9	Proper transportation and communication facilities for SSFs should be ensured
10	Biological control using ducks/ Chemical control/Coconut cake application
11	Trainings on scientific seed production should be organised
12	Nil
13	Possibilities of farm mechanisation should be examined
14	Farm mechanization in the form of artificial seed driers
15	Late planting should be avoided
16	Quality of Breeder/Foundation seed -1 should be maintained
17	Co-ordination between RSS and SISS should be improved
18	Change in government policy required
19	Computerization of SSFs
20	Adequate clerical staff should be recruited
21	Barbed wire fencing around the farms
22	Frequent seed fares, exhibitions and workshops should be organised
23	Use of herbicides
24	Chemical control of pests

*Refer table 68

4.5.5.4 Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the RSS

No measures were suggested for tackling the research constraints cited such as 'developmental variation' and 'evolution of minor diseases into major diseases'. For imparting proper knowledge about varietal characters and adaptability of newly released varieties, organization of annual seed workshops and seminars were suggested. The following table summarizes the suggestions put forward by the ESS to counter the seed production constraints.

Table 73. Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the RSS

Constraint No.*	Suggestions
1	Additional sources of water should be explored
2	Placement of timely seed intent by the SISS should be ensured
3	Temporary hands should be appointed during peak seasons of operation
4	Farm mechanization needs to be encouraged
5	Temporary hands should be appointed during peak seasons of operation
6	Biological control using ducks/ Chemical control
7	Breeding farmer-preferred varieties suggested
8	Adequate facilities for threshing & storing seeds should be established
9	Nil

*Refer table 69

4.6 District-based ranking of rice varieties based on multi-seasonal adaptability

Multi-Seasonal Adaptability Index (MSAI) was used to find out the 'adaptability' of rice varieties to the seasons, *virippu* and *mundakan*. Among the 41 *virippu* varieties and 33 *mundakan* varieties identified in Palakkad district, 20 were found to be cultivated in both the seasons. The results of the analysis are presented in table 74.

Aiswarya and Kanchana were found to be more adaptable to both the seasons, followed by 'Kunjukunju', Athira, ASD-16, TKM-9 and Mattathriveni. Rice varieties such as Mashuri, CO-10, Neeraja, 'Undamashuri' and Paiyur-1 were found to be least adaptable to multiple seasons (Table 74).

Table 74. Multi seasonal adaptability ranking of rice varieties/cultivars

Sl.No	Variety/Cultivar	Rank order		Rank score*	Final ranking**
		Virippu n_1	*Mundakan* n_2		
1	Aiswarya	20	20	4.000	1
2	Kanchana	19	19	3.610	2
3	'Kunjukunju'	18	17	3.150	3
4	Athira	13	14	1.890	4
5	ASD-16	15	18	0.990	5
6	Mattathriveni	14	12	0.910	6
7	TKM-9	17	13	0.640	7
8	'Vanitha'	8	8	0.640	8
9	'Sulochana'	7	6	0.450	9
10	Pavizham	12	9	0.420	10
11	Jaya	16	10	0.350	11
12	'Kalyani'	9	15	0.300	12
13	'Lakshmi'	10	5	0.150	13
14	Vellapponni	4	16	0.130	14
15	Pranava	11	4	0.120	15
16	Paiyur-1	6	3	0.090	16
17	'Undamashuri'	2	11	0.079	17
18	Neeraja	3	2	0.075	18
19	CO-10	1	7	0.050	19
20	Mashuri	5	1	0.040	20

* When the rank scores obtained were found to be equal, final ranking was done based on the highest average performance of the concerned varieties across seasons.

** When there was no variation in the varietal performance across the seasons, a minimum of one per cent variation was maintained in the calculations.

4.7 Comparative rankings of rice varieties, varietal traits and farmers' constraints to rice seed production and distribution as perceived by the FSS and ESS of Palakkad district

4.7.1 Comparative perception of the FSS and the ESS on the ranking of *virippu* varieties

The comparative perception of the FSS and the ESS based on the ranking of *virippu* varieties were worked out using Mann-Whitney "U" test. The results are presented in table 75.

Table 75. Relative perception of the FSS and the ESS on the ranking of *virippu* varieties

Category	N	Mann-Whitney "U"
ESS	41	
FSS	41	U = 1053
Total	82	Z = 1.967*

*Significant at 0.05 level

The calculated value of 'Z' (table 75) was greater than that of the table value at five percent level of significance. Hence, it could be concluded that there was significant difference in the perception of ESS and FSS with respect to the ranking of *virippu* varieties.

4.7.2 Comparative perception of the FSS and the ESS on the ranking of *mundakan* varieties

The relative perceptions of the FSS and the ESS with respect to the ranking of *mundakan* varieties were worked out using Mann-Whitney "U" test, as presented in table 76.

Table 76. Relative perception of the FSS and the ESS on the ranking of *mundakan* varieties

Category	N	Mann-Whitney "U"
ESS	33	
FSS	33	U = 823
Total	66	Z =1.980*

*Significant at 0.05 level

The data in table 76 revealed that the calculated value of 'Z' was greater than that of the table value at five per cent level of significance. Hence it could be concluded that there was significant difference in the perception of the FSS and the ESS with respect to the ranking of *mundakan* varieties.

4.7.3 Comparative perception of the FSS and the ESS on the ranking of rice varietal attributes

The relative perception of the FSS and the ESS with respect to the ranking of 34 preferential attributes of rice varieties was worked out using Spearman's Rank Order Correlation (r_s) and the results are summarized in table 77.

Table 77. Relative perception of the FSS and the ESS on the ranking of rice varietal attributes

n_1	n^2	$\sum d^2_i$	Spearman's Rank Order Correlation (r_s)
34	1156	274	0.9581**

**Significant at 0.01 level

The analysis of table 77 revealed that there was significant correlation between the perception of the FSS and ESS on the ranking of preferred varietal attributes

4.7.4 Comparative perception of the FSS and the ESS on the constraints faced by the farmers in rice seed production and distribution

The relative perception of the FSS and the ESS regarding the ranking of 28 constraints faced by the rice farmers of the district were worked out using Mann-Whitney "U" test. The results are summarized and presented in table 78.

Table 78. Relative perception of the FSS and the ESS on the ranking of constraints faced by the farmers in rice seed production and distribution

Category	N	Mann-Whitney "U"
ESS	28	U = 403.5
FSS	28	$Z = 0.1886^{NS}$
Total	56	

Table 78 revealed that the calculated value of 'Z' was lower than that of the table value at five per cent level of significance. Hence, it could be concluded that there was no significant differences in the perception of the FSS and the ESS with respect to the ranking of farmers' constraints to rice seed production and distribution in the district.

4.8 Rice seed production status of Palakkad district

The Secondary data on the status of rice seed production elicited from RARS, Pattambi, the five SSFs, the records of Registered Seed Growers' Programme

(RSGP) and National Seed Corporation (NSC) seed Production Unit, Alathur, for five consecutive years (1996-1997 to 2000-2001) formed the basis of this analysis.

4.8.1 Status of rice seed production in RARS, Pattambi (1996-1997 to 2000-2001)

The details of rice seed production from RARS, Pattambi for the five consecutive years (1996-1997 to 2000-2001) is given in table 79.

The data revealed that 19 varieties were included in the seed production programme for the five years under study. The seed production out put from RARS, Pattambi during these years was 56.000 t, 62.505 t, 48.370 t, 47.239 t and 57.022 t respectively (Table 79).

4.8.2 Status of rice seed production in the SSFs of Palakkad district (1996-1997 to 2000-2001)

The status of rice seed production from the five SSFs for the five consecutive years (1996-1997 to 2000-2001) is given in table 80.

Rice seed production was carried out in 15 varieties. The seed production output from the SSFs during the years (1996-1997 to 2000-2001) was 165.797 t, 153.512 t, 119.869 t, 154.399 t and 129.766 t respectively.

4.8.3 Registered Seed Growers' Programme (RSGP)

It could be concluded from table 81 that Kanchana, Kanakom, Pranava, Pavithra and ASD-16 were the rice varieties chosen for seed production during the years, 1998-1999, 1999-2000 and 2000-2001. Rice seed productions for these years were 30.800 t, 31.700 t and 98.613 t respectively.

4.8.4 NSC-Rice Seed Production Unit, Alathur

NSC operates their seed production programme through selected seed growers. The available seed production data gathered from secondary sources is presented in table 82.

Table 79. Status of rice seed production in RARS, Pattambi (1996-1997 to 2000-2001)

Sl. No	Varieties/ Cultivars	1996-1997		1997-1998		1998-1999		1999-2000		2000-2001	
		Virippu	*Mundakan*	*Virippu*	*Mundakan*	*Virippu*	*Mundakan*	*Virippu*	*Mundakan*	*Virippu*	*Mundakan*
1	Mattathriveni	4.000	3.670	5.360	4.810	2.640	5.880	3.440	2.140	4.690	4.100
2	Jyothi	6.400	7.000	13.740	5.210	7.000	4.630	9.980	3.580	8.900	6.800
3	Annapoorna	1.940	0.490	0.430	-	1.910	-	0.600	0.290	0.775	1.000
4	Kairali	4.380	4.470	4.990	2.310	3.260	5.050	1.830	2.020	-	-
5	Athira	1.060	1.090	1.230	-	1.250	0.600	1.740	0.260	4.091	-
6	Aiswarya	1.830	3.260	3.310	3.050	3.340	2.390	3.990	1.430	1.884	4.400
7	Jaya	0.440	0.280	0.970	0.470	1.600	0.610	0.147	0.845	-	0.645
8	Mangala Mashuri	1.320	0.320	4.330	-	0.290	-	1.100	0.460	-	0.750
9	Mashuri	0.090	-	0.070	-	0.100	-	0.220	-	-	-
10	Bharathi	0.700	-	0.015	0.440	0.650	0.510	0.750	-	-	-
11	Neeraja	0.610	2.170	0.570	-	1.240	-	0.180	1.170	0.366	0.100
12	Jayathi	0.140	-	0.220	-	0.630	-	0.100	-	-	-
13	Swarnaprabha	0.370	-	0.030	-	0.062	-	0.040	-	0.200	-
14	Kanchana	-	7.910	6.820	3.510	1.050	0.840	3.930	4.020	6.945	4.616
15	Njavara	-	-	-	0.100	0.128	-	-	0.087	-	-
16	CO-25	-	0.800	-	0.060	-	0.110	-	-	-	-
17	Nila	-	0.800	-	0.260	-	0.750	-	1.260	-	1.100
18	PTB-20	-	-	-	0.200	-	0.120	-	0.190	-	0.730
19	Karuna	-	0.460	-	-	-	1.730	-	1.430	-	4.930
Total		23.280	32.720	42.085	20.420	25.150	23.220	28.057	19.182	27.851	29.171
Grand total		56.000		62.505		48.370		47.239		57.022	

Table 80. Status of rice seed production by the SSFs of Palakkad district (1996-1997 to 2000-001)

Sl. No	Variety/Cultivar	1996-1997		1997-1998		1998-1999		1999-2000		2000-2001	
		Virippu	*Mundakan*	*Virippu*	*Mundakan*	*Virippu*	*Mundakan*	*Virippu*	*Mundakan*	*Virippu*	*Mundakan*
1	Aiswarya	27.148	44.718	16.834	-	0.817	-	-	-	1.004	0.275
2	Kanchana	31.092	7.443	31.400	35.412	42.124	56.774	42.853	15.184	36.677	18.521
3	Kairali	5.000	24.386	4.820	24.500	-	11.150	1.069	10.800	10.800	4.900
4	Pranava	-	-	-	-	-	-	20.300	3.300	-	-
5	Pavithra	-	-	-	-	-	0.480	0.450	18.110	-	-
6	Kanakom	-	-	-	-	0.320	0.550	13.917	15.040	16.030	-
7	Jyothi	-	-	-	9.467	-	-	-	-	3.828	28.176
8	Mattathriveni	-	-	-	-	-	-	-	-	0.200	0.335
9	ASD-16	-	-	-	-	-	-	-	0.437	3.338	-
10	Mangala Mashuri	-	26.010	31.079	-	-	-	-	-	-	-
11	Pavizham	-	-	-	-	6.051	-	-	-	-	-
12	Makom	-	-	-	-	1.603	-	-	-	-	-
13	Vellapponni	-	-	-	-	-	-	1.364	-	4.944	-
14	Ponmani	-	-	-	-	-	-	-	11.515	-	-
15	Athira	-	-	-	-	-	-	-	-	-	0.738
Total		63.240	102.557	84.133	69.379	50.915	68.954	79.953	74.386	76.821	52.945
Grand total		165.797		153.512		119.869		154.339		129.766	

Table 81. Status of rice seed production, RSGP- in Palakkad district (1998-1999 to 2000-2001)

Sl.No.	Variety/Cultivars	Rice seed production (t)		
		1998-1999	1999-2000	2000-2001
1	Kanchana	30.800	31.700	43.900
2	Kanakom	-	-	24.800
3	Pranava	-	-	20.700
4	Pavithra	-	-	7.983
5	ASD-16	-	-	1.230
Total production (t)		30.800	31.700	98.613

Table 82. Status of the rice seed production in NSC-Rice seed production Unit, Alathur (1999-2000 to 2000-2001)

Sl.No	Variety/Cultivar	Rice seed production (t)	
1	Jyothi	68.000	70.000
2	Uma	32.000	30.000
3	Kanchana	25.000	25.000
4	Mattathriveni	12.000	15.000
5	Karishma	28.000	30.000
Total production (t)		165.000	170.00

Jyothi, Uma, Kanchana, Mattatriveni and Karishma were the varieties taken up for seed production programme. The total rice production recorded was 165.000 kg and 170.000 kg during 1999-2000 and 2000-2001 respectively. (Table 82)

4.8.5 Comprehensive status of the rice seed production under public sector in Palakkad district (1996-1997 to 2000-2001)

Rice seed production statistics for Palakkad district (1996-1997 to 2000-2001) is summarised in table 83.

Table 83. Comprehensive status of the rice seed production under public sector in Palakkad district (1996-1997 to 2000-2001)

Sl.No	Variety/Cultivar	Rice seed production (t)				
		1996-97	1997-98	1998-99	1999-00	2000-01
1	Aiswarya	76.956	23.194	6.547	5.420	7.563
2	Mangala Mashuri	27.650	35.409	0.290	1.570	0.750
3	Jyothi	13.400	28.417	11.630	81.560	117.704
4	Pavithra	-	-	0.480	18.560	7.983
5	Kanakom	-	-	0.870	28.957	40.830
6	Makom	-	-	1.603	-	-
7	Kanchana	46.445	77.142	131.588	122.687	135.659
8	Pavizham	-	-	6.051	-	-
9	Pranava	-	-	-	23.600	20.700
10	Ponmani	-	-	-	11.515	-
11	Vellapponni	-	-	-	1.364	4.944
12	Athira	2.150	1.230	1.850	2.000	4.829
13	Mattathriveni	7.670	10.170	8.520	17.580	24.325
14	Annapoorna	2.430	0.430	1.910	0.890	1.775
15	Kairali	38.236	36.626	19.460	15.719	15.700
16	Jaya	0.720	1.440	2.210	0.992	0.654
17	Mashuri	0.900	0.070	0.100	0.220	-
18	Bharathi	0.700	0.455	1.160	0.750	-
19	Neeraja	2.780	0.570	1.240	1.350	0.466
20	Jayathi	0.140	0.220	0.630	0.100	-
21	Swarnaprabha	0.370	0.300	0.062	0.400	0.200
22	CO-25	0.800	0.060	0.110	-	-
23	Nila	0.800	0.260	0.750	1.260	1.100
24	Karuna	0.460	-	1.730	1.430	4.930
25	Njavara	-	0.100	0.128	0.870	-
26	PTB-20	-	0.200	0.120	0.190	0.730
27	ASD-16	-	-	-	1.667	4.568
28	Uma	-	-	-	32.000	30.000
29	Karishma	-	-	-	28.000	30.000
Total production (t)		221.797	216.017	199.939	399.508	455.401
Total rice area (ha)		129356	120809	107467	107467	107467
Seed requirement (t)		10348.48	9664.72	8597.36	8597.36	8597.36
Seed supply from the public sector (%)		2.14	2.24	2.32	4.65	5.30
Demand-supply gap (%)		97.86	97.76	97.68	95.35	94.70

Thirty rice varieties were found to be involved in the seed production programmes of various public sector seed production agencies operating in the district viz., RARS, Pattambi, SSFs, RSGP and NSC, Alathur. Rice seed production by these agencies during the five years (1996-1997 to 2000-2001) was 221.80 t, 216.02 t, 199.04 t, 399.51 t and 455.40 t respectively (Table 83).

DISCUSSION

DISCUSSION

The discussion on the results of the study is presented under the following subheads:

5.1 Rice production systems of Palakkad district

5.2 Crop season calendars of the selected Agricultural Development Blocks under study

5.3 Rice varietal status of Palakkad district

5.4 Rice varietal preference and current seed production status of Palakkad district

5.5 Attribute ranking of the rice varieties of Palakkad district

5.6 Constraints to rice seed production and distribution as perceived by the FSS, ESS, SISS and RSS of Palakkad district and the suggestions for improvement thereon

5.7 Ranking of rice varieties/cultivars based on multi seasonal adaptability

5.8 The comparative rankings of rice varieties, varietal traits and farmers' constraints to rice seed production and distribution as perceived by the FSS and the ESS of Palakkad district.

5.9 Practical utility of the preferential indices developed for the study

5.10 Suggestions for effective operation of rice breeding set up and public seed production agencies of Palakkad district

5.11 Empirical model of the rice varietal preferences of the farmers of Palakkad district- *Virippu*

5.12 Empirical model of the rice varietal preferences of the farmers of Palakkad district – *Mudakan*

5.13 Suggestions for streamlining rice varietal release, seed production and distribution in Palakkad district

5.14 Proposed model for decentralised participatory rice varietal selection and seed production for Palakkad district

5.1 Rice production systems of Palakkad district

In this study, an attempt was made to explore the different rice production systems of Palakkad district through semi-structured interviews with the key informants. As is typical of the midland rice belts of Kerala, the predominant systems according to the seasons were *virippu* (first crop) and *mundakan* (second crop). The dominance of these two is evidenced by the participatory crop season calendars prepared by the farmers of the 10 ADBs under study (Figs.4 to14). Recent statistics (FIB, 2000) corroborate this finding. Of the gross rice area available in Palakkad district, about 94 per cent accounts for *virippu* and *mundakan* and a negligible area under *punja* (third crop), proving that the district is more of a double-cropped rice belt. Sidelining *punja* deprives the district of higher production and productivity. The district level average productivity of *punja* crop (2303 kg ha^{-1}) was much higher than *virippu* (2221 kg ha^{-1}) and *mundakan* (2112 kg ha^{-1}), according to 1997-1998 estimates (FIB, 2000). Despite the presence of major and minor irrigation projects like Walayar, Malampuzha, Gayathri, Mangalam, Pothundy, Chitturpuzha and Kanhirapuzha and blessed with irrigation projects with a total ayacut of 54,200 ha, it is an irony that Palakkad district is now being reduced to a double-cropped belt. This may in turn be due to the lesser command areas and the consequent dearth of water supply from the projects at the tail ends. A typical example is Walayar project.

Apart from the predominant *virippu* and *mundakan* seasons, three other unique traditional systems of growing rice namely, *Koottumundakan, Karingora* and *Poonthalpadams* were found to be in vogue (Figs.14, 10 and 12). Though very limited in area and confined to certain pockets, specific micro-farming situations, and sometimes comparatively low yielding, these systems are being continued by the farmers. The reasons could be social, economic, contextual, temporal and spatial.

5.1.1 *Kootumundakan*

Koottumundakan system of rice cultivation in Palakkad district is confined to the Ottappalam taluk. In this system, a mixture of seeds of a non-photosensitive variety and a photosensitive variety of rice in the proportion 70:30 is sown during *virippu* season. The first crop variety becomes ready for harvest in August-September and the photosensitive long duration variety can be harvested by December-January (Fig.14). Not much cultural operations are done after the harvest of first crop. Manuring and plant protection are not usually done for the second crop. This system gives only poor yields when compared to two independent crops. Despite this, many farmers of certain pockets were found continuing the practice. Actually *Kootumundakan* had its origin in places where land preparation and transplantation were difficult in the second season due to inundation of contextual NE monsoon water. However, recently other considerations like high labour cost for transplantation, manuring and weeding during second crop season and non-availability of labourers during the peak periods of operations might have influenced the farmers in favour of the practice.

A local variety Chettadi was found predominantly used as the long duration photosensitive second crop component. Some of the non-photosensitive first crop varieties used along with Chettadi were: i. Veluthettan, ii. Chenkazhama, iii. Chamban, iv. Arivakaari, v. Swarnali, vi. Ponnaryan, vii Aryan, viii Velutharikazhama, ix. Aiswarya.

