IMPACT OF PROMINENT KAU RICE VARIETIES ON THE ECONOMIC STATUS OF FARMERS IN KERALA AND KARNATAKA

By
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(2014-11-221)

THESIS

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DECLARATION

I hereby declare that the thesis entitled **"Impact of prominent KAU rice varieties on the economic status of farmers in Kerala and Karnataka"** is a bonafide record of research done by me during the course of study and the thesis has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.

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"DEDICATED TO MY PARENTS,
FARMING COMMUNITY IN KERALA
AND KARNATAKA"

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Dhruthiraj B.S.

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Introduction

1. INTRODUCTION

Rice is one of the major food crop for over 60 per cent people in the world and it is regarded as the choicest staple food crop (Kumari, 2011). In India, rice constitutes around 44 per cent of total food grain consumption which occupies 23 per cent of gross sown area (Satishkumar *et al.* 2016). Production of rice has immense impact on food and nutritional security throughout the world (Mishra *et al.* 2014). In India rice was cultivated in an area of 30.81 million hectares during 1950-51. The area has increased to 43.90 million hectares in 2013-14 with a production enhancement from 20.58 million tonnes during 1950-51 to 106.54 million tonnes in 2013-14. An average yield of about 2424 kg ha^{-1} has been observed in 2013-14 (GOK, 2015).

Area wise India ranks first, followed by China, but production wise China is leading in the world. The rice production and productivity of China was 207 million tonnes and 6744 $kgha^{-1}$ respectively during 2013-14. It becomes evident that in China rice production is almost twice that of India with the productivity of nearly three times that of India (IRRI, 2014). This points out that in order to meet the food security of growing population in the country production and productivity of rice in India needs to be addressed.

Within our country the area under rice cultivation showed declining trend from 14.83 lakh ha in 2000-01 to 13.26 lakh ha in 2014-15 in Karnataka, but the production showed increasing trend from 38.46 lakh tonnes in 2000-01 to 40.25 lakh tonnes in 2014-15. The average productivity of rice in Karnataka (3184 kg ha^{-1}) was high when compared to national average (2424 kg ha^{-1}) during 2014-15 but low in comparison to Punjab (3952 kg ha^{-1}), (Government of Karnataka, 2016).

Rice is the major staple food crop of Kerala too. Rice production in Kerala amounts to 5.62 lakh tonnes with a productivity of 2837 kg in 2014-15. The area under rice in Kerala has drastically reduced from 8.75 lakh ha in 1970-71 to 1.98 lakh hectare during 2014-15. The area and production of rice in Kerala during the last three decades showed a declining trend of 73.6 per cent in area with a

corresponding decrease of 54.2 per cent in production. At present rice occupies the third position in terms of area under cultivation after rubber and coconut in the state (Government of Kerala, 2015).

The reduction in area of rice is mainly due to the conversion of agricultural land for rubber plantations and urbanization. As per the latest report of Commission on Agricultural Costs and Prices and (Government of Kerala, 2015) this conversion is mainly attributed to the increasing cost of cultivation due to high labour cost and seasonal shortage of labour. The average cost of rice production was high in Kerala as compared to remaining states in India and the conversion of land also leads to more than fifty per cent increase in the gap between demand and supply of rice (Kumari, 2011).

Research problem background

In order to make rice farming profitable and to prevent reduction in area under rice cultivation, further conversion of paddy land for non-agricultural purpose should be prevented. Expansion of area can be thought off by bringing fallow lands under paddy cultivation (Kumari, 2011). Under the limited scope of expansion of area under paddy, productivity enhancement can be achieved through promotion of high yielding rice varieties and promotion of scientific rice farming in larger area through group approach in a participatory mode. Among these the use of the high yielding varieties is recommended as the best alternative (Kumari, 2011). The high yielding rice varieties *i.e* Uma (Mo 16) released from Rice Research Station, Moncompu in 1998 and Jyothi (PTB 39) developed and released from Regional Agricultural Research Station, Pattambi in 1974 continue to be the prominent varieties grown in Kerala and spread in other states especially in some parts of Karnataka (Kumari, 2011).

