IMPACT OF THE RICE VARIETY, UMA (Mo16) ON FARMERS

By

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(2013-11-168)

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KERALA, INDIA

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DEPARTMENT OF AGRICULTURAL EXTENSION
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2015

DECLARATION

I, hereby declare that the thesis entitled **"Impact of the rice variety, Uma (Mo16) on farmers"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me any degree, diploma, associate ship, fellowship or other similar title, of any other University or Society.

Vellanikkara
07/10/2015

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CERTIFICATE

Certified that this thesis entitled **"Impact of the rice variety, Uma (Mo16) on farmers"** is a record of research work done independently by **Mrs. Neshva C.P. (2013-11-168)** 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 her.

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CERTIFICATE

We, the undersigned members of the advisory committee of **Mrs. Neshva C.P. (2013-11-168)**, a candidate for the degree of **Master of Science in Agriculture** with major field in **Agricultural Extension**, agree that the thesis entitled **"Impact of the rice variety, Uma (Mo16) on farmers"** may be submitted by **Mrs. Neshva C.P.** in partial fulfilment of the requirement for the degree.

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EXTERNAL EXAMINER

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Neshva C.P.

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INTRODUCTION

1. INTRODUCTION

Rice is one of the most important food crops of India and second in the world. It feeds more than 50 per cent of the world population. It is the staple food of most of the people of South-East Asia. Asia accounts for about 90 per cent and 91 per cent of world's rice area and production respectively. Among the rice growing countries, India is having the largest area under rice in the world and in case of production it is next to China. However, productivity of India is much lower than that of Egypt, Japan, China, Vietnam, USA and Indonesia and also the average productivity of the world. **(**Directorate of Rice Development, 2009)

Rice occupies about 23.3 per cent of the gross cropped area in India. It plays a vital role in the national food grain supply by contributing 43 per cent of the total food grain production and 46 per cent of the total cereal production of the country. Rice is grown in all the states and Union Territories in India. The state of West Bengal ranks first in area and production of rice. Punjab has the highest productivity in the country. The major rice growing States are West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Tamil Nadu, Orissa, Bihar and Chhattisgarh. These States contribute about 72 per cent of the total area and 76 per cent of the total rice production in the country. The other 25 States and Union Territories contribute the rest 28 per cent of the area and 24 per cent of the total rice in the country. There is a wide variation in the productivity at State level. **(**Directorate of Rice Development, 2006)

Traditionally, the cultivation of rice has occupied pride of place in the agrarian economy of Kerala State. The lush green of paddy fields is one of the most captivating features of Kerala's landscape. Kerala is a deficient state in rice production. The deficit in rice production is increasing year after year due to

reduction in rice area arising out of the large scale conversion of paddy lands for raising other crops or for residential purposes. The sharp fall in the area under paddy cultivation as well as in the quantity of rice produced in the state has important implications for Kerala's economic, ecological and social development. The area under rice cultivation shows a decreasing trend especially from 1994-1995. The area under rice cultivation which was in its peak during mid seventies, dwindled to 4.71 lakh ha by 1995-96 and 2.87 lakh ha by 2003-04. The total rice production of 12.8 lakh tonnes in 1980-81 came down to 10.86 lakh tonnes in 1990-91 and 5.70 lakh tonnes by 2003-04. During this period, the share of rice in the total cropped area also showed a steep decline ie, from 33.2 per cent in 1960-61 to 12.01 per cent in 2003-04. The situation slightly changed after 2006-07, mainly due to concerted efforts of the Government (Kumari, 2011). At present, rice is grown in a gross area of 1.97 lakh ha producing 5.08 lakh tonnes with a productivity of 2577 kg. (Government of Kerala, 2014)

Even though the food habits of the people of Kerala had remarkably changed over the last few decades, rice still continues to be their staple food. It is the most important cereal and staple food produced and consumed in Kerala. It is grown in a vast array of ecological niches, ranging from regions situated three meters below MSL level as in Kuttanad to an altitude of 1400 m as in the high ranges. It is cultivated under three meters depth of water, as well as in purely rainfed uplands with no standing water. Probably nowhere else in the world, rice crop is cultivated under such a diversity of conditions (Kumari, 2011). Rice accounts for nearly 18 per cent of the total amount of food grains produced within the state (Government of Kerala, 2014).The estimated requirement of rice for the state is 35-40 lakh tonnes/year; it produces less than one-fifth of its requirement (Kumari, 2011).

Palakkad and Alappuzha are the two major rice producing districts of Kerala. Kuttanad in Alappuzha district, known as the rice bowl of Kerala is perhaps the only region in the world where farming is done one to three meters below sea level. The Kuttanad Wetland System comprising of 32 grama panchayats of Alappuzha district, 27 grama panchayats of Kottayam district and five grama panchayats of Pathanamthitta district is a predominantly agriculture belt of Kerala where people are dependent on farming and allied sectors like fishing, animal husbandry etc. for their livelihood. This region is endowed with a large system of backwaters. It enjoys a significant status in the production of rice. The total area of Kuttanad region is around 1,10,000 ha comprising 28 per cent dry land, 60 per cent wetland and 12 per cent other water bodies such as lakes, rivers, channels etc. (Kurup and Ranjeet, 2002) Wetlands in Kuttanad are mainly used for rice cultivation with a total extent of 40,000 ha. The agricultural practices and cropping methods used in Kuttanad are quite unique when compared to those in the rest of Kerala and India.

About 600 varieties of rice were grown in the sprawling paddy fields of Kerala. The most popular rice variety of the Kerala state is Uma (Mo16) developed by Rice Research Station, Moncompu, released in 1998 followed by Jyothi (1974), developed from Regional Agricultural Research Station, Pattambi. Uma occupies more than 60 per cent of the rice area in Kuttanad. (Kumari, 2011). Being the ruling variety, the impact made by this variety on farmers is highly worthwhile to analyse. Hence the present study was undertaken with the following objectives:

Objectives of the study:

1) To analyse the attributes of the rice variety, Uma (Mo16) vis-a-vis other rice varieties as perceived by farmers
2) To assess the socio economic impact of Uma on rice cultivating farmers

Scope of the study

Uma, being the ruling variety of rice, cultivated in Kerala, an analysis of the attributes of this variety in the farmers perspective, as well as the impact created by this variety on farmers would be highly useful to know the present status, constraints, inadequacies, requirements and gaps, and in turn would help to work out a viable strategy for remunerative rice production. The study would also give necessary feed back to the rice researchers. Further, the Kerala Agricultural University would be benefitted by this study in the sense that this research would bring out the social and economic impact of one of its major varieties. In these perspectives, the study has immense scope and utility.

Limitations of the study

The study was conducted as part of Masters Research and was restricted to Kuttanad tract of Alappuzha district of Kerala state, which makes it difficult to generalise the findings of the study for the entire state. Being a Post graduate research, the researcher had limitations of time, money and other resources. Further the study was based on perceived opinion of the respondents and heavily depended on their memory. However, all efforts were made to conduct the study as objective and systematic as possible.

Organisation of thesis

The thesis is organised in five chapters. The first chapter is an introductory section, highlighting the objectives, scope and limitations of the study. The second chapter provides the review of literature in line to the objectives of the study. The third chapter is the methodology that was followed in carrying out the research. The fourth chapter deals with the results and discussions of the study. The fifth chapter includes summary and conclusions of the study. References, appendices and abstract are attached at the end.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

A review of previous research studies helps in delineating new problem areas and research priorities and provides basis for developing a theoretical frame work and methodology for research. The review of literature relevant to the present study is presented in the following sub headings:

2.1 Status of rice cultivation in Kerala

2.2 Rice cultivation in Kuttanad

2.3 Farmers' perception on the attributes of rice varieties

2.4 Impact assessment: concept and methodologies

2.5 Social impact of rice varieties on farmers

2.6 Economic impact of rice varieties on farmers

2.7 Constraints of farmers in rice production

2.1 Status of rice cultivation in Kerala

Rice forms the staple food of the people of Kerala and contributes a major share towards its economy. In Kerala, Palakkad district, Kuttanad region in Alappuzha district, and the coastal areas of Thrissur district are the main rice producing regions.

Radhakrishnan (1983) reported that the relative as well as absolute profitability in paddy cultivation has declined considerably after 1974-75 and this seems to be only one of the reasons for the recent decline in paddy area and production. The low profitability in paddy cultivation appears to have a depressing effect on paddy land prices and this may also contributed to the shifting of land away from cultivation.

In terms of prospects for increased paddy production in Kerala, it is unlikely that the area under paddy can be increased. While, maintaining the parity between paddy prices and wage rates might prevent farmers from keeping land fallow, price incentives are unlikely to induce a shift in the cropping pattern in favour of paddy.(George and Mukherjee,1986)

Santha(1993) stated that cultivation during the *Mundakan* season was the most profitable in terms of total returns and net income. The *Viruppu* crop performed best in terms of benefit cost ratio and cost of production. Hired labour was the most important input in all seasons.

Kumar (2005) reported that rice area dropped by 60 per cent between 1975 and 2003, while the cultivation of coconut, rubber, arecanut and banana+plantains increased spectacularly (106, 627, 41 and 96 per cent respectively) between 1955 and 2000.

In Kerala, area and production of rice had decreased significantly but productivity had increased (28%) from 1654 kg/ha during 6^{th}plan to 2112 kg /ha during 9^{th}plan period.(Directorate of Rice Development, 2006)

Directorate of Rice Development (2009) recorded that in Kerala, productivity of 11 districts out of 14 districts were higher than the national average productivity and 3 districts were having productivity below national average productivity. Productivity of one district out of 14 districts came under high productivity group (yield more than 2500 kg/ha), 10 districts under medium productivity group (yield in the range of 2000 to 2500 kg/ha), 2 districts under medium low productivity group (yield in the range of 1500 to 2000kg/ha) and one district under low productivity group (yield in the range of 1000- 1500 kg/ha). Alappuzha and Kozhikode were having the highest productivity of 2569 kg/ha and the lowest productivity of 1422 kg/ha, respectively.

Rice production in the State had declined from 7.3 lakh tonnes in 1998-1999 to 5.90 lakh tonnes in 2008-09, that is, only around 15 per cent of the requirement was produced in the State and more than 80 per cent was imported rice. (Government of Kerala, 2010)

Historical rice productivity trends in three countries of South Asia (India, Bangladesh, and Nepal) showed that growth in yield had been sluggish and unstable in rainfed areas due to the regular occurrence of abiotic and biotic stresses. Therefore, improving the productivity of rice through stress-tolerant technologies was a key entry point to enhance the income and livelihood of resource-poor farmers in these stress-prone environments. (Pandey*et al*.,2010)

InKerala context, rice was having stiff competition from substitutable crops such ascoconut and banana and a variety of mixed crops.(Kannan,2011)

The most popular rice variety of Kerala is Uma (Mo16) developed by Rice Research Station,Moncompu followed by Jyothi, developed from Regional Agricultural Research Station, Pattambi. Theother varieties popular in the State in the order of their preference wereAiswarya, Kanchana, Aathira,MattaTriveni, Harsha, Vaisagh, Bhadra, Krishnanjana, Makom and Gouri(Kumari,2011)

After a long period of continous decline, area under rice increased from 2.29 lakh ha in 2007-08 to 2.34 lakh ha in 2008-09 but it sharply declined by 20828 ha in 2010-11 period over to the previous year. During 2011-12, the area under rice declined by 5027 ha, but the production increased by 0.5 lakh MT. The upland rice development was implemented in 6539.06 ha and fallow land cultivation in another 731.7 ha. In 2012-13,there was a 5.2 per cent decline in area under rice while the production declined by 10.6 per cent in Kerala. (Government of Kerala,2014)

The reduction in the paddy production lead to loss of diversity of rice variety in food system and shortage in supply of rice to the market in required quantity and it would cause price hike and related socio economic problems in Kerala. (Scaria*et al.*,2014)

Kerala had about 300,000 rice growers, mostly small and marginal farmers with their average land holding below 0.4ha- one fifth of the national average. Since 1970s, the state had witnessed a steady decline in the area under paddy. In the last four decades, rice fields have reduced by 76 per cent from 875,000 ha in 1970 to 208,000 ha in 2012.(Suchitra,2014)

From the above reviews, it can be concluded that the low profitability in paddy cultivation appears to have contributed to the shifting of paddy land to other crops. The future of the rice production in Kerala lies in improving productivity with reasonable cost of production through promotion of high yielding varieties and scientific management of cultivation to make rice production a remunerative enterprise for the farmers.

2.2 Rice cultivation in Kuttanad

Kuttanadpopularly known as the rice bowl of Kerala is endowed with a large system of backwater.Overthe years,Kuttanad has remainedas the major rice bowl of the stateand livelihood of thousands offarmers. Farmers of Kuttanad havedeveloped and mastered themarvelous system of below sealevel cultivation on lands thatwere 2.5-3 meters below the sealevel.The agricultural practices and cropping methods used in Kuttanad are quite unique when compared to those in the rest of India.

Joseph(1982) revealed that operation wise, gap filling and weed control formed the largest expenses for rice cultivation in Kuttanad followed by fertilizer and its application. Input wise, human labour use per hectare was the most important input cost amounting about 45 per cent of the total cost.

The constraints identified for paddy cultivation in Kuttanad region were non availability of required number of labours during peak crop season,declining profitability of the crop,militant trade unionism, slow pace mechanisation, lack of easy credit, lack of proper marketing facilities, recurring crop failures and uneconomic size of holdings.(Thomas, 2002)

Prominent constraints identified by Job (2006) in the Kuttanad region were floods, untimely sowing, absence of suitable varieties, lack of good quality seeds, scarcity of labour, and high cost of inputs. There was an ample scope for increasing rice production by bridging the yield gap through addressing the production constraints.

Kumari (2011) reported that in Kuttanad, gall midge attack appeared sporadically during the eighties and a severe incidenceoccurred in 1990 and later in 1996, damaging the rice crop in about 30,000 ha and bringing about a loss of eight crore rupees. The strain of gall midge was identified as GM Biotype 5. Research efforts wereinitiated at Rice Research Station, Moncompu of Kerala Agricultural Universityin the eighties itself which resulted in the development ofthree gall midge resistant varieties and the timely release of these varieties viz, Uma, Pavithra andPanchami in 1998 and could combat the problem of Gall midge to a great extent in Kuttanad.

'Gouri' is a rice variety, which is moderately resistant to sheath blight which was released from RiceResearch Station, Moncompu, followed by Prathyasa, a short duration rice variety for the double croppedwet lands of Kuttanad during 2009.(Kumari,2011)

Rice cultivation in Kuttanad is unique when compared to other regions in Kerala. Pest and disease attack is more when compared to other regions.So, specific rice varieties are required in this region for increased rice production.

2.3 Farmers' perception on the attributes of rice varieties

Attributes of rice varieties perceived by the farmers are in varying degrees depending uponthe types of production environment and the considerations for attributes.

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

Elsy*et al.* (1994) reported that the varietal attributes like the quality of grain, low requirement of purchased inputs, reasonable yield of grain even under stress situations had a significant say on the varietal selection of the rice farmer.

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. (Sthapit*et al.*, 1996)

Witcombe and Joshi (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 characters measured in plant breeder's trials before varieties were ultimately selected.

Ahamed*et al*. (1997) reported 50 desirable varietal attributes to rice cultivars as perceived by the rice farmers and categorized and prioritized them into nine groups such as 'Grain yield related attributes', 'Grain quality related attributes', 'Traits related to inputs and cultivation costs', 'Multiple adaptability related attributes',

‘Straw yield’, ‘Pest and disease tolerance’, ‘Traits related to harvest and post harvest operations’, ‘Straw quality’, ‘Marketability’ and ‘price’.

Prema*et al*. (2000) summarised the traits preferred by the Kerala rice farmers as fast growing habit, ability to withstand water stress in nursery, good tillering, tolerance to pests and diseases in nursery and main field, optimum duration for first crop, uniform flowering habit, strong and long ear head, less chaff content, non-lodging habit, bold grains, high grain weight, low shedding of grain in the field, absence of germination on ear head and on staking, easy to thresh, good quality straw, marketability, good taste, high volume expansion and quick cooking quality

Farmers can view some attributes of rice varieties as positive and others as negative. The choice of one variety over others is greatly influenced by the balance between these two attributes. Depending on the preferences, resources,and constraints that individual farmers face, a beneficial attribute for one farmer may be a negative one for the other, or the balance between positive and negative traits may be acceptable for one farmer but not for another (Bellon, 2001)

Kent and Mokuwa (2001) reported that the characteristics of farmer preferred rice varieties were high tillering ability and large panicle formation, adaptability to various soil conditions, high yield, tolerance/resistance to iron toxicity, quick maturity, palatability, high swelling during cooking, red attractive grain colour and good storage after cooking.