It is interesting to note that Aiswarya is the only released variety that could fit into this unique cropping system and is an indication of the lack of research endeavour to breed rice varieties suitable for *Kootumundakan* which has established itself as an important system of cultivation in the western blocks of Palakkad especially Sreekrishnapuram, Pattambi and Thrithala. Recent studies (KAU, 2002) on

Palakkad rice system have recommended for the identification/breeding of suitable varietal combinations for *Koottumundakan* with varieties having high photosynthetic efficiency for the first crop and high grain and straw yield for the second crop.

5.1.2 *Karingora*

Karingora system was found confined to some isolated pockets in Pattambi and Thrithala blocks of Palakkad district. It is a late *virippu* crop extending to the following *mundakan* season. Extra long duration, (160 to 180 days) photosensitive varieties like Chettadi, Nila or long duration (140 to 145 days) non-photosensitive varieties like Neeraja or Mangala Mashuri were found to be cultivated. There was no second or third crop in the *Karingora* fields.

In the case of extra-long duration photosensitive varieties like Chettadi and Nila, 50 to 60 days old seedlings are transplanted by Semptember 15 to 30. Harvesting of the crop is done by the last fortnight of January (Fig.10). For non-photosensitive long duration varieties like Neeraja and Mangala Mashuri, 40 to 45 days old seedlings are transplanted by first week of October and harvested by mid January.

Originally, *Karingora* was practiced in areas where the normal *virippu* crop could not be taken due to heavy rains and water rush during the first few months of South West monsoon season. Of late, the following considerations also were reported to have prompted the farmers to practice this unique system: i. Easy transportability of the harvested paddy to far away *'Kalams'* (threshing yards) ii. Easy availability of labour force iii. Reduced incidence of pests and diseases iv. Good quality straw v. High cost of production, discouraging rice farmers to go for two independent crops vi. Perceived low profitability of rice crop.

5.1.3 *Poonthalpadams*

Poonthalpadams cover around 700 ha in Pattancherry and Muthalamada blocks of Chittoor taluk. They are characterised by the presence of black montmorillionite (2:1 lattice) deep clayey soils. These soils are alkaline in reaction with scattered $CaCo_3$ deposits, low in organic matter, Nitrogen (N), Phosphorus (P) and Cation Exchange Capacity (CEC) and are very sticky and plastic in nature (KAU, 1997). *Poonthalpadam* soils are highly deflocculated with excess amounts of sodium. The impeded drainage and slushy soil conditions restrict the use of tractor for land preparation. Ploughing and other preparatory operations were found done by either power tiller or manually using spade. These ill-drained black soils produce toxic gases soon after the planting of second crop. Sulphide injury is common during this season. The PRA investigations in Pattanchery panchayat revealed that sulphide injury is limited to the second crop. The absence of yellowing in the first crop suggests that the toxic compounds responsible for yellowing are leached out of the active root zone during the southwest monsoon. However, the real reasons are still to be explored. Based on the elevation of land and drainage, farmers have classified the *Poonthatpadams* into *Poonthals* (ill-drained low lands) and *mettuppurams* (well drained lands of medium elevation). Rice is cultivated in two cropping seasons. Generally, long duration rice varieties were reported to perform well in both the seasons, particularly in *poonthals.* The impeded drainage makes it difficult for the transplanted rice to establish itself. This could be the reason why short duration varieties are not cultivated in these areas. By the time the seedlings establish, flowering would occur limiting the productivity of the crop.

KAU (2002) observed two major constraints to the adoption of HYVs in eastern Palakkad: i. Lack of standardisation of suitable varieties specific to these micro farming situations ii. Non-availability of tall and high yielding varieties for double crop sequence mainly in Kollengode and Chittur taluks.

Farmers reported that the *poonthals* seriously lacked suitable HYVs for *mundakan* and the productivity of the crop was reported to be badly limited by the ill-drained soil conditions affecting the tillering ability; sulphide toxicity leading to yellowing of the crop and low grain filling reducing the market demand and price of the produce (Table 55).

5.1.3.1 First crop (*virippu*) of *poonthals*

The crop season calendar revealed that the *virippu* season in *poonthals* starts by the first week of April and ends by the first week of October. In *mettuppurams* cropping season begins with the last pre-monsoon showers (last week of May) and the crop is harvested by the first week of October. Usually 28 to 30 days old seedlings are used for transplantation (Fig.12).

5.1.3.2 Second crop (*Mundakan*) of *poonthals*

As depicted in Fig.12, for the second crop in both *poonthals* and *mettuppurams*, nursery is prepared even before the harvest of the previous crop, i.e. during the first week of October. Generally, 45 days old seedlings are used in *poonthals*, whereas in *mettuppurams* 28 to 30 days old seedlings are transplanted. Harvesting is done by the last week of March in *poonthals*, whereas in *mettuppurams* harvesting is over by the second week of February.

The popular varieties of *poonthalpadams* as reported by the farmers (Tables 26 to 28) revealed a wide spectrum specific to *virippu* and *mundakan*, that too distinctly for *poonthals* and *mettuppurams*. This situation establishes the fact that farmers by virtue of their rich experience over generations have specifically classified the varieties. This should give immense motivation to the rice breeder to focus on the unique *poonthalpadams*.

5.1.3 The need to preserve the three unique systems

A debate is natural whether the unique systems viz., *Koottamudakan, Karongora* and *poonthalpadams* have to be continued or not. The main apprehension levelled against them at policy level is the long duration nature of the crop, consequential extended cropping season and inherent inferior yield of the varieties when compared to the HYVs. But the PLA exercises and the semi-structured interview sessions with the farmers of these unique systems revealed that there were obvious contextual and situational reasons like rainfall, soil conditions, non-availability of labour during peak periods of operation, high labour charge, drudgery of intensive rice cultivation for the three seasons, less remunerative rice production, lack of assured irrigation, small and fragmented land holdings unsuitable for mechanisation, convenient transportability of the harvested paddy to the threshing yards, reduced incidence of pests and diseases, good quality of the straw, and non-availability of quality seeds in time, to continue with these endemic but unique rice production systems. This has been evidenced by the constraints listed in tables 59, 51and 55 and as supported by Ahamed *et al.* (1996); KAU, (1997) and KAU, (2002). The district-based ranking of constraints to rice seed production and distribution as presented in table 66 and attribute ranking presented in table 38 also give justification to the farmers' resolve to adopt *Koottumundakan, Karingora* and *Poonthalpadam* systems in their respective domains.

In another way, encouraging such traditional systems adds to the rice production method cum varietal diversity and conserves valuable genetic material on-farm. Convention on Biological Diversity (CBD) has recognised the continued maintenance of traditional varieties *in situ* as an essential component of sustainable agricultural development. In 1995, the International Plant Genetic Resources Institute (IPGRI) together with partners in nine countries began to explore the potential of on-farm conservation in a global project. Many scientists have opined that traditional production systems are important sources of biodiversity and therefore needs to be conserved either *in situ* or *ex situ* (Witcombe *et al.* 1996; Sthapit and Jarvis, 1999).

To conclude, the status of these unique systems in the district provides ample indications to the breeders and agronomists to assess and refine suitable varieties, agro-techniques and management practices to make these systems more productive.

5.2 Crop season calendars of the selected Agricultural Development Blocks under study

The temporal scheduling of rice in the 10 major paddy growing ADBs of Palakkad district is discussed here under:

The crop seasonal calendars prepared through participatory exercises are presented in Figs. 4 to 14. These seasonal calendars provided several details like the commencement and termination of cropping seasons, the seasonality of different cultural operations like sowing, transplantation and harvesting, the type of establishment systems followed and the duration of rice crop at various locations in the district.

The data thus elicited could be a valuable feed back to the policy makers and input agencies to decide on the schedule to be followed for the optimum and timely supply of inputs such as seeds, fertilizers and plant protection chemicals to the farmers, for preparing irrigation schedules for different locations and seasons so as to make irrigation water available to each locality at the critical stages of crop growth and the like.

A critical analysis of seasonal calendars obtained from the 11 panchayats representing 10 ADBs of Palakkad district revealed that there was a wide variation in the crop duration and sequencing, relative extent of growth phases and crop establishment systems followed within and across the seasons at various locations in the district (Figs. 4 to 14).

The two crop establishment systems identified in the district were dry sowing and transplantation. *virippu* season was characterised by a predominant dry sowing system and the *mundakan* by seedling transplantation. Dry sowing was found to prevail in the eastern blocks like Nenmara, Kollengode, Kozhalmannan and Palakkad, where the summer showers during the month of May were low and it was difficult to find enough water during that part of the year for puddling and conventional nursery preparation. This proposition is justified by the system of seedling transplantation followed widely in the western blocks of Sreekrishnapuram, Shoranur and Pattambi during *virippu* where adequate pre-monsoon showers and irrigation facilities are available.

It is certain that labour issues also play a major role in influencing the rice systems of the district (Table 66). Hence, wet sowing (*chettuvitha*) using pre-germinated seeds or dry sowing (*podivitha*) could be seen as austerity measures to reduce the cost of production by skipping more labour intensive operations such as seedling transplantation.

In ADBs like Nemmara and Kollengode where severe drought and crop loss during late *mundakan* is a serious concern (KAU, 2002), dry sowing early in the *virippu* season could be a viable strategy for starting and finishing the crop early in both *virippu* and *mundakan*.

The sequencing of cropping seasons also showed considerable variation over different locations. *Virippu* starts as early by April 15 in Sreekrishnapuram block (*Koottumundakan*; Fig.14) and ends as late by January 31 in Pattambi block (*Karingora*; Fig.10). Similarly, *virippu* in Pattambi (*Karingora*) commences as late by July 31 and finishes as early by August 10 in Thrithala block (Fig.11). A wide variation in the commencement and termination of *mundakan* crop was also observed. *Mundakan* starts as early by August 25 in Thrithala block and end as late by April 10 in the *Poonthalpadams* of Pattamchery panchayat (Fig.12).

Interestingly, the above situation revealed that the *virippu* season in Palakkad district was found to spread in excess of 10 months (April to next January) and *mundakan* season spread over nine months (except the months of May, June and July) at different locations in the district. As the duration and extent of cropping seasons depend heavily upon the quantity and distribution of the monsoons and the subtle differences in the timeliness and volume of pre-monsoon showers, such a variation is not really astonishing for a crop like rice, which is highly sensitive to the availability of water in the field.

These wide and distinct variations in cropping seasons and establishment systems give immense caution and warning, questioning rice research and extension endeavours, and input supply system, on the logistics of continuing the centralised seed production system now followed, where seed production is confined to the research stations and seed farms. Here arises the importance of the concepts of 'participation' and 'decentralisation' in seed production and distribution discussed later on in this chapter.

5.3 Rice varietal status of Palakkad district

The preference ranking of rice varieties as perceived by the rice farmers and the extensionists over *virippu* and *mundakan* (Tables 36 and 37) are self explanatory to the existence of a wide and diverse spectrum of rice varieties/cultivars comprising HYVs, non-descript strains and landraces in Palakkad district. This observation is endorsed by the studies of Girija *et al.* (1991) and KAU, (2002). In a survey conducted in the eastern blocks of Palakkad district, KAU, (2002) reported 35 rice varieties in *virippu* and 36 varieties in *mundakan.* A cursory look at the district based preface ranking of rice varieties/ cultivars (Tables 84 to 89) revealed that those varieties/cultivars could be categorised into the following distinct types: i. Landraces/ traditional varieties released as pure line selections from the erstwhile CRS and

RARS, Pattambi ii. Landraces/traditional varieties (non-released) iii. HYVs released from the erstwhile RRS/ CRS and present RARS, Pattambi iv. HYVs released from the research stations of Kerala other than RARS; Pattambi v. HYVs released from the research stations outside Kerala vi. Non-descript strains (high/ low yielding).

5.3.1 Landraces/ traditional varieties released as pure line selections from the erstwhile RRS/CRS and present RARS, Pattambi

Block-wise distribution and ranking of landraces released as pure lines are presented in table 84. (Abstracted from tables 9, 10, 20, 21, 23, 24, 33, 34)

Table 84. Landraces/ traditional varieties released as pure line selections from the erstwhile RRS/CRS and present RARS, Pattambi

Sl. No	Name of the ADB	Variety/cultivar			
		Virippu	Rank*	*Mundakan*	Rank*
1.	Pattambi	Veluthettan Aryan Chenkazhama	2/9 5/9 6/9		
2.	Thrithala	-		Chitteni	4/5
3.	Sreekrishnapuram	Thavalakkannan Velutharikazhama Chenkazhama Arivakaari	1/7 2/7 3/7 5/7		
4.	Shoranur	-		Thekkencheera Chitteni Vellari	5/6 1/8 2/8

*Rankings were done out of the total number of varieties reported from the respective *padasekharams*.

As the data given in table 84 indicate, two entirely different sets of varieties were used in *virippu* and *mundakan*. The *virippu* varieties were Veluthettan (Ptb-22), Chenkazhama (Ptb-26), Thavalakkannan (Ptb-8), Arivakaari (Ptb-32), Velutharikkazhama (Ptb-5) and Aryan (Ptb-1). All of them are photosensitive, characterised by low tillering ability and red kernel (Leenakumari and Nair, 1996). The duration of these varieties, except the last two ranged from 115 to 125 days. Aryan had the longest duration (140-145 days). Chitteni (Ptb-12), Vellari (Ptb-4) and Thekkencheera (Ptb-10) were the *mundakan* varieties reported (Table 84). They too are red kernelled and low tillering, but photosensitive.

It is interesting to note that the traditional varieties that were released well back in 1936 too are still popular among the farmers of Pattambi, Thrithala, Shoranur and Sreekrishnapuram ADBs. In the zonal classification, the first three blocks are included under the central midland zone, characterised by a medium elevation of 7.5 to 75 m above MSL and high rainfall (KAU, 2002). Since they are closely located, it is likely that they have similar agro-ecosystem features and climate and hence a similar varietal pattern. Sreekrishnapuram was quite different from others with the dominance of traditional released/non-released varieties both in *virippu* and in *mundakan* (Tables 20 and 21). This distinctness could be attributed to high elevation (15-75 m above MSL) and rainfall conditions.

In spite of RARS, Pattambi being centrally located to the above said four blocks, the presence of traditional varieties listed in tables 84 and 85 could be attributed to a few unique reasons. As discussed earlier, Sreekrishnapuram and Pattambi blocks are famous for very special systems of rice cultivation namely *Koottumundakan* and *Karingora*. Obviously, most of the varieties found here were either components of *Koottumundakan* or *Karingora* or cultivated separately in the first and second seasons. This would mean that the existence of these traditional varieties amidst the HYVs and non-descript strains either dominating or otherwise, could be due to their micro-agro ecological system adaptability, superior qualitative characters like pest/ disease tolerance, drought tolerance, better taste of cooked rice,

quality straw, ability to perform reasonably under stress, low input requirements and the like.

Non-existence of HYVs suitable for the region indicates the lack of efficient research endeavour in the identification, improvement and release of superior HYVs. This might have forced the farmers to stick on to the original set of traditional varieties. The influence of gulf money, high cost of living and high wage rates of agricultural labourers might have retarded the enthusiasm of the farmers of western Palakkad in agricultural occupation (KAU, 2002). This, along with low input and management requirements and ability to perform reasonability under stress could also be reasons for the continuance of these unique rice production systems and its component varieties despite their inherent low tillering ability and yield.

5.3.2 Land races/ traditional varieties (non-released)

Block-wise distribution and ranking of land races/ traditional varieties (non-released) are presented in table 85. (Abstracted from tables 9, 10, 20, 21, 30, 31)

Table 85. Land races/ traditional varieties (non-released)

Sl. No.	Name of the ADB	Variety/cultivar			
		Virippu	Rank*	Mundakan	Rank*
1.	Sreekishnapuram			Chuvanna chettadi Cheruvellari Paramchitteni	1/6 2/6 4/6
2.	Shoranur	-		Cheera	8/8
3.	Chittur				

*Rankings were done out of the total number of varieties reported from the respective *padasekharams*.

The analysis of table 85 revealed that certain traditional *mundakan* varieties such as Chuvannachettadi, Cheruvellari, and Panamchitteni were not subjected to pure line selection programmes of the erstwhile ARS/CRS and present RARS, Pattambi. A *virippu* variety chamban and a *mundakan* variety cheera were also not taken up for crop improvement programmes. The reason is self-explanatory as evidenced from their inferior preference ranking presented in table 85. However, chuvannachettadi and cheruvellari, which were rated first and second in the varietal ranking exercise in Sreekrishnapuram block, could be taken up for crop improvement programmes. All the above said rice varieties, irrespective of the seasons grown, were red grained.

5.3.3 HYVs released from the erstwhile RRS/CRS and present RARS, Pattambi

Block-wise distribution and ranking of HYVs released from the erstwhile RRS/CRS and present RARS, Pattambi are presented in table 86. (Abstracted from tables 4, 6, 7, 9, 10, 12, 13, 5, 16, 18, 20, 21, 23, 24, 26, 30, 31, 32, 34).

Table 86. HYVs released from the erstwhile RRS/CRS and present RARS, Pattambi

Sl. No.	Name of the ADB	Variety			
		Virippu	Rank*	*Mundakan*	Rank*
1.	Nemmara	Aiswarya	2/9	Aiswarya	2/9
		Kanchana	8/9	Kanchana	8/9
2.	Koyalmannam	Kanchana	3/7	Kanchana	2/6
		Aiswarya	4/7		
3.	Kollengode	Kanchana	5/9		
		Bharathi	9/9		

4.	Chittur				
	(Poonthalpadams)				
	a. Poonthals	Neeraja	3/4		
	b. Mettuppurams	Kanchana	4/10	Kanchana	4/10
		Mattathriveni	9/10	Mattathriveni	9/10
		Kairali	10/10	Kairali	10/10
5.	Palakkad	Aiswarya	3/6	Aiswarya	2/5
		Athira	6/6	Athira	5/5
		Kanchana	3/7	Kanchana	3/7
6.	Alathur	Aiswarya	4/7	Aiswarya	4/7
		Mattathriveni	5/7	Mattathriveni	5/7
		Aiswarya	4/7	Aiswarya	3/6
7.	Sreekrishnapuram	Kanchana	6/7	Kanchana	6/6
		Aiswarya	2/6	Athira	3/8
		Jyothi	3/6	Aiswarya	6/8
8.	Shoranur	Kanchana	4/6		
		Aiswarya	5/6		
		Jyothi	1/6	Aiswarya	1/5
		Aiswarya	2/6	Kanchana	2/5
9.	Thrithala	Kanchana	3/6	Mattathriveni	5/5
		Mattathriveni	5/6		
		Annapoorna	6/6		
		Aiswarya	1/9	Neeraja	3/5
		Athira	3/9		
10.	Pattambi	Jyothi	4/9		
		Mattathriveni	9/9		

*Rankings were done out of the total number of varieties reported from the respective *padasekharams*.

Data in table 86 profusely appreciate the worthy research contribution from Pattambi. Presumably their high productivity might have made their presence felt in all the 10 ADBs and in almost all the production systems under study. Aiswarya (Ptb-

52) and Kanchana (Ptb-50) virtually ruled the *padasekharams* of the district irrespective of seasons, and to an extent locations. Both these varieties were found together in eight blocks, irrespective of seasons, establishing their multi locational and multi seasonal adaptability, endorsed by the multi seasonal adaptability ranking provided in table 74. This is in conformity with the observations of Leenakumari and Nair (1996) and Prema *et al.* (2000). However, it was interesting to note that a favourite among the extension and input agencies and a variety widely accepted by the rice farmers of Kerala, Jyothi (Ptb-39) was almost eliminated from the *mundakan* fields of Palakkad district. It was found limited to the *padasekharams* of the central midland zone represented by Shoranur, Pattambi and Thrithala ADBs. Again, Sreekrishnapuram looked distinct with the absence of Jyothi (Ptb-39). It is worth notice that in the high elevation-low rainfall regions of Nemmara, Koyalmannam and Kollengode blocks, where frequent crop losses occur during late *mundakan* (KAU, 1997) Aiswarya (Ptb-52) and Kanchana (Ptb-50) were the only KAU varieties. This could be an indicator of their ability to withstand stress and perform reasonably under medium management conditions. Particularly, Aiswarya (Ptb-52) was found exceptionally good which is reiterated by the farmers'choice (Tables 36 and 37).

All the HYVs from RARS, Pattambi referred above viz., Aiswarya (Ptb-52), Kanchana (Ptb-50), Athira (Ptb-51), Mattathriveni (Ptb-45), Kairali (Ptb-49), Jyothi (Ptb-39), Bharathi (Ptb-41), Annapoorna (Ptb-35) and Neeraja (Ptb-47) were photo insensitive and so, should be suitable for both *virippu* and *mundakan*. But this proposition was not fully supported by the ranking of rice varieties based on multi seasonal adaptability (Table 74). Except Aiswarya, Kanchana and to some extent Mattathriveni,all others were poor in multi seasonal adaptability. Among the released varieties, except Neeraja, all were red kernelled.