Considering the need to assess and analyse the impact of rice crop on the economic status of rice farmers who have adopted rice varieties Uma and Jyothi in Kerala and Karnataka the present study was formulated with the following specific objectives:

1. To work out the costs and returns of prominent rice varieties namely Jyothy and Uma released from KAU in Karnataka and Kerala.
2. To find out the relationship between varietal adoption and net farm income.
3. To identify the specific reasons for adoption of KAU varieties.
4. To assess the relative profitability of the KAU varieties in comparison with a local non-KAU variety in the states of Kerala and Karnataka.

Limitation of the study

The study has been restricted to limited locations of two districts of Kerala and two districts of Karnataka and conducted for a limited period of time as a part of M.Sc research work, hence the result of the study can represent only a part of the two states, so the results need to be carefully applied to the other situations in both the states. The results of the study are based on primary data collected through pre-tested interview schedules from farmers, who were not maintaining any field records. However, data were collected based on their memory and could suffer from recall bias and cross checked to minimize the errors and misconceptions.

Plan of thesis

The entire thesis is divided into five different sections. The first section covers an introduction about the topic, research problem background, objective of the research and limitations of the research. In the second section detailed review of earlier works related to proposed research has been included. The description of study area and methodology followed in conducting research is included in the third chapter. In the fourth section results of the research work are discussed and in the fifth chapter summary and conclusion of the research are presented followed by references, abstract and appendices.

Review of literature

2. REVIEW OF LITERATURE

Review of past literature helps to identify the important methodologies that have been used by other researchers and also the findings from related studies. In this chapter, important past studies relevant to the present study have been reviewed and discussed. The reviews are arranged under the following headings.

2.1. Economics of rice cultivation

2.2. A comparative study of rice varieties

2.3. Specific reasons and factors affecting varietal adoption

2.4. Marketing channels of paddy varieties

2.1. Economics of rice cultivation

Panthhe and Tripathi (2003) estimated the costs and returns of rice production and identified the problems faced by rice growers in a study conducted in Bardiya district of Nepal. It was found that cost of production of high-yielding rice varieties increased as the size of farms increased and high-yielding varieties of rice are more profitable with adequate facilities over conventional varieties. They concluded that high-yielding varieties of rice are intensive resource oriented crops as they require all recommended technologies for achieving maximum production.

Shanmugam and Venkataramani (2006) conducted a study to analyse the technical efficiency in agricultural production in different states of India. The study revealed that the variables such as labour, land area, fertilizer quantity had positive influence on agricultural production with 1 per cent level of significance and also added that mean technical efficiency of the sample was 79 per cent at all India level. It was reported that the technical efficiency of agricultural production in Orissa (84.95 per cent) was highest and Madhya Pradesh (77.07 per cent) was the lowest.

In a study conducted by Suresh and Reddy (2006) in the Peechi command area of Thrissur district in order to examine the resource productivity, allocative and technical efficiency of cultivation of paddy, it was found that the total cost of cultivation of paddy was ₹21,603 ha^{-1} and the human labour followed by farmyard manure accounted for the highest share in the total cost of cultivation with 63.47 per cent and 11.67 per cent, respectively. The B:C ratio of cultivation of paddy was 1.34 with average return of ₹28, 999 ha^{-1}. The study also revealed that the coefficient of area under paddy cultivation, human labour, fertilizer and supplementary irrigation had positive signs and were statistically significant.

To find out the technical efficiency in rice production Abedullah *et al.* (2007) conducted a study in Pakistan among 200 rice farmers. Stochastic frontier approach was used for the analysis of the data. It was found that variables such as sowing area, irrigation hour and labour hour are positive and significant on output of rice, however number of ploughings and fertilizer nutrients were significant but negative. It was reported that rice farmers' in the study area were operating at an average of 91 per cent technical efficiency level and hence adoption of new varieties was the only alternative for higher productivity in the long run.

Nirmala and Muthuraman (2009) in their study to identified the constraints and analyse the cost and return aspects in rice cultivation covering four villages of two blocks in Kaithal district of Haryana, found that in the total variable cost machine labour contributed highest percentage (25.27 per cent) followed by human labour (19.72 per cent), fertilizer (18.9 per cent) and pesticides (11.56 per cent). They stated that per hectare gross costs of cultivation of rice as ₹33778.68 and the B:C ratio of the paddy cultivation in the study area was 1.27. Pests and disease incidence, lack of remunerative price, labour shortage were observed as the major constraints in rice production in Kaithal district.