George (2002) reported that out of the twenty attributes perceived as significant by the farmers, ‘good yield’ was given the maximum priority by both the extension subsystem and the farmer subsystem. ’Market preference and demand’, ’high milling percentage’ and ‘low grain shattering’ were given the next priorities by the extension support system. Whereas, attributes like ‘more productive tillers’,

’market preference and demand’ and ‘pest/disease tolerance’ were perceived to be important by the farmer subsystem

Farmer’s perceptions of the varietal characteristics such as pest resistance, drought tolerance and suitability for making special products were important in determining technology choices in the areas of Nepal where current adoption rates were quite high.(Joshi and Pandey,2005)

Joshi and Bauer (2006) stated that easy threshability, usage of grains for preparing special products, early maturity of the variety, less irrigation requirement were the attributes of rice varieties preferred by the rice growing farmers in the rain fed ecosystem of Nepal.

Helen and Shanmugasundaram (2008) reported thateven after the introduction of more than hundred high yielding varieties of rice in Kerala, farmers still preferred some of the traditional rice varieties for their superiorqualitative characters like good taste, higher straw yield and tolerance during stress situations.

Majority of the farmers neededhigh yielding, good aroma, marketability, grain heaviness, and disease and drought resistance as prime traits in rice variety selection in Nzega and Igunga districts in Tabora region, Tanzania.(Bucheyeki*et al*., 2011)

Lodin (2012) reported that NERICA-4 was a new rice variety introduced in Uganda, which was appreciated by farmers for its hardiness, high yields and shorter maturation time (90-100 days vs. 120-140 days) compared with the traditional rice varieties.

A few rice varieties had been extensively used by farmers for over a decade in South Asia, covering from 1 million to over 6 million ha. This was mainly because of the superior performance of these varieties, their adaptation to local conditions and

their good grain quality characteristics that meet the needs of farmers, consumers and millers (Mackill*et al.*,2012)

Addison*et al.* (2014) studied about rice varietal characteristics preferences in the low land rice ecosystem of Ghana. The varietal preferences of males were marketability, good taste, cooking quality, medium plant height and good aroma, whilst good taste, early maturity, high yield, hightillering ability and marketability loom very large in females' choice of rice varieties.

The above reviews showed that majority of the rice cultivating farmers preferred high yield as the important attribute required for a rice variety, followed by good cooking quality and tolerance to pest and disease attack.

2.4 Impact assessment: concept and methodologies

Impact assessment can be defined as a set of logical steps which structure the preparation of policy proposals.

Impact concerns long-termand sustainable changesintroduced by a given intervention inthe lives of beneficiaries. Impact can be related either to the specific objectives of anintervention or to unanticipated changes caused by an intervention; such unanticipatedchanges may also occur in the lives of people not belonging to the beneficiary group. Impactcan be either positive or negative, the latter being equally important to be aware of.(Blankenberg, 1995)

Participatory Impact Assessment (PIA) is an extension of Participatory Rural Appraisal (PRA) and involves the adaptation of participatory tools combined with more conventional statistical approaches specifically to measure the impact of humanitarian assistance and development projects on people's lives. The approach consists of a flexible methodology that can be adapted to local conditions. The

approach acknowledges local people, or project clients as experts by emphasizing the involvement of project participants and community members in assessing project impact and by recognizing that ‘local people are capable of identifying and measuring their own indicators of change’ (Catley, 1999)

One definition that captures the concept of impact assessment effectively is: “The systematic analysis of lasting or significant change –positive or negative, intended or not – in people’s lives brought about by an action or a series of actions. (Roche, 1999)

In the livelihood approach of impact assessment, central focus is on people’s lives rather than on resources or defined project outputs. Project impact assessment must be based upon a prior understanding of people’s objectives as well as on an informed view of how their livelihoods are constructed and which factors are the essential causes and manifestations of their poverty (Ashley and Hussein, 2000)

The participation of different stakeholders in an assessment is important in terms of ownership and sustainability of the process and the use of the findings. And also evaluation and impact assessment processes are very much linked to the ongoing development process. (Adams, 2001)

Impacts were described in qualitative, quantitative, and in monetary terms when reliableestimates are possible. Expressing all impacts in monetary terms more it easier tocompare different impacts, because everything was then expressed in the same units.However, not all impacts can be quantified in monetary terms, and the main effort should go into describing and quantifying impacts in their own terms.(Tamborra, 2002)

2.5 Social impact of rice varieties on farmers

To assess the impact created by a particular rice variety, it is very much relevant to assess the social impact created by that variety among the farmers. Social impacts created by different rice varieties are reviewed here.

Social impacts include all social and cultural consequences to human populationsofany public or private actions that alter the ways in which peoplelive, work, play, relate to one another, organize to meet their needs, andgenerally cope as members of society(Burdge andVanclay, 1991)

Beneficiary Assessment (BA) is a method of social impact assessment and it is a systematic investigation of the perceptions of a sample of beneficiariesand other stakeholders to ensure that their concerns are heard and incorporated into project and policyformulation. The purposes are to (a) undertake systematic listening, which "gives voice" to poor andother hard-to-reach beneficiaries, highlighting constraints to beneficiary participation and (b) obtainfeedback on interventions (Jacob, 2000)

Social Impact Assessment included the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change process invoked by those interventions. Its primary purpose was to bring about a more sustainable and equitable biophysical and human environment. (Vanclay,2003)

The introduction of improved upland rice varieties had vastly expanded rice production in Uganda. For many women farmers, the change was not only bringing a valuable new crop, but also gained decision making power in their household’s vis-à-vis their husbands. It also improved the financial and food security for small holder farmers. (Lodin, 2012)

Yadavendra and Witcombe (2013) observed that the introduction of Ashoka 200F and Ashoka 228 in eastern India created social benefits related to improved style of living and house hold food self sufficiency.

From the above reviews it can be understood that the social impact made by a rice variety is the changes brought about by a rice variety in a particularsociety.Social impact can be negative or positive.

2.6.Economic impact of rice varieties on farmers

Economic impact is an important parameter for assessing the overall impact made by a rice variety.

An economic impact analysis (EIA) examines the effect of an event on the economy in a specified area, ranging from a single neighborhood to the entire globe.

Modern rice varieties had created large disparities in regional income distribution, as the productivity gap between favourable and unfavourable rice production environments widened due to differential technology adoption throughout South and South East Asia. (Otsuka*et al.*, 1990)

Santha (1993) found that hired labour was the most important input invariably used for all the seasonsin spite of the variation in the cost of cultivation for different seasons. The average net income was lowest in *puncha* season (Rs.1,095.19 per hectare). The return per rupee invested was also lowest for *puncha*.

Although there were no differences between progressive and less progressive farmers in terms of family size, farm size, and non-agricultural income, income earned from rice cultivation was considerably higher for progressive farmers, and they also invested more in land purchases. Visible investments in cattle and improvements in housing facilities had resulted in increased adoption of modern rice varieties amongst less progressive farmers. (Sarker*et al.*, 1997)

Shrestha (2002) found that farmers' netincome increased by 23 per cent with the adoption of LMVs (Lao modern rice varieties) representing an increase of $75 per ha .With the adoption of OMVs (other modern varieties) farmers' income increased by only $19 per ha.

The lower price of hybrids contributed to a minimal positive impact of hybrid rice on farm household's income fromrice. (Vienand and Nga, 2010)

Nquezet*et al.* (2011) reported that NERICA varieties helped to raise household per capita expenditure and income by averages of 49.1 per cent and 46.0 per cent, respectively, thereby reducing the probability of adoptive households falling below the poverty line.

Srinivasan (2012) analysed the state of rice cultivation in the Kole land (a wetland area in Kerala) in terms of input use, yield and profitability.The returns to scale indicated that Kole rice production was operating under diminishing returns to scale. For a large number of farmers, cultivation of rice as a single crop is not economically viable.

Yadavendra and Witcombe (2013) noticed that the introduction of Ashoka 200F and Ashoka 228 in eastern India showed that the income earned reduced the need to borrow money.

Wiredu*et al.*(2014) in their study on impact of NERICA adoption on incomes of rice-producing households in northern Ghana identified that agriculture and rice production were the most important livelihood activities as they contributed 80 per cent and 55.09 per cent of total household income respectively. NERICA adoption significantly increased rice income, agricultural income, per-capita income and total annual income by $196.52, $446.37, $0.44, and $498.44 respectively.

From the above reviews, it can be derived that the economic impact can be positive or negative, depending on the attributes and climatic adaptability of the particular variety.

2.7 Constraints of farmers in rice production

A number of constraints had been faced by the rice cultivating farmers in all over India. Each constraint is different from one production environment to another. Different constraints faced by the rice cultivating farmers are reviewed here.

Joseph (1982) reported that a series of problem crop up from time to time, such as occasional floods and tides, intrusion of salt water and salinity and lack of communication facilities in Kuttanad rice producing area.

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 summarised by Prakash (1989)which were drought in *mundakan*, lack of sufficient irrigation facilities, lack of good quality seeds, low coverage of high yielding varieties, lack of varieties suited for different agro climatic regions, high cost of seeds,non availability of labour in peak season, lack of efficient input supply system, lack of adequate transport facilities, lack of co-ordination at government level among different departments.

Research findings of Prakash and Nair (1993) revealed that the rice production constraints faced by the rice farmers in the problem zone of Kerala as 1) Drought 2) Low adoption of High yielding varieties 3) Non-availability of high yielding variety seeds 4) High cost of high yielding variety seeds 5) Non-availability of Farm Yard Manure 6) High cost of Farm Yard Manure 7) High wage rate of agricultural labour 8) Non-availability of agricultural labour 9)Low labour productivity 10) Lack of storage facilities 11) Lack of marketing facilities.

Mohandas (1994) identified that nonavailability of labour during the peak agricultural season and their increased costs were the most important constraints in rice cultivation. Weed infestation was the second important constraint as explained by 75 per cent of the farmers in Kuttanad and 80 per cent of the farmers in *kole* area. Incidence of pests and diseases and higher prices of inputs were the third and fourth important constraints in both areas.

Reddy *et al*. (2001) reported that rice cultivation in Kerala was declining due to non-remunerative returns owing to high cost of labour combined with poor productivity. The analysis of problem-cause relationship through farmer participatory approach revealed that low profitability was mainly due to the reasons of unavailability of quality seed, imbalanced use of fertilizers, improper plant protection measures, weed menace and high labour cost.

Thanh and Singh (2006) found that poor infrastructure, high cost of inputs, credit problems, low price for rice, inadequate inputs, and lack of training were perceived as the most important socio economic constraints faced by the Vietnamese and Indian farmers in rice production and export.

The reasons for giving up the cultivation of rice by majority of the farmers of Kerala causing a fearful reduction in area were attributed to increased cost of production, high input cost, non-availability of skilled labourers, frequentcrop loss due to natural calamities, soil ill heath and degradation, low productivity, poor marketability and unpredicted price fluctuations for the produce.(Nair, 2007)

Reddy (2008) noticed that biophysical factors like intermittent soil moisture stress, poor soils, heavy infestation of weeds, insects, diseases, birds and rodents, saline, alkali and acid soils in the coastal districts with poor drainage, low organic matter, wide spread Zn deficiency were limiting the productivity of rice in India.

Singhand Varshney(2010) reported that non availability of high yielding varieties, high cost of labour, lack of conviction in the new technology and weak extension activities at the village level were the major constraints faced by the farmers in Jabalpur district of Madhya Pradesh.

Bucheyeki*et al*. (2011) identified that major rice production constraints were lack of improved varieties, diseases susceptibility, seeds unavailability, drought and high input prices in Nzega and Igunga districts in Tabora region, Tanzania.

Qiu*et al*. (2013) found that lack of high yielding varieties suitable for simplified rice cultivation, restriction of labour transfer, frequent occurrence of natural disasters and a low level of mechanization were the factors constraining the development of rice production in Jiangsu Province in China.

Ravikumar and Sudheesh (2013) revealed that70 per cent of the farmers had the problem of shortage of labour in Palakkad district of Kerala. This alone was the prime problem, and sometimes the farmers put their land as fallow due to this problem. The next important problem in the study region was lackof water storage (10%).All other problems viz. higher wage rate, natural calamities, low price for paddy, and water availability were the minor ones among the paddy cultivators.

Scaria*et al*. (2014) reported that heavy infestation of insect pests, problem of high weed occurrence and high labour cost were the major constraints in paddy production as perceived by the farmers.

The prime reason for the high production cost in Kerala was steep rise in farm wages. Wages had increased much faster in Kerala than in any other state. (Suchithra, 2014)

Mukesh (2015) had reported that causes for the decline of paddy cultivation in Kerala included seasonal shortage of labour supply, small size of holdings and decline in the number of full time farmers, lack of proper marketing system, low level of profitability, growing aversion of new generation to paddy cultivation, pressure of population on land and low level of profitability.

It can be summarised that scarcity of labour,high labour cost,high cost of inputs, lack of good quality seeds, pest and disease incidence,weed menace, low price for paddy,lack of proper marketing system and low level of profitability were the major constraints faced by the farmers in rice production.

RESEARCH METHODOLOGY

3. RESEARCH METHODOLOGY

A suitable design of the study is an important component of any systematic research. Research methodology is the description, explanation and justification of various methods of conducting research.

This chapter deals with the brief description of methods and procedures employed for meeting the objectives set forth in this study, and is presented under the following subheads:

3.1 Research design

3.2 Locale of the study

3.3 Brief description about the study area

3.4 Sampling procedure

3.5Operationalisation and measurement of variables

3.6Tools used for data collection

3.7Statistical tools used for the study

3.1 Research design

The study is *ex-post-facto* in its nature as there is no scope to manipulate the research design for the independent variables. *Ex-post-facto* research design is a systematic inquiry in which the researcher does not have a direct control over the independent variables because their manifestations have already occurred or because they are inherently not manipulatable.(Kerlinger,1973)

3.2 Locale of the study

The study was confined to Kuttanad tract of Alappuzha district of Kerala state. It is one of the major rice producing area in the state.

3.3 Brief description about the study area

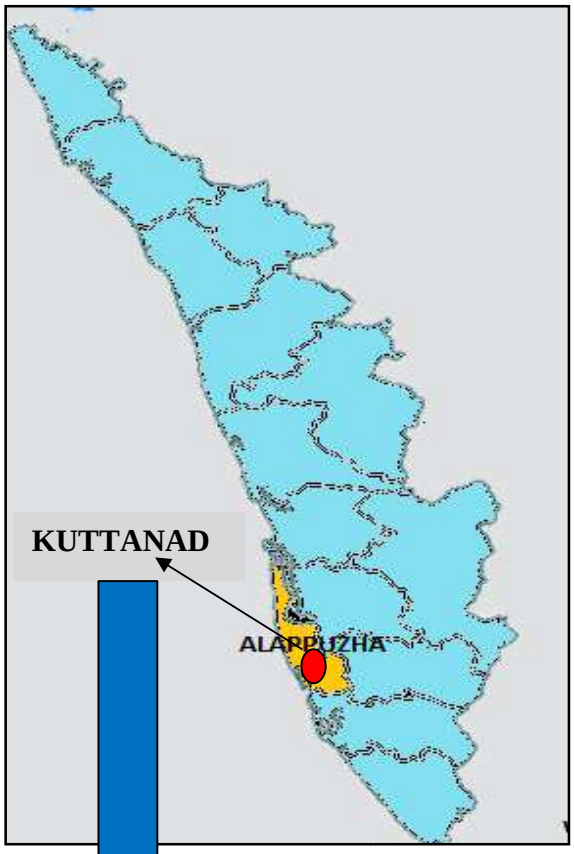
Kuttanad meaning 'low lying lands' is one of the most fertile regions of the world spread over Alappuzha, Kottayam and Pathanamthitta districts of Kerala, which is crisscrossed by rivers, canals and waterways. Four major rivers namely Achenkoil, Pampa, Manimala and Meenachil originating from the high ranges discharge their water into the Arabian Sea through the Kuttanad region. The Kuttanad Wetland System comprising of 32 grama panchayats of Alappuzha district, 27 grama panchayats of Kottayam district and five grama panchayats of Pathanamthitta district is a predominantly agriculture belt of Kerala where people are dependent on farming and allied sectors like fishing and animal husbandry for their livelihood. This is the only part of the world where rice is cultivated below sea level.

Food and Agriculture Organization of the United Nations recognized 'Kuttanad Below Sea Level Farming' as a Globally Important Agricultural Heritage System (GIAHS). It is the second farming system after the Traditional Agricultural System of Koraput in Odisha to be accorded heritage status by the FAO in India. Below Sea level Farming System is distinctive; as it is one of the two systems in the world,where farming is practiced below sea level. The other place is in the Netherlands.