Many studies, both in Kerala and other parts of the world (Ceccarelli, 1994; Elsy *et al.*, 1994; Rosamma *et al.*,1994; Cromwell, 1996; Prema *et al.*, 2000) have pointed out that HYVs in most cases failed to perform well under low-input marginal agriculture. According to Gopalakrishnan (1994) the main reason for the low

coverage of HYV rice in Kerala was due to their inferior milling and cooking qualities, when compared to the traditional varieties. These observations should be an eye opener to the plant breeders who still heavily rely on the handful of set criteria for breeding programmes dominated by yield and yield related attributes.

5.3.4 HYVs released from the research stations of Kerala other than RARS, Pattambi

Block-wise distribution and ranking of HYVs released from the research stations of Kerala other than RARS, Pattambi are presented in table 87. (Abstracted from Tables 4, 6, 7, 12, 13,15, 16, 26, 27, 28,30, 31).

Table 87. HYVs released from the research stations of Kerala other than RARS, Pattambi

Sl. No.	Name of the ADB	Variety			
		Virippu	Rank*	*Mundakan*	Rank*
1	Nemmara	Pavizham	3/9	Pavizham	3/9
2	Koyalmannam	Kanakom	6/9	-	
3	Kollengode	Kanakom	2/9	-	
		Bhadra	8/9		
4	Chittur	Kanakom	2/7	-	
		Bhadra	4/7		
	Poonthalpadams	a. Uma	1/10		
		b. Bhadra	4/4	Uma	1/10
5	Palakkad	Pavizham	1/6	-	

*Rankings were done out of the total number of varieties reported from the respective *padasekharams*.

Analysis of table 87 revealed that varieties released from RRS, Mankombu were found to have a comfortable status in the eastern blocks of the district such as Chittur, Nemmara, Koyalmannam, Kollengode and Palakkad. They were: Pavizham (MO.6), Kanakom (MO.11), Uma (MO.16) and Bhadra (MO.4). All of them are red

kernelled. Comparatively old varieties like Bhadra (released in 1978), to the recently released ones such as Uma (released in 1998) were found to be popular among the farming community.

5.3.5 HYVs released from research stations outside Kerala

Block-wise distribution and ranking of HYVs released from the research stations outside Kerala are presented in table 88. (Abstracted from tables 4, 6, 7, 9, 10, 12, 13,15, 16, 18, 23, 24, 26, 27, 28,30, 31, 33, 34).

It could be concluded from the data given in table 88 that a number of TNAU varieties were found dominating the rice varietal spectrum of eastern blocks of the district especially in the ADBs of Kollengode, Chittur and Koyalmannam. Sreekrishnapuram block was a clear exception, devoid of varieties from outside the state. Mashuri, Jaya, Pranava and IR-50 were identified as the 'non-Tamil Nadu' varieties. Chittur and Kollengode ADBs, which have their borders with Tamil Nadu were obviously more influenced by the TNAU varieties. This could be due to their proximity to Tamil Nadu, and similar agro-climatic environments. The popularity of TNAU varieties in the eastern blocks of Palakkad district has been noted (KAU, 2002).

All the varieties from outside the state except TKM-19 namely, Ponmani, Vellapponni, ASD-16, CO-10, Paiyur-1, Mashuri, Jaya and Pranava, are white kernelled. The popularity of ASD-16 and Ponmani could be attributed to their bold and white grain type. PRA investigations revealed that most of the rice farmers preferred white bold varieties for home consumption (Table 38). This finding has been supported by recent studies (KAU, 2002). Cultivation of extra long duration, slender, white-grained varieties such as Vellapponni, Mashuri, Paiyur-1 and IR-50 were obviously aimed at markets across the border.

5.3.6 Non-descript strains (high/low yielding)

Block-wise distribution and ranking of non-descript strains are presented in table 89 (Abstracted from tables 4, 6, 7, 9, 10, 12, 13,15, 16, 18, 23, 24, 26, 27, 28,30, 31).

Table 88. HYVs released from research stations outside Kerala

Sl. No	Name of the ADB	Variety			
		Virippu	Rank*	*Mundakan*	Rank*
1.	Nemmara	ASD-16	6/9	ASD-16	6/9
2.	Koyalmannam	TKM-9	2/7	Ponmani	1/6
		CO-10	7/7	TKM-9	3/6
3.	Kollengode	ASD-16	3/9	TKM-9	2/6
		TKM-9	4/9	Ponmani	3/6
				ASD-16	4/6
				Paiyur-1	6/6
4.	Chittur	TKM-9	3/7	Ponmani	1/3
		Vellapponni	5/7	ASD-16	2/3
		Jaya	6/7	Mashuri	3/3
	Poonthalpadams	a. TKM-9	2/0	a. Pravana	7/10
		IR-50	5/10		
		Jaya	6/10	b. Ponmani	1/2
		Pranava	7/10	Vellamashuri	2/2
		b. Mashuri	1/4		
5.	Palakkad	ASD-16	5/6	ASD-16	3/6
				Vellapponni	4/6
6.	Alathur	ASD-16	7/7	ASD-16	7/7
		Pranava	6/7	Pranava	6/7
7.	Shoranur	-	-	CO-10	4/8
				Ponmani	5/8
8.	Pattambi	Jaya	7/9	Jaya	4/5
9.	Thrithala	Jaya	4/6	Jaya	3/5

*Rankings were done out of the total number of varieties reported from the respective *padasekharams*.

Table 89. Status of non-descript strains (high/low yielding)

Sl. No.	Name of the ADB	Variety			
		Virippu	Rank*	Mundakan	Rank*
1.	Nemmara	Kunjukunju	1/9	Kunjukunju	1/9
		Vanitha	4/9	Vanitha	4/9
		Kalyani	5/9	Kalyani	5/9
		Sulochana	7/9	Sulochana	7/9
		Lakshmi	9/9	Lakshmi	9/9
2.	Koyalmannam	Kunjukunju	1/7	Vellamashuri	5/6
		393	5/7	Undamashuri	6/6
3.	Kollengode	Kunjukunju	1/9	Kunjukunju	1/6
		Lakshmi	7/9		
4.	Chittur Poonthalpadams	Kunjukunju	1/7		
		a. 17-27	3/10		
		OTP-8	8/10		
		b. Aayirathonnu-matta	2/4		
5.	Palakkad	Kunjukunju	2/6	Valiyakanchana	1/5
		Cheriyakanchana	4/6		
6.	Alathur	Kunjukunju	1/7	Kunjukunju	1/7
		Kalyani	7/7	Kalyani	7/7
7.	Shoranur	010	1/6	Undamashuri	7/8
		Undamashuri	6/6		
8.	Pattambi	010	8/9	Karna	2/5
				Rocket	5/5

*Rankings were done out of the total number of varieties/cultivars reported from the respective *padasekharams*.

Ahamed *et al.* (1996) in a study conducted in Palakkad district found a group of rice varieties called non-descript strains characterised by short stature, short to medium duration and of unknown pedigree. 'Kunjukunju', a non-descript variety dominated the preferential rankings in most of the eastern blocks of Palakkad such as Nemmara, Koyalmannam, Kollengode, Chittur, Alathur and Palakkad (Table 89). The non-descript strains could be classified into low, medium and high yielders. The low yielding group consisted of 'Lakshmi', 'Sulochana', 'Rocket', 'Undamashuri', 'Vellamashuri' and 'Aayirathonnumata'. The medium yielders included 'Kalyani', 'Vanitha', 'OTP-8', '17-27', 'Cheriyakanchana', 'Karna' and 'Valiyakanchana' and the high yielding strains were 'Kunjukunju' and '010'. Surprisingly, the 16 non-descript strains outnumbered the other groups (Table 89).

However, it could be argued that '17-27' and '010' were the original culture numbers given to the released varieties, Jayathi (Ptb-46) and Ahalya respectively. But the rice farmers of the district did not accept such a relationship.

In 1981, RRS, Kayamkulam released an extra long duration (175-180 days) photosensitive rice variety with an exceptionally high milling percentage (80%) for the sandy tracts of Onattukara and Southern Kerala (FIB, 1993 and Leenakumari and Nair, 1996). Though the variety was named Lakshmi, it had no characters similar to that of the non-descript strain identified with the same name. The later was photo insensitive, low yielder and the period of maturity ranged from 115-130 days during *virippu* to 145 days in *mundakam* season. Moreover, the strain was characterised by short panicles, medium grain density, poor milling percentage and tolerance to water stress as revealed by the matrix ranking exercises of the present study. The non-descript strains called 'Valiyakanchana' and 'Cheriyakanchana' might be the variations of the released variety Kanchana (Ptb-50), probably due to the perceived difference in the plant stature, duration and grain size and shape, which in turn could be because of developmental variations under different micro farming situations.

As mentioned earlier, majority of the non-descript strains (13 nos.) were limited to the eastern ADBs of Palakkad district. But, '010', 'Karna' and 'Rocket' were typical of Pattambi and Shoranur blocks. Out of the 16 non-descript varieties identified in the district, 10 were red kernelled.

It would be interesting to probe into the possible reasons for the existence of a wide spectrum of non-descript strains in the midst of a number of released varieties, which enjoyed the bulk of research and extension backup. High productivity, short duration and local adaptability of the two famous non-descript strains 'Kunjukunju' and '010' might have prompted the farmers to chose and continue using them. These two strains were found highly suited for *podivitha* (dry sowing) system followed widely during the first cropping season. In fact, dry sowing was the only system of establishment reported for '010'. Thus, avoiding the labour intensive seedling transplantation meant a lower cost of production for an already less remunerative rice crop.

Almost all of these non-descript strains were highly adaptable to the specific local soil/climatic situations where they belonged. Despite this, as exposed in the tables highlighting the varietal attributes, many of them have inherent setbacks. 'Kunjukunju', 'Kalyani', 'Vanitha', 'OTP-8', 'Undmashuri', 'Rocket' and 'Vellamashuri' were reported to be susceptible to pest/disease attack. 'Lakshmi', 'Sulochana', 'Undamashuri', 'Rocket', 'Vellamashuri' and 'Aayirathonnumatta' are low yielders. The percentage of chaff content in 'Kalyani' was as high as 30 per cent and the hulling/milling percentage of 'Lakshmi' and 'Sulochana' were distinctly inferior.

At the same time 'Kunjukunju', 'Kalyani' and 'Aayirathonnumatta' enjoyed better marketability. According to the farmers, the cooking and keeping qualities of these strains were good. 'Aayirathonnumatta' has more 'stem girth', non-lodging nature, low seed germination in panicle and longer duration (150 days) adaptable to the flooded soil conditions of *'Poonthalpadams'*. White bold grain of 'Vanitha' was preferred for home consumption. Drought tolerance of 'Lakshmi' and 'Sulochana', high

milling percentage, pest and disease resistance and better grain weight of '17-27', were perceived as the positive traits which influenced farmers' opinion in favour of continuing with these varieties.

5.4 Rice varietal preference and current seed production strategy

The district-based status of seed production and varietal preference of farmers over different cropping seasons and locations are discussed hereunder:

The sources of rice seed in public sector identified were: the five SSFs, RARS, Pattambi, RSGP and NSC Unit, Alathur. Among these, the seed production in RARS, Pattambi was also found aimed at catering to the requirements of other parts of Kerala and the '*Kole*' lands of Thrissur district as well.

Analysis of the data presented in tables 36 and 37 revealed that a wide spectrum of 54 rice varieties/cultivars is being cultivated in Palakkad district in *virippu* and *mundakan* seasons. Out of these, only 19 varieties (35%) were reported to have come under public seed production and distribution programmes of the district. Moreover, among the 29 rice varieties currently (1996-1997 to 2000-2001) under Foundation/Certified/ Registered seed production, almost 38 per cent (11 nos.) did not have any notable status in the rice fields of Palakkad (Table 83). They were: Mangalamashuri (Ptb-53), Karishma (MO-18), Pavithra (MO-13), Karuna (Ptb-54), Nila (Ptb-48), Makom (MO-9), Swarnaprabha (Ptb-43), Vadakkenchitteni (Ptb-20), Jayathi (Ptb-46) and CO-25. They might have made their entry and exit from the scene without causing much impact on the rice varietal status of the district. Hence, such varieties not in the reckoning of the farmers could be removed from the official Foundation/Certified/ Registered seed production programmes, if there are no other genuine reasons for doing so. Such propositions are supported by the seed system studies done elsewhere (Douglas, 1980; Kelly, 1989).

It takes about six to eight years for a new rice variety released under conventional breeding programme to get popularised among the farmers (Pal *et al.*, 2000). Therefore, it would not be fair to judge that the recently introduced varieties such as Pavithra (MO-13), Karishma (MO-18) and Uma (MO-16) as totally rejected by the farmers of Palakkad. Joining KAU, (2002), it is suggested that varieties like Krishnanjana, (MO-19) Remanika (MO-15) and Panchamy (MO-14) reported to be adaptable to Palakkad rice system could be tested in farmers' fields for local adaptation and acceptability.

Nevertheless, the real basis for the final acceptance or rejection of a variety by any farming community is more complex. It is very much depended on the varietal needs or the preferred varietal attributes as perceived by the local farmers. The attribute ranking attempted by rice farmers from the different ADBs of Palakkad district (Table 38) is a proof for the existence of a diverse set of needs and preferences which could be satisfied only by an equally diverse spectrum of cultivars.

As an example, table 29 revealed that the rice farmers of *poonthalpadams* required tall, non-loding extra long duration varieties (160-180 days) for both the seasons, while most of their counterparts in other parts of the district were satisfied with short to medium duration varieties for *mundakan*. Similar is the case with preferred colour, size and shape of grains. Rice varieties with fine, slender, white grains (Mashuri, Vellapponni and Paiyur-1) were preferred in situations of assured marketability and premium price. Even within a *padasekharam*, farmers preferred red bold grains for the market and white bold grains for home consumption, in the eastern blocks of the district.

However, one cannot insist on the inclusion of all the 54 reported varieties, under public rice seed production and distribution programmes. Nevertheless, the most common and farmer-preferred varieties could be included. But the comparison of varietal ranking as perceived by the rice farmers of the district (Tables 36 and 37) and ranking of varieties under public seed production based on highest average annual

seed production for five years (1996-1997 to 2000-2001) given in table 83 revealed a different story.

A perusal of table 36 revealed that the top ten *virippu* cultivars preferred by the farmers of the district were: Aiswarya (Ptb-52), Kanchana (Ptb-50), 'Kunjukunju', TKM-9, Jaya, ASD-16, Mattathriveni (Ptb-45), Kanakom (MO-11), Jyothi (Ptb-39) and Bhadra (MO-4). Most popular *mundakan* varieties/cultivars were: Aiswarya (Ptb-52), Kanchana (Ptb-50), Ponmani, ASD-16, 'Kunjukunju', Vellapponni, Chitteni, 'Kalyani', Athira and TKM-9 (Table 37). But the public seed agencies supported the seed production of Kanchana (Ptb-50), Jyothi (Ptb-39), Kairali (Ptb-49), Aiswarya (Ptb-52), Kanakom (MO-11), Mattahtriveni (Ptb-45), Mangala Mashuri (Ptb-53), Uma (MO-16), Karishma (MO-18) and Pranava, which meant that popular strains like 'Kunkukunju', TKM-9, Bhadra, 'Kalyani' and Chitteni, rated among the top ten by the farmers were not included in seed production programmes, which could be due to official and policy restrictions.

'Kunjukunju', TKM-9 and 'Kalyani', being cultivars not released or varieties not released from Kerala, could not be taken up for Breeder, Foundation/Certified/Registered seed production under the official machinery. However, Bhadra (MO-4) should have been definitely included in rice seed production programmes of the district.

In the light of the above discussion, it could be suggested that seed production of Mangala Mashuri (Ptb-53) and Kairali (Ptb-49) be brought down and Karishma (MO-18) and Uma (MO-16), being recently introduced varieties be given a gestation period before deciding on the level of acceptance by the rice farmers of Palakkad district.

Analysis of table 83 revealed that the variety Jyothi (Ptb-39) was given second place in seed production. This cannot be justified by its poor preference as perceived by the majority of rice farmers of Palakkad district. It is a strange paradox

that Jyothi (Ptb-39), despite being the most well-known and farmer-preferred variety in Kerala, could not find a place in the *mundakan* fields of Palakkad district. Nevertheless, Breeder seed production of the variety should be continued in RARS, Pattambi, as it still holds name and fame in the *Kole* lands and the *Kuttanad* paddy growing tracts in Kerala. However, the Certified seed production in the SSFs of Palakkad district should be discouraged.

The highest average annual seed production (1996-1997 to 2000-2001) of Kanchana (Ptb-50) through the various seed production agencies viz., the SSFs, RARS, Pattambi, RSGP and NSC seed production unit, Alathur, is well justified by the preference ranking given by the rice farmers of the district (Tables 36 and 37). At the same time, it is quite strange and disturbing to find that Aiswarya (Ptb-52), the most farmer preferred rice variety both in *virippu* and *mundakan* was not given the deserved status in public seed production programmes of the district as revealed by its declining trend in RARS, Pattambi and the five SSFs (Tables 79 and 80). It is interesting to note the inclusion of Ponmani, Vellapponni and ASD-16, despite having varieties from outside Kerala, in the seed production programme of the SSF, Muthalamada. This is a clear indication of the popularity of these Tamil Nadu varieties among the rice farmers of eastern Palakkad as corroborated by the preference ranking presented in tables 36 and 37.

5.5 Attribute ranking of rice varieties of Palakkad district as perceived by the FSS

It is disturbing to note that many preferred varietal attributes which intimately decide the continued acceptance or rejection of a rice variety by the farmers, have not been given proper importance by the conventional plant breeding set up. Hence as suggested by Ahmed *et al.* (1996), there is a need for streamlining the rice breeding strategy to evolve varieties to match the preferential traits as perceived by the farmers. Ashby *et al.* (1987) lend support to this as rice farmers of small production systems have their own varietal selection and preferential criteria based on

their limited resources and quantitative, economic, domestic and socio-cultural requirements.

Many studies across the seed systems of the world have highlighted the importance of understanding farmer preferred varietal traits in framing objectives for plant breeding programmes (Johnson *et al.*, 1967; Joon *et al.*, 1970; Joshi and Witcombe, 1996; Witcombe *et al.* 1996). According to Gopalakrishnan (1994), the main reason for low coverage of HYVs in Kerala was attributed to the inferior milling and cooking qualities of HYVs when compared to the traditional varieties. This would not have happened if proper attention were given on these post harvest qualitative traits, even at the cost of exorbitant overall productivity. Weltzien *et al.* (2000) opined that breeding programmes should understand farmers' preferences for specific crop traits and that the same information could be brought out through the analysis of varieties farmers grow. Hence, a comprehensive analysis of farmer-preferred rice varietal traits was made in the present study and the results are discussed hereunder (Abstracted from table 38 of results chapter):

The ranking of farmer-preferred attributes given in table 90 revealed that the varietal needs of the rice farmers of the district are many and diverse. The ranking of 34 varietal traits can be classified into eight categories viz., i. Traits related to yield, ii. Traits related to grain quality, iii. Traits related to multiple adaptability, iv. Pest/disease tolerance, v. Marketability, vi. Straw quality vii. Traits related to harvest and post harvest operations viii. Traits related to inputs. As expected, the traits related to yield and quality (both grain and straw quality) fetched higher ranks. This finding is in conformity with the studies of earlier seed system analysts (Sthapit *et al.*, 1996; Ahamed *et al.*, 1996; Prema *et al.*, 2000; Kent and Mokuwa, 2001).

According to KAU (2002) high grain yield, pest and disease resistance and marketability were the most important varietal traits perceived by the farmers of eastern Palakkad. Studies of Elsy *et al.* (1994) and Rosamma *et al.* (1994) showed that the varietal attributes like the quality of grain, biotic and abiotic stresses, low

requirement of purchased inputs and reasonable grain yield even under stress situations have a significant say on the varietal selection of the rice farmers.

Good taste (Ahamed *et al.*, 1996; Joshi and Witcombe, 1996;Prema *et al.*, 2000), less chaff content (Sthapit *et al.*, 1996; Prema *et al.*, 2000), non-sticky rice with good cooking quality (Sthapit *et al.*, 1996; Joshi and Witcombe, 1996; Kent and Mokuwa, 2001); bold and red grains for market (Ahamed *et al.*, 1996; Prema *et al.*, 2000; Kent and Mokuwa, 2001); bold and white grains for home consumption (KAU, 2002) and less cooking time required (Ahamed *et al.*, 1996; Prema *et al.*, 2001) were some of the farmer preferred traits related to grain quality (Table 38).

Multiple adaptability traits such as correct duration for season, drought tolerance, reasonable yield under stress, multi planting system adaptability, tolerance to yellowing and poor drainage were also perceived as decisive in determining the varietal choice of the rice farmers of Palakkad district. Qualities such as non-lodging nature of the crop, quality straw, preferred plant height and good stem girth were also highlighted. These observations agree with similar studies conducted in the district (Elsy *et al.* 1994; Rosamma *et al.*, 1994; Ahamed *et al.*, 1996; Prema *et al.*, 2000).