A study to determine yield, input use, and net returns from paddy cultivation in the Kole land of Kerala was conducted in 2012 by Srinivasan. It was found that per hectare yield of paddy in Kole land cultivation was 3705 kg ha^{-1}. It was reported that labour cost constitutes over 65 per cent of the total cost of

cultivation and this can be reduced by using machines for transplanting and harvesting.

Ahirwar *et al.* (2013) conducted a study on cost of cultivation, cost of production, profitability and constraints of rice cultivation at different size of farms in Central Narmada Valley agro climatic region of Madhya Pradesh. Based on the study it was found that the cost of cultivation was highest in large farm (₹33128.51ha^{-1}) compared to the small (₹26623.81ha^{-1}) and medium farms (₹30177.59 ha^{-1}). They reported that the rice grower of small farms received a higher income of ₹71543 ha^{-1} as compared to rice grower of large (₹70952.50 ha^{-1}) and medium farms (₹69793.50 ha^{-1}). B:C ratio was found to be highest for the Small farmer (₹2.69) as compared to medium (₹2.31) and large (₹2.14) farmer. It was concluded that the profit in rice production can be further increased by eliminating constraints like high cost of input, insect pests, weed problems, lack of hired human labour during the operation period, soil problems and by providing knowledge on recommended package of practices.

Grover (2013) in his study on the economic profile of rice cultivation in Punjab. It was found that total variable cost of cultivation of rice was ₹17657 ha^{-1} and gross return per hectare was ₹54585 with a returns over variable costs of ₹36927. Based on regression analysis, he reported that there existed scope for further increase in the use of insecticides/pesticides, manures/ fertilizer and irrigation for improving the rice yield in Punjab and also noticed bacterial leaf blight and false smut as the major challenges. He concluded by stating that the need of the hour for the rice farmer was breeding of high yielding varieties to improve the yield.

The study conducted to examine the costs and returns in the production of paddy by Suneetha and Kumar (2013), in Andra pradesh among 400 farmers. The study revealed that per acre average total cost of production of paddy was ₹20,983, average total return was ₹40,251 per acre and average net return of paddy cultivation per acre was ₹19268.

To test the farmer's technical efficiency in paddy cultivation Kadiri *et al.* (2014) conducted a study in Nigeria. The technical efficiency of the rice farmers was estimated by using stochastic frontier production function. The study revealed that the coefficient of land area, seed, family labour, hired labour, fertilizer application and herbicide application had positive signs and were statistically significant at 1% level. It was reported that majority of sample respondents (38.40 per cent) had technical efficiency of inputs between (0.61 – 0.70 per cent) followed by 30 per cent in (0.51 – 0.60 per cent level) and only 3.00 per cent respondents are operating in (0.91 – 1.00) per cent efficiency level and mean technical efficiency of the rice farmers was estimated as 0.626.

To study the economics of rice cultivation and to know the constraints faced by farmers in the production of Mahamaya variety of rice a study was conducted in Dhamtari district of Chhattisgar by Churpal *et al.* (2015). The results showed that total cost of cultivation of Mahamaya was found to be ₹37090.31ha^{-1}, which comprised of 61.14 per cent of labour cost followed by input material cost (32.56 per cent) and fixed cost (6.30 per cent). The yield of Mahamaya was recorded to be 55.79 quintal ha^{-1}. The study concluded that due to its industrial importance for the preparation of flakes and due to the higher net return of ₹50342.09 ha^{-1}, Mahamaya with a B:C ratio of 2.36 was reported as a more profitable rice variety than that of other rice varieties.

To analyse the cost and returns, resource use efficiency and technical efficiency in rice production, Devi and Singh (2015) conducted a study in Manipur. By using stochastic production function approach they analysed the resource use and technical efficiency of rice cultivation. The average cost of cultivation of paddy was estimated as ₹ 68924.64 ha^{-1} and found that the imputed rental value of owned land and hired human labour accounted for a major portion in the total cost of cultivation contributing 27.56 and 26.37 per cent respectively, followed by machine labour (11.47 per cent), fertilizer (6.42 per cent) and managerial cost (5.62 per cent). Regression coefficients of fertilizer and human labour were reported to be significant and positive at 1 per cent level of significance. The mean technical efficiency of rice farmers in the study area was

found to be 96.30 per cent. Fourty per cent of the respondents were operating at the 99-100 per cent technical efficiency level.