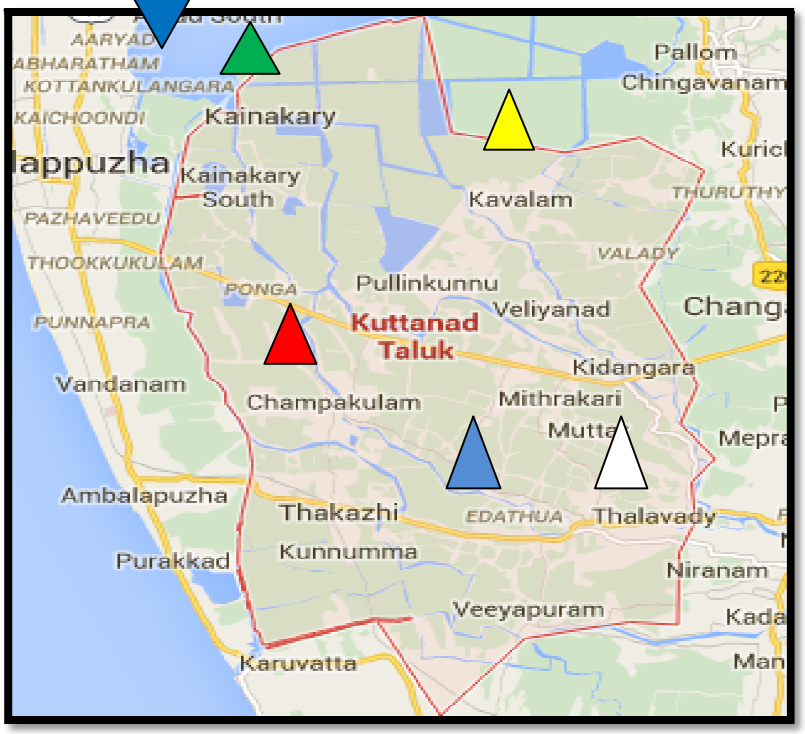
3.3.1. Climate

Kuttanad region experiences fairly uniform temperature throughout the year ranging between 21^{o}C to the maximum of 36^{o}C.The average annual rainfall varies between 2800mm in the north and south west to 3200mm in the middle of eastern periphery. The relative humidity ranges from 80 to 95 per cent which is very high

Fig 1: Map of the study area



Map of Kerala showing the study area



Map of the Kuttanad tract of Alappuzha, showing selected Gramapanchayats

-Kainakary

-Kaavalam

-Champakkulam

-Edathua

-Thalavady

when compared to other regions. This higher humidity is attributed to the sudden outbreak of many pests and diseases.

3.3.2.Soil

The soils of Kuttanad form the typical waterlogged soils and are entirely different fromnormal well-drained soils intheir morphological, chemicaland physical characteristics.Depending on the type of soilthe entire wetland area of theregion can be classified into Kayal lands, Karappadams and Kari lands. According to waterlevel, there are garden lands, which are 0.5 to 2.5 m above mean sea level, kayal lands-0.60m to 2.00m below MSL andwater areas consisting of riversand lakes.

1)Kayal soils:

They are of typical fine loamy soils,poorly drained, slightly acidic, having moderate amounts of organic matter and are poor in available nutrients, but are fairly rich in calcium. They cover nearly 13000ha in Kainakary, Pulinkunnu, Neelamperoor, Kaavalam, Thiruvarppu, Kumarakam and Nattakam panchayats.

2)Karappadam soils:

These are typically clayey, highly acidic, high in salt content and moderate amounts of decaying organic matter. They are generally poor in available nutrients, particularly phosphorous and highly deficient in calcium. They cover an area of 33000 ha.

3)Kari soils:

Kari soils are typically clayey and poorly drained.Decomposed organic matter is often observed in the lower layers. These soils are highly acidic. They cover an area of 9000 ha.

3.3.3. Irrigation

As the land is below sea level (about 2m),irrigation is done by gravitational flow of water from the innumerable crisscross channels of the rivers Meenachil, Pampa, Manimala and Achenkoil, which enter into the Kayal lands. The total length of water courses is about 82.4 Km

3.3.4. Major crops

Rice is grown as the main crop during *Puncha* season(September-October to January-February). An additional crop is also taken during April-May to September-October. On the earthern bunds strengthened by brick around the *padasekharam* at a height of two meters, crops like coconut, banana, sugarcane etc. are raised.

3.3.5. Rice cultivation in Kuttanad

Kuttand is the major rice growing tracts in Kerala, where the cultivation is a challenging task mainly due to natural constraints. Farmers of Kuttanad have developed and mastered the marvelous system of below sea level cultivation over one and a half centuries ago on lands that were 2.5 to 3 meters below the sea level. Rice cultivation in Kuttanad is taken up along contiguous blocks or *padasekharams* or polders bounded by rivers and canals. Extent of *padasekharams* range from few hectares to 1000 ha. Each *padasekharam* is owned by several cultivators and group farming is practiced. The main season is the *Puncha* crop (Rabi season) when sowing takes place in November / December immediately after the North East Monsoon and harvesting is done in March / April. A second crop is taken in selected areas as Virippu crop (Kharif season) when sowing takes place in June / July immediately after the South West Monsoon and harvesting is done in September / October. Paddy cultivation is taken up in about 40,000 ha out of which double cropping takes place in 10,000 ha.

3.4. Sampling procedure

Kuttanad region comprises ten taluks spread over the three districts of Alappuzha, Kottayam and Pathanamthitta. In this region there are 1231 *padasekharams* covering a total area of 59375 hectares (Thomas, 2002). From this, all the *padasekharams* in the Kuttanad region of Alappuzha, where the variety,Uma is cultivated were identified. There were 591 such *padasekharams* in Kuttanad tract of Alappuzha district. From that, five *padasekharams* were selected randomly, and

from each *padasekharam*, 20 farmers cultivating the rice variety, Uma were selected, thus constituting a sample size of 100.

Selection of *padasekharam*

The basic unit of operation of the study was *'padasekharams'*, continous stretches of paddies delineated as one of the rice growers' group in a '*Krishibhavan*' (Agricultural Development office at grama panchayath level). The number of farmers sampled from the selected *padasekharams*of Kuttanad tract of Alappuzha for this study is given below.

Number of farmers sampled from selected *padasekharams*

Sl. No.	**Name of *Padasekharam* (gramapanchayath)**	**Area of *Padasekharam* (ha)**	**No. of members in *Padasekharam***	**No. of farmers sampled**
1	Chithira (Edathua)	312.20	320	20
2	Ashtamy (Champakkulam)	173.50	180	20
3	Rajapuram (Kainakary)	153.40	163	20
4	Kannankary (Kaavalam)	128.00	130	20
5	Shakthankary (Thalavady)	236.00	227	20
Total Sample size				**100**

Participatory Rural Appraisal sessions were also conducted as part of this study. In that, time line of rice varieties cultivated in Kuttanad, weighted matrix ranking and SWOC analysis were done. The details with regard to the number of farmers who attended PRA sessions were given below:

Number of farmers who attended PRA sessions

Sl. No.	Name of *Padasekharams*	Number of farmers attended
1	Chithira	25
2	Ashtamy	26
3	Rajapuram	33
4	Kannankary	36
5	Sakthankary	18
	Total	**138**

3.5. Operationalisation and measurement of variables

The variables analysed as part of this study can be broadly classified into three.

3.5.1 Personal variables of farmers

3.5.2 Variables related to cultivation of the rice variety, Uma

3.5.3 Adoption attributes of the rice variety, 'Uma'

3.5.4 SWOC analysis of the rice variety, Uma

3.5.5 Socio-economic variables

3.5.1. Personal variables of farmers

The operational definitions and scoring methods used to quantify the personalvariablesselected for the study are explained below:

3.5.1.1. Age

Age is operationally defined as the number of chronological years respondents have completed at the time of study since birth. The respondents were categorised into four groups by slightly modifying the Government of India classification followed for census 2011, which is as follows:

Age group	Score
<35 Years	1
35-45 Years	2
45-60 Years	3
>60 Years	4

3.5.1.2 Gender

It is a dichotomised variable having only two categories namely 'male' and 'female'. It indicates whether the respondent belongs to the male or female category. The respondents were categorised using nominal classification method.

3.5.1.3 Educational status

Education is operationally defined as the extent of formal schooling undergone by the respondents at the time of investigation and their ability to read and write. The sub-items were illiterate (people who didn't know how to read and write), people who can only read, functionally literate(people who can read and write), people with lower primary education (up to 5^{th} grade in schools), people with upper class education (from 5^{th} to 7^{th} standard in schools), people with high school education (up to 10^{th} standard in schools), plus two, degree, and post graduation. The scoring procedure developed by Trivedi (1963) followed by Shinogi (2007), Bhavya (2008), Priya (2009), Esakkimuthu (2010), Shincy (2012) was used with slight modifications.

Sl. No	Category	Score
1	Illiterate	1
2	Can read only	2
3	Functionally literate (Can read and write)	3
4	Lower primary level	4
5	Upper primary level	5
6	High school level	6
7	Plus two or equivalent	7
8	Degree or equivalent	8
9	Post graduate degree & above	9

3.5.1.4 Family educational status

Family educational status was operationalised as the extent of formal or informal learning possessed by the family members of the respondents who were above 18 years old at the time of interview. The scoring procedure followed by Bhavya (2008), Priya (2009) was used with slight modifications.

Sl. No.	Category	Score
1	Illiterate	1
2	Can read only	2
3	Functionally literate (Can read and write)	3
4	Lower primary level	4
5	Upper primary level	5
6	High school level	6
7	Plus two or equivalent	7
8	Degree or equivalent	8
9	Post graduate degree and above	9

The scores of each individual member of the family were identified and the family educational score was calculated as follows:

$$\text{Family educational score} = \frac{\text{Total score of the members of the family}}{\text{Total number of members in the family above 18 years of age}}$$

3.5.1.5 Family type

In this study, family type means, nuclear family or joint family. Nuclear family is one which consists of husband, wife, and their unmarried children, where as joint family is one which is composed of grand parents and their children including married sons and daughters with their spouses. The respondents were categorized as joint or nuclear family as per the number of occurrence in each case.

3.5.1.6 Occupational status

Occupation was operationalised as the main vocation and other additional vocation that the respondents were engaged in at the time of interview. The scoring procedure followed by Priya (2009), Krishnan (2013), Shilpa (2013) was used for the study, which is as follows:

Category of occupation	**Score**
Agriculture alone	1
Agriculture+ Private employment	2
Agriculture+ Government employment	3
Agriculture+ Self employment	4

3.5.1.7. Family Size

Size of family was operationally defined as the total number of members in the family consisting of husband, wife, children and other dependent members. It was measured as the absolute number of members in the household sharing the same economic unit. The scoring procedure followed by Jonna (2010) was used in this study as shown below:

Category	**Size of family**	**Scores**
Small family	<5 members	1

Medium family	5-8 members	2
Large family	>8 members	3

3.5.1.8 Farm size

This refers to the actual area of land, both wet land and garden land possessed by the farmer respondent, which was expressed in hectare. Procedure followed by Jonna (2010) was used in this study.

Category	**Farm size (ha)**	**Scores**
Marginal	<1 ha	1
Small	1-2 ha	2
Large	> 2 ha	3

3.5.1.9 Farming experience

Farming experience was measured in terms of the number of years since the farmer respondent was actually involved in the farming activities. Scoring procedure followed by Shinogi (2007), Priya (2009) with slight modification was used. The respondents were classified into four categories, *viz.*, low,medium, high and very high, as follows:

Category	**Experience in farming**	**Scores**
Low	<5 years	1
Medium	5-10 Years	2
High	10-20 years	3
Very High	> 20 years	4

3.5.2 Variables related to cultivation of the rice variety, Uma

3.5.2.1 Area covered under the rice variety, 'Uma'

This refers to the wetland area (in ha) covered under the rice variety, Uma (both owned and leased in land) by the farmers. The actual area of 'Uma', cultivated by the farmers was collected, and accordingly the farmers were categorised as follows:

Category	Scores
< 1ha	1
1-2 ha	2
>2 ha	3

3.5.2.2 Year of first adoption of 'Uma'

This refers to the year of starting of cultivation of the rice variety, Uma by the farmers.The respondents were then categorised into classes with two years interval.

3.5.2.3 Varietal shift

In this study, 'varietal shift' refers to shifting of cultivation of the rice variety,'Uma' to other rice varieties by the rice farmers. The response items were dichotomized into two categories viz. farmers who shifted from the cultivation of the rice variety, Uma and farmers who still continue with the variety, Uma. The scoring procedure was as follows:

Varietal shift	Score
Farmers shifted from the rice variety,'Uma'	0
Farmers who still continue with the variety, 'Uma'	1

3.5.2.4 Number of years of continous cultivation of the rice variety, 'Uma'

This refers to the number of years of continous cultivation of the rice variety, 'Uma' by the farmers. The scoring procedure followed is given below:

Years of continous cultivation of the variety, Uma	Score
1-15 Years	1
5-10 Years	2
10-15 Years	3
15-17 Years	4

3.5.2.5 Rice variety cultivated before 'Uma'

This refers to the name of the rice variety cultivated before cultivation of the variety, Uma. This was collected by directly asking the respondents.

3.5.2.6 Source of rice seed

Source of rice seeds refers to the agency to which the respondents depended for purchasing seeds of the rice variety, Uma. The scoring procedure adopted for the study is given below:

Source of rice seed	Score
Government institutions	1
Fellow farmers	2
Self produced	3

3.5.2.7 Average yield of the rice variety, 'Uma'

Average yield obtained from cultivation of the rice variety, Uma, expressed in Kg/ha by the respondents was recorded. Based on the data obtained, a logical classification was adopted, as follows.

Yield (Kg/ha)	Score
6000-7250	1
7250	2
7500	3
7500-8500	4

3.5.3. Adoption attributes of the rice variety, 'Uma'

Based on review of literature and discussion with non-respondents, farmers and experts, important adoption attributes of the rice variety, Uma (attributes which prompted farmers to adopt it) were listed. A list of nine important attributes, were identified.

Each of the identified attributes used to analyse the rice variety, 'Uma'. The variety was rated based on these attributes on a five point continuum ranging from highly favourableness of the attribute to highly unfavourableness of the attribute with scores of five to one respectively.

Index was calculated for each attribute of the rice variety, 'Uma'. For this, frequency of the response under each category multiplied with the respective scores and added up to get the total score for that particular item. Then index was calculated using the formula,

$$\text{Index} = \frac{\text{Score obtained}}{\text{Maximum possible score}} \text{x } 100$$

Based on the index, ranking was given to the attributes of the rice variety, 'Uma'.

3.5.3.1 Varietal comparison on selected attributes of rice varieties by matrix ranking

Matrix ranking was used as a PRA tool to explore preferences of individual community members, their ranking criteria and priorities. The reasons for local preferences for an item were better understood by using this tool. In this method, farmers were asked to list out the important rice varieties cultivated in Kuttanad and the preferred attributes of a rice variety. This was finalised based on triangulations and consensus. Then, they were guided to develop a matrix using the important rice varieties in columns and preferred attributes of rice varieties in rows. There were seven attributes in the rows and five rice varieties in the columns. The farmers were asked to assign scores (weightage) ranging from one to ten to the listed preferred attributes of rice, depending on the importance they assign to each attribute. Based on the group consensus, weightage scores were assigned to each attribute. After that, the farmers were asked to assign scores ranging from one to ten to each rice varieties for each attribute. Total scores were worked out by multiplying scores of each rice varieties with the respective weightage of the attributes. These scores were added to get the total score for a rice variety. Ranks were assigned in the descending order of the total scores obtained by the rice variety. Weighted matrix ranking of rice varieties was done in all the 5 randomly selected *padasekharams* using PRA techniques. Average score obtained for each rice variety, by combining the scores obtained from each PRA session on each attribute and divided it with the number of number of PRA sessions. In-depth discussion, mental evaluation, instantaneous correction and group consensus to assign ranks were the creative outcome of this participatory tool.

3.5.4 Socio-economic variables

3.5.4.1 Social participation

It is the degree of involvement of the respondents in formal organizations either as a member or office bearer. Procedure followed by Gurubalan (2007),

Plate 1. PRA Session with farmers

Esakkimuthu (2010), Shincy (2012), Shilpa (2013) was used. The scoring procedure was as follows:

Social participation	Category	Item score
Membership	No membership	0
	Membership in one organization	1
	Membership in more than one organization	2
	Office bearer in one organization	3
	Office bearer in more than one organization	4
Frequency of attending meetings	Not attended	0
	Occasionally	1
	Regularly	2

The final score of a respondent was obtained by adding up the scores for the frequency of attending meetings with the score secured as member/office bearer of the organization in which participation was reported.

Social participation of the respondents at the time of interview and before the start of Uma rice cultivation were compared to analyse the impact of the rice variety, 'Uma' on this variable.

3.5.4.2 Information seeking behaviour

Information seeking behaviour is operationalised as the extent to which the farmers sought information from different communication sources.