It could be concluded from the above discussion that though yield and yield related attributes were given the highest priority, traits related to grain quality and multiple adaptability were also perceived as crucial by the rice farmers of Palakkad. Most of the attributes related to grain quality have either a direct or indirect influence on the marketability and price of a particular rice variety. Unlike the other rice growing tracts of Kerala, a good number of rice farmers of Palakkad district are commercial and hence any attribute or group of attributes determining market preference/demand and price has to be given proper attention while deciding on the objectives for future rice breeding programmes for the district.

Table 90. Attribute ranking of rice varieties of Palakkad district as perceived by the FSS

Sl. No.	Attributes	Rank*
I	Traits related to yield	
	1. Good yield	1
	2. More grain weight	2
	3. More productive tillers	5
	4. Low grain shattering	6
	5. More grains per panicle	7
	6. Long panicle	14
	7. Synchronised flowering	21
	8. Low germination in panicle	19
II	Traits related to grain quality	
	1. Good taste	11
	2. Less chaff	17
	3. Non-sticky rice with good cooking quality	15
	4. Quality flour	20
	5. Bold and red grains for market	23
	6. Less weight reduction on storage	25
	7. Bold and white grains for home consumption	29
	8. Less cooking time required	30
	9. Awn less grains	34
III	Traits related to multiple adaptability	
	1. Correct duration for season	12
	2. Drought tolerance	13
	3. Reasonable yield under stress	18
	4. Deep and spreading roots	26
	5. Multi planting system adaptability	27
	6. Shade tolerance	28
	7. Tolerance to poor drainage	31
	8. Tolerance to yellowing	32

IV	1. Pest/disease tolerance	3
V	Marketing	
	1. Marketability and demand	4
VI	Straw quality	
	1. Non-lodging	9
	2. Preferred plant height	16
	3. Good stem girth	24
	4. Quality straw	33
VII	Traits related to harvest and post harvest operations	
	1. High milling percentage	8
	2. Easily threshable	10
VIII	Traits related to inputs	
	1. Secured seed supply	22

*Rankings were done out of the total number of 34 attributes reported from the district

5.6 Constraints to rice seed production and distribution, and suggestions for improvement as perceived by the FSS, ESS, SISS and RSS of Palakkad district

A cursory glance at the literature searched for the present study revealed that most of the constraints to rice seed systems of India and elsewhere were more or less common. The constraints experienced by the various stakeholders during different phases and types of rice seed production and distribution in Palakkad district are discussed hereunder:

5.6.1 Constraints to rice seed production and distribution by the FSS of Palakkad district.

The 28 constraints perceived by the FSS of the district could be categorised into eight groups as consolidated in table 91 (Abstracted from table 66 of results chapter):

Table 91. Constraints to rice seed production and distribution as perceived by the FSS

Sl. No	Constraints	Rank*
I	Seed availability constraints	
1.	Untimely availability of KB seeds	1
2.	Non-availability of preferred varieties from KB	2
3.	Non-availability of KB seeds in adequate quantities	3
II	Socio-economic constraints	
1.	Labour shortage during peak season	7
2.	High labour charge	9
3.	High cost of seeds from public seed agencies	14
4.	Extra payment for seed bags	22
5.	Low price for farmer produced seeds	24

III	Infrastructural constraints	
1.	Conveyance inaccessibility of remote fields	8
2.	Lack of assured irrigation	15
3.	Lack of facilities for seed storage	17
4.	Absence of marketability arrangement for farmer produced seeds	23
5.	Small and fragmented holdings unsuitable for mechanisation	25
6	Inaccessibility of seed production/distribution agencies	28
IV	Technological constraints	
1.	Poor germination of KB seeds	5
2.	Low genetic purity of KB seeds	13
3.	Varietal mixing and genetic impurity of farmer - produced seeds	16
4.	Low physical purity of KB seeds	19
5.	Deterioration of seed quality in poly bags	26
V	Extension policy constraints	
1.	Delayed payment of seeds procured through RSGP	10
2.	Insufficient procurement of RSGP seeds	11
3.	Complex procedure for seed testing in RSGP	12
4.	Inconvenient seed bag size/quality	18
VI	Biological constraints	
1.	Difficulty in processing *virippu* seed	4
2.	Drought towards the end of *mundakan*	6
3.	Germination of seeds in panicle	20
VII	Information constraints	
1.	Lack of awareness about quality seed production	21
VII	Psychological constraints	
1.	Lack of co-operation among farmers during critical farm operations	27

*Rankings were done out of the total number of 28 constraints reported by the rice farmers of the district

Analysis of table 91revealed that input, socio-economic, infrastructural and technological constraints to rice seed production and distribution were perceived as the most limiting by the farmers of Palakkad district.

Many studies (Singh and Sharma, 1986; Nikhade and Bhople, 1989; Prakash, 1989; KAU, 1992; Agnihotri and Tripati, 1994) on rice seed systems have revealed that untimely availability of essential inputs, non-availability of quality seeds of preferred varieties in required quantities and lack of efficient input supply system were responsible for the poor performance of the same in India including Kerala. Upadhyaya (1998) opined that lack of significant quantity of seed and delay in supply were the constraints in seed production and distribution in Maharashtra. These reports endorse the findings of the present study (Table 91).

Third important group of constraints identified in the study was infrastructural constraints. Inadequate sources of irrigation water were reported as a situational constraint common to the major rice growing tracts of India (Nikhade and Bhople, 1989). The constraints to rice production systems of Kerala were summarised by Prakash (1989) and Prakash and Nair (1990) which included lack of adequate transport, irrigation, storage and marketing facilities as infrastructural constraints limiting rice production in Kerala.

The main rice seed production and distribution constraints faced by the farmers of Palakkad district identified in the study namely, conveyance inaccessibility of remote fields, lack of assured irrigation, lack of facilities for seed storage and absence of marketing arrangements for farmer-produced seeds are justified by similar observations in other seed systems.

Poor germination of KB seeds, low genetic and physical purity of KB seeds, varietal mixing and genetic impurity of farmer-produced seeds and deterioration of seed quality in poly bags were the constraints identified under technological constraints. Prakash (1989), KAU (1992) and Upadhyaya (1998) have reported the

non-availability of quality seed as a major constraint common to rice production systems of India. KAU (2002) opined that non-availability of quality rice seed was the most important constraint faced by the rice farmers of Palakkad district, which corroborates the present findings.

The extension and policy constrains identified were unique to the rice system of Palakkad district. RSGP was an attempt to decentralise rice seed production in the district. But the programme at present was found to be only partially successful, owing to its inherent weaknesses as presented in table 91.

Difficulty in processing *virippu* seeds because of high relative humidity present during that season of the year, germination of seeds in panicle and severe drought towards the end of *mundakan* season were the major biological constraints reported in the study (Table 91). Similar observations were made by Prakash (1989) and Prakash and Nair (1990). KAU (2002) reported significant crop loss in the four eastern blocks of the district namely, Nemmara and Kollengode, during *mundakan* due to severe drought. Germination of seeds in panicle is a constraint specific to the low lying paddy lands of Chittur block known as *Poonthalpadams.*

Information constraint faced by rice farmers of the district was limited to the lack of awareness of farmers about the needs and ways of quality seed production. Nikhade and Bhople (1989) opined that lack of technical knowledge and skill were the information constraints faced by Indian farmers in the adoption of improved agricultural technology.

5.6.2 Constraints to rice seed distribution as perceived by the ESS of Palakkad district

Altogether 14 constraints were reported in the study (Table 67), which could be categorised into five groups as presented in table 92 given below:

Table 92. Constraints to rice seed distribution as perceived by the ESS of Palakkad district.

Sl. No.	Constraints	Rank*
I	Infrastructural constraints	
1	Inadequate staff	1
2	Inadequate storage facilities for inputs	2
II	Input constraints	
1	Untimely availability of SISS seeds	5
2	Non-availability of farmer-preferred varieties	6
3	Non-availability of SISS seeds in adequate quantities	10
III	Psychological constraints	
1	High work load for staff	3
2	Monitoring of RSGP difficult	7
3	Reduced demand for KB seeds	8
4	Service Co-operative banks' unwilling to procure seeds from farmers	9
5	KB officials compelled to dispose precious seed stock	12
6	Undue interference of local bodies	13
IV	Technological constraints	
1	Poor germination of SISS seeds	11
2	Poor genetic purity of SISS seeds	12
VI	Extension and policy constraints	
1	Accumulation of seeds	4

It could be concluded from table 92 that infrastructural and psychological constraints were the two important groups of constraints faced by the ESS of Palakkad district. However, the prominence of psychological constraints cannot be considered

as a healthy sign for any system, since the 'system blame syndrome', ignoring ones own faults tends to limit the scope for self-criticism and improvement. Nevertheless, the perceived importance of infrastructural constraints such as inadequate staff and storage facilities for inputs could be justified by previous studies (Kunju, 1989).

Critical analysis of the constraints perceived by non-availability of quality seeds in adequate quantities in time and non-availability of the seeds of farmer-preferred varieties were quoted as constraints by both the sub-systems, which is indicative of their magnitude and severity and therefore must be addressed urgently. Accumulation of seeds in *Krishibhavans* is a paradox especially when the farmers complain of inadequate supply of rice seeds through KBs. Hence, this is a clear indication of improper seed demand from the farmers, which could be due to the non-availability of farmer- preferred varieties in time. It could also be attributed to high cost of HYV seeds as perceived by the farmers (Table 66).

5.6.3 Constraints to rice seed production and distribution as perceived by the SISS of Palakkad district

The constraints (28 nos.) faced by the SSFs of the district were identified and categorised into eight different groups (Abstracted from table 68) and is presented hereunder (Table 93):

Biological and infrastructural constraints were found to be the most important categories identified (Table 93). Constraints such as drought towards the end of *mundakan*, untimely availability of seeds, labour shortage, small and fragmented paddies, inadequate seed processing and storage facilities, high work load for staff, and insufficient supporting staff were common to the FSS and the SISS and in some case to the ESS of the district as well (Tables 66 to 68).

Table 93. Constraints to rice seed production and distribution as perceived by the SISS of Palakkad district

Sl. No.	Constraints	Rank*
I	Infrastructural constraints	
1	Poor work efficiency of aged labourers	4
2	Small and fragmented paddy lands	7
3	Inadequate seed processing and storage facilities	8
4	Lack of transportation and communication facilitates for SSFs	9
5	Inadequate farm mechanisation	13
6	Inadequate facilities for drying *virippu* seed	14
7	Insufficient supporting staff	20
II	Biological constraints	
1	Drought towards the end of *mundakan*	1
2	Crab menace in *virippu*	10
3	Pest/disease menace in *mundakan*	15
4	Wild boar menace	21
5	Weed menace in *virippu*	23
6	BLB menace in *virippu*	23
III	Socio-economic constraints	
1	Labour shortage	3
2	Financial constraints	5
3	Lesser work norms for SISS labourers	18
IV	Technological constraints	
1	Excess inputs required for seed production	6
2	Inconsistent viability of RSS seeds	16
V	Psychological constraints	
1	General apathy of SSF labourers towards work	12
2	High work load for the staff	19
VI	Information constraints	
1	Absence of skill training to SSF labourers regarding quality seed production	11
2	Inadequate feedback about farmers' varietal preferences	22
VII	Input constraints	
1	Untimely availability of RSS seeds	2
VIII	Extension and policy constraints	
1	Poor coordination between the RSS and SISS	17

The identification of constraints to Palakkad rice seed system such as drought towards the end of *mundakan* (Prakash, 1989; Prakash and Nair, 1990 ; KAU,

2002) untimely availability of seeds from the responsible agencies (Upadhyaya, 1998), labour shortage (Prakash and Nair, 1990; KAU, 1992; KAU, 2002) poor work efficiency of aged labourers and general apathy of SISS labourers towards work leading to low labour productivity (Prakash and Nair, 1990), financial constraints, small and fragmented paddy lands and inadequate farm mechanization (KAU, 2002) and inadequate seed processing and storage facilities (Prakash and Nair, 1990), are in conformity with the results of the study.

5.6.4 Constraints to rice seed production and distribution as perceived by the RSS of Palakkad district

The constraints to the development, multiplication and distribution of rice seeds faced by the RSS of Palakkad district were classified into research, production and extension constraints as presented and discussed hereunder:

5.6.4.1 Research constraints

Developmental variation of rice varieties due to temporal and geographic variability and the evolution of minor diseases into major diseases making it difficult for the breeders to fix research priorities were the two research constraints identified. Developmental variation of varieties loosing their original character over time and space has been reported as a major research constraint by Ceccarelli and Grando (1999). During the PRA investigations of the present study, it was reported that Mashuri, a variety popular in Tamil Nadu characterised by much preferred long slender white grains, when cultivated in Palakkad district for more than two or three seasons, lost its original fineness and thereby market demand. Similarly, *Helminthosporium* leaf spot, a minor disease before, has obtained the status of a major disease making it difficult for the breeders to fix research priorities.

5.6.4.2 Production constraints

Constraints to rice production as perceived by the rice researchers of RARS, Pattambi (Table 69) lead to the following interpretation: Water scarcity during *mundakan* leading to partial or full crop loss was reported by all the sub systems concerned with rice seed production in the district including the RSS (Tables 66 to 69). As discussed before, non-availability of seeds in time and in adequate quantitities is a serious problem faced by each subsystem and they blamed one another for the delay. The RSS wanted the authorities of SISS to place timely indents so that the seeds could be supplied in time. All these arguments suggest lack of proper discipline and co-ordination among the components of rice seed production system and distribution in Palakkad district. High cost of HYVs combined with non-availability of farmer-preferred varieties could be the reasons for the reduced demand for seeds from the rice farmers. In turn, high production costs and financial constraints could be the reasons for increased cost of the Breeding/Foundation seeds distributed through the RARS, Pattambi. Mechanisation of labour intensive operations like transplanting and harvesting could reduce seed production costs. It could also make up the labour shortage experienced during peak periods.

5.6.4.3 Extension and policy constraints

Apprehension of the SISS and the ESS personnel towards 'new' varieties and their inadequate knowledge about the varietal characters and location/season specific adaptability of recently released cultivars were the extension and policy constraints perceived by the RSS. The failure of the RSS to develop farmer-preferred rice varieties would mean that either the extension endeavour in Palakkad district has not been effective enough to convey the much wanted farmers' feedback on varietal needs and preferences to the RSS; or the rice breeders were not able to translate them into viable strategies for developing farmer-preferred rice varieties.

5.6.5 Suggestions for improving the present rice seed production scenario of Palakkad district as perceived by the FSS, ESS, SISS and RSS

The suggestions for containing the constraints faced by the four component systems that were elicited from them point by point are presented elsewhere in tables 70 to 73. As they are plain and self-explanatory, a separate discussion was not attempted.

5.7 Ranking of rice varieties based on multi-seasonal adaptability

The examination of rice varietal ranking provided in tables 36 and 37 revealed that out of the 54 rice varieties reported, 20 (37%) were found cultivated both in *virippu* and *mundakan* seasons. Since multi-seasonal adaptability is an added advantage for any farmer-preferred variety (Ahamed *et al.*, 1996), an index (MSAI) was developed and tested in the present study to measure the same (Table 74). In other words, the temporal variability responsible for differential ranking of genotypes in the same location over time (Ceccarelli and Grando, 1999) was measured. A higher MSAI score indicated better multi-seasonal adaptability and therefore, a lower temporal variability.

The analysis of the adaptability ranking presented in table 74 revealed that Aiswarya (Ptb-52), Kanchana (Ptb-50), 'Kunjukunju', Athira (Ptb-51) and ASD-16 were the rice varieties most adapted to both the seasons. The photo insensitive nature of these varieties makes them most suitable for *virippu* and *mundakan*. It is encouraging to note that except 'Kunjukunju' and 'ASD-16' all others have been officially recommended for the different rice growing tracts of Kerala (Leenakumari and Nair, 1996). As one goes down the table, multi season adaptability decreases and hence those varieties not included in the table should be least suited for multiple seasons. For example, out of the eight blocks where Aiswarya (Ptb-52) and Kanchana (Ptb-50) were found cultivated, in six blocks they were grown during both the seasons which is a testimony for their multi-seasonal adaptability.

5.8 Comparative ranking of rice varieties, varietal traits and farmers' constraints to rice seed production and distribution as perceived by the FSS and ESS of Palakkad district

The block based ranking of *virippu* and *mundakan* varieties revealed that in majority of ADBs (6/10 in *virippu* and 7/11 in *mundakan*), there was no significant correlation between the perception of the FSS and the ESS (Tables 75 and 76). This would mean that in general, the ESS were not either fully aware of the rice varieties existed in the *padasekharams* of corresponding panchayats, or were unfamiliar with the farmer-preferred attributes on which they were ranked by the FSS of the respective panchayats. However, the block-based ranking of farmer-preferred attributes confirmed that in majority of the ADBs (9/11) there was significant correlation between the perception of the FSS and ESS (Table 77). It could be argued that, though the extension personnel were well versed with farmer-preferred attributes, they were unable to correlate them with the ranking of rice varietal attributes as perceived by the farmers. This observation justifies the 'accusation' made by the RSS that the officials of the ESS/SISS lacked adequate knowledge of varietal characters and specific adaptability of rice cultivars.

The data given in table 78 revealed that there was agreement between the FSS and the ESS regarding the ranking of farmers' constraints to rice seed production and distribution.

5.9 Practical utility of the preferential indices developed for the study

Five 'preferential indices' namely, Matrix Ranking Index (MRI), Varietal Ranking Index (VRI), Attribute Ranking Index (ARI), Constraint Ranking Index (CRI) and Multi Seasonal Adaptability Index (MSAI) were developed for the present study. At block level, Spearman's rank order correlation (r_s) was used to compare the perception of the FSS and the ESS. Both Mann-Whitney 'U' test and Spearman's rank order correlation (r_s) were used for the comparison of rankings arrived through the above indices at district level. The results of block-based ranking of varieties, varietal

traits and farmer's constraints had conformity with the district-based ranking. This is indicative of the reliability of these indices.

5.10 Suggestions for effective operation of rice breeding set up and public seed production agencies in Palakkad district

The rice varieties that were not found in the reckoning of farmers could be eliminated from public rice seed production and distribution programmes. Seed production of varieties such as Aiswarya (Ptb-52) could be increased to meet the demands from farmers. Seed production of rice varieties from outside the state which cannot be included in public seed production programmes at present (Ponmani, ASD-16, TKM-9 and Vellapponni) need to be legitimised. As the official procedures for releasing a variety is cumbersome (Witcombe *et al.*, 1998), it is suggested that these varieties be included in the Package of Practices recommendations of the research system. Promising non-descript strains may be subjected to pure line selection programmes. Farmer participatory approach in such crop improvement programmes would ensure farmers' varietal acceptance, high rate of varietal dissemination and replacement and most of all, reduce the time gap between varietal testing and their official release (Pal *et al.*, 2000 and Weltzien *et al.*, 2000).

5.10.1 Current rice seed production status of public seed sector in Palakkad district

Many seed experts around the world have pointed out the lack of varieties suitable for specific situations and non-availability of quality HYV seeds in any seed system. (Pal, 1975; Singh and Sharma, 1986; KAU, 1992; Kunju, 1989; Vyas, 1998; Virk, 1998; Agnihotri and Tripati, 1994; Prakash; Nair, 1990; Prakash, 1989)

Kelly (1989) observed that in many developing countries the state seed farms were not able to grow enough seed to satisfy the requirements of the farming community. Recently, KAU (2002) conducted a study on the rice seed system of Palakkad district and opined that the five SSFs of the district could only satisfy 1.66

per cent and 1.72 per cent of the seed requirements for *virippu* and *mundakan* seasons respectively. A detailed analysis of rice seed production data obtained from the different sources of rice seed in the district namely the SSFs, RARS, Pattambi, RSGP and NSC unit, Alathur made in the present study endorses these findings (Table 83). The percentage seed production contributed by each of the aforesaid agencies including farmer-produced seeds in the year 2000-'01 is presented in fig. 15. The lions share of the seed requirement was found to be met by either farm-saved seeds or seeds obtained via farmer-to-farmer exchange.

It is disgusting to note that the annual rate of increase in rice seed production from the various public sector seed agencies is far from satisfactory as evidenced by the seed demand-supply bar diagram shown in fig. 16. The situation is dismal as only two to five per cent of the seed requirement was found being fulfilled by the formal seed production sector. More over, the farmers' main source of rice seed, the SSFs had recorded a negative growth in gross seed output over the five years under study (Table 80). The total seed production of the five SSFs fell by more than 21 per cent in five years (from 166 t in 1996-1997 to 130 t in 2000-2001).