A study on the economics and constraints of rice cultivation in Koriya district of Chhattisgarh by Uday *et al.* (2015). The study revealed that the cost of cultivation was ₹ 8472.69 ha^{-1}. The average yield of paddy was 18.61 quintal ha^{-1}. The lack of technical knowledge, low adoption of recommended package of practices and lack of financing were the major problems faced by the paddy growers in the region and therefore disseminating technical knowledge and providing irrigation facilities, the farmers could be able to adopt improved technologies thus increase production as well as net income from the paddy cultivation.

Vasanthi and Sivasankari (2015) in their study on resource use and technical efficiency of rice farm in the Cauvery delta of Tamil nadu found that the regression coefficients for seed and labour hours were significant but negative at 5 per cent level, whereas the fertilizer coefficient was found to be positive and highly significant at 1 per cent level and mean technical efficiency of rice farm was 82.97 per cent and about 28.44 per cent of the total respondent farmers were operating at 90-100 per cent technical efficiency level.

2.2. A comparative study of rice varieties

Mian (1976) assessed the relative profitability of rice crops in Comilla, Bangladesh by means of a detailed analysis of cost of production and returns. It was found that the cost of cultivation of HYV is higher than the local varieties, since HYV rice require more inputs (particularly fertilizers and insecticides) than the local varieties. It was concluded that per acre net return from local varieties is 50 per cent lesser than that of HYV at both government and local market rates.

A study was conducted in 33 locations of Bangladesh to evaluate four imported hybrid rice cultivars *i.e.*, one from China (Sonarbangla1) and three from India (Amarsiri1, Aalok and Loknath) and with a high yielding variety (BRRI Dhan29) as control by Parvez *et al.* (2003). In this study Sonarbangla1, performed better than the other three Indian cultivars and the control in terms of all the parameters considered and all the three Indian cultivars had lower

performance than the control. It was reported that Sonarbangla1 gave a 20 per cent higher yield (7.55 tons ha^{-1}) than the control (6.26 tons ha^{-1}) and Sonarbangla1 had 32 per cent higher cost of cultivation than the control. It was concluded that Sonarbangla1 yielded 21 per cent higher gross return than the control.

To make comparative cost benefit analysis of per acre rice production of different rice varieties, Hussain *et al.* (2008) conducted a study in Swat district of Pakistan where the total per acre rice production of seven varieties namely JP-5, Basmati-385, Sara Saila, Dil Rosh-97, Swat-1 and Swat-2 and Fakhr-e-Malakand are ₹40000, ₹52500, ₹33600, ₹34000, ₹30400, ₹30400 and ₹68750 respectively. Fakhr-e-Malakand was found to be the most profitable variety after considering total costs, total production and total net production per acre.

To examine the costs and returns and the problems confronting the NERICA rice and local rice production, a study was conducted in Nigeria by Kudi *et al.* (2010) and found that labour cost and fertilizer inputs accounted for the highest share in total variable cost of both NERICA rice and local rice production with 73.99 and 52.75 per cent respectively. The total cost of production for NERICA rice and local rice were N116,638.10 and N85,803.45, with gross revenue of N351,280.00 and N157,500.00 per ha respectively. The study concluded that NERICA rice production was more profitable than the local rice production. Inadequate improved seed varieties, bad road network, pests and diseases, lack of capital and storage facilities were identified as the major problem faced by the rice producing farmers of the study area.

To determine the costs, returns and relative profitability of BARI GOM-24 and BARI GOM-23 wheat varieties, a study was conducted by Islam (2012) in Dinajpur distict of Bangladesh. The results showed that per hectare gross cost of production of BARI GOM-23 was higher than BARI GOM-24 with Tk. 54104.15 and Tk. 49898.54 and BARI GOM-24 showing higher gross return of about Tk. 67111.82 than BARI GOM-23 was Tk. 58406.40. It was reported that per hectare net return of production of BARI GOM-24 was more profitable than BARI GOM-23. BCR was found to be higher for BARI GOM-24 (1.35) than

BARI GOM-23 (1.08). It was concluded that cultivation of BARI GOM-24 was more profitable than BARI GOM-23 wheat variety.