In the present study the scale developed and used by Deepa (1999) and followed by Bhavya (2008) was used to find out the information seeking behaviour of farmers. The different sources of information for obtaining agricultural technology were listed out. Each respondent was asked to indicate as to how often he tried to get information regarding improved agricultural practices from each of the listed sources and the respondents were asked to give response on a three point continuum ranging from two to zero and the scoring procedure was as follows:

Frequency	Score
Regularly	2
Some times	1
Never	0

Information seeking behaviour of the respondents at the time of interview and before they started Uma rice cultivation were compared to analyse the impact of the rice variety, 'Uma' on this variable.

3.5.4.3 Labour use

In this study, labour use is operationalised as the total number of labourers (including male and female) used for rice cultivation in a season of rice production. This was collected by asking the respondents about the actual number of male and female labourers used for rice cultivation in one hectare in different categories such as casual labour, permanent labour and family labour.

Labour use of the respondents at the time of interview and before they started Uma rice cultivation were compared to analyse the impact of the rice variety, 'Uma' on labour use.

3.5.4.4 Communication behaviour

In the present study, communication behaviour is operationally defined as the frequency of sharing of agricultural information by farmers with neighbours, relatives, progressive farmers, other fellow farmers and agricultural labourers. The farmers were asked to give their response on how often they share information regarding agricultural information and farm technologies. The responses were collected on a three point scale viz. rarely, some times and never with the following scoring procedure.

Frequency	Score
Regularly	2
Some times	1
Never	0

Communication behaviour as of now (at the time of interview) and before they started Uma rice cultivation were compared. This was used to analyse the impact of the rice variety, 'Uma' on the variable.

3.5.4.5 Annual income

It was operationally defined as the total earning of the respondent from both farm and non-farm sources in a year after deducting the cost of cultivation incurred, expressed in terms of rupees. The farm sources included income from rice cultivation including 'Uma' and income from other different crops, while non-farm sources included income from government employment, business and such other vocations. The annual income so collected was converted in to net income by deducting the cost incurred for cultivation of crops.

The annual income as of now (at the time of interview) and before they started cultivating the rice variety, Uma were compared after converting the amount of the annual income before cultivating the rice variety, Uma into its current price by using GDP deflator. It is the ratio of Gross State Domestic Product (GSDP) in current prices and GSDP at constant prices. The GDP deflator with 2004-05 (2004-05= Rs.100) as the base period was collected from Economic Review, Government of Kerala. Then 2004-05 base as 100 was adjusted to 1998 as Rs. 100 using the usual adjustment procedure and this index was used for finding out the present value of income in real prices. This was used to analyse the impact of the rice variety, 'Uma' on the annual income of farmers.

3.5.4.6 Family expenditure

Family expenditure is defined as the financial commitments involved typically in the manner of living by the household. It takes into account two aspects: food expenditure and non-food expenditure.

Family expenditure as of now (at the time of interview) and before they started cultivating the rice variety, Uma were compared by converting the amount of family expenditure before cultivating 'Uma' into its current price as done in annual income. This was used to analyse the impact of the rice variety,'Uma'.

3.5.4.7 Savings

Savings was operationalised as the amount of money which the family of the respondents saved in the form of deposits, which are readily available if needed with external agencies. The agencies included both formal and informal institutions. Savings was measured in this study as the actual amount saved, with different agencies.

Savings as of now (at the time of interview) and before they started Uma rice cultivation were compared after converting the value of savings of farmers before they started cultivation of the rice variety, Uma into its current price as done in annual income. This was used to analyse the impact of the rice variety, 'Uma' on savings of farmers.

3.5.4.8 Indebtedness

Indebtedness was defined as the total loan (debt) in terms of cash, a farmer owes at the time of investigation to various money lending sources such as bank, chitty, relatives and friends.

This was collected by asking the farmers the amount in rupees, they owe to different money lending sources. Indebtedness as of now (at the time of interview) and before they started Uma rice cultivation were compared by converting the value of debt

before Uma rice cultivation into its current price as done in annual income. This was used to analyse the impact of the rice variety, 'Uma', on this variable.

3.5.4.9 Asset creation

This variable is useful in estimating the value of possessions of both permanent and durable nature by the respondents. Asset creation, in this study is operationalised as the values of permanent assets like land owned, house, ornaments etc. and consumer articles like radio, furniture, T.V etc. These were summed up to find the value of assets created by the farmers.

Asset as of now (at the time of interview) and before they started cultivation of 'Uma' were compared by converting the value of asset created before Uma rice cultivation into its current price as done in annual income. This was used to analyse the impact of the rice variety, Uma.

3.5.4.10. SWOC Analysis of the rice variety, 'Uma'

SWOC analysis of the rice variety, Uma was done using Participatory Rural Appraisal techniques and analysed the strengths, weaknesses, opportunities and challenges of the rice variety, Uma. For this, semi-structured group interview was adopted. The farmer groups were asked to list out the Strengths, Weaknesses, Opportunities and Challenges of the rice variety, Uma. This was finalised based on the triangulations, cross verification and consensus of the group members. After identifying the Strengths, Weaknesses, Opportunities and Challenges, the farmers were guided to rate the items in each category as a 10 point scale, based on its importance. The total scores obtained by the item in all the five PRA sessions were found out. This was converted into index using the formula:

$$\text{Index} = \frac{\text{Score obtained}}{\text{Maximum possible score}} \text{x } 100$$

3.5.4.11 Comparative advantage on income of farmers by cultivating the rice variety, Uma

Comparative advantage on income of farmers of Kuttanad tract of Alappuzha gained by the cultivation of the rice variety, Uma was analysed by comparing the income advantage of 'Uma' over Jyothi and local varieties. The variety, Jyothi was taken here since it was the predominant variety cultivated before 'Uma'. Traditional varieties were considered to know the income advantage of this HYV over traditional varieties. For, this purpose, the average yield of 'Uma', Jyothi and traditional varieties were found out in all the five selected *padasekharams* using PRA technique.

3.5.4.12 Rice seed distribution in Kerala

The details of rice seed distribution in Kerala was analysed by collecting the quantity of rice seeds distributed by various agencies viz. Kerala Agricultural University, Kerala State Seed Development Authority, National Seed Corporation, Karnataka State Seed Corporation and State Seed Farms in Kerala. The quantity of rice seeds of the variety, Uma as well as the total quantity of rice seeds distributed during 2013-14 was collected from the office records of these agencies.

3.5.5 Constraint analysis:

Constraint analysis was done to identify and analyse the constraints of rice cultivating farmers.

Constraints were operationalised as difficulties or problems experienced by the farmers in rice cultivation.

Based on review of literature and discussion with non-respondent farmers, a list of constraints being encountered during rice cultivation was identified.

A total of 16 constraints were listed. The response on each constraint was obtained on a five point continuum namely 'very important', 'important', 'slightly important',

'less important' and 'least important' with a score of five to one respectively.

For each constraint, the frequency of the responses under the constraint was multiplied with the respective scores and added up to get the total score for that particular constraint. For easy comprehension, this was converted into index using theformula:

$$\text{Index} = \frac{\text{Score obtained}}{\text{Maximum possible score}} \text{x } 100$$

Then the constraints were ranked based on the index values in the descending order of importance.

3.6 Tools used for data collection

Keeping in view the objectives and variables under study, a structured interview schedule was prepared by reviewing the previous research studies, consultation and discussion with the experts and professionals in the field of Agricultural Extension, Plant Breeding, and Agronomy. The interview schedule was pre-tested in a non-sample area and validated in the pilot study. The final interview schedule was prepared by necessary modifications, additions and deletions based on pre-tested results. The Malayalam version of interview schedule was also prepared. The final format of the interview schedule is furnished in Appendix-1.

In addition, PRA techniques were employed using the tools such as weighted matrix ranking, SWOC analysis, timeline, semi-structured interview guides and semi structured interviews were used.

For the purpose, further, secondary data pertaining to rice seed distribution in Kerala were also collected by visiting various agencies viz. Kerala State Seed Development Authority at Thrissur, National Seed Corporation branch at Palakkad and Thiruvananthapuram, Karnataka State Seed Corporation, State Seed Farms of

Plate 1: Interaction with farmers

Department of Agriculture, Government of Kerala and Kerala Agricultural University. The Krishibhavans under each grama panchayath in Kuttanad tract of Alappuzha were also contacted to collect the basic details of rice cultivation in different *padasekharams* of Kuttanad tract of Alappuzha.

3.7 Statistical tools used for the study

The data collected from the respondents were scored, tabulated and analysed by using suitable statistical methods. For this, the data collected were entered in excel sheet and the following statistical tests were administered using SPSS (Statistical Package for Social Science) package, version 16.

3.7. 1 Percentage Analysis:

Percentage distribution of the respondents on all the variables was worked out by dividing the frequency of response in each category with the total number of respondents and multiplying by hundred.

3.7.2Wilcoxon signed-rank test

The Wilcoxon signed-rank test is a non-parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ i.e. it is a paired difference test. In the study, the social impact of the rice variety, Uma on farmers was assessed using this test for comparing social variables (Social participation, Information seeking behavior, communication behavior) before and after Uma rice cultivation, to know the impact of the rice variety, Uma on these aspects.

3.7.3 Paired ‘t’ test

The paired‘t’ test is a parametric statistical hypothesis test, which is the difference between population means for a pair of random samples whose differences are approximately normally distributed. It can be used for comparing before-and-after observations on the same subjects. In this study, it was used to test the significance of the difference, if any, between means of the variables viz. annual income, family expenditure, savings, indebtedness and asset creation and labour use, before and after cultivation of the rice variety, Uma, so as to assess the impact of this variety.

RESULTSAND DISCUSSION

4.RESULTS AND DISCUSSION

This chapter deals with the results obtained in the study and the discussions on the results.Keeping the objectives in view, the findings as well as the discussions are presented under the following titles.

4.1 Area under ‘Uma’ in Kuttanad tract of Alappuzha

4.2Personal profile of rice farmers of Kuttanad

4.3Profile of farmers related to cultivation of the rice variety, Uma

4.4Adoption attributes of the rice variety, Uma (Mo16)vis-a-vis other rice varieties

4.5SWOC analysis of the rice variety, Uma

4.6 Socio-economic impact of ‘Uma’ on rice farmers

4.7 Constraints in rice production

4.1 Area under ‘Uma’ in Kuttanad tract of Alappuzha

Since the study area was in Kuttanad tract of Alappuzha district, an attempt was made to find out the total area under rice cultivation in this region, with special reference to the rice variety, Uma. The results in this regard are presented in Table 1.

Table 1.Area under rice cultivation in Kuttanad tract of Alappuzha

Sl. No.	Gramapanchayath	Total no. of *padasekharams*	Total area(ha)	No. of *Padasekharams* under cultivation	Area under 'Uma' (ha)	Area under rice cultivation (ha)	No. of *Padasekharams* kept as fallow	Area under current fallow (ha)
1	Thanneermukkam	3	46.00	3	46.00	46.00	-	-
2	Muhamma	1	15.00	1	10.00	15.00	-	-
3	Mannachery	3	124.00	2	83.00	84.00	1	40.00
4	Alappuzha	14	723.00	12	600.00	715.00	2	8.00
5	Aryad	6	255.00	6	250.00	255.00	-	-
6	Punnapra North	6	274.30	6	274.30	274.30	-	-
7	Punnapra South	6	452.73	6	452.73	452.73	-	-
8	Ambalappuzha North	14	478.00	14	478.00	478.00	-	-
9	Ambalappuzha South	19	575.00	18	557.00	557.00	1	18.00
10	Thakazhy	24	1713.00	24	1618.00	1713.00	-	-
11	Purakkad	12	1191.40	9	991.40	991.40	3	200.00
12	Karuvatta	13	700.00	11	436.40	650.00	2	50.00
13	Cheruthana	26	723.00	24	705.00	705.00	2	18.00
`14	Haripad	9	400.00	7	350.00	380.00	2	20.00
15	Veeyapuram	16	1300.00	16	1270.00	1300.00	-	-
16	Pallipadu	15	500.00	12	300.00	400.00	3	100.00
17	Chennithala	15	993.00	14	851.17	975.00	1	18.00
18	Puliyoor	8	224.00	7	180.00	200.00	1	24.00
19	Mannar	12	635.00	8	520.00	540.00	4	95.00

20	Pandanad	6	325.00	6	325.00	325.00	-	-
21	Budhanoor	17	1125.00	17	995.00	1125.00	-	-
22	Ramankary	44	955.80	44	955.80	955.80	-	-
23	Muttar	28	750.00	28	745.00	750.00	-	-
24	Neelamperoor	51	3610.00	51	3610.00	3610.00	-	-
25	Veliyanad	44	1362.00	44	1320.00	1350.00	1	12.00
26	Pulinkunnu	27	2400.00	27	2400.00	2400.00	-	-
27	Kavaalam	17	1285.00	17	1285.00	1285.00	-	-
28	Kainakary	27	2015.00	26	1920.00	2000.00	1	15.00
29	Edathua	20	1510.00	20	1510.00	1510.00	-	-
30	Champakulam	32	944.00	32	944.00	944.00	-	-
31	Nedumudi	18	500.00	18	500.00	500.00	-	-
32	Thalavady	24	965.00	24	965.00	965.00	-	-
	Total	590	29069.23	566	27447.80	28451.23	24	618 .00

Table1showsthat the total number of *padasekharams* in Kuttanad tract of Alappuzha district was 590 with an area of 29069.23 ha and the number of *padashekharams* with rice cultivation was 566 with an area of 28451.23 ha.Whereas, 24 *padasekharams* covering an area of 618 ha were kept under current fallow in Kuttanad tract of Alappuzha.Neelamperoorgramapanchayath in Kuttanad tract of Alappuzha was having the highest number of *padasekharams*(51) and Muhammagramapanchayath was having the least number of *padasekharams*(1). Area wise, Neelamperoorgramapanchayath had the maximum area under rice cultivation(3610ha) followed by Pulinkunnugramapanchayath with an area of 2400 ha. Muhammagramapanchayath was having the least area under rice cultivation (15 ha). The total area under Uma rice cultivation was found to be 27447.8 ha, which is 96 per cent of the total area under rice cultivation in Kuttanad tract of Alappuzha.From these

results, it can be inferred that the ruling variety of rice in Kuttanad tract of Alappuzha is ‘Uma’.

4.2. Personal profile of rice farmers of Kuttanad

This section reveals the distribution of farmers with respect to various profile characters such asage, gender, educational status, occupational status, family type, family size, family educational status, farm size and farming experience. This is useful in analysing and interpreting the results of this study.

4.2.1.Age

Age classificationof the respondents is presented in Table 2

Table 2. Distribution of farmers according to their age (N=100)

Sl. No.	Age group	Percentage
1	<35 Years	0
2	35-45 Years	4
3	45-60 Years	47
4	>60 Years	49
	Total	**100**

It is observed from Table2 that 47 per cent of the respondentswere in the age group of 45-60 years and 49 per cent were in the age group of more than 60 years. Only four per cent of the farmers were in the age group of less than 45 years (35-45 years). None of the farmers belonged to the age group of less than 35 years. Thus the table clearly shows thatvast majority of the farmers belonged to or nearing old age group.This indirectly shows that the younger generation in Kerala is less interested in farming,and this sector sustains because of the involvement of old aged people. The results are in conformity with the findings of Preetha (1997) and Priya (2009).

4.2.2. Gender

Categorisation of the respondents according to their gender(male/female) is given in Table 3.

Table 3. Distribution of farmers according to gender (N=100)

Sl. No.	Category	Percentage
1	Male	100
2	Female	0
	Total	**100**

From Table 3, it can be seen that all the respondents (100%) were males. No female was there in the respondent category. This is in accordance with the socio-cultural situation of Kerala.

4.2.3 Educational status

Educational status of the respondents is presented in Table 4

Table 4. Distribution of farmers according to their Educational status (N=100)

Sl. No.	Category	Percentage
1	Lower primary level	1
2	Upper primary level	8
3	High school level	52
4	Plus two or equivalent	27
5	Degree or equivalent	11
6	Post graduate degree & above	1
	Total	**100**

It is observed from Table4 that more than 50 per cent ofthefarmerswere having high school level education followed by 27 per cent farmers having educational

statusof plus two or equivalent. Only eleven per cent of the farmers had degree or equivalent education. The results in this regard revealed that the farmers of Kuttanad are well educated.

4.2.4 Family educational status

Family educational status of the respondent is presented in Table 5

Table 5. Distribution of farmers according to family educational status (N=100)

Sl. No	Category	Percentage
1	Lower primary level	1
2	Upper primary level	2
3	High school level	25
4	Plus two or equivalent	64
5	Degree or equivalent	8
	Total	**100**

It is observed from Table5 that majority(64%) of the respondents' family had educational status of plus two or equivalent, and one fourth (25%) of the respondents' family had high school level of education.

Kerala is the State in India having the highest literacy rate of 93.9 per cent (Government of India, 2011) and Keralites are giving much importance to formal education. This is the reason for good family educational status of the farmers.