The reasons for such a fall in seed output is worth exploring. Seed production of Kairali (Ptb-49) from the SSFs dropped from around 30 t in the year 1996-1997 to about 15 t by 2000-2001. Similarly, seed production of Mangala mashuri (Ptb-53) that was around 31 t in 1997-1998, fell to nothing in 2000-2001. These observations are in conformity with the rice varietal rankings (Table 36). In short, it could be concluded that the primary reason for such a reduction in seed production in the SSFs was due to poor demand for varieties currently under seed production. It is suggested that this statement should be evaluated in the light of the constraints identified by the FSS, ESS and RSS such as non-availability of preferred varieties from KB (Table 66), accumulation of KB seeds, reduced demand for KB seeds (Table 67), reduced demand for seeds by rice farmers at RARS, Pattambi (Table 69) and inadequate feedback about farmers' varietal preferences (Table 68). Such a situation calls for demand-driven and timely shifts in the seed production policies.

Fig. 15. Rice seed production status of Palakkad district (2000-'01)

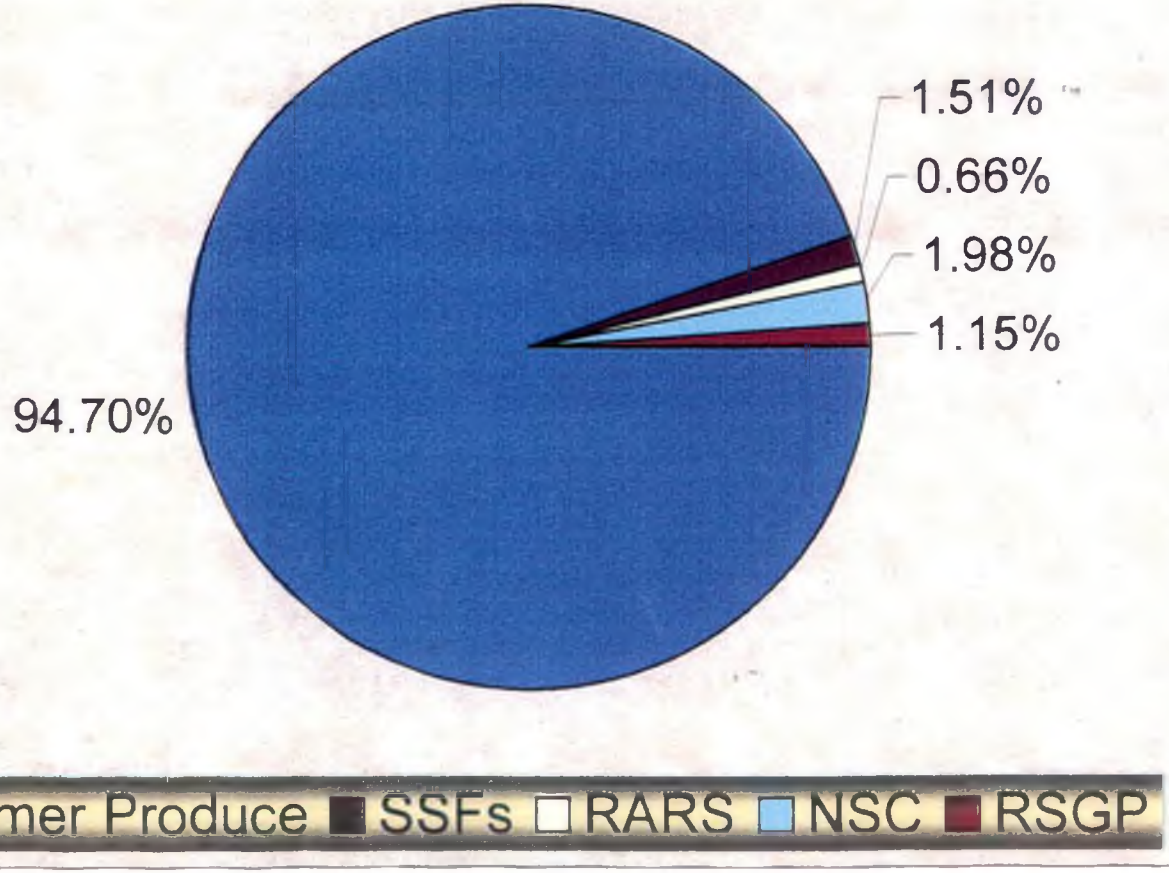
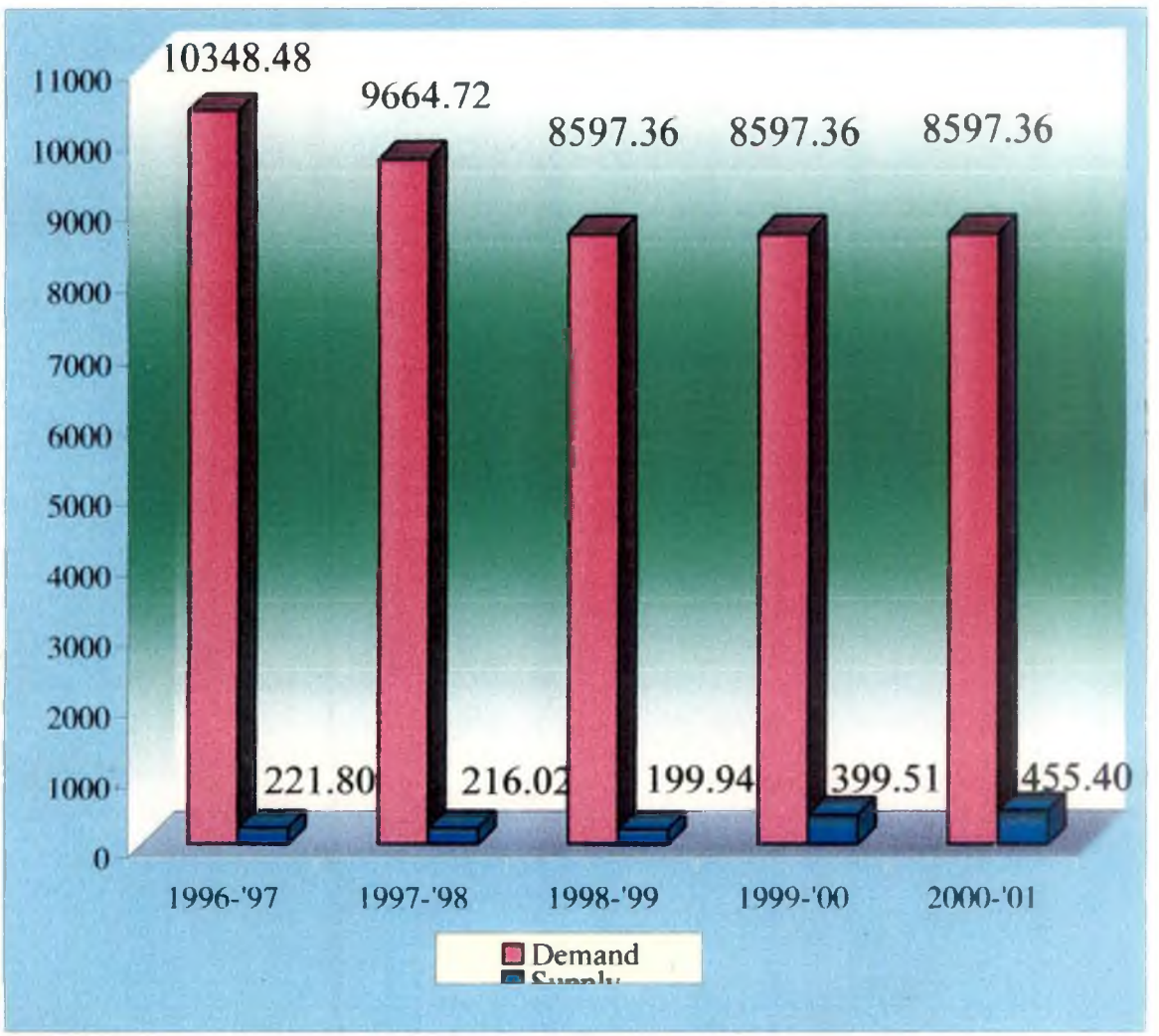


Fig. 16. Rice seed-demand supply diagram for Palakkad district (1996-'97 to 2000-'01)



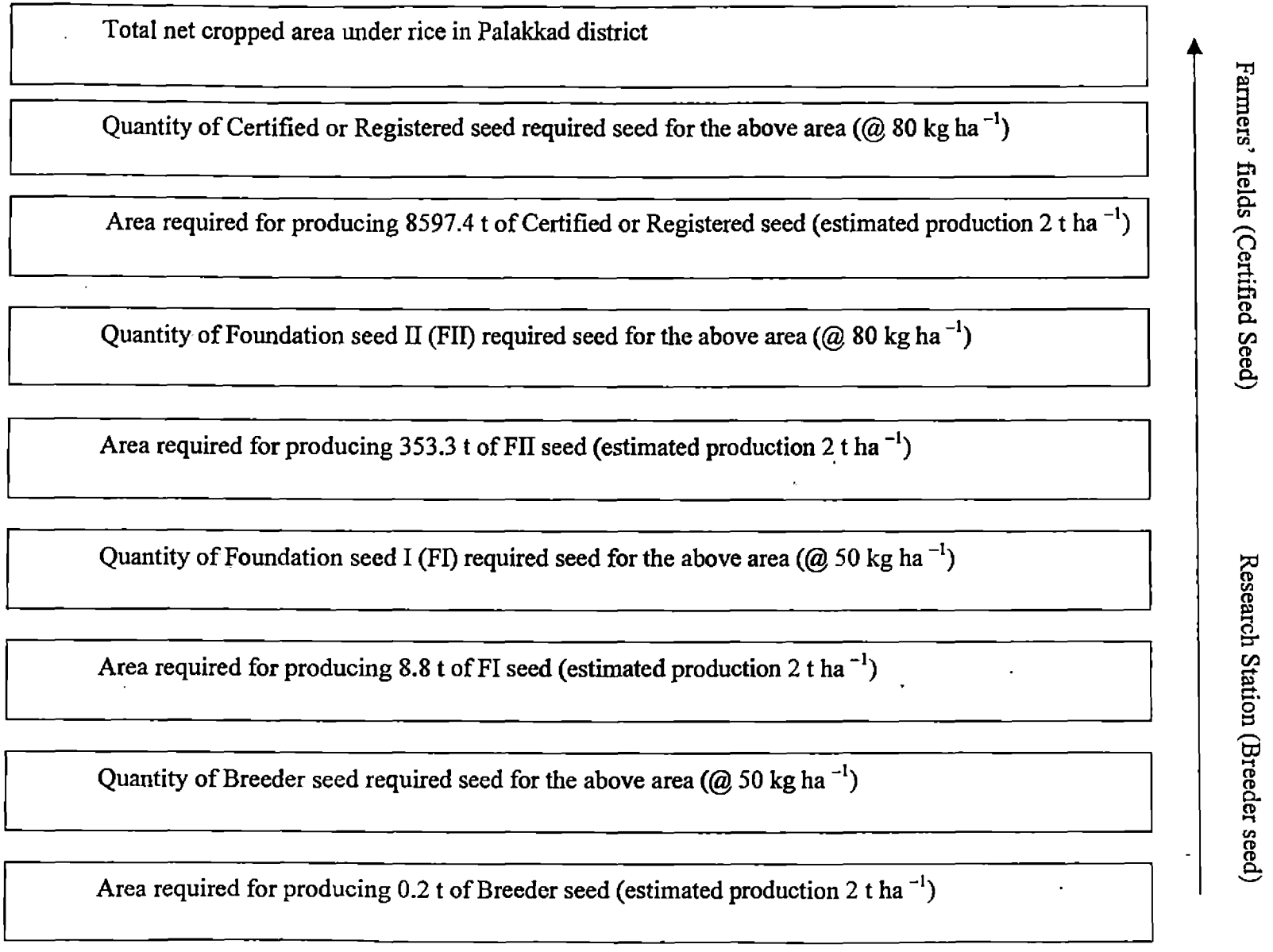
5.10.2 Current seed production capacity of the State Seed Farms of Palakkad district

It would be interesting to investigate whether the main seed production and distribution agency operating in Palakkad district, the five SSFs have enough infrastructural facilities, especially land, to support the production of required amount of rice seed. Fig.17 highlights a computed situation where the SSFs produce seeds to the maximum of their current capacity.

The estimation presented in fig.17 projects that the amount of Breeder, FS-I, FS-II and Certified/Registered seeds required at present in Palakkad district are 200 kg, 8.8 t, 353.3 t and 8597.4 t respectively. It is generally agreed that for a self-pollinated crop like rice, farmers need to replace their original seed stock only once in three years. This means that the actual seed requirement at each level (Breeder, FS-1, FS-2 and Certified/Registered seed production) would be reduced to one-third of the original requirement.

The total area available for rice seed production in five SSFs together is 63 ha and the estimated seed production from the above said area is 126 t. Though the Certified/Registered seed requirement of Palakkad district is 8597 t, owing to the seed replacement principle stated above, rice seed requirement could be limited to 2866 t per season. Even at this minimal situation, the demand - supply gap of Certified/Registered rice seed required for Palakkad district is more than 95 per cent. This indicates that the five SSFs or any other public seed production agency functioning in Palakkad district cannot meet the Certified/Registered rice seed requirement of the district in full. As shown in fig.17, the FS-2 requirement is 353 t, again based on the principle discussed above; FS-2 seed requirement could be refined as 117 t. The rice land area required for the production of 117 t seed being around 58 ha, is well under the maximum seed production capacity (126 t) as well as the total land area available (63 ha) in the five SSFs of the district.

Fig. 17. Flow diagram depicting the current rice seed production capacity of the five State Seed Farms of Palakkad district



Thus, if the SSFs take up the exclusive responsibility of producing the FS-1 and FS-2, the rest of the seed production chain has to be continued by either by a localised private system or programmes like the RSGP. It could be concluded that only a decentralized system of seed production, where Certified/Registered seeds are fully grown in farmers' fields; and centralization is limited to FS-1 and FS-2 seed production in the SSFs; and Breeder seed production alone by the RSS, can meet the requirement of quality rice seed for Palakkad district.

5.11 Empirical model of rice varietal preferences of the farmers of Palakkad district- *Virippu*

The empirical model depicting the comparative ranks of *virippu* rice varieties as perceived by the farmers of Palakkad district is presented in fig. 18.

5.12 Empirical model of rice varietal preferences of the farmers of Palakkad district – *Mudakan*

The empirical model depicting the comparative ranks of *mundakan* rice varieties as perceived by the farmers of Palakkad district is presented in fig. 19

5.13 Suggestions for streamlining rice varietal release, seed production and distribution in Palakkad district

The present investigation on Palakkad rice seed system has brought to light the following major weakness:

i. A very unhealthy demand - supply gap existed, where the demand for quality rice seed far exceeded its supply from the various public sector seed agencies.

ii. The failure of Research Sub System to release rice varieties suitable for the micro-farming situations experienced, especially in eastern Palakkad.

iii. Unscientific choice of varieties for seed multiplication by the SSFs, without considering the location specific rice varietal preferences, predominance and adaptability.

Fig. 18. Empirical model of the rice varietal preference of the farmers of Palakkad district - *virippu*

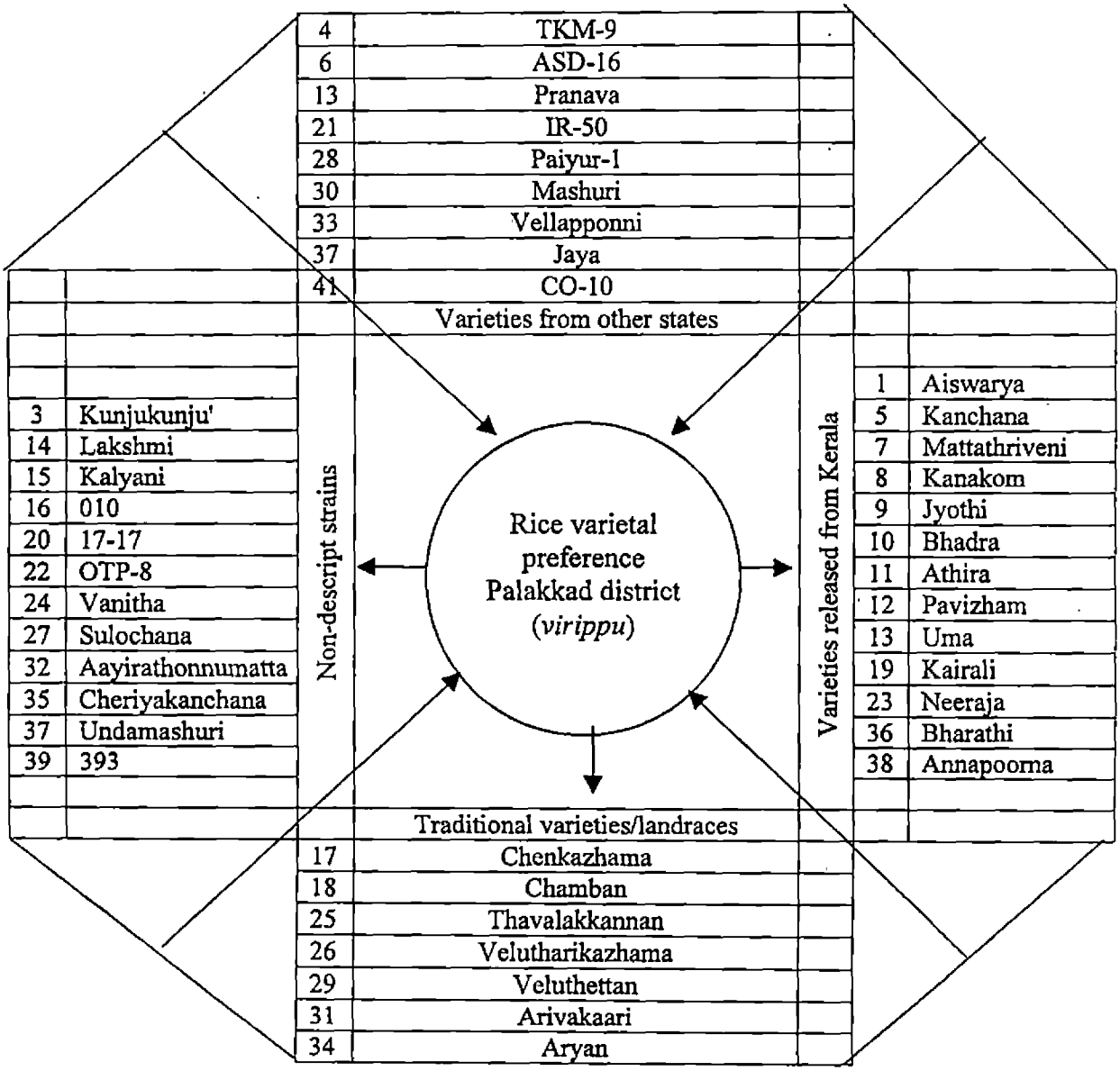
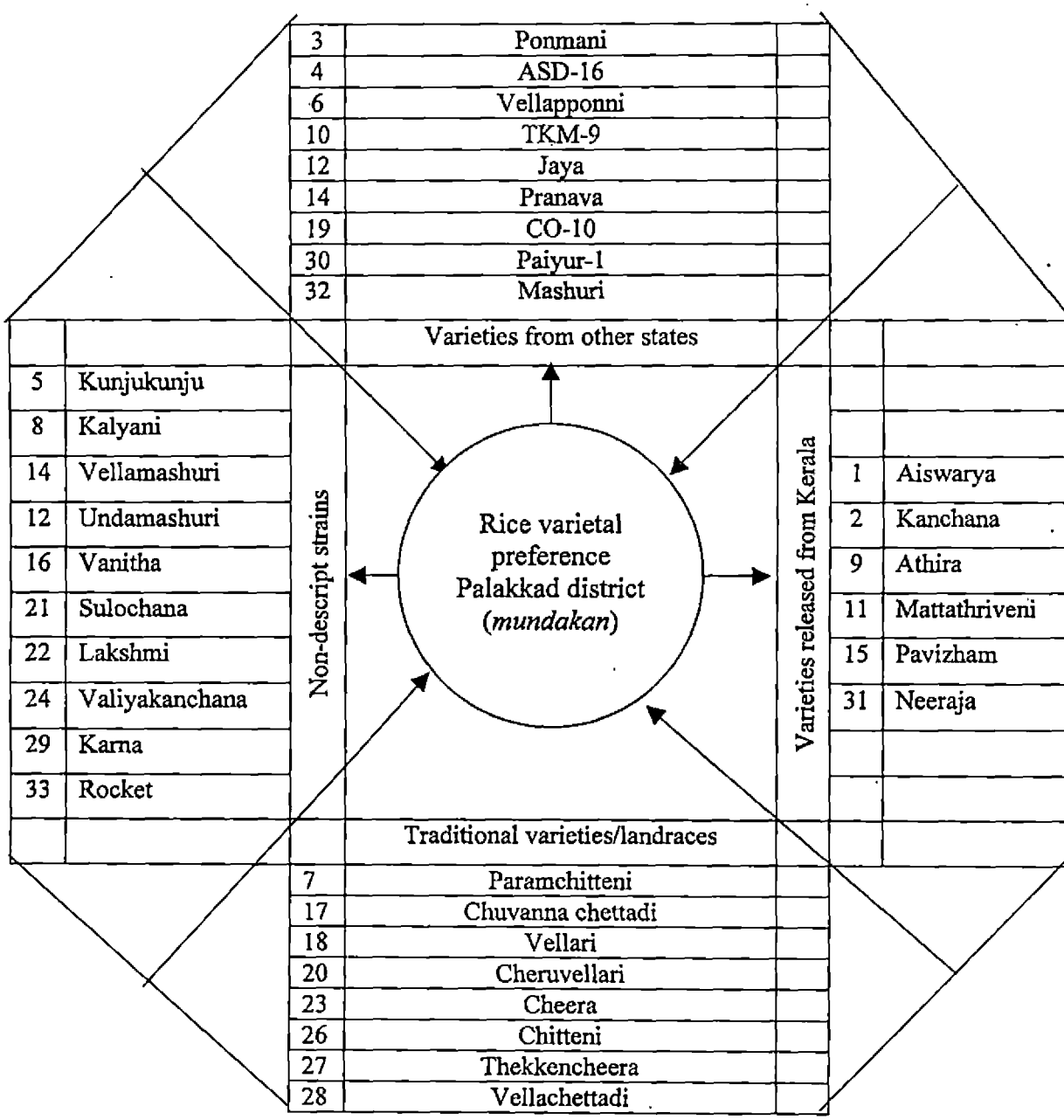


Fig. 19. Empirical model of the rice varietal preference of the farmers of Palakkad district - *mundakan*



iv. Lack of effective linkage among the different subsystems namely, the FSS, ESS, SISS and RSS of Palakkad district in major issues of rice seed research, production and distribution.