To identify the farm level adoption, differential performances and relative performances of two rice varieties, BRRI dhan 51 and BR11 a study was conducted by Rakib (2012) in Mymensingh district of Bangladesh. The study showed that BRRI dhan 51 had a higher total cost of production of about TK.39022.55 ha^{-1} with productivity of 4.7 tons yield ha^{-1} than BR11 (Tk.35973.5 ha^{-1}) with 4.5 tons yield ha^{-1} and therefore reported that gross return was higher in BRRI dhan 51 (Tk.99660.84) than BR11 (TK.78953.01) and hence BRRI dhan 51 was more profitable. The main factors responsible for adoption of BRRI dhan 51 was due to its flood tolerance, short duration, higher yield, weed resistance and good taste.

Rahman and Kamruzzaman (2012) in their study to identify the relative profitability of an early variety BRRI Dhan51 and BR11 in Rangpur region of Bangladesh, with a total of 60 farmers selected purposively from one village of Sadar Upazila of Rangpur district and found that gross cost of production was Tk. 55105.21 ha^{-1} and Tk. 56185.79 ha^{-1} for BRRI Dhan 51 and BR11 respectively and concluded that growing BRRI Dhan 51 was much more profitable than BR11.

To identify the farm level adoption, differential performances and relative profitability of two rice varieties Guti Sharna and Nepali Sharna rice a study was conducted in Gaibandha district of Bangladesh (Anonymous, 2013). Simple cost and return analysis and relative profitability of two varieties were assessed. The results showed that the per hectare total cost of production for Guti Sharna and Nepali Sharna rice varieties were Tk 44,324.08 and Tk 44,765.15 respectively and per hectare yield of Guti Sharna was found to be higher than Nepali Sharna with 4.97 tons and 4.55 tons respectively. It was reported that gross return per hectare from Guti Sharna and Nepali Sharna rice were Tk 73,389.23 and Tk 69,329.58 and Net returns per hectare were found to be Tk 29,065.14 and Tk 24,564.425 respectively. It was concluded that production of Guti Sharna was more profitable than Nepali Sharna.

Hussain (2013) conducted a comparative economic analysis of seven rice varieties JP5, Basmati385, Sara Saila, Swat1, Swat2, Dil Rosh97 and Fakhr-e-Malakand of rice (*Oryza sativa*) in the district Swat of Pakisthan by using the benefit cost ratios, log linear Cobb-Douglas production function, Wald test and marginal rate of substitutions as analytical tools. It was found that maximum benefit cost ratio was reported for variety Fakhr-e-Malakand (3.41) followed by Basmati 385 (3.37). It was concluded that Fakhr-e-Malakand was the most profitable variety as compared to all other rice varieties and the farmers were advised to cultivate high yielding varieties like Fakhr-e-Malakand.

In a study to evaluate the performance of local aromatic rice cultivars such as Kalijira, Khaskani, Kachra, Raniselute, Morichsail and Badshabhog, Islam *et al.* (2013) reported that Raniselute had high grain weight compared to Kalijira with 32.09 g and 13.32 g respectively and the highest grain yield was produced by Morichsail (2.53 tons ha^{-1}) followed by Kachra (2.41 tons ha^{-1}), Raniselute (2.13 t ha^{-1}) and Badshabhog (2.09 tons ha^{-1}) and the lowest grain yield was produced by Kalijira (1.80 tons ha^{-1}).

A study was conducted by Sarker *et al.* (2013) to identify the morphological, yield and yield contributing characters of three local varieties namely Bashful, Poshursail and Gosi with one high yielding variety BRRIdhan 28. The results revealed that BRRIdhan 28 was significantly superior with more tillering capacity, higher leaf number than the local cultivars and produced higher number of grains per panicle and bolder grains. It was concluded that BRRIdhan 28 produced higher grain yield of 7.41 tons ha^{-1} than that of local varieties.