4.2.5Family type

Family type of the respondents is presented in Table 6

Table 6. Distribution of the respondents according to family type (N=100)

Sl. No.	Category	Percentage
1	Nuclear	77
2	Joint	23
	Total	**100**

It is seen from Table6 that more than three-fourth(77%) of the respondents had nuclear family. The results are in concordance with the nuclear family system prevailing in Kerala. However 23 per cent of the farmers were having joint families.

4.2.6Occupational status

Occupational status of the respondents is given in Table 7

Table 7. Distribution of farmers according to their occupational status (N=100)

Sl. No.	Category of occupation	Percentage
1	Agriculture alone	86
2	Agriculture+ Private employment	1
3	Agriculture+ Government employment	1
4	Agriculture+ Self employment	12
	Total	**100**

Table7 revealed that 86 per cent of the farmers had ‘agriculture alone’ as the occupation. Only 12 per cent of the respondents were self employed in addition to engagement in farming. Thus it is vivid that majority of the farmers of Kuttanad are solely depending on farming.This observation is in agreement with the findings of Manoj (2000) and Shilpa (2013).

4.2.7Family Size

Family size of the respondents is presented in Table 8

Table 8.Distribution of farmers according to family size (N=100)

SI.No.	Category	Family size	Percentage
1	Small family	< 5 members	76
2	Medium family	5-8 members	24
3	Large family	> 8 members	0
	Total		**100**

It is observed from Table8 that majority (76%) of the farmers had small family (less than five members), which is in tune with prevailing family system in Kerala state. Twenty four per cent of the respondents had medium family (5-8 members).This is because of the presence of joint family among some farmers. No respondent is seen with large family.

4.2.8. Farm size

Farm size of the respondents is presented in Table 9

Table 9. Distribution of farmers according to farm size (N=100)

Sl. No.	Category	Farm size	Percentage
1	Marginal	<1 ha	43
2	Small	1-2 ha	38
3	Large	>2 ha	19
	Total		**100**

Table9 shows that 43 per cent of the respondents belonged to the category of marginal farmers, while 38 per cent fell in the small farmer category. Only 19 per cent of the farmers were large farmers.

The result is in concordance with the finding of Government of Kerala (2011), which states that majority of the farmers of Kerala are marginal farmers.

4.2.9. Farming experience

Farming experience of the respondents is presented in Table 10

Table 10. Distribution of farmers according to theirfarming experience (N=100)

Sl. No.	Category	Farming experience	Percentage
1	Low	<5 Years	1
2	Medium	5-10 Years	1
3	High	10-20 Years	8
4	Very High	> 20 Years	90
	Total		**100**

It is observed from Table10 that a vast majority (90%) of the respondents had more than 20 years of experience in rice farming, while eight per cent of the respondents had 10-20 years of experience. This is because 96 per centof the respondent farmers were above the age of 45 and the livelihood of majority of these farmers depended on agriculture, which might have prompted them to continue farming and thereby they gained very high experience in farming. .This observation is inconcordance with the findings ofPriya(2009). There were only two per cent of the farmers having less than 10 years of experience. Thus the results reveal the very high experience of farmers of Kuttanad in rice farming.

4.3. Profile of farmers related to cultivation of the rice variety, Uma

Profile of farmers related to cultivation of 'Uma'included the variables such as'area covered under the rice variety, Uma', 'year of first adoption of Uma', 'varietal shift', 'number of years of continous cultivation of the rice variety, Uma', 'rice variety cultivated before Uma' and 'average yield obtained from Uma'. It is useful for the study to get an overall picture of cultivation of the variety, 'Uma' inKuttanad tract of Alappuzha.

4.3.1.Area covered under the rice variety, 'Uma'

The wetland area(in ha) covered under 'Uma' variety, (both owned and leased in land) cultivated by the respondents is presented in Table 11.

Table 11. Area covered under the rice variety, 'Uma'(N=100)

Sl. No.	Area	Frequency
1	<1 ha	40
2	1-2 ha	36
3	>2 ha	24
	Total	**100**

It is observed from Table11 that around 50 percent of the farmers were cultivating the rice variety, 'Uma' in less than one hectare area, whereas 36 per cent of the farmers were cultivating therice variety, 'Uma' in 1-2 ha area. However 24 per cent of the farmers were cultivating the rice variety, Uma in more than 2 ha area.

4.3.2. Year of first adoption of the rice variety, 'Uma'

Year of first adoption of the rice variety, 'Uma' by the respondents is shown Table 12

Table 12. Year of first adoption of the rice variety, 'Uma'(N=100)

Sl. No.	Year	Percentage
1	1998-2000	24
2	2000-2002	37
3	2002-2004	8
4	2004-2006	13
5	2006-2008	14
6	Since 2008	4
	Total	**100**

It is observed from Table12 and Fig.2that 61 per cent of the farmers started Uma rice cultivation during 1998-2002, that is, immediately after the release of the rice variety, 'Uma' in 1998 from Rice Research Station, Moncombu of Kerala Agricultural University. There on, other farmers gradually joined the group, over the years. The yield advantage and the dormancy of seeds are the two major reasons for the adoption of the rice variety, 'Uma' by the farmers.

4.3.3. Varietal shift

A farmer shifting from cultivation of the rice variety, 'Uma' to other rice varieties is given in Table 13

Table 13. Varietal shift (N=100)

Sl. No.	Items	Percentage
1	Farmers shifted from the rice variety, 'Uma'	0
2	Farmers who still continue with the variety, 'Uma'	100
	Total	**100**

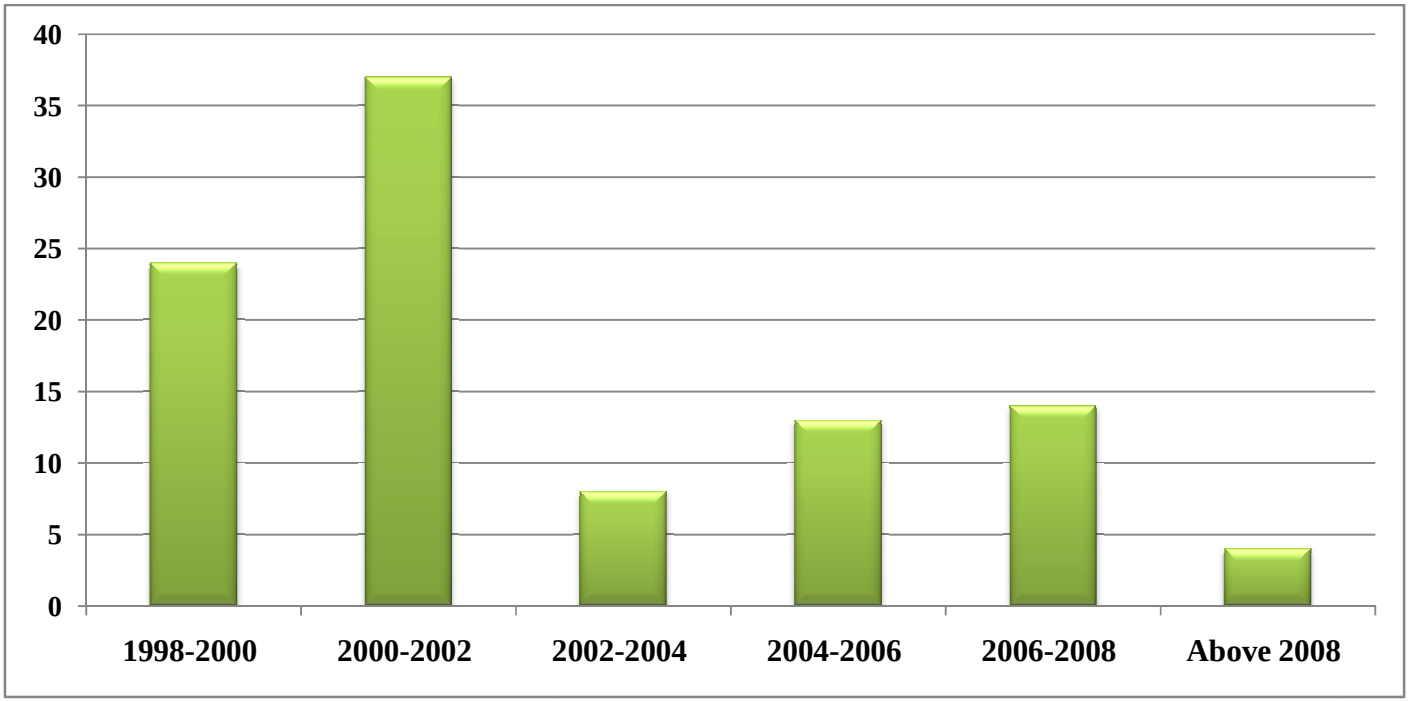


Fig. 2: First year of adoption of the rice variety, Uma

From Table13, it can be seen that all the respondents (100%) were continously cultivating Uma without shifting to any other rice varieties. This result reveals that, farmers still stick on to Uma without moving to any other rice varieties. It shows the strength of the rice variety, Uma.

4.3.4. Number of years of continous cultivation of the rice variety, 'Uma'

Number of years of continous cultivation of the rice variety, 'Uma' is given in Table 14

Table 14.Number of years of continous cultivation of 'Uma'(N=100)

Sl. No.	Years	Percentage
1	1-5 Years	2
2	5-10 Years	17
3	10-15 Years	25
4	15-17 Years	56
	Total	**100**

It is observed from the Table14 that majority (56 %) of the farmers had been continously cultivating the rice variety, 'Uma' for the last 15 to 17 years. One-fourth (25 %) of the farmers had been continously cultivating 'Uma' for 10 to 15 years, while 17 per cent of the farmers had been continously cultivating it for 5-10 years.The results presented in Table 11 and 13 reveal that a vast majority of the farmers who started cultivating Uma arecontinously cultivating it, because ofits several strengths.

4.3.5Rice variety cultivated before 'Uma'

The rice variety used before'Uma'forcultivation by the respondents is given in Table 15.

Table 15. Rice variety cultivated before 'Uma' (N=100)

Sl. No.	Variety	Percentage
1	Jyothi (PTB 39)	97
2	Jaya	2
3	Kunjathikkira (Mo3)	1
	Total	**100**

It is observed from Table 15 that 97 per cent of the farmers cultivated 'Jyothi' before 'Uma'.'Jaya' and 'Kunjathikkira' were there among the respondents (2% and 1% respectively) before cultivation of the rice variety, Uma. After the introduction of the rice variety, 'Uma', 100 per cent of the respondents shifted to 'Uma' cultivation. This is because of the dormancy of seeds, higher yield and less pest and disease incidence of the rice variety, 'Uma' as compared to other rice varieties.

4.3.6Sources of seed

Sources of rice seeds for cultivation of'Uma' by the respondents is given in Table 16.

Table 16. Sourcesof'Uma' rice seed (N=100)

Sl. No.	Sources of seed	Percentage
1	Government institutions	98
2	Fellow farmers	1
3	Self produced	1
	Total	**100**

Table 16 reveals that majority (98%) of the farmers procured seeds from government institutions. This is because of the belief of the farmers that quality of the seeds from government agencies would be better ascompared to theseeds from other

sources. That is why, only one per cent of the farmers depended on other fellow farmers as well as self produced seeds for meeting seed requirements.

4.3.7 Average yield of the rice variety, 'Uma'

Average yield obtained from cultivation of 'Uma' by the respondents is given in Table 17

Table 17. Average yield of the rice variety, 'Uma' (N=100)

Sl. No.	Yield (Kg/ha)	Percentage
1	6000-7250	6
2	7250	56
3	7500	18
4	7500-8500	20
	Total	**100**

It can be seen from the Table 17 that majority of the farmers (56%) got an average yield of 7250 Kg per ha from cultivation of the rice variety, 'Uma', while 20 per cent of the farmers got an average yield of 7500-8500 Kg per ha. Over all, the average yield varied between 6000-8500 Kg per ha. This variation can be attributed to the soil type, season of cultivation, climatic variations and cultural operations.

4.4.Adoption attributes of the rice variety, Uma (Mo16) vis-a-vis other rice varieties

Rice varieties are often described in terms of attributes (e.g. duration, yield) andby the presence or absence of some attributes (e.g. resistance/susceptibility to pests and diseases). Attributes of rice varieties perceived by the farmers are in varying degrees depending uponthe types of production environment and the considerations for attributes.

4.4.1. Time line of rice varieties in Kuttanad tract of Alappuzha

Time line of rice varieties is relevant in this study to understand the different rice varieties cultivated during different time periods in the study area (Kuttanad tract of Alappuzha). Time line of rice varieties collected using Participatory Rural Appraisal technique is presented in Table18

Table 18.Time line of rice varieties cultivated in Kuttanad tract of Alappuzha

Year	Rice varieties
1955-60	Kochuvith, Mayila, Kochathikkira, Chitteni, Njavara, Vykatharyan, Kulappala, Champavu(Mo2),Karivenna, Kunjathikkira(Mo3),Kunjunju, Putharichambav, Jeerakachambav, Thirinjavella
1960-1970	Taichung Native-1,IR8,Culture-12814,Culture-1954,Culture-25331
1972	Jaya
1975	Jyothi
1978-79	PTB-10, PTB-4, PTB-22, Bhadra(Mo4)
1981-1982	Asha(Mo5), Culture-12814
1985	Pavizham(Mo6)
1987	Karthika(Mo7)
1990	Aruna(Mo8), Kanakom(Mo11)
1992	Culture 1727
1996	Ranjini (Mo12)
1998	Ramanika(Mo15), Karishma(Mo18), Pavithra(Mo13), Panchami(Mo14), Krishnanjana(Mo19), Uma(Mo16)
2002	Gouri
2006	Anaswara
2009	Prathyasa

Before green revolution, during 1950's and 60's, local varieties ruled Kuttanad wetlands. Later different high yielding varieties came into picture. Taichung Native-1 and IR8 came to cultivation during green revolution. Jaya came in 1972 whereas Jyothi came in 1975. Jyothi was the ruling variety of Kuttanad, before the arrival of Uma. After 1975, farmers tried many varieties like Pavizham, Karthika, Kanakam, and Aruna. The variety, Uma was used by farmers of Kuttanad for cultivation in 1998. In 1998, farmers tried other varieties like Panchami, Pavithra, Karishma, Ramanika, and Krishnanjana. In 2006, the variety Anaswara came to Kuttanad. The latest variety popular in Kuttanadis Prathyasa, which isshort duration rice variety for the double croppedwet lands of this region. However the ruling variety ofKuttanad is Uma, and it occupies around 60 per cent of the paddy cultivated in Kuttanad as opined by the farmers

4.4.2. Perception of farmers on selected attributes of the rice variety, 'Uma'

Before analysing the attributes of the rice variety, 'Uma' in comparison with other rice varieties, the pronounced adoption attributes of the rice variety, 'Uma' as perceived by the farmers are given in Table 19

Table 19. Perception of farmers on selectedattributes of the rice variety, 'Uma'

Sl. No.	Attributes	Index	Rank
1	Tolerance to pests and diseases	94.6	I
2	Non-lodging nature of plant	92.6	II
3	Non-shattering nature of panicle	86.7	III
4	Amenability to mechanization	75.4	IV
5	Predictability of yield	74.1	V
6	Adaptability to local climatic conditions	71.2	VI
7	Response to fertilizer application	57.4	VII
8	Millers' preference	49.6	VIII

9	Cooking quality	42	IX

Table 19 shows that tolerance to pests and diseases was the highly rated attribute with an index of 94.6, which means that 94.6 per cent preference rating on this attribute.Uma is resistant to the pests like gall midge and brown plant hopper (Kumari, 2011) and resistant to the diseases like sheath blight and sheath rot (Devika*et al.*,2004);these pests and diseases are very much prevalent in Kuttanad tract of Alappuzha.Non-lodging nature of plant and non-shattering nature of panicle were also comparatively more satisfying with indices 92.6 and 86.7 respectively. Non-lodging nature of the plants makes the machinery operations easier like machine harvesting. Non-shattering nature of the panicle reduces the yield loss from rice cultivation. Further the yield of Uma is predictable and the variety is adaptable to the local conditions of Kuttanad. However, Millers' preference and cooking quality of the rice variety 'Uma' were low with indices of 49.6 and 42 respectively.This is because, the variety Jyothi, a competitor to the variety, Uma is having excellent cooking quality and this was preferred by most of the millers. Due to the low cooking quality of 'Uma', it was less preferred by the millers.

4.4.3. Varietal comparison of rice in Kuttanad on selected adoption attributes

Matrix ranking is a powerful tool for group decision making and planning. Here, matrix ranking gave an overall picture of the farmer groups' preferences for selected varieties against selected adoption attributes. The group members were facilitated to give their preferences for the attributes listed by them and benefits obtained from them.