A critical analysis of the available studies on seed systems revealed that the aforesaid constraints are more or less common to all formal, centralized and non-participatory varietal release and seed production and distribution systems of developing countries (Surendran, 1982; Kelly, 1989; Kunju, 1989; Agnihotri and Tripati, 1994; Cromwell, 1996).

Reports of Song and Manikand (1999) revealed that there was a wide gap between breeders' limited supply of varieties and the diversity of farmers' needs. Rice researchers, extensionists and the rice farmers of Kerala had consistently lamented on the insufficiency of varieties suited for specific agro-climatic regions and unique situations, as one of the major constraints to rice seed systems of the state.

5.13.1 Decentralized seed production system

The results and the discussion of the present study has empirically established the inability of the centralized system to cater to the seed requirements of the rice farmers of Palakkad. The alternatives could be:

i. Public-private partnerships in seed production and marketing.
ii. 'Seed village' programmes, as initiated by the SDA, Andhra Pradesh.
iii. Involvement of NGOs in seed production, multiplication and distribution programmes.

5.13.1.1 Public-Private interface

Involvement of private sector in the development and spread of rice varieties could be an effective alternative to tackle the following constraints faced by the ESS, SISS and RSS:

i. Lack of adequate infrastructural facilities for the development, multiplication, storage and distribution of rice seeds.
ii. Insufficient staff strength for monitoring decentralized seed production and distribution.
iii. Lack of adequate funds.

The above suggestions may be read along with the following steps initiated by the ICAR, as measures to foster public-private interface in seed production and distribution (Pal and Joshi, 1999):

i. Mechanism for sharing resources between public and private agencies.
ii. Better access for private sector to the products of public research institutions.
iii. Public-private joint programmes, involving private sector's participation in policymaking.

Such novel considerations have reflected in the new Seed Policy 2001, which recommended:

i. Regular interaction amongst the private and public sector researchers, seed companies/organizations and development agencies.
ii. Access for private seed production agencies to breeder seed, subjected to the terms and conditions decided by the Government of India.
iii. Provision of a supportive environment to the private sector to enhance and expand their role.
iv. Provision of encouragement and motivation to restructure and re-orient the private sector for catering to the needs of non-traditional areas.

Though public-private interface for the development of new HYV/seed production or both is a welcome suggestion for the national rice seed sector, the review of the situation and the results of the present study show that it has little immediate future in Kerala. When the private sector companies sold 19,370 t of rice

seed in Andhra Pradesh during both rice seasons in 1998, there was a total absence of private sector in rice seed production and marketing in Kerala during that period. Moreover, in their study on the public-private interface and information flow in the rice seed system of Andhra Pradesh, Pal *et al.* (2000) observed the incompetancy and lack of will on the part of private seed companies to promote 'new varieties'. It could be due to their reluctance to take 'risk' by dealing 'new varieties' without assured ready demand from the farmers unlike the time tested ones.

5.13.1.2 Non-Governmental Organisations (NGOs)

Rice seed production under the auspicious of NGOs could be another alternative for the present ineffective seed system existing in Palakkad district in particular and in Kerala in general.

According to Farrington *et al.* (1993) the advantages of NGOs were, their: i. quick response to needs ii. Participatory nature iii. Independence iii. Flexibility in the choice of work, information sources, communication methods and iv. organisational structure, which made them suitable for working in marginal/variable environments. Many recent studies have reported the success stories of NGOs in Participatory Technology Development (PTD) and decentralised variety testing and seed production in rice and other crops (Martin and Sherrington, 1996; Pal *et al.*, 2000).

A closer look at the case studies on the role of NGOs in popularisation of varieties conducted in Madhya Pradesh, Gujarat and Rajasthan (Garg *et al.*, 1998) revealed that most of the NGOs engaged in rural development activities and on-farm and land-based enterprises were either not involved in seed-based technologies or were solely dependent upon the formal research and extension agencies for seed-related issues. The situation in Kerala is not much different, and Palakkad district was found obviously lacking the involvement of NGOs in rice seed sector so far, as evidenced by the present study.

5.13.1.3 'Seed Village' concept

For streamlining rice seed production and distribution in Kerala, Gopalakrishnan (1994) suggested that seeds of location specific varieties should be produced through group farming units in each panchayat, based on the concept of 'seed village'.

'Seed village' was an attempt to decentralise rice seed system in Andhra Pradesh, started by the SDA in the early 1990's. The main objective of the programme was to involve farmers in rice seed production and thereby make quality seeds available at a reasonable price within the village itself (Pal *et al.*, 2000). Local seed production at block/panchayat level could also be an effective strategy.

Despite sounding attractive, such programmes were only partially successful because of, i. non-consideration of farmers' varietal preferences, which lead to inappropriate selection of varieties for local multiplication ii. Lack of adequate funds making the farmers hesitant to store rice seed for the next season, and iii. Lack of assured seed procurement for marketing even if the seeds were stored.

In the case of Palakkad seed system, RSGP was a similar attempt for decentralisation in rice seed production. Though the programme was started with much hopes, the response from the people concerned were not encouraging (Table 66 and 67). Lack of assured seed procurement and inappropriate selection of varieties for local multiplication were the constraints common to both 'seed village' programme and RSGP. The present investigation could find that RSGP was negatively affected by delay in payment for the seed procured, and the complex and cumbersome procedures for seed testing envisaged in RSGP. There was a general feedback that the quality (genetic purity) of the RSGP seeds was inferior. This could be related to the constraints reported by the ESS, regarding their inability to monitor seed production effectively because of high workload and lack of supporting staff (Table 67). Moreover, according to the 2000-2001 estimates, seed production through RSGP

accounted for only about 22 per cent of the total seed supply from the public sector, and just over one per cent of the total seed requirement of the district (Fig.15). Nevertheless, if the afore-said constraints are solved, local seed production based on 'seed village' concept could be first experimented on a pilot basis in a few selected panchayats. Learning from the experience, it can be gradually extrapolated to all the ADBs of the district.

5.13.2 Decentralised breeding and varietal release

It is interesting to look at Weltzein *et al.* (2000) who opined that breeding programmes should understand farmers' preferences for specific crop traits, which could be brought out through the analysis of varieties that farmers grow.

The need for farmer participation and local specific varieties, the limitations of centralised/formal breeding set up, and the superiority of participatory crop improvement over conventional breeding system, have been discussed elaborately in the theoretical orientation of the present study. Further, the results hint that stakeholder participatory crop improvement could either be Farmer Participatory Varietal Selection (FPVS) or Farmer Participatory Plant Breeding (FPPB).

5.13.2.1 Farmer Participatory Varietal Selection (FPVS)

FPVS is the selection of fixed lines (released, advanced lines or land races) by farmers in their target environment using their own selection criteria. A successful FPVS involves the following steps (Joshi and Witcombe, 1996; Sthapit *et al.*, 1996; Witcombe *et al.*, 1996).

i. Identification of farmer's needs in a cultivar.
ii. Search for suitable material (varieties)
iii. Experimentation on varietal acceptability in farmer's held.
iv. Wider dissemination of farmer - preferred or farmer developed varieties.

An exhaustively analytical study of Witcombe *et al.* (1998) summarised that participatory approaches such as FPVS could be used to bring about a higher intake of modern cultivars and faster replacement rates of older cultivars in farmers' fields. Situations explored in the present investigation prompt to discuss the report of Ceccarelli and Grando (1999) that, there could be four strategies for a varietal selection programme namely, i. Decentralised participatory selection, where the selection is done by the farmers in their own fields ii. Centralised participatory selection, where the selection is done by the farmers but done in research stations iii. Centralised non-participatory selection carried out by the breeders in farmers' fields and iv. Centralised non-participatory selection (conventional selection) carried out by the breeders in research stations.

The above classification was based on the level and extent of decentralisation and farmer participation. The overall outcome of the present study indicates that the effectiveness of varietal selection may decline gradually from the first to the last option.

5.13.2.2 Farm Participatory Plant Breeding (FPPB)

The strategy of FPPB can be considered as an advanced step of FPVS, wherein farmers could be involved in the selection of segregating material.

Cooper *et al.* (1992) has motivated the stakeholders by appreciating farmers' ability to carry out controlled crossing successfully. Farmers were found, many a times, more efficient than the breeders in identifying high yielding materials and were able to formulate suggestions about potential parents for crossing in an FVPS conducted in Syria (Ceccarelli and Grando, 1996). Sthapit *et al.*, (1996) lent support to this by reporting that there was significant agreement between farmers' perception of the variety and crop harvest results, when the same varieties were grown on the field and tested. Weltzien *et al.* (2000), while reporting the results of a bean study in Rwanda, pointed out that the farmers had more knowledge and expertise in

identifying varieties with the right trait combinations to match the needs of specific growing conditions.

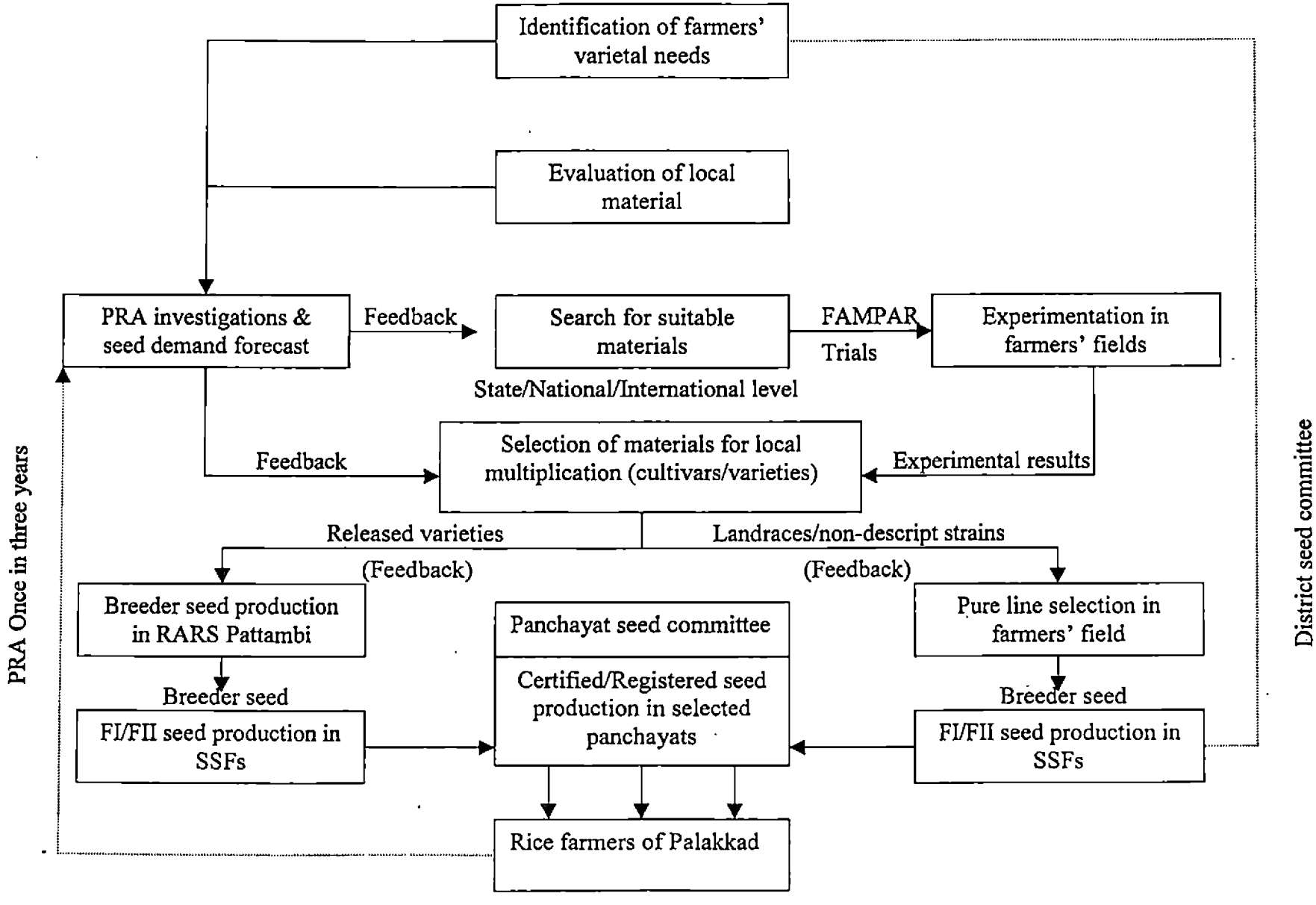
The aforesaid reports, despite sounding revolutionary and threatening to the conventional breeding programmes of the formal research system, would be worth trying,though the first preference may be given to FPVS since FPPB is more resource consuming. FPPB may be resorted to only when FPVS is tried, but failed or when the search process fails to identify any suitable candidate varieties. FPPB can also be utilised to build on the results of FPVS, by using farmer-preferred cultivars identified in FPVS on parents for participatory breeding programmes.

5.14 Proposed model for decentralised participatory rice varietal selection and seed production for Palakkad district

The present study has so far discussed in depth the different alternatives to streamline an efficient seed production strategy for the district. In the light of this, it could be concluded that coupling the formal RSS, ESS and a decentralised plant breeding and decentralised seed production systems would yield the maximum benefit. Hence, an attempt was made to formulate a model for decentralised participatory varietal selection and seed production, as presented in fig. 20.

The identification of farmers' varietal needs and preferential attributes and evaluation of local materials released or non-released (landraces/non-descript strains), based on those needs and preferences may be done through PRA/PLA investigations; and seed demand forecasting done at panchayat or ADB levels. If the researcher's aim is not to compromise with the accuracy and authenticity of the sample data, at the same time maintain enough flexibility and convenience, it would be better to choose two panchayats each, from the 12 ADBs of the district. Therefore, the total number of panchayats in the model would be 24. Out of the two panchayats, one could be selected based on the highest net-cropped area under rice at the ADB level and the second one, randomly. If the existence of distinct agro-climatic zones, micro farming

Fig. 20. Proposed model for decentralised participatory varietal selection and seed production for Palakkad district



situations and/or unique production/ establishment systems is revealed through preliminary investigations, more panchayats/*padasekharams* could be included in the model to satisfy the variability. A district level seed committee comprising of PRA/PLA experts, officials of the department of agriculture (from district level to panchayat level) including the farm officers of SSFs, rice researchers of central zone (KAU), NSC personnel, farmer representatives, and officials of the irrigation department would be the members of the committee with the responsibilities of these selection processes. The committee can be re-designed once the model is considered in principle.

These PRA/PLA investigations would provide ample feedback regarding the rice varietal choices, preferential attributes, crop season calendars, rice seed requirement and the like at the specific locations and levels. The results of these investigations could be crosschecked through FAMPAR trials on farmers' fields. The local gene pool can also be enriched or supplemented by search for suitable materials (cultivars/varieties) at international, national or state levels based on farmers' varietal needs and preferences.

The district seed committee should be responsible for the district-based selection of materials for seed multiplication. It is recommended that the maximum number of varieties be limited, say to 20. They may include released varieties from Kerala or from other states, medium to high yielding landraces/non-descript strains adaptable to local conditions or advanced lines from research stations. Whenever a variety/cultivar is introduced, the local adaptability and acceptability of the same should be tested in the participatory way.

The final decision on the panchayat-based selection of varieties for local multiplication should be made in consultation with the panchayat seed committee responsible for monitoring the Certified/Registered seed production. This would consist of the farmer representatives from each *padasekharam*, the AO of the

concerned *Krishibhavan*, the president of the local body (*Grama panchayat*) and the local seed expert from the KAU.

Experimentation in farmers' fields; trials for local adaptability and acceptability; and monitoring of Certified/Registered seed production require much technical support and time, which the local extensionist may not be able to provide. Agriculture graduates could be appointed on contract basis after undergoing training on scientific rice seed production and PLA techniques. They will be the field personnel acting in accordance with the directives of the concerned rice scientist in charge and panchayat seed committee.

Each panchayat seed committee shall contribute a portion of their profit from seed sales to the district committee, which will form the district seed fund. The share of each panchayat towards district seed fund will be proportional to the area under seed production in each panchayat, and shall be fixed by the district seed committee. Scientists (rice researchers and PRA expert) deputed to the district seed committee shall serve on full time basis and their salary will be met from district seed fund. The number of rice researches shall depend on affordability. However, it is recommended that at least two scientists, one for the eastern ADBs comprising Chittur, Kollengode, Nenmara, Palakkad, Alathur and Koyalmannam; and the other for Sreekrishnapuram, Pattambi, Thrithala, Shoranur, Mannarkad and Agali blocks would be required. Supporting staff to assist the seed committee shall also be appointed on contract basis/deputed from the SDA. The salary or consultancy/honorarium for local seed experts shall be met from the local/panchayat seed fund. Thus, the whole system of decentralised participatory varietal selection and seed production should be a well-knit and structured set up.

Breeder seed production of the selected rice varieties may be done at RARS, Pattambi; FS-1 and FS-2 seeds be produced from the Breeder seed at the concerned SSFs, and passed on to the RSGP. The local RSGPs have to be designed,

implemented and supervised by the Panchayat Krishibhavan to make it fool proof and credible. Already, the AO of the Krishibhavan is the Seed Inspector of the panchayat.

According to the provisions of National Seed Act 2001, the state government can establish one or more seed certification agencies in the concerned state. Hence, the district seed committee would act as rice seed certification agency for Palakkad district. Farmer participatory pure line selection of superior genotypes could be conducted in farmers' fields at places decided by the district seed committee. Promising pure line selections emerging out of these selection programmes can be checked for distinctiveness, uniformity and stability (DUS) and registered under Plant Varieties and Farmers' Rights Protection (PVP) authority as envisaged in the new National Seed Policy. Accordingly, the rights of researchers to use seeds of these varieties for bonafide research and breeding new plant varieties should be protected. At the same time, individual farmers/farmers' groups/village may be rewarded suitably for their significant contribution to the evolution of these varieties.

Finally, as the seed system of a seasonal crop like rice is very dynamic and farmers' preference of varieties and preferred varietal attributes are likely to get modified in fairly short periods of time, it is suggested that reviews and PLA studies as designed in the present investigation may be conducted once in three years and the seed policy be revised accordingly.

SUMMARY

SUMMARY

Rice is the staple food of the people of Kerala and Palakkad district is widely acknowledged as the 'rice granary' of the state. But the recent statistics revealed very disturbing trends jeopardizing the prospect of rice cultivation in the district. Many HYVs released from the state, after an initial spurt, failed to impress and inspire the common rice farmers of Palakkad. Farmers' affinity towards rice cultivars other than released ones pose serious problems to the State Department of Agriculture and the Kerala Agricultural University, since only released varieties come under the purview of formal seed production, Registered Seed Production Programme (RSGP) and seed subsidy programmes.

There are allegations that the state of Kerala lacks an efficient seed policy and the public seed agencies are able to meet only a negligible portion of the seed requirement of rice farmers. Hence a viable strategy has to be streamlined for breeding farmer-preferred varieties and for Breeder /Foundation/ Certified rice seed production, multiplication and distribution for the district. The present investigation was designed with the following objectives:

i. To analyse the existing cultivar use pattern, varietal preferences and seed production and distribution status of rice in Palakkad district.

ii. To study the constraints to the production and distribution of rice seeds at different levels in Palakkad district.

iii. To streamline a viable strategy for the production and distribution of rice cultivars in Palakkad district.