Wagan *et al.* (2015) in their study to compare the hybrid rice with conventional rice in terms of financial gain in Pakistan using data from the 30 hybrid and 30 conventional rice growing farmers. The study asserted that the total cost of production of hybrid rice per acre was more than conventional rice with ₹ 62010.87 per acre for hybrid rice and ₹ 56972.09 per acre for conventional rice. This was mainly due to the higher seed prices, higher land management costs for hybrid rice. It was also reported that the higher average yield of about 79.41monds per acre was obtained from hybrid rice than conventional rice

(59.74 monds per acre) wherein and market price of both hybrid rice (₹981.72/mound) and Conventional Rice (₹992.25/mound) was nearly the same. Hence they concluded that hybrid Rice farmers had a higher farm yield and farm profit compared to conventional rice farmers.

2.3. Specific reasons and factors affecting varietal adoption

Singh *et al.* (1970) conducted a study in Uttar Pradesh to determine important reasons for adoption and non-adoption of improved rice varieties and it was found that high yield and high net income from improved varieties were the main reasons for adoption of improved varieties and lack of information, small size of holdings and lack of financing were the reasons for its non-adoption.

In order to identify the risk and uncertainty found in adopting new technology like high yielding varieties against local varieties a study was done in Guyana and Nigeria. It was found that a higher market price of rice generally leads to adoption of high yielding varieties (HYVs) over the traditional varieties. (Henry, 1988).

Shrestha and Bhandari (2000) in a study in Nepal to determine the important reasons for adoption and non-adoption of improved varieties in three different systems such as normal, spring and upland systems of rice cultivation. They found that higher yield and lodging tolerance in normal season rice, easier threshing and good cooking quality in spring season and higher productivity, early maturity, higher milling recovery and good quality of grain in upland systems were the main reasons for adopting improved rice variety. Lack of technical information, lack of improved seeds and lower straw yield were identified as the main factors for non- adoption of improved varieties.

Saka *et al.* (2005) in their study to identify the factors affecting the adoption of improved rice varieties in south-western Nigeria. Logit regression model was used for the study. Education, age, membership in organizations, yield potential of the variety and size of the rice farm were identified as important factors affecting the adoption of improved rice varieties. Adopters of improved rice varieties were considered to be younger in age (42.8 years), more educated

(93.7 per cent), more membership in organization (87 per cent), than the non-adopters and rate of adoption was more among the farmers growing improved varieties (68.7 per cent) than local varieties growing farmers (31.3 per cent). The study concluded that average yield of improved rice varieties was significantly higher than the local varieties with 1.601 tons ha^{-1} and 1.154 tons ha^{-1} respectively.

To determine factors influencing adoption and specific reasons for preferring improved varieties over traditional varieties, a study was conducted by Joshi and Pandey (2005) in Nepal. They identified the variables affecting adoption of improved varieties as education, experience and availability of extension services. They concluded that attributes of improved varieties such as high gain and straw yield, drought tolerance and straw quality were the main reasons for preferring improved varieties over local or traditional varieties.

To know the extent of adoption of improved varieties and to determine the factors affecting the adoption of modern varieties Hossain *et al.* (2006) in their study in Bangladesh, found that the area under the modern varieties (MVs) was only 16 per cent of total rice-cropped area in 1980s, which was extended to 65 per cent in 2001-02. They reported that prepotency of small and marginal farmer was the important socioeconomic factor that affected the adoption of modern varieties and small and tenant farms showing a higher rate of adoption than medium and large farms. The main constraints observed for the varietal adoption were non availability of irrigation facilities in the dry season and salinity of the soil in the coastal region.

A study was conducted by Devi and Ponnarasi, (2009) in Tamil nadu to determine the costs and returns of paddy in the System of Rice Intensification (SRI) in comparison with conventional method and also to identify the factors influencing the adoption of SRI and problems in its adoption. It was found that per hectare total cost of cultivation was lower by 10 per cent in SRI method (₹ 21655) than the conventional method (₹25914) and human labour occupied the highest share in total cost of cultivation in both the methods of rice cultivation with 43.61 per cent in SRI method and 41.87 per cent in conventional method.

It was reported that net returns was higher in SRI (₹27009) than conventional method (₹14499) as the productivity of paddy is higher in SRI method. By using Logistic Regression Model the socio -economic characteristics of the respondents, such as age, literacy level, farm size, income from farm, number of earning members in the family, and number of contacts with the extension agencies were identified as important factors affecting the adoption behaviour of respondents. Hence they concluded that the number of earning members was found to be having a higher degree of influence on adoption behaviour of respondents followed by number of contacts with extension agencies, farm size, income of the farm, literacy level and age.