The comparative position of rice varieties popular in Kuttanad in respect of different adoption attributes as assed by weighted matrix ranking is given in Table 2

Table 20.Rating of rice varieties by farmer groups on selected adoption attributes

Attributes (Weightage)	**Scores obtained (Out of 10)**				
	Uma	**Jyothi**	**Prathya-sa**	**Kancha-na**	**Red Thriveni**
High grain yield (9.80)	10.00	6.80	6.80	6.00	5.00
Tolerance to pests and diseases(8.90)	9.00	6.10	6.20	5.90	4.80
Non-lodging nature of plant (8.90)	9.00	9.00	7.90	5.80	4.80
Non-shattering nature of panicle (8.00)	8.90	7.00	7.00	5.90	4.80
Amenability to mechanization(7.90)	8.90	8.90	8.90	7.00	5.90
Adaptability to local climatic condition (7.90)	8.90	5.90	5.90	6.90	5.80
Millers' preference (7.00)	7.20	10.00	7.20	8.10	6.90

Table 20 shows that high grain yield, tolerance to pests and diseases,non-lodging nature of plant, non-shattering nature of panicle, amenability to mechanisation, adaptability to local climatic condition and millers' preference were the attributes of rice varieties considered by farmers in preferring rice varieties for adoption. Of these, high grain yield was the most preferred attribute based on which adoption decision is made, followed by tolerance to pests and diseases and non-lodging nature of plant. Millers' preference was given comparatively less weightage, may be because, though millers' preference was very important in selling paddy, it did not affect the farmers much due to the procurement of paddy by the State government. The major varieties preferred by farmers of Kuttanad, at present, are, Uma, Jyothi, Prathyasa, Kanchana, and Red Thrivenias selected by the farmer groups. So, comparison of these varieties was done on the selected attributes.

Table 20 further reveals that ‘Uma’was ranked first with regard to high grain yield, tolerance to pests and diseases, non-shattering nature of panicle and adaptability to local conditions of Kuttanad wetlands. The top position was shared by Uma and Jyothi with regard to non-lodging nature of the plant while the position is shared by Uma, Jyothi, and Prathyasa in case of amenability to mechanisation. Regarding millers’ preference, Jyothi occupied the top position. This is in concordance with the results of KAU(2006), which stated that the numbers of varieties preferred by millers are a few, numbering Jyothi, Kunjukunju and Jaya. Altogether it is clear from Table 20 that as of now, Uma is the highly rated variety in Kuttanad

4.4.4Comparative position of rice varieties based on selected adoption attributes

The weighted matrix ranking of selected rice varieties based on selected adoption attributes led to positioning of these varieties according to ranks. The comparative positions of rice variety derived accordingly are given in Table 21.

Table 21.Comparative position of rice varieties based on weighted matrix ranking

Sl. No.	Variety	Score	Rank
1	Uma	520.42	I
2	Jyothi	443.95	II
3	Prathyasa	418.72	III
4	Kanchana	377.27	IV
5	Red thriveni	314.94	V

As evidenced by varietal preference matrix (Table 20), the rice variety, ‘Uma’ was perceived as the superior variety by the farmers of Kuttanad tract of Alappuzha with a weightage score of 520.42 followed by the rice variety, ‘Jyothi’ with a weightage score of

443.95. The third preferred variety was Prathyasa (418.72) followed by Kanchana (377.27) and Red thriveni (314.94).

The rice variety, 'Uma' was perceived as the superior variety by the farmers. This may be due to the fact that the rice variety, Uma was having several strengths (high grain yield, tolerance to pests and diseases, high seed dormancy, non-shattering nature of panicle, non-lodging nature of plant) as compared to other rice varieties. The second preferred variety was Jyothi and this may be due to the fact that the rice variety, 'Jyothi' was having good cooking quality and most of the millers preferred this variety.

4.5SWOC Analysis of the rice variety, 'Uma'

SWOC analysis was done to analyse the Strengths, Weaknesses, Opportunities and Challenges of the rice variety, 'Uma'. It was done with the help of farmer groups using Participatory Rural Appraisal techniques, the findings of which are discussed below:

4.5.1 Strengths of the rice variety, 'Uma'

Table 22. Strengths of the rice variety, 'Uma'

Sl. No.	Strengths	Index	Rank
1	High yield	98.8	I
2	Highly tolerant to pests and diseases when compared to other rice varieties	96.0	II
3	Grains having more weight	91.0	III
4	High tillering capacity	89.0	IV
5	Very high seed dormancy	85.2	V
6	Non-lodging nature of plant	83.0	VI
7	Highly suitable for mechanization	81.2	VII
8	Adaptable to local climatic condition of Kuttanad	80.0	VIII
9	Non-shattering nature of panicle	78.3	IX
10	Highly suitable to acidic soils	76.1	X

As evident from Table 22, the major strength of the rice variety, ‘Uma’ was its higher yield with an index of 98.8 when compared to other rice varieties in Kuttanad. Uma has recorded a maximum yield of 9.1 tonnes/ha in Palakkad (Anon.,2014). Some farmers opined that they received a yield of 8.75 tonnes/ha for ‘Uma’ in Kuttanad. However, the average yield of ‘Uma’, as perceived by the farmers was 7.5 tonnes/ha in Kuttanad tract of Alappuzha. Another important strength was the tolerance of this rice variety against pest and disease incidence (96.0), which secured second rank among the strengths. This is because Uma is tolerant to the pests like gall midge and brown plant hopper (Kumari, 2011) and tolerant to the diseases like sheath blight and sheath rot(Devika*et al.*,2004). The third ranked strength was the higher grain weight (91.0), followed by high tillering capacity (89.0). The fifth important strength is its high seed dormancy (85.2). This is very important in Kuttanadwetlands,becauseharvesting the *kharif*rice (additional crop)generally coincides with the rainyseason. Heavy rains during the crop maturity phase andthereafter, in particular, may lead to *in situ* seed sproutingboth in the field as well as in the threshing yard, especiallyif the varieties do not possess post-harvest seed dormancy.Many popular high yielding varieties like Jyothi, however, lack dormancy in full measure.Consequently, considerable yield losses occur on account of *insitu*seed germination. (Devika*et al*.,2004).Other important strengths of the variety perceived by the farmers were non-lodgingnature of plant, suitability to mechanisation, adaptability to local conditions of Kuttanad wet lands, non-shattering nature of panicle and suitability to acidic soils.

4.5.2. Weaknesses of the rice variety, Uma

Table 23. Weaknesses of the rice variety, Uma

Sl. No.	Weaknesses	Index	Rank
1	Cooking quality is less	96.1	I
2	Less preferred by the millers	94.2	II

It is observed from Table 23 that, the major weaknesses of the variety were its low cooking quality when compared to other rice varieties with an index of 96.1 and less preference of the variety by millers (94.2). This is because the variety Jyothi, a competitor to Uma is having excellent cooking quality, as compared to 'Uma' whose poor cooking quality results in less preference of the variety by the millers.

4.5.3. Opportunities of the rice variety, 'Uma'

The opportunities of the rice variety, 'Uma' elicited from the farmers are presented in Table 24

Table 24.Opportunities of the rice variety, 'Uma'

Sl. No.	Opportunities	Index	Rank
1	Combining good attributes of 'Uma' with cooking quality of 'Jyothi'	97.2	I
2	Improving the basic facilities for rice cultivation, to expand the area under 'Uma'	95.4	II

Table 24 reveals that the major opportunity was to combine the good attributes of 'Uma' with the cooking quality of the rice variety, Jyothi, which secured

an index of 97.2. ‘Uma’ was having good quality such as high yield, tolerance to pests and diseases, dormancy of seed and the like. This can be combined with good qualities of other varieties, especially the cooking quality of ‘Jyothi’, thereby developing a variety having more desirable characters. Another opportunity was to improve the basic facilities like road transportation and bund formation for rice cultivation (indices obtained was 95.4). By this, the area under the rice variety, ‘Uma’ can be expanded. This is pertinent because there were 618 ha of wetland kept as fallow in the study area of Kuttanad, mainly due to the lack of basic facilities.

4.5.4. Challenges of the rice variety, ’Uma’

Though Uma had many strengths with very few weaknesses, there were some challenges faced by the farmers. These are presented in Table 25.

Table 25. Challengesofthe rice variety,’Uma’

Sl. No.	Challenges	Index	Rank
1	Fertilizers and pesticides were used unscientifically	85.0	I
2	Due to the cultivation of ‘Uma’ there is an increase in the spread of weed namely *varinellu* in Kuttanad.	71.1	II

Table 25 shows that farmers were unscientifically using fertilizers and pesticides and this was the major challenge of the rice variety, Uma which secured an index of 85.0. This may leads to air pollution and water pollution in the area. Another important challenge was the increased spread of the weed, *Varinellu*in Kuttanad paddy fields (Index of 71.1). This weed cause decrease in the yield of the rice variety, ‘Uma’

4.6. Socio-economic impact of ‘Uma’ on rice farmers

Impact concerns long-termand sustainable changesintroduced by a given intervention inthe lives of beneficiaries. Impact can be related either to the specific

objectives of anintervention or to unanticipated changes caused by an intervention; such unanticipatedchanges may also occur in the lives of people not belonging to the beneficiary group. Impactcan be either positive or negative, the latter being equally important to be aware of. (Blankenberg, 1995)

While assessing the impactcreated by a particular rice variety, it is very much relevant to assess the socio-economic impact created by that variety among the farmers.

4.6.1. Social impact of the rice variety, 'Uma' on rice farmers

Social Impact Assessment includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment (Vanclay, 2003)

In this study, the social impact created by the rice variety, Uma was assessed in terms of social participation, labour use, information seeking behaviour and communication behaviour. The results of Wilcoxon signed rank test and paired 't' test to assess the social impact created by the rice variety, Uma on farmers with respect to the selected variables are shown in Table 26.

Table 26. Significance of the changes in social variables after introduction of the rice variety 'Uma'

SI. No.	Parameter	Mean Rank†		Z value†††
		Negative	Positive	
1	Social participation	0.00††	46.00	8.379**
2	Information seeking behavior	23.89††	24.05	2.499*

3	Communication behavior	13.56††	12.74	1.506 NS
	Parameter	**Mean**		**t-value**
		Before	**After**	
4	Labour Use	72.18	60.34	18.656**

** 1% Level of sigmificance * 5% Level of significance NSNon significant

†Ranking based on the difference of scores as 'before-after'

††Basis for the calculation of test statistics

†††Z- value computed from Wilcoxon signed rank test

Table 26 shows that, the social participation of the farmers improved positively as revealed by the Wilcoxon signed rank test and was significant at 1 per cent level. Information seeking behaviour also showed positive improvement. However, there was no significant change incommunication behaviour of farmers. From these, it can be understood that social participation and information seeking behaviour of the farmers increased significantly after cultivation of the rice variety, Uma. The positive and significant impact of the rice variety, Uma on farmers with regard to social participation and information seeking behaviour may be attributed to the high potential yield of Uma, which prompted farmers to get more information on good agricultural practices, which may increase the yield from the variety. When farmers get good yield and income, chances for social participation and interaction would be naturally more. However, the communication behavior seems to have no significant change.

In contrast, the labour use decreased significantly at 5 per cent level. There was significant reduction in the use of labour after cultivating Uma. The average number of labourers employed/used for one hectare rice cultivation was 72 before introduction of the rice variety, Uma, which has come down to 60 after adopting 'Uma' Thus, the rice variety, Uma could reduce the labour use for rice cultivation.Though the

labour shortage in Kuttanad area might have caused the situation, farmers perceived that this could be achieved because of the amenability of Uma to mechnisation.

A detailed picture on the social impact of the rice variety, Uma on farmers with regardtoeach parameter viz.social participation, labour use, information seeking behaviour and communication is given below:

4.6.1.1. Social participation

Social participation was assessed in terms of membership of the farmers in different organizations and their frequency of attending meetings and the significance in the difference of these parameters before and after cultivation of the rice variety, 'Uma ' is given in Table 28.

Table 27. Change in the social participationafter cultivation of the rice variety Uma

Sl. No	Social participation	Mean Rank†		Z value†††
		Negative	Positive	
1	Membership in organizations	0.00††	42.50	8.123**
2	Frequency of attending the meetings	0.00††	33.00	7.597**

** 1% Level of significance * 5% Level of significance ^{NS}Non significant

†Ranking based on the difference of scores as 'before-after'

††Basis for the calculation of test statistics

†††Z- value computed from Wilcoxon signed rank test

It is observed that the constituents measuring social participation like membership in organization and frequency of attending the meetings in organizations by the farmers showed a highly significant and positive improvement as evident from Table 27. That means, both the parameters of social participation has improved

significantly after cultivation of Uma. Social participation increases contact between individuals and it enhances communication between them. This impact may be due to the fact that after the introduction of the rice variety, Uma interest among the farmers got increased towards rice cultivation. Majority of the farmers started actively participating in *padasekhara*samithies to reduce the cost of cultivation and to reap the benefits out of group farming and also participate in programmes conducted by Krishibhavans (local agricultural development unit) in order to improve their rice production.

4.6.1.2. Labour use

In order to assess the labour use in rice cultivation, the numbersof casual labourers (both male and female), family labourers (both male and female) and permanent labourers (both male and female) used both before and after introduction of the rice variety, Uma were taken into consideration. The results of the paired 't' test , in this respect, to know the significant difference in the number of labourers used is given in Table 28.

Table 28. Change in the use oflabour after cultivation of the rice variety, Uma

Sl. No	Parameter	Mean		't' value
		Before	After	
1	Labour-Female	51.23	43.28	16.207**
2	Labour- Male	22.61	17.18	14.621**
3	Casual labour –Male	21.43	17.32	13.580**
4	Casual labour-Female	48.14	41.26	7.904**
5	Family labour- Male	6.02	2.03	4.323*
6	Family labour –Female	6.18	4.21	2.193*

7	Permanent labour–Female	28.34	16.20	2.913*
8	Permanent labour-Male	10.13	4.61	3.580*

** 1% Level of sigmificance * 5% Level of significance

Table 28 reveals that, there was significant reduction in the use of different types of labourers after introduction of Uma; the use of all the casual, family and permanent labour was reduced in rice cultivation. The reduction was significant at 1 per cent level in the case of casual labour whereas that was significant at 5 per cent level in case of family and permanent labour.

When we take the total male and female labour, the reduction in labour use was significant at 1 per cent level. Thus it is clear that the rice variety, Uma has made a good impact in reducing the labour use among farmers, but without affecting the rice yield. Nowadays most of the labourers are engaged in non-agricultural works in which they earn more money. This leads to labour shortage in the farming sector, which is a serious problem. The farmers could overcome this shortage by using different machines for different operations in rice production. But, in a place like Kuttanad special types of machines are required because of the uniqueness of Kuttanadwetland system, as opined by farmers. The rice variety, Uma is non-lodging and non-shattering in nature and is highly amenable to mechanization. This might have helped the farmers in using machines and reducing the use of labour.

4.6.1.3. Information seeking behaviour

Information seeking behaviour of farmers with elderly persons, extension functionaries, input dealers, neighbours, relatives and other fellow farmers were assessed by comparing the change occurred in these aspects before and after

introduction of 'Uma'.The result of the Wilcoxon signed rank test in this regard is depicted in Table 29

Table 29.Change in the information seeking behaviour of farmers after cultivation of the rice variety, Uma

Sl. No	Information sought from	Mean Rank†		Z value†††
		Negative	Positive	
1	Elderly persons	1.75	2.50††	0.272^{NS}
2	Extension functionaries	35.50††	21.88	5.121**
3	Input dealers	2.00††	3.00	0.378^{NS}
4	Neighbours and relatives	0.00††	1.50	1.414^{NS}
5	Other fellow farmers	15.59	7.41††	1.499^{NS}

** 1% Level of significance * 5% Level of significance ^{NS}Non significant

†Ranking based on the difference of scores as 'before-after'

††Basis for the calculation of test statistics

†††Z- value computed from Wilcoxon signed rank test

As discussed earlier (Table 26) information seeking behaviour of the farmers increased significantly at 5 per cent level. Table 29 shows that information seeking behaviour of farmers with elderly persons, input dealers, neighbours, relatives and other fellow farmers were non-significant. It means that the dependence of elderly persons, input dealers, neighbours, relatives and other fellow farmers for getting new information has not changed significantly. Whereas, Information seeking behaviour of farmers with the extension functionaries showed significant positive improvement after cultivation of the rice variety, Uma, which means that farmers started depending

more on extension functionaries for information, after the introduction of 'Uma'. This may be due to the fact that, extension functionaries like Agricultural Officers were equipped with scientific information, which could be utilized by the farmers for improving their rice production.

4.6.1.4. Communication behaviour

Communication behaviour of farmers with agricultural labourers, fellow farmers and other needy persons were assessed to know the changes occurred after cultivation of the rice variety, Uma. The results of the Wilcoxon signed rank test in this regard are presented in Table 30.