The study was conducted in the ten major rice growing ADBs of Palakkad district. A multistage sampling procedure was followed for the purpose of drawing samples for the present investigation. Four stakeholder systems namely, the Farmer

Sub System (FSS), the Extension Sub System (ESS), the Seed Input Sub System (SISS) and the Research Sub System (RSS) operating in the district were reckoned for the study.

The farmer respondents comprised of 30 rice farmers, 30 each from the selected 11 *padasekharams* (one from each ADB). The ADBs/ Panchayats/ *Padasekharams* were selected based on the criterion of highest net-cropped area under rice. The ESS comprised of the extension personnel of the SDA (41 nos). The AO's and the AA s of the five State Seed Farms (SSFs) of the district formed the respondents from the SISS (20 nos.) and the rice researchers of central zone (RARS, Pattambi) constituted the respondents from the RSS.

Data was collected through PRA/PLA sessions with suitable modifications. A combination of FGDs, Brainstorming and SSGIs were followed. The analysis of data was done using special indices developed for the study namely, Matrix Ranking Index (MRI), Attribute Ranking Index (ARI), Varietal Ranking Index (VRI), Constraint Ranking Index (CRI) and Multi Seasonal Adaptability Index (MSAI). Spearman's Rank Order Correlation and Mann-Whitney 'U' test were the main statistical tests used other than mean, average, percentage and standard deviation. The salient features of the study are furnished below:

1. Palakkad district has become a double-cropped rice belt with *virippu* and *mundakan* as the predominant cropping seasons.

2. Minor, but unique rice production systems namely *Koottumundakan Karingora* and *Poonthalpadams* were identified and their status and technologies documented.

3. Rice farmers were found to continue with these unique systems because of contextual and situational reasons such as rainfall, soil conditions, non-availability of labour during peak periods of operation, high labour charges,

drudgery of intensive rice cultivation for the three seasons, less remunerative rice production, lack of assured irrigation, small and fragmented land holdings unsuitable for mechanization, easiness of transporting harvested paddy to threshing yards, reduced incidence of pests and diseases, good quality straw and non-availability of HYV seeds from Krishibhavan.

4. The analysis of crop season calendars revealed that there was wide variation in crop duration, sequencing, relative extent of growth phases and crop establishment systems followed both within and across the seasons at different locations of the district. The main crop establishment systems identified were dry sowing and transplantation.

5. The rice varieties /cultivars of Palakkad district could be classified into six distinct types namely, landraces/traditional varieties released by selection from the erstwhile RRS/CRS and the present RARS, Pattambi; landraces/traditional cultivars (not released); HYVs released from the erstwhile RRS/CRS and present RARS, Pattambi; HYVs released from the research stations of Kerala other than RARS, Pattambi; non-descript strains (high/low yielding) and varieties from other states mainly Tamil Nadu.

6. The rice varieties released from RRS, Mankombu was found to have a fairly good status in the eastern ADBs of Palakkad district namely, Chittur, Nemmara, Koyalmannam, Kollengode and Palakkad.

7. The dominance of Tamil Nadu varieties was a unique feature of rice cultivation in Chittur and Kollengode ADBs.

8. *'Kunjukunju'*, a non-descript strain, was found to be preferred by the majority of rice farmers of eastern Palakkad.

9. Non-descript strains namely, '010', 'Karna' and 'Rocket' were found endemic to the ADBs of Pattambi and Shoranur.

10. In the study, 41 *virippu* and 33 *mundakan* varieties/cultivars were documented from Palakkad district.

11. Out of these, only 19 varieties (30%) come under the purview of public sector seed production and distribution programmes.

12. Among the 29 rice varieties currently under public seed production and distribution programmes, 11 varieties (38%) were reported not cultivated recently by the farmers of Palakkad district.

13. Rice varieties that are not in the reckoning of farmers could be removed from the official Foundation/Certified seed production programmes.

14. According to the rice farmers of Palakkad district, the varietal preference for *virippu* season was in the order; Aiswarya, Kanchana, 'Kunjukunju', TKM-9, Jaya, ASD-16, Mattathriveni, Kanakom, Jyothi, Bhadra, Athira, Pavizham, Pranava, 'Lakshmi', 'Kalyani', '010', Chenkazhama, Chamban, Uma, '17-27', IR-50, 'OTP-8', Kairali, 'Vanitha', Thavalakkannan, Velutharikazhama, 'Sulochana', Paiyur-1, Veluthettan, Mashuri, Arivakaari, 'Aayirathonnumatta', Vellapponni, Aryan, 'Cheriyakanchana', Neeraja, 'Undamashuri', Bharathi, '393', Annapoorna and CO-10.

15. The varietal preference for *mundakan* season was in the order; Aiswarya, Kanchana, Ponmani, ASD-16, 'Kunjukunju', Vellapponni, Chitteni, 'Kalyani', Athira, TKM-9, Mattathriveni, 'Undamashuri', Jaya, 'Vellamashuri', Pavizham, 'Vanitha', Chuvanna Chettadi, Vellari, CO-10, Cheruvellari, 'Sulochana', Lakshmi', Cheera, 'Valiyakanchana', Pranava, Paramchitteni, Thekkencheera, Vellachettadi, 'Karna', Paiyur-1, Neeraja, Mashuri and 'Rocket'.

16. The ranking of rice varieties based on highest average annual seed production from public seed agencies in Palakkad district over the five years (1996-1997 to 2000-2001) was found to be in the order; Kanchana, Jyothi, Kairali, Aiswarya, Kanakom, Mattathriveni, Mangalamashuri, Uma, Karishma, Pranava, Pavithra, Athira, Ponmani, Karuna, Annapoorna, Neeraja, Vellapponni, ASD-16, Pavizham, Jaya, Nila, Bharathi, Makom, Swaranaprabha, PTb-20 and Njavara.

17. The inclusion of Tamil Nadu varieties like Ponmani, Vellapponni and ASD-16 in Muthalamada SSF indicated their preference and demand among the farmers of the area.

18. The 34 preferred varietal attributes of rice were ranked and classified into eight categories namely, traits related to grain quality, multiple adaptability, straw quality, traits related to harvest and post harvest operations and traits related to inputs.

19. The 28 constraints to rice seed production and distribution as perceived by the farmers of Palakkad district could be classified into eight categories namely, input constraints, socio-economic constraints, infrastructural constraints, extension and policy constraints, biological constraints, information constraints and psychological constraints.

20. The 14 constraints to rice seed distribution as perceived by the extension personnel of Palakkad district could be classified into five categories namely, infrastructural constraints, psychological constraints, input constraints, technological constraints and extension and policy constraints.

21. The constraints to rice seed production and distribution as perceived by the five SSFs of Palakkad district were identified and categorized into seven groups namely, infrastructural constraints, biological constraints, input constraints,

socio-economic constraints, psychological constraints, information constraints and extension and policy constraints.

22. The constraints to the evolution of varieties and breeder/foundation seed production as perceived by the RSS of the district were classified into three groups namely, research constraints, production constraints and extension and policy constraints.

23. Multi-seasonal adaptability ranking using MSAI revealed that Aiswarya, Kanchana, 'Kunjukunju', Athira and ASD-16 were the rice varieties adaptable to *virippu* and *mundakan* alike.

24. Comparison of perception of the FSS and the ESS of Palakkad district on the ranking of rice varieties, varietal traits and prioritization of farmers' constraints to rice seed production and distribution revealed that there was significant disagreement between the sub systems, on the ranking of *virippu* and *mundakan* varieties. However, the perception of the two sub systems on varietal traits and farmers' constraints were more or less similar.

25. The present investigation on the rice seed system of Palakkad district revealed that even at their maximum seed production capacity, the five SSFs of the district could satisfy only five per cent of farmers' demand for certified rice seed.

26. The results of the study indicate the need for decentralized participatory rice varietal selection coupled with community level seed production so as to tackle the inadequacies and problems of Palakkad rice seed system.

Implications

Even after a thorough literature search, there was a visible lack of appropriate methodology for analyzing the data elicited through matrix ranking

exercises. Hence, the researcher had to develop new indices for the present study, which in turn became highly revealing and worthy tools. Once properly modified, these indices could be of extrapolative use in similar and other socio-economic investigations such as demand forecasting of consumer goods, assessment of technologies across disciplines and the like. These indices could be of utmost use to plant breeders especially.

The varietal needs and preferences of the rice farmers of Palakkad have been brought into light through the present study. The decentralized participatory rice varietal selection and seed production model proposed highlights the need for coupling decentralized seed production and participatory varietal selection programmes. Hence, the results of the study is expected to give much warranted feedback to the extension personnel, policy makers and rice researchers of the district, which could help them set objectives for evolving farmer-preferred rice varieties; formulate and implement demand driven plant breeding cum seed research and a viable seed policy. The present research approach, methodology and tools can be extrapolated to any problem-oriented farm research at local, regional, state and national levels.

Suggestions for future research

It is recommended that a comprehensive study of similar nature be conducted for the whole state of Kerala. Apart from the Palakkad rice system, *Kuttanad, Onattukara, Kolelands* and *Pokkali* systems may be included in the proposed study. Other stakeholders like rice mill owners, rice vendors, non-official plant breeders (farmers, retired scientists, private research organizations and NGOs) and consumers especially the women folk. Rice being a crop sensitive to weather parameters, topography, soil type, presence of water in the field; and the price of the produce being dependent on choice of mill owners, traders and consumers, farmers' choice of varieties would also depend on all these. Hence it is proposed that the suggested study should try to relate the aforesaid factors as well.

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APPENDICES

APPENDIX – I (a)

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE

Department of Agricultural Extension

Semi-structured Interview schedule for the ESS *(Krishibhavan* Officials)

1. Name of the panchayat:
2. ADB block:
3.
   i. Please list the constraints to rice seed procurement as experienced by you in this *Krishibhavan*
   ii. Please prioritize them considering their severity and importance
4.
   i. Please list the constraints to rice seed distribution in this panchayat as experienced by you in this *Krishibhavan*
   ii. Please prioritize them considering their severity and importance
5. What are the constraints to rice seed production and distribution as felt by the farmers of your panchayat?
6. Please put forth your valuable suggestions to overcome each constraint

APPENDIX – I (b)

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE

Department of Agricultural Extension

Semi structured interview schedule for the SISS (State Seed Farm Officials)

1. Name of the State Seed Farm:

2. ADB block:

3. Name of the official:

4. i. Please list the constraints to rice seed production as experienced by you in this State Seed Farm:

   ii. Please prioritize them considering their severity and importance

5. i. Please list the constraints to rice seed distribution as experienced by you in this State Seed Farm:

   ii. Please prioritize them considering their severity and importance

6. Please put forth your valuable suggestions to overcome these constraints:

APPENDIX – I (c)

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE

Department of Agricultural Extension

Semi-structured interview schedule for the Research Sub System

1. Name of the research station:

2. Name of the scientist:

3. Department:

4. What are the constraints to the evolution, production and distribution of rice seeds as felt by you in the rice research system of Central Zone?

5. Please prioritize them:

6. Please classify them as research, production and/or extension constraints:

7. Please put forth your valuable suggestions to overcome these constraints:

APPENDIX- II (a) [Similar matrices were prepared for the rest of the ten panchayats]

Matrix ranking of rice varieties by the FSS of Pallassena panchayat (*Virippu/Mundakan*)

Sl No	Attribute	Matrix Ranking*									Attribute Raking*
		Kunljukunju	ASD-16	Kalyani	Aiswarya	Pavizham	Lakshmi	Kanchana	Vanitha	Sulochana	
1	Low grain shattering	9	2	3	1	8	5	4	7	6	9
2	Easily threshable	1	8	7	9	2	5	6	3	4	3
3	Market preference and demand	9	1	5	7	8	4	3	2	6	16
4	Less weight reduction on storage	9	2	7	1	8	6	5	3	4	1
5	Pest/disease tolerance	1	4	7	9	2	8	5	3	6	15
6	Good yield	8	3	6	9	7	1	5	4	2	18
7	More productive tillers	9	4	6	1	7	5	2	8	3	17
8	Long panicle	8	5	4	9	6	2	1	7	3	12
9	Synchronized flowering	8	6	2	9	7	1	3	5	4	10
10	More grain per panicle	8	5	3	9	6	1	2	7	4	14
11	More grain weight	9	7	5	8	4	2	4	6	3	13
12	High milling percentage	9	5	4	1	7	3	8	6	2	7
13	Non-sticky rice- good keeping quality	7	8	1	3	6	4	5	9	2	6
14	Drought tolerance	3	2	7	9	4	8	6	1	5	11
15	Non-lodging	9	2	8	1	3	6	7	4	5	5
16	Less chaff	9	6	5	1	8	4	3	7	2	8
17	Reasonable yield under stress	1	4	5	9	2	6	7	3	8	4
18	Low germination in panicle	9	2	7	1	8	6	5	3	4	2

*Ranks were given such that the most preferred variety/attribute got the highest rank value9/20. Similarly, matrices for the other 10 panchayats were also made by the respective FSS

APPENDIX- II (b) [Similar matrices were prepared for the rest of the ten panchayats]

Matrix ranking of rice varieties by the ESS of Pallassena panchayat (*Virippu/Mundakan*)

Sl No	Attribute	Matrix Ranking									Attribute Raking
		Kunljukunju	ASD-16	Kalyani	Aiswarya	Pavizham	Lakshmi	Kanchana	Vanitha	Sulochana	
1	Low grain shattering	9	5	7	1	8	4	5	3	2	15
2	Easily threshable	1	5	3	9	2	6	4	7	8	14
3	Market preference and demand	9	1	5	6	7	4	8	2	3	17
4	Less weight reduction on storage	9	1	2	7	8	5	6	4	3	4
5	Pest/disease tolerance	1	2	6	9	3	7	8	5	4	11
6	Good yield	6	1	8	9	3	2	7	4	5	18
7	More productive tillers	6	2	3	4	5	9	7	1	8	13
8	Long panicle	8	4	3	9	7	5	6	2	1	12
9	Synchronized flowering	7	3	4	8	6	2	9	1	5	5
10	More grain per panicle	3	6	8	7	9	5	4	2	1	10
11	More grain weight	9	2	3	4	8	5	7	1	6	9
12	High milling percentage	9	2	3	4	8	5	7	1	6	16
13	Non-sticky rice- good keeping quality	7	9	1	4	5	2	6	8	3	8
14	Drought tolerance	1	3	5	9	2	8	7	4	6	3
15	Non-lodging	9	3	4	5	8	2	7	6	1	2
16	Less chaff	9	6	1	4	8	5	7	3	2	7
17	Reasonable yield under stress	1	2	6	9	5	7	4	3	8	6
18	Low germination in panicle	7	6	8	2	3	9	1	5	4	1

*Ranks were given such that the most preferred variety/attribute got the highest rank value9/20. Similarly, matrices for the other 10 panchayats were also made by the respective ESS

APPENDIX- III (a)

District-based ranking of *virippu* varieties by the FSS

Sl No	Panchayat			Varieties (1-20)																		
		m_{pi}	p_i	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
				6	4	2	8	2	2	8	1	1	4	1	3	1	2	3	3	1	1	1	4
1	Pallasseana	9		3.3	1.3	0.7	4.4	0.9	0.6	2.5	0.4	0.3	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	7		2.2	-	-	1.7	-	-	2.1	-	-	1.2	1.8	0.5	0.1							
3	Vaniyamkulam	6		-	-	-	1.4	-	-	1.3	-	-	-	-	-	-	0.7	0.9	0.6	0.2	-	-	-
4	Parali	6		2.0	0.8	-	2.0	0.7	-	-	-	-	-	-	-	-	-	-	0.4	-	02	-	-
5	Elappulli	9		2.5	1.5	-	-	-	0.6	2.5	-	-	1.4	-	1.2	-	-	-	-	-	-	-	-
6	Erimayur	7		2.0	0.5	0.3	1.8	-	-	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	9		-	-	-	2.5	-	-	-	-	-	-	-	-	-	0.3	0.6	0.7	-	-	-	0.8
8	Thrithala	6		-	-	-	2.2	-	-	2.2	-	-	-	-	-	-	-	0.9	-	-	-	-	1.0
9	Pattanchery (Mettuppuram)	10		-	-	-	-	-	-	3.5	-	-	2.4	-	-	-	-	-	-	-	-	0.4	1.7
	Pattanchery (Poonthal)	4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Nalleppilly	7		2.1	-	-	-	-	-	-	-	-	1.1	-	0.9	-	-	-	-	-	-	-	0.6
11	Kadampazhi-ppuram	7		-	-	-	2.5	-	-	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

Contd.

APPENDIX- III (a) continued

Sl No	Panchayat			Varieties (21-41)																		
		m_{pi}	p_i *	V21	V22	V23	V25	V26	V27	V28	V29	V30	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40	V41
				1	4	1	1	1	3	1	2	1	1	1	2	2	1	1	1	1	1	1	1
1	Pallasseana	9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	7		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Vaniyamkulam	6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Parali	6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Elappulli	9		-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-
6	Erimayur	7		-	0.9	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	9		-	0.6	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	0.2	-	0.2
8	Thrithala	6		-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-
9	Pattanchery (Mettuppuram)	10		0.4	1.6	0.6	0.5	0.4	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-
	Pattanchery (Poonthal)	4		-	-	-	-	-	0.4	0.2	-	0.2	0.2	-	-	-	-	-	-	-	-	-	-
10	Nalleppilly	7		-	-	-	-	-	0.7	-	-	-	-	0.2	0.3	-	-	-	-	-	-	-	-
11	Kadampazhi-ppuram	7		-	-	-	-	-	-	-	-	-	-	-	0.5	0.7	0.2	0.3	0.3	-	-	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

APPENDIX- III (b)

District-based ranking of *virippu* varieties by the ESS

Sl No	Panchayat			Varieties (1-20)																		
		m_{pi}	p_i *	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
				6	4	2	8	2	2	8	1	1	4	1	3	1	2	3	3	1	1	1	4
1	Pallasseana	9		3.1	1.1	0.7	4.1	0.9	0.8	4.3	0.2	0.4	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	7		1.5	-	-	1.8	-	-	2.8	-	-	1.3	0.1	0.5	0.1	-	-	-	-	-	-	-
3	Vaniyamkulam	6		-	-	-	1.9	-	-	1.8	-	-	-	-	-	-	0.7	0.6	0.6	0.1	-	-	-
4	Parali	6		2.2	0.7	-	2.0	0.7	-	-	-	-	-	-	-	-	-	-	0.5	-	02	-	-
5	Elappulli	9		2.4	1.4	-	-	-	0.6	2.5	-	-	1.2	-	1.0	-	-	-	-	-	-	-	-
6	Erimayur	7		2.3	1.0	0.4	1.3	-	-	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	9		-	-	-	1.5	-	-	-	-	-	-	-	-	-	0.5	0.8	0.7	-	-	-	0.7
8	Thrithala	6		-	-	-	2.6	-	-	2.5	-	-	-	-	-	-	-	1.0	-	-	-	-	0.9
9	Pattanchery (Mettuppuram)	10		-	-	-	-	-	-	3.3	-	-	2.4	-	-	-	-	-	-	-	-	0.4	2.0
	Pattanchery (Poonthal)	4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Nalleppilly	7		1.4	-	-	-	-	-	-	-	-	1.2	-	0.6	-	-	-	-	-	-	-	1.3
11	Kadampazhi-ppuram	7		-	-	-	2.3	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

Contd.

APPENDIX- III (b) continued.

Sl No	Panchayat			Varieties (21-40)																		
		m_{pi}	p_i *	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40
				1	4	1	1	1	3	1	2	1	1	1	2	2	1	1	1	1	1	1	1
1	Pallasseana	9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	7		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Vaniyamkulam	6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Parali	6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Elappulli	9		-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-
6	Erimayur	7		-	0.7	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	9		-	0.7	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	0.2	-	0.2
8	Thrithala	6		-	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-
9	Pattanchery (Mettuppuram)	10		0.2	1.9	0.3	0.6	0.4	-	-	1.3	-	-	-	-	-	-	-	-	-	-	-	-
	Pattanchery (Poonthal)	4		-	-	-	-	-	0.5	0.2	-	0.2	0.1	-	-	-	-	-	-	-	-	-	-
10	Nalleppilly	7		-	-	-	-	-	0.5	-	-	-	-	1.9	0.5	-	-	-	-	-	-	-	-
11	Kadampazhi-ppuram	7		-	-	-	-	-	-	-	-	-	-	-	0.5	0.6	0.3	0.4	0.3	-	-	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

APPENDIX- III (c)

District-based ranking of *mundakan* varieties by the FSS

Sl No	Panchayat			Varieties (1-20)															
		m_{pi}	p_i *	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17
				3	5	2	6	1	1	5	1	1	2	5	3	2	2	2	1	1
1	Pallasseana	9		1.8	1.7	0.8	3.8	0.5	0.5	3.2	0.3	0.4	-	-	-	-	-	-	-	-
2	Pudussery	6		-	-	-	-	-	-	1.1	-	-	0.5	1.2	0.6	0.3	0.4	-	-	-
3	Vaniyamkulam	8		-	-	-	2.3	-	-	-	-	-	-	2.5	-	-	0.7	0.9	0.4	0.4
4	Parali	5		-	1.0	-	1.4	-	-	-	-	-	-	-	0.8	-	-	-	-	-
5	Elappulli	6		1.0	1.0	-	-	-	-	-	-	-	0.6	1.6	0.8	-	-	-	-	-
6	Erimayur	7		1.4	1.5	0.4	1.2	-	-	1.9	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Thrithala	5		-	-	-	1.7	-	-	1.4	-	-	-	-	-	-	-	-	-	-
9	Pattanchery (Poonthal)	2		-	-	-	-	-	-	-	-	-	-	0.9	-	0.2	-	-	-	-
10	Nalleppilly	3		-	0.7	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-
11	Kadampazhippuram	6		-	-	-	1.9	-	-	1.2	-	-	-	-	-	-	-	0.6	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

Contd.

APPENDIX- III (c) continued.

Sl. No	Panchayat			Varieties (18-33)														
				V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32	V33
		m_{pi}	p_i *	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
1	Pallasseana	9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Vaniyamkulam	8		0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-
4	Parali	5		0.4	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Elappulli	6		-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-
6	Erimayur	7		-	-	-	-	-	-	0.4	0.1	-	-	-	-	-	-	-	-
7	Kulukkallur	5		-	-	-	-	-	-	-	-	0.2	0.1	0.1	0.2	0.1	-	-	-
8	Thrithala	5		-	-	-	-	-	-	0.3	-	-	-	-	0.5	-	0.2	-	-
9	Pattanchery (Poonthal)	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Nalleppilly	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
11	Kadampazhippuram	6		-	-	0.4	0.3	0.2	-	-	-	-	-	-	-	-	-	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

APPENDIX- III (d)

District-based ranking of *mundakan* varieties by the ESS

Sl No	Panchayat			Varieties (1-20)															
		m_{pi}	p_i*	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17
				3	5	2	6	1	1	5	1	1	2	5	3	2	2	2	1	1
1	Pallasseana	9		2.0	1.9	0.9	4.0	0.5	0.3	1.8	0.4	0.3	-	-	-	-	-	-	-	-
2	Pudussery	6		-	-	-	-	-	-	1.2	-	-	0.4	1.5	0.6	0.3	0.2	-	-	-
3	Vaniyamkulam	8		-	-	-	2.4	-	-	-	-	-	-	2.1	-	-	0.6	0.9	0.4	0.3
4	Parali	5		-	1.4	-	1.6	-	-	-	-	-	-	-	0.7	-	-	-	-	-
5	Elappulli	6		1.0	1.2	-	-	-	-	-	-	-	0.6	1.6	0.6	-	-	-	-	-
6	Erimayur	7		1.2	0.8	0.4	1.7	-	-	1.6	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Thrithala	5		-	-	-	1.6	-	-	1.3	-	-	-	-	-	-	-	-	-	-
9	Pattanchery (Poonthal)	2		-	-	-	-	-	-	-	-	-	-	0.9	-	0.2	-	-	-	-
10	Nalleppilly	3		-	0.6	-	-	-	-	-	-	-	-	0.9	-	-	-	-	-	-
11	Kadampazhippuram	6		-	-	-	1.8	-	-	1.1	-	-	-	-	-	-	-	0.6	-	-

* The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

Contd.

APPENDIX- III (d) continued.

Sl No	Panchayat			Varieties (18-33)														
		m_{pi}	p_i*	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32	V33
				2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
1	Pallasseana	9		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Vaniyamkulam	8		0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	-
4	Parali	5		0.4	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Elappulli	6		-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
6	Erimayur	7		-	-	-	-	-	-	0.5	0.2	-	-	-	-	-	-	-	-
7	Kulukkallur	5		-	-	-	-	-	-	-	-	0.2	0.2	0.1	0.2	0.1	-	-	-
8	Thrithala	65		-	-	-	-	-	-	0.4	-	-	-	-	0.5	-	0.2	-	-
9	Pattanchery (Poonthal)	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Nalleppilly	3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
11	Kadampazhippuram	6		-	-	0.4	0.4	0.2	-	-	-	-	-	-	-	-	-	-	-

*The number of *padasekharams* where the given variety is present, m_{pi} is the number of varieties in a given *padasekharam*

APPENDIX- IV (a)

District-based varietal attribute ranking by the FSS

Sl No	Panchayat			Attributes (1-17)															
		m	p_i *	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17
				11	11	10	9	6	9	11	11	10	11	9	7	1	10	10	4	8
1	Pallasseana	20		0.5	0.5	0.4	0.4	0.2	0.3	0.4	0.08	0.1	0.2	-	0.1	-	0.2	0.1	0.1	0.2
2	Pudussery	14		0.4	0.2	0.3	-	-	-	0.3	0.1	-	0.08	-	-	-	0.2	0.05	-	0.2
3	Vaniyamkulam	19		0.5	0.5	0.4	0.3	0.2	0.3	0.4	0.1	0.1	0.2	0.2	0.2	0.002	0.2	0.2	0.03	0.04
4	Parali	19		0.5	0.2	0.4	0.4	0.2	0.3	0.3	0.1	0.08	0.1	0.1	0.1	-	0.3	0.1	-	-
5	Elappulli	17		0.5	0.2	0.4	0.3	-	0.3	0.3	0.1	0.02	0.1	0.2	-	-	0.2	0.08	-	0.1
6	Erimayur	15		0.4	0.3	0.3	-	-	-	0.1	0.2	0.1	0.2	0.05	-	-	0.2	0.3	-	0.1
7	Kulukkallur	12		0.3	0.3	-	0.1	-	0.2	0.2	0.08	0.02	0.1	0.1	-	-	-	-	-	0.04
8	Thrithala	18		0.5	0.4	0.4	0.4	0.1	0.3	0.3	0.1	0.05	0.2	0.1	0.1	-	0.2	0.08	0.1	-
9	Pattanchery (Poonthal)	23		0.6	0.5	0.5	0.3	0.08	0.4	0.5	0.02	0.2	0.2	0.3	0.1	-	0.4	0.3	0.1	-
10	Nalleppilly	16		0.4	0.3	0.4	0.3	-	0.3	0.3	0.1	0.02	0.2	0.07	0.07	-	0.2	0.1	-	0.1
11	Kadampazhippuram	20		0.5	0.5	0.2	0.3	0.1	0.2	0.5	0.02	0.05	0.5	0.2	0.07	-	0.4	0.3	-	0.2

* The number of *padasekharams* where the given attribute is considered, 'm.' is the number of attributes in a given *padasekharam*

Contd.

APPENDIX- IV (a) continued.

Sl. No	Panchayat			Attributes (18-34)															
		m	p	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	A32	A33	A34
				5	10	4	3	4	4	2	2	1	1	2	1	1	1	1	2	1
1	Pallasseana	20		0.08	0.2	-	0.008	0.1	0.02	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	14		-	-	-	-	-	-	0.005	0.03	-	-	-	-	-	-	0.02	0.02	0.01
3	Vaniyamkulam	19		0.05	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Parali	19		-	0.3	0.02	-	0.1	-	-	0.04	0.002	-	-	-	-	-	-	-	-
5	Elappulli	17		0.1	0.3	-	0.01	-	-	-	-	-	0.05	-	-	-	-	-	-	-
6	Erimayur	15		0.2	0.08	-	0.03	0.3	-	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	12		-	0.2	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-
8	Thrithala	18		0.06	0.2	-	-	-	-	0.005	-	-	-	-	-	-	-	-	-	-
9	Pattanchery (Poonthal)	23		-	0.5	0.1	-	0.1	0.03	-	-	-	-	0.03	0.005	0.01	0.02	-	-	-
10	Nalleppilly	16		-	0.2	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Kadampazhippuram	20		-	0.2	0.03	-	-	0.07	-	-	-	-	0.02	-	-	-	0.01	-	-

'p' number of *padasekharams* where the given attribute is considered, 'm.' is the number of attributes in a given *padasekharam*

APPENDIX- IV (b)

District-based varietal attribute ranking by the ESS

Sl No	Panchayat			Attributes (1-17)															
		m	p	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17
				11	11	10	9	6	9	11	11	10	11	9	7	1	10	10	4	8
1	Pallasseana	20		0.5	0.3	0.5	0.3	0.2	0.2	0.3	0.02	0.05	0.11	-	0.1	-	0.4	0.4	0.07	0.1
2	Pudussery	14		0.2	0.3	0.3	-	-	-	0.3	0.1	-	0.2	-	-	-	0.05	0.1	-	0.2
3	Vaniyamkulam	19		0.5	0.3	0.5	0.4	0.2	0.3	0.4	0.3	0.3	0.2	0.2	0.2	0.002	0.1	0.1	0.1	0.1
4	Parali	19		0.5	0.4	0.2	0.4	0.2	0.3	0.3	0.2	0.1	0.2	0.1	0.1	-	0.3	0.1		-
5	Elappulli	17		0.5	0.4	0.3	0.3	-	0.3	0.4	0.3	0.05	0.2	0.2	-	-	0.1	0.2		0.1
6	Erimayur	15		0.4	0.3	0.3	-	-	-	0.2	0.2	0.05	0.3	0.05	-	-	0.02	0.1		0.2
7	Kulukkallur	12		0.3	0.3	-	0.1	-	0.02	0.08	0.2	0.1	0.2	0.1	-	-	-	-		0.08
8	Thrithala	18		0.5	0.3	0.4	0.3	0.1	0.2	0.2	0.02	0.05	0.1	0.1	0.1	-	0.4	0.3	0.07	-
9	Pattanchery (Poonthal)	23		0.6	0.6	0.4	0.1	0.04	0.3	0.05	0.1	0.1	0.3	0.3	0.1	-	0.5	0.5	0.1	-
10	Nalleppilly	16		0.4	0.2	0.4	0.2	-	0.2	0.3	0.1	0.08	0.3	0.07	0.07	-	0.2	0.1		0.04
11	Kadampazhippuram	20		0.5	0.4	0.3	0.3	0.3	0.3	0.5	0.05	0.02	0.3	0.2	0.07	-	0.3	0.1		0.1

'p' number of *padasekharams* where the given attribute is considered, 'm.' is the number of attributes in a given *padasekharam*

Contd.

APPENDIX- IV (b) continued.

Sl No	Panchayat			Attributes (18-34)															
				A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	A32	A33	A34
		m	p	5	10	4	3	4	4	2	2	1	1	2	1	1	1	1	2	1
1	Pallasseana	20		0.1	0.4	-	0.04	0.09	0.03	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery	14		-	-	-	-	-	-	0.03	0.04	-	-	-	-	-	-	0.02	0.02	0.01
3	Yaniyamkulam	19		0.1	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Parali	19		-	0.3	0.02	-	0.2	-	-	0.09	0.01	-	-	-	-	-	-	-	-
5	Elappulli	17		0.06	0.2	-	0.03	-	-	-	-	-	0.002	-	-	-	-	-	-	-
6	Erimayur	15		0.05	0.08	-	0.05	0.2	-	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur	12		-	0.05	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
8	Thrithala	18		0.08	0.4	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-	-
9	Pattanchery (Poonthal)	23		-	0.5	0.1	-	0.4	0.2	-	-	-	-	0.03	0.005	0.01	0.02	-	-	-
10	Nalleppilly	16		-	0.3	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Kadampazhippuram	20		-	0.4	0.05	-	-	0.2	-	-	-	-	0.02	-	-	-	0.01	-	-

'P' number of *padasekharams* where the given attribute is considered, 'm.' is the number of attributes in a given *padasekharam*

APPENDIX- V

District-based ranking of constraints to rice seed distribution as perceived by the ESS

Sl No	Panchayat/ Krishibhavan	Constraints (1-14)													
		p	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
			10	9	7	4	4	4	6	2	1	1	4	2	1	2
1	Pallasseana		0.91	0.16	0.38	0.15	-	-	-	-	-	-	-	-	-	0.15
2	Pudussery		0.18	0.33	-	-	-	0.29	0.33	-	-	-	0.36	-	-	-
3	Vaniyamkulam		0.73	0.33	0.38	-	0.36	-	0.11	-	-	-	-	-	-	-
4	Parali		0.18	0.49	0.51	0.15	-	-	-	-	-	-	-	-	-	0.18
5	Elappulli		-	0.14	0.64	-	0.30	0.18	-	-	-	-	0.24	0.06	-	-
6	Erimayur		0.61	-	-	-	-	-	0.45	0.03	-	-	0.36	0.09	0.03	-
7	Kulukkallur		0.73	0.33	0.64	-	-	-	-	-	-	0.02	0.22	-	-	-
8	Thrithala		0.36	0.49	-	0.36	-	-	0.44	-	0.02	-	-	-	-	-
9	Pattanchery		0.18	0.49	-	-	0.15	0.36	0.44	-	-	-	-	-	-	-
10	Nalleppilly		0.73	-	0.64	-	-	0.22	0.22	0.04	-	-	-	-	-	-
11	Kadampazhippuram		0.18	033	0.64	0.29	0.22	-	-	-	-	-	-	-	-	-

'p' number of *Krishibhavans* where the given constraint is felt.

APPENDIX- VI (a)

District-based ranking of farmers' constraints to rice seed production and distribution as perceived by the FSS

Sl No	Panchayat		Constraints (1-14)													
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
		P	10	10	7	10	2	6	1	4	6	5	1	9	3	3
1	Pallasseana		0.81	0.71	-	0.20	0.10	-	-	-	0.24	0.45	0.06	0.09	0.09	-
2	Pudussery		0.85	0.79	0.51	0.30	-	-	-	-	-	0.45	-	0.44	0.11	0.05
3	Vaniyamkulam		0.91	0.81	0.49	0.10	-	0.24	-	-	-	0.30	-	0.27	-	0.06
4	Parali		0.91	0.80	-	0.11	0.14	0.34	0.02	0.18	0.20	-	-	-	-	-
5	Elappulli		0.91	0.74	0.58	0.58	-	0.05	-	-	-	0.33	-	0.22	-	-
6	Erimayur		-	-	0.64	-	-	-	-	-	-	-	-	-	-	-
7	Kulukkallur		0.91	0.81	-	0.30	-	-	-	0.16	0.30	-	-	0.55	-	0.21
8	Thrithala		0.91	0.80	0.48	0.23	-	0.20	-	0.23	0.27	-	-	0.10	-	-
9	Pattanchery		0.91	0.76	-	0.30	-	-	-	-	-	-	-	0.55	-	-
10	Nalleppilly		0.91	0.83	0.52	0.17	-	0.25	-	0.23	0.05	0.33	-	0.45	-	-
11	Kadampazhippuram		0.91	0.81	0.07	0.40	-	0.36	-	-	0.42	-	-	0.27	0.15	-

'p' number of panchayats where the given constraint is felt.

Contd.

APPENDIX- VI (a) continued.

Sl No	Panchayat	Constraints (15-28)													
		p	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28
			2	1	2	2	3	3	3	2	1	1	1	1	1	1
1	Pallasseana		-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery		0.05	0.01	0.01	0.08	0.16	0.18	0.20	-	-	-	-	-	-	-
3	Vaniyamkulam		-	-	-	-	-	-	-	0.10	-	-	-	-	-	-
4	Parali		-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Elappulli		-	-	-	-	0.10	0.12	0.15	0.03	-	-	-	-	-	-
6	Erimayur		-	-	0.03	-	0.18	0.41	0.23	-	-	-	0.03	-	-	-
7	Kulukkallur		0.02	-	-	0.04	-	-	-	-	-	-	-	-	-	-
8	Thrithala		-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Pattanchery		-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.05
10	Nalleppilly		-	-	-	-	-	-	-	-	0.02	0.03	-	-	-	-
11	Kadampazhippuram		-	-	-	-	-	-	-	-	-	-	-	0.02	-	-

'p' number of panchayats where the given constraint is felt.

APPENDIX- VI (b)

District-based ranking of farmers' constraints to rice seed production and distribution as perceived by the ESS

Sl No	Panchayat	Constraints (1-14)													
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
		P	10	10	7	10	2	6	1	4	6	5	1	9	3	3
1	Pallasseana		0.64	0.55		0.40	0.16				0.06	0.45	0.03	0.45	0.06	
2	Pudussery		0.79	0.85	0.30	0.18						0.45		0.33	0.22	0.15
3	Vaniyamkulam		0.91	0.71	0.57	0.20		0.30				0.30		0.27		0.12
4	Parali		0.91	0.80		0.22	0.07	0.40	0.01	0.18	0.34					
5	Elappulli		0.91	0.83	0.52	0.17		0.19				0.04		0.22		
6	Erimayur				0.64											
7	Kulukkallur		0.91	0.81		0.10				0.20	0.36			0.64		0.06
8	Thrithala		0.68	0.80	0.07	0.23		0.20		0.23	0.27			0.20		
9	Pattanchery		0.91	0.15		0.76								0.27		
10	Nalleppilly		0.83	0.91	0.52	0.74		0.05		0.13	0.35	0.30		0.22		
11	Kadampazhippuram		0.91	0.71	0.07	0.40		0.36			0.06			0.45	0.09	

'p' number of panchayats where the given constraint is felt.

Contd.

APPENDIX- VI (b) continued.

Sl No	Panchayat	Constraints (15-28)													
		p	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28
			2	1	2	2	3	3	3	2	1	1	1	1	1	1
1	Pallasseana		-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Pudussery		0.01	0.02	0.02	0.06	0.16	0.18	0.20	-	-	-	-	-	-	-
3	Vaniyamkulam		-	-	-	-	-	-	-	0.18	-	-	-	-	-	-
4	Parali		-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Elappulli		-	-	-	-	0.17	0.14	0.20	0.03	-	-	-	-	-	-
6	Erimayur		-	-	0.03	-	0.14	0.09	0.23	-	-	-	0.06	-	-	-
7	Kulukkallur		0.06	-	-	0.08	-	-	-	-	-	-	-	-	-	-
8	Thrithala		-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Pattanchery		-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.04
10	Nalleppilly		-	-	-	-	-	-	-	-	0.01	0.04	-	-	-	-
11	Kadampazhippuram		-	-	-	-	-	-	-	-	-	-	-	0.02	-	-

'p' number of panchayats where the given constraint is felt.

RICE SEED PRODUCTION AND DISTRIBUTION STRATEGIES IN PALAKKAD DISTRICT

By

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ABSTRACT OF THE THESIS

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ABSTRACT

The present study on Palakkad rice seed system was basically aimed at understanding farmer-preferred varieties and attributes, the constraints to rice seed production and distribution at sub system level, public sector rice seed production status of the district for five consecutive years (1996-'97 to 2000-'01) and streamline a seed system strategy for Palakkad district. PRA/PLA investigations were conducted in ten ADBs (except Mannarkad and Agali) with 330 farmers (FSS), 41 AOs/AAs (ESS), 20 farm officials from the SSFs (SISS) and the rice researchers (RSS) of central zone as the respondents of the study.

The analyses of data elicited through matrix ranking exercises was done using special 'preferential indices' developed namely MRI, VRI, ARI, CRI, MSAI. The results of the study confirmed the existence of a large number of rice varieties/cultivars (54 nos) raised in diverse agro climatic and micro-farming situations. Three unique systems apart from the traditional *virippu* and *mundakan*, namely *Koottumundakan, Karingora* and *Poonthalpadams* were identified. The major crop establishment system for *virippu* and *mundakan* were dry sowing and transplantation respectively. There was a huge gap in the demand and supply of quality rice seed facilitated by the SSFs, RARS, Pattambi, NSC unit, Alathur and RSGP. Together they accounted only for around five per cent of the rice seed requirement of the district. According to the latest estimates (2000-2001), 94.70 per cent of the rice seeds were farmer-produced, 1.51 per cent was contributed by SSFs, 0.66 per cent by RARS, Pattambi, 1.98 per cent by the NSC unit, Alathur and 1.15 per cent by RSGP.

The 34 farmer-preferred rice varietal attributes were classified into eight categories namely, traits related to grain quality, multiple adaptability, pest/disease tolerance, straw quality, traits related to harvest and post harvest operations and traits related to inputs. The constraints to rice seed production and distribution at the various stakeholder systems (FSS, ESS, SISS and RSS) were classified into eight

categories namely input constraints, socio-economic constraints, infrastructural constraints, technological constraints extension and policy constraints, biological constraints, information constraints and psychological constraints. The constraints to the evolution and spread of rice varieties perceived by the RSS of the district were categorized into research, production and extension and policy constraints. Comparison of the FSS and the ESS of Palakkad district on the ranking of rice varieties, varietal traits and prioritization of farmers' constraints to rice seed production and distribution revealed that there was significant disagreement between the two sub systems, on the ranking of both *virippu* and *mundakan* varieties, while their perception on preferred varietal traits and farmers' constraints were more or less similar.

Results of the study indicate the need for decentralized participatory rice varietal selection coupled with community level seed production, to tackle the inadequacies and problems of Palakkad rice seed system. Hence, a decentralized participatory rice varietal selection and seed production model was prepared for Palakkad district.