Table 30. Change in the communication behaviour of farmers after cultivation of the rice variety, Uma

Sl. No	Communication with	Mean Rank†		Z value†††
		Negative	Positive	
1	Agricultural labourers	2.83	1.50††	1.300^{NS}
2	Other fellow farmers	0.00††	6.00	3.207**
3	Other needy persons	0.00††	1.50	1.414^{NS}

** 1% Level of significance * 5% Level of significance ^{NS}Non significant

†Ranking based on the difference of scores as 'before-after'

††Basis for the calculation of test statistics

†††Z- value computed from Wilcoxon signed rank test

Table 30 reveals that changes in communication behaviour of the farmers with viz. agricultural labourers and other needy persons was non-significant. i.e., no

significant change happened for the communication behaviour of farmers of Kuttanad tract of Alappuzha with these two categories after introduction of the rice variety, Uma. Whereas, communication of farmers with other fellow farmers have been increased. i.e., communication among fellow farmers increased considerably after introduction of the rice variety, Uma. This may be due to the fact that, interest among the fellow farmers got increased towards rice cultivation due to the high yield obtained from Uma rice cultivation. Due to this, in every stage of crop production, they have to communicate with the fellow farmers properly for better rice production.

4.6.2Economic impact of the rice variety, Uma on rice cultivating farmers

Economic impact is an important parameter for assessing the overall impact made by a rice variety.Economic impact created by the rice variety, Uma was assessed in terms of increase in annual income, family expenditure, increased savings, reduced indebtedness and asset creation. The paired 't' test was used to know the significance of the changes in these variables before and after cultivating Uma, and the results are furnished in Table 31.

Table 31. Significance of the changes in economic variables after introduction of the rice variety, Uma

Sl. No.	Parameter	Mean		t-value
		Before	After	
1	Annual income	172090	322480	12.303**
2	Family expenditure	165780	246720	18.757**
3	Savings	2775	25271	8.277**
4	Indebtedness	208050	48815	8.574**
5	Asset creation	4459400	4672900	2.52**

**1% Level of significance *5% Level of significance

A perusal of Table 31 revealed that annual income, family expenditure, savings and asset creation of the farmers had significantly increased after cultivation of the rice variety, Uma as compared to pre-Uma period, while significant reduction was there in the indebtedness of farmers. The t- value is significant at one per cent level for all the variables.

There was an increment of annual income by 87.39 per cent after the cultivation of 'Uma'. The probable reason for this might be its yield advantage over other varieties.In addition, some of the farmers could enter into other self employment avenues including business, due to cultivation of the rice variety, Uma.

Further, there was a significant increase in the family expenditure by 48.82 per cent.Expenditure, in general, will be in accordance with the income and asincome increases, people will try to satisfy more needs, and this could be the reason for increase in their family expenditure.

An enormous (810%) increase in the savings of the farmers was observed after cultivation of the rice variety, Uma. The increased income of farmers during post Uma period coupled with very less saving during pre-Uma period is the probable reason for this increase.Incase of asset creation, 4.87 per cent increase was observed. Though the percentage seems to be less, the difference was statistically significant. The major asset of the farmers was the landed property, inherited from their ancestors. The farmers could add more assets using the profits from cultivation of the rice variety, Uma

As regards indebtedness, 76.5 per cent reduction was observed after cultivation of the rice variety, Uma. when compared to pre Uma period.. This can be attributed to the high income the farmers derived from cultivation of this variety.. ..

Thus, the rice variety, Uma could make a very promising impact on the economic variables of farmers

4.6.3 Comparative advantage on income of farmers by 'Uma' cultivation

To know the direct advantage of the rice variety, Uma on income of farmers the yield advantage of Uma over Jyothi and local varieties and the subsequent income advantage were compared. The results are given in Table 32

Table 32. Comparative advantage on income of farmers by cultivating 'Uma' in Kuttanad tract of Alappuzha

Variety	Average yield (Kg/ha)	Yield advantage of 'Uma'(Kg/ha)	Income Advantage (Rs.)	
			For one hectare (per season)	For the Kuttanad tract of Alappuzha (per season)
Uma	7500	_	0	_
Jyothi	5500	2000	38000/-	104.3 Crores
Local varieties	2500	5000	95000/-	260.75 Crores

It is observed from Table 32 that the average yield of the rice variety, Uma in Kuttanad tract of Alappuzha was 7500 Kg/ha. The average yield of the rice variety, Jyothi reported by the farmers was 5500 Kg/ha and for local variety, they reported an average yield of 2500 Kg/ha. Thus, as perceived by farmers, the variety, Uma has a yield advantage of 2000 Kg/ha and 5000 Kg/ ha over Jyothi and local varieties respectively, in Kuttanad tract of Alappuzha.

The procurement price of paddy fixed by the Government of Kerala in 2013-14 was Rs.19 per Kg. With this price and the average yield reported, the income that could be obtained from the grain yield of the rice variety, Uma was Rs.1,42,500 per ha in Kuttanad tract of Alappuzha, while those of Jyothi and local varieties were

Rs.1, 04,500 and Rs. 47, 500 per ha respectively. Thus, cultivation of ‘Uma’ will fetch an additional income of Rs.38000 per ha over Jyothi and Rs.95000 per ha over local varieties in Kuttanadtract of Alappuzha.

The total area covered under ‘Uma’ in the study area (Kuttanad tract of Alappuzha) during 2013-14 was 27447.8 ha. Hence the additional income generated through cultivation of the rice variety, Uma by farmers in theKuttanad tract of Alappuzha was computed to be Rs.104.3 crores in a season as compared to Jyothi, and Rs.260.75 crores per season as compared to local varieties. There was cultivation of rice in two seasons in the study area. If we consider, the two seasons and all the previous years (17 years) of cultivation of ‘Uma’ in this tract, this variety surely had given a very high income advantage there by creating a high impact on the farmers.

4.6.4 Rice seed distribution details of Kerala

In the study, an attempt had been made to know the area covered under ‘Uma’ in the state of Kerala. Since, data was not available from various sources, it was attempted to calculate the area based on the rice seed distribution details. The quantity of rice seeds distributed by different agencies throughout Kerala is presented in Table 33.

Table 33. Quantity of rice seeds distributed in Kerala in 2013-14 by different agencies with special reference to 'Uma'

Agency	**Seed distribution of the rice variety, Uma (Tonnes)**	**Total seed distribution in Kerala (Tonnes)**
Kerala Agricultural University	48.463	106.007
KSSDA	5778.68	9330.424
NSC	1500	1650
KSSCP	1100	2050
State Seed Farms	86.86	280.39
Total (Tonnes)	**8514.003**	**13416.821**
Total Area (Hectare)	**106425.038**	**167710.262**

Table 33 and Fig.3shows that Kerala State Seed Development Authority (KSSDA), National Seed Corporation (NSC), Karnataka State Seed Corporation (KSSCP), State Seed Farms and Kerala Agricultural University were the important agencies from where rice seeds were distributed in Kerala. The major share of rice seed distribution was done by KSSDA. The total quantity of rice seeds distributed by different agencies in Kerala during 2013-14 was 13416.821 tonnesand the total quantity of Uma rice seed distributed was 8514.003 tonnes. Based on the available seed distribution data, the total area under cultivation of the rice variety, Uma in Kerala was 106425.038 ha and the total area of rice under cultivation was 167710.262 ha (computed using 80 Kg of seed requirement for one hectare rice cultivation). As per this available data, it can be seen that 63.4 per cent of the area is covered by the rice variety, Uma. This itself show the impact of the rice variety, Uma amongfarmers.

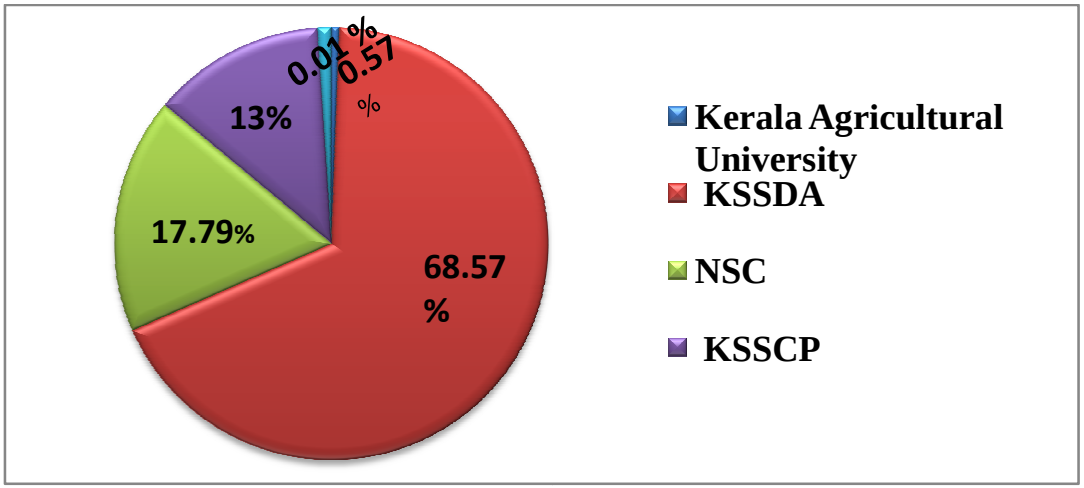


Fig.3 Uma rice seed distribution details of Kerala 2013-14

4.7. Constraints in rice production

A number of constraints have been faced by the rice cultivating farmers of Kerala. Each constraint is different from one production environment to another. The major constraints faced by the rice farmers of Kuttanad are presented in Table 34.

Table 34. Constraints in rice production

Sl. No.	Constraints	Index	Rank
1	Non- availability of labourers	98.60	1
2	High cost of inputs	89.60	2
3	Vagaries of weather and climatic condition	81.20	3
4	Non-fixing of floor price on time	70.80	4
5	Non-standard weights and measure for selling	69.80	5
6	Problems in harvesting	59.20	6
7	Untimely supply of seeds, fertilizers and subsidies	55.60	7
8	Weed menace	53.40	8
9	Political intervention	51.00	9
10	Improper govt. policies and procedures	48.80	10
11	Performance and attitude of labourers	46.00	11
12	Drudgery of cultivation	34.60	12
13	Lack of timely supply of water	33.40	13
14	Poor research and extension contact	29.40	14
15	Lack of co-operation among farmers	29.00	15
16	Non availability of recommended fertilizers	27.60	16

Table 34 shows that the most important constraint faced by the Kuttanad farmers was the non availability of labourers. This constraint recorded an index of 98.60. As we know, labour plays an important role in the entire production period of

rice cultivation. Now a days, most of the labourers are engaged in non agricultural works in which they can earn more money compared to the farming activity. The situation had been worsened by Mahathma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) as opined by the farmers. This might be the reason for their poor interest towards rice farming related labour.

The second important constraint was the high cost of inputs like fertilizers and pesticides with an index of 89.60. Due to this, the cost of cultivation of the farmers got increased and income obtained through rice cultivation reduced. The third important constraint was the vagaries of weather and climatic condition (index of 81.20). Majority of the Kuttanad tract of Alappuzha is covered by low lying wetland area, and untimely and varying rain and drought will create inorbitant problems to the rice farmers. This may reduce the crop yield through pest and disease incidence and crop loss.

Another important constraint was the ‘non fixing of floor price on time’ with an index of 70.80. Majority of the farmers in Kuttanad tract of Alappuzha are marginal and small farmers. So the floor price have to be fixed and modified regularly, which is unfortunately not done on time, as opined by farmers. Moreover, the farmers launch cultivation with money borrowed from bank or other financial institutions. They have to repay the amount immediately after harvest. Though the government had been procuring paddy through the Civil Supplies Corporation, payment of the procurement price is always delayed.

Other constraints of rice farmers includedproblems in harvesting (transportation of the harvested grains), untimely supply of seeds, fertilizers, subsidies, weed menace, political intervention, improper government policies and procedures, performance and attitude of labourers, drudgery of cultivation, lack of timely supply of water, poor research and extension contact, lack of co-operation among farmers and non availability of recommended fertilizers.

SUMMARY AND CONCLUSIONS

5. SUMMARY AND CONCLUSIONS

Rice form the staple food of the people of Kerala. Traditionally, the cultivation of rice has occupied pride of place in the agrarian economy of the State. Palakkad and Alappuzha are the two major rice producing districts of Kerala. Kuttanad (mainly in Alappuzha district) is the region in Kerala where farming is done one to three meters below sea level. The present study entitled 'Impact of the rice variety, Uma(Mo16) on farmers was conducted in Kuttanad tract of Alappuzha district of Kerala state.

The rice variety, 'Uma' (Mo16) developed by Rice Research Station, Moncompu of Kerala Agricultural University released in 1998 and 'Jyothi' (PTB 39), developed from Regional Agricultural Research Station, Pattambi of Kerala Agricultural University in 1974 are the two most popular rice varieties of Kerala. Of these, Uma is said to be the ruling variety at present. Hence an analysis of the attributes of the rice variety, Uma in the farmers perspective, as well as the impact created by this variety on farmers would be highly useful to know the present status, constraints, inadequacies, requirements and gaps, and in turn would help to work out a viable strategy for remunerative rice production.

In this backdrop, the present study was undertaken with the objectives of analysing the attributes of the rice variety, Uma (Mo16) vis-a-vis other rice varieties as perceived by farmers, and assessing the socio economic impact of Uma on rice cultivating farmers.

The study was conducted in Kuttanad tract of Alappuzha. This study employed *ex-post facto* design. A pre-tested structured interview schedule was mainly used for collecting primary data.Of the total 590 *padasekharams* in the study area, five *padasekharams* were selected through simple random sampling method, and from each

padasekharam, 20 farmers cultivating the rice variety, Uma were selected, thus constituting a sample size of 100.

In addition, PRA techniques were employed using the tools such as time line, weighted matrix ranking and SWOC analysis. A total of 138 farmers participated in the five PRA sessions conducted for the purpose. Further, secondary data pertaining to the distribution of rice seedsin Kerala, with special reference to Uma was also collected.

The category of variables analysed in the study included personal variables of farmers, variables related to cultivation of the rice variety, Uma, Adoption attributes of the rice variety, Uma and socio-economic variables. Percentage,Wilcoxon signed rank test and paired 't' test were used for analysing the data. The data were analysed using Statistical Package for Social Science.

Summary of the findings:

The important findings of the study are:

1. The total number of *padashekharams* in Kuttanad tract of Alappuzha district was 590 with an area of 29069.23 ha and the number of *padashekharam* with cultivation is 566 with an area of 28451.23 ha. Whereas, 618 ha area was kept under current fallow in Kuttanad tract of Alappuzha.
2. Fourty seven per cent of the respondents were in the age group of 45-60 years and 49 per cent were in the age group of more than 60 years. Only four per cent of the farmers were in the age group of less than 45 years (35-45 years). None of the farmers belonged to the age group of less than 35 years.
3. All the respondents (100%) were male. No female was there in the respondent category.
4. Fifty per cent of the farmers had'high school level education'followed by 27 per cent farmers'having educational qualification of plus two or equivalent.

5. Majority (64%) of the respondents' families had educational status of plus two equivalent, and one-fourth (25%) of the respondents' families had high school level of education.
6. More than three-fourth(77%) of the respondents had nuclear family.
7. Majority of the farmers (86%) had 'agriculture alone' as the occupation. Only 12 per cent of the respondents were self employed along with engaging in farming.
8. Majority (76%) of the farmers had small family (less than five members) and24 per cent of the respondents had medium family (5-8 members).
9. Exactly 43 per cent of the respondents fell in the category of marginal farmers, while 38 per cent fell in the small farmer category.
10. Majority (90%) of the respondents had more than 20 years of experience in rice farming, while 8 per cent of the respondents had 10-20 years of experience. There were only 2 per cent of the farmers having less than 10 years of experience.
11. Fifty percent of the farmers were cultivating the rice variety, Uma in less than one hectare area, whereas 36 per cent of the farmers were cultivating it in 1-2 ha.
12. Sixty one per cent of the farmers started cultivation of the rice variety, 'Uma' during 1998-2002.
13. All the respondents (100%) were continuously cultivating Uma without shifting to any other rice varieties.
14. Majority (56 %) of the farmers had been continuously cultivating the rice variety, Uma for the last 15 to 17 years. One-fourth (25%) of the farmers had been continuously cultivating 'Uma' for 10 to 15 years.
15. Most(97%) of the farmers cultivated the rice variety, Jyothi before the rice variety, Uma.
16. Most (98%) of the farmers procured seeds from government institutions. Only 1 per cent of the farmers depended on other fellow farmers as well as self production for meeting seed requirements.

17. Majority of the farmers (56%) got an average yield of 7250 Kg/ha from cultivation of the rice variety, Uma, while 20 per cent of the farmers got an average yield of 7500-8500 Kg/ha.
18. With regard to the positive attributes of the rice variety, Uma, tolerance to pests and diseases was the highly rated attribute with an index of 94.6, as perceived by the farmers followed by non-lodging nature of plant and non-shattering nature of panicle
19. Varietal comparison of major rice varieties prevalent in Kuttanad tract Alappuzha revealed that 'Uma' was ranked first with regard to high grain yield, tolerance to pests and diseases, non-shattering nature of panicle and adaptability to local conditions of Kuttanad wetlands. Regarding millers' preference, Jyothi occupied the top position. Altogether, among the varieties, 'Uma' was the superior variety with a score of 520.42 followed by Jyothi (443.95), Prathyasa (418.72), Kanchana (377.27) and Red thriveni (314.94).
20. The major strength of the rice variety, Uma was its 'higher yield' when compared to other rice varieties with an index of 98.8,followed by 'tolerance of the rice variety against pests and disease incidence','higher grain weight', and 'high tillering capacity' with indices 96.0, 91.0 and 89.0 respectively.
21. The major weaknesses of the variety, Uma were its low cooking quality when compared to other rice varieties with an index of 96.1 and less preference of 'Uma' by the millers (94.2).
22. The major opportunity was to combine the good attributes of 'Uma' with the cooking quality of the rice variety, Jyothi, which secured an index of 97.2. Another opportunity was to improve the basic facilities like road transportation and bund formation for rice cultivation (index obtained was 95.4).
23. Farmers were unscientifically using fertilizers and pesticides and this was the major challenge (index of 85.0). Another important challengewas the increased spread of the weed, *Varinellu* in Kuttanad paddy fields (index of 71.1), which caused decrease in the yield of the rice variety, 'Uma'

24. With regard to the social impact of Uma on farmers, social participation and information seeking behaviour had increased positively, whereas labour use had decreased significantly.
25. As regards economic impact, 'annual income', 'family expenditure', 'savings' and 'asset creation' of farmers had increased significantly after cultivation of the rice variety, Uma as compared to pre-Uma period. Indebtedness of farmers was found decreased.
26. Regarding comparative income advantage of Uma, it was found that this variety had an income advantage of Rs.38000/- per ha over the variety, Jyothi and Rs.95000/- per ha over local varieties. Thus, for a single *puncha* season, Uma had given an additional income of Rs.104.3 crores as compared to Jyothi and Rs.260.75 crores as compared to local varieties, in Kuttanad tract of Alappuzha alone.
27. The total quantity of rice seeds distributed by different agencies in Kerala during 2013-14 was 13416.821 tonnes and the total quantity of Uma rice seed distributed was 8514.003 tonnes. Based on the available seed distribution data, the total area under cultivation of the rice variety, Uma in Kerala was 106425.038 ha and the total area of rice under cultivation was 167710.262 ha. As per this available data, it can be seen that 63.4 per cent of the area is covered by the rice variety, Uma.
28. Most important constraint faced by the Kuttanad farmers was the non-availability of labour with an index of 98.60. The next important constraint was the high cost of inputs like fertilizers and pesticides (89.60), followed by vagaries of weather and climatic condition (81.20).

Implications of the study

1.Eventhough the rice variety, Uma has got many positive attributes like high grain yield, tolerance to pests and diseases, non-shattering nature of panicle, adaptability to local conditions etc. research may be focused to enhance the cooking quality of Uma so that millers' preference towards Uma can be improved. If cooking quality of Uma is improved, the price obtained from Uma may also increase.

2. The alarming situation of younger generation moving away from rice cultivation is highlighted in the study. Therefore necessary steps may be initiated to attract and retain younger generation in rice cultivation.

3. The study showed that insufficient infrastructure and basic facilities including transport and storage facilities was a limiting factor of rice cultivation in Kuttanad. Thus the study implies the need for appropriate policy level decisions to allot more funds for the infrastructure development in Kuttanad.

4. Unscientific use of inputs led to high cost of cultivation, imbalance in the rice ecosystem and various health hazards. Hence, extension efforts may be initiated to educate the farmers on the judicious use of inputs and integrated management of resources.

5. Lack of sufficient labour on time was found as one of the major constraints in rice production. Introduction of the concepts of ‘Food Security Army’ and ‘Small Farm Mechanisation’ may be thought of to satisfy the labour problem to a certain extent.

6. The study revealed the huge impact a single rice variety could make amongst farmers.Thus if we assess the impact of good agricultural technologies and research findings generated by agricultural universities, research institutes, research stations and centers, the impact could be still enormous. Thus the study implies the need for intensive and concerted research efforts in the field of agriculture. At present, the share received for Kerala Agricultural University for undertaking research is very less. The results of the study emphasize the need for providing sufficient funds to KAU for agricultural research.

Future line of research

The present study was conducted only among the farmers of Kuttanad tract of Alappuzha district. The study area was limited due to time constraints. Hence similar studies need to be conducted covering other major rice producing areas of Kerala state. A detailed impact assessment of the rice variety, Uma covering the whole state of Kerala can also be done. Assessment of the impact of other major varieties of rice and other crops, as well as impact assessment of other agricultural technologies may be conducted.

Conclusion

As evidenced from the results of the study, it can be concluded that, Uma is the most popular variety in the Kuttanad tract of Alappuzha with a share of 96% of the area under rice cultivation. The importance assigned by the farmers to this variety is evident from the long and continous cultivation of this particular variety. As reported by the farmers, this variety has excellent attributes like high grain yield, tolerance to pest and disease, seed dormancy suited to Kuttanad region, non-shattering nature of panicle and non-lodging nature of plant. But its cooking quality is low, which affects millers' or market preference of this variety. However farmers are not affected because of the procurement of rice by government of Kerala.

The rice variety, Uma could make a very promising impact on the socio-economic variables of farmers. Information seeking behaviour and social participation of farmers improved after cultivation of the rice variety, Uma. Uma made a good impact in reducing the labour use among farmers. With regard to economic impact, annual income, family expenditure, savings, and asset creation of farmers had increased after cultivation of 'Uma'.Indebtedness of farmers was also found to have decreased.

From the Kuttanad tract of Alappuzha alone, in a single season, the rice variety, Uma could make an income advantage of Rs.104.3 crore over Jyothi and Rs.260.75 crore over traditional rice varieties respectively. This will have a multiplier effect if we consider all the seasons of rice production,all the years of Uma cultivation, and all the rice cultivating areas of Kerala. Thus a single variety could make enormous impact among the farmers of Kerala. This itself would justify the funds spent for agricultural research and would highlight the need and significance of agricultural research in Kerala.

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APPENDICES

KERALA AGRICULTURAL UNIVERSITY

Department of Agricultural Extension

College Of Horticulture, Vellanikkara, Thrissur

Respondent No.

INTERVIEW SCHEDULE

(For academic purpose only)

1. Name and address of farmer:

2. Age:

3. Gender:

4. Educational Qualification:

Please give tick mark (✓) in the appropriate column:

Sl. No	Category	Response
1	Lower primary level	
2	Upper primary level	
3	High school level	
4	Plus two or equivalent	
5	Degree or equivalent	
6	Post graduate degree & above	

5. Occupation

Category	Response
Agriculture alone	
Agriculture+ Private employment	
Agriculture+ Govt. employment	
Agriculture+ Self employment	

6. Family type: a) Joint b) Nuclear

7. Details of family members:

Sl. No.	Name	Relationship with farmer	Age	Educational Qualification	Occupation	Monthly Income (Rs)

8. Experience in rice farming: ———— Years

9. Farm size

Type of land	Area in acres			Area under Uma rice cultivation
	Owned	Leased in	Leased out	
Garden land				
Wet land				

10. When did you start cultivating the rice variety, Uma?

11. What was the variety cultivated before the rice variety, Uma?

12. What was the reason behind the shift to the rice variety, Uma?

13. How long Uma has been continuously cultivated by you? ———— Years

14. a) Do you continuously cultivate Uma in the same area ? (Yes/No)

b) Or alternate with some other variety?

c) If yes, which variety?

15. a) Did you shift Uma to some other rice varieties?

b) If yes, which variety and what are the reasons?

c) If no, what are the reasons for sticking on to Uma?

16. Initial impression of Uma rice variety:

a) Excellent b) Very good c) Good d) Fair e) Poor

17. Average grain yield obtained from the rice variety, Uma (Kg/ha):

18. Average straw yield obtained from the rice variety, Uma (Kg/ha):

19. Cooking quality

a) Excellent b) Very good c) Good d) Fair e) Poor

20. Nature of panicle

a)Extremely shattering b) Highly Shattering c)Medium shattering d)Slightly shattering e)Non shattering

21. Lodging:

a)Extremely lodging b) Highly lodging c) Medium lodging d) Slightly lodging

e) Non lodging

22. Tolerance to pests:

a) Extremely tolerant b) Highly tolerant c) Medium tolerant d) Slightly tolerant e) Susceptible

23. Tolerance to diseases:

a) Extremely tolerant b) Highly tolerant c) Medium tolerant d) Slightly tolerant e) Susceptible

24. Milling preference or Market preference:

a) Excellent b) Very good c) Good d) Fair e) Poor

26. Adaptability to local climatic condition:

a) Excellent b) Very good c) Good d) Fair e) Poor

27. Amenability to mechanisation:

a) Excellent b) Very good c) Good d) Fair e) Poor

28. Response to fertilizer application:

a) Excellent b) Very good c) Good d) Fair e) Poor

29. Sources of seeds: a) Govt. institutions b) Persons (Other farmers) c) Self production

30. Whether the yield of the rice variety, Uma is predictable?

a) Clearly predictable b) Predictable c) Slight variations d) Unpredictable

31. Labour use

Type	**Gender**	**Number of labourers used for Uma rice cultivation**	**Number of labourers employed before Uma rice cultivation**
Family	M		
	F		
Hired	M		
	F		
Casual	M		
	F		
Others a)	M		
	F		
b)	M		
	F		

32. Average distance to rice market (Km):

33. Information seeking behaviour

Sl. No.	**Information seeking behaviour**	**Frequency of use**					
		Before Uma rice cultivation			**After Uma rice cultivation**		
		Always	Some times	Never	Always	Some times	Never
1.	Neighbours and relatives						
2.	Progressive farmers						
3.	Other fellow farmers						
4.	Elderly persons						
5.	Extension functionaries						
6.	Scientists						
7.	Input dealers						

8.	Skilled labourers						

34. Communication behaviour

Sl. No.	**Communication behavior**	**Frequency of use**					
		Before Uma rice cultivation			**After Uma rice cultivation**		
		Always	**Some times**	**Never**	**Always**	**Some times**	**Never**
1.	Neighbours and relatives						
2.	Progressive farmers						
3.	Other fellow farmers						
4.	Agricultural labourers						
5.	Other needy persons						

35. Social participation status: (Give tick mark on the appropriate column)

Social participation status	**Before cultivation of 'Uma'**	**After cultivation of ' Uma'**
No membership		
Membership in one organization		
Membership in more than one organization		
Office bearer in one organization		
Office bearer in more than one organization		

Frequency of attending meetings	**Before cultivation of 'Uma'**	**After cultivation of 'Uma'**
Not attended		
Occasionally		
Regularly		

35. If so, what was the reason that actually promoted your social participation?

36. Annual production: ———————— tonnes

37. Annual gross income (Rs.):

a) From Uma rice cultivation:

b) From agriculture other than uma rice cultivation:

c) From non-agricultural activities:

38. Annual gross income before Uma rice cultivation (Rs.):

39. Cost of cultivation (Rs.)/ha:

a) For Uma rice cultivation

b) For agriculture other than uma rice cultivation

40. Cost of cultivation before Uma (Rs.)

41. Family expenditure /month:

42. Family expenditure/ month before cultivation of the rice variety, 'Uma':

43. What are the assets you have?

Sl. No.	**Item**	**Cost**	**Created after cultivating Uma (Tick if Yes)**
1	**Land**		
2	**Farm machinery**		
	Country/Iron plough		
	Levelling board		
	Tractor		
	Tiller		
	Thresher		
	Pump set		
	Harvester		
	Knapsack sprayer		
	Power sprayer		
3	**Home construction/Modification**		
4	**Ornaments**		
5	**Automobiles Car/Jeep/Others**		
6	**House hold equipment**		

	Radio		
	Telephone		
	Mobile phone		
	Television		
	Furniture a)		
	b)		
	c)		
	d)		
	Refrigerator		
	Washing Machine		

44. Savings

Sl. No.	**Agency**	**Amount(Rs.)**
1	Bank	
2	Chitty	
3	Policies	
4	Friends/Relatives	
5	Others specify	

The amount of savings before uma rice cultivation: _____

45. Indebtedness

Sl. No.	**Agency**	**Amount (Rs.)**
1	Bank	
2	Chitty	
3	Money lender	
4	Friends/Relatives	
5	Others specify	

The amount of debt before uma rice cultivation: _____

46. What are the positive changes brought about by the rice variety, Uma?

47. What are the negative changes due to the cultivation of this rice variety?

48. Kindly rate the following constraints in rice production experienced by you according to its severity:

Sl. No.	Constraints	Very important	Important	Less important	Least important	Not important
1	Non-availability of labourers					
2	Political intervention					
3	Vagaries of weather and climatic condition					
4	Lack of timely supply of water					
5	Performance and attitude of labourers					
6	Drudgery of cultivation					
7	Non-standard weights and measure for selling					
8	Non-fixing of floor price on time					
9	Improper govt. policies and procedures					
10	Weed menace					
11	Lack of co-operation among farmers					
12	Untimely supply of seeds, fertilizers, subsidies					
13	Non availability of recommended fertilizer					
14	Problems in harvesting					
15	Poor research and extension contact					
16	High cost of inputs					

IMPACT OF THE RICE VARIETY, UMA (Mo16)

ON FARMERS

By

NESHVA C.P.

ABSTRACT OF THE THESIS

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ABSTRACT

Rice is the staple food of the people of Kerala, and traditionally, the cultivation of rice has occupied pride of place in the agrarian economy of the state. Palakkad and Alappuzha are the two major rice-producing districts of Kerala. About 600 varieties of rice were grown in the sprawling paddy fields of Kerala. One of the most popular rice varieties of Kerala is Uma (Mo.16) developed by the Rice Research Station, Moncompu of Kerala Agricultural University and it occupies more than 60 percent of the paddy cultivation area in Kuttanad region.

The study intended to analyse the attributes of the rice variety, Uma (Mo16) vis-a-vis other rice varieties as perceived by farmers and to assess the socio economic impact of Uma on rice cultivating farmers.

The study was confined to Kuttanad tract of Alappuzha. An ex-post facto research design was adopted for the study. Five *padasekharams* were selected through simple random sampling method, and from each *padasekharam*, 20 farmers cultivating the rice variety, Uma were selected, thus constituting a sample size of 100. A pretested structured interview schedule and PRA techniques were employed for data collection.

The results revealed that tolerance to pests and diseases was ranked first with an index of 94.60 followed by non-lodging nature of plant (92.60), non-shattering nature of panicle (86.70), amenability to mechanisation (75.40), millers' preference (49.60) and cooking quality (42.00).

Varietal comparison of other rice varieties prevalent in Kuttanad area with 'Uma' using PRA technique revealed that 'Uma' was perceived as the superior variety with a score of 520.42 followed by Jyothi (443.95) and Prathyasa (418.72).

Results of SWOC analysis done using PRA techniques, revealed that among the strengths, 'high yield' ranked first with an index of 98.80 followed by 'tolerance against pest and disease incidence' (96.00), 'high grain weight' (91.00), 'high tillering capacity' (89.00) and 'high seed dormancy' (85.2). However, low cooking quality (96.10) and less preference of the rice variety by millers (94.2) were emerged as the major weaknesses.

It was, also found that all the respondents were continuously cultivating 'Uma' without any varietal shift. Majority (56 per cent) of the farmers had been continuously cultivating the rice variety, Uma for the past 15-17 years.

With regard to the social impact on farmers, it was revealed that social participation has improved significantly. Similarly, information seeking behaviour has also increased positively, where as labour use has decreased significantly. However, there was no significant change in the communication behaviour of farmers. As regards economic impact, 'annual income', 'family expenditure', 'savings' and 'asset creation' of farmers have increased significantly after cultivation of the rice variety, Uma as compared to pre-Uma period. Indebtedness of farmers was also found to have decreased. Thus, the rice variety Uma could make a very promising impact on the socio- economic variables of farmers.

Regarding comparative income advantage of Uma, it was found that this variety had an income advantage of Rs.38000/- per ha over the variety, Jyothi and Rs.95000/- per ha over local varieties. Thus, for a single *puncha* season, Uma had given an additional income of Rs.104.30 crores as compared to Jyothi and Rs.260.75 crores as compared to local varieties, in Kuttanad tract of Alappuzha alone.

With regard to constraints faced by Kuttanad farmers, 'non-availability of labour' was ranked first with an index of 98.60 followed by 'high cost of inputs' like fertilizers and pesticides (89.60), 'vagaries of weather and climatic conditions' (81.20) and 'non fixing of floor price on time' (70.80).