Tura *et al.* (2010) in their study in Central Ethiopia to identify the determinants of adoption of the improved maize seeds. Bi–variate probit model used as an analytical tool. It was found that about 63 per cent of the sample households adopted improved maize seeds whereas remaining 37 per cent were non-adopters. The study revealed that rate of adoption in study area was estimated as 92 per cent and membership of the farmers in cooperative societies, access of the farmers for credit from formal sources, large family size were found to have a positive influence on the decision of the farmers to adopt improved maize seeds.

To analyse the adoption pattern of modern and traditional rice varieties and important factors influencing adoption in different hydrological conditions a study was carried out in coastal Orissa by Samal *et al.* (2011). By using probit model, adoption behaviour of the farmers were analysed. Results of the study showed that the adoption of modern varieties by all farms in both lowland and midland were 11 and 37 per cent respectively and on an average modern varieties (MVs) was adopted only by 28 per cent of farms. The percentage coverage of total rice area in the midland by the MVs was maximum with varieties Swarna (18 percent), followed by Mahsuri (2.5 per cent), Parijat (1.0 per cent), Lunishree (0.9 per cent), and Chandrika (0.9 per cent). In low lands the modern variety which covered maximum area of rice was CR-1018 (0.7 per cent). It was 16 per cent in case of Bhaluki in medium land and Panisaanla in lowlands.

To identify the difference between NERICA and non-NERICA rice growing households and to know the factors that affect the adoption and diffusion of NERICA rice, a study was done by Kijima and Sserunkuuma (2013) in Uganda. From the first survey, it was observed that adoption rate at national level was very low for NERICA rice (0.67 per cent) however in the second survey adoption rate of NERICA in sample area was 16.5 per cent which is higher than the adoption rate at national level. It was found that membership in farmers' groups, formal education and number of household members were identified as important factors affecting the adoption of NERICA varieties.

Borthakur *et al.* (2014) in a study in three districts of Assam to assess the extent of adoption of rice varieties recommended by Assam Agricultural University (AAU), Jorhat in different rice growing seasons like Sali, ahu, boro and bao. They found that in Sali season, the highest percentage of adoption was showed by Ranjit variety (91.94 per cent) followed by Bahadur (38.33 per cent) and Mahsuri (22.22 per cent), whereas in Ahu season Krishna variety had the highest percentage of adoption (14.44 per cent) followed by Kaveri (12.22 per cent). In Bao season Boga Amana had the highest percentage of adoption (4.72 per cent) followed by Rangabau (2.50 per cent). They also found that due to the menace created by the stray cattle in the study area, the cultivation of boro rice has come to an end. It was concluded that a positive and significant correlation exists between the extent of adoption of AAU recommended rice varieties with age, family size and operational land holding.

To identify the factors that influence the adoption behaviour of the farmers towards improved rice varieties and its outcome on rice output, a study was taken up by Bruce *et al.* (2014) in Ghana. A treatment effect model including a probit model and a production function were used as analytical tool to identify important factors that affect the adoption behaviour. It was found that farmers with formal education, bigger households and with smaller farm size adopted improved rice varieties. It was also reported that adoption of improved rice varieties and rice output had a positive relationship. They concluded that formation of farmers

organization and improving literacy rate of the farmers increased the adoption rate of the improved rice varieties in the study area.

Chekene and Chancellor (2015) in his study to determine important factors such as socioeconomic characteristics of the respondents and institutional factors that affect the adoption of improved rice varieties in borno state of Nigeria. It was observed that among the total respondents 44 per cent of the respondents belonged to fast adopters category, followed by slow adopters and non-adopters of 35 per cent and 21 per cent respectively. It was reported that gender, level of experience in farming, farm size, seed access are the important socioeconomics characteristics and credit access, extension contact, farmers association and subsidising input are the important institutional factors that affect the adoption behaviour of respondents. It was concluded that inappropriate supply chain of input or late arrival of input (seed, fertilizer, chemical spray) influenced the adoption decision of farmers.

Chhogye and Bajgai (2015) in their study to examined the specific reasons for the adoption of modern paddy varieties and found that high yielding nature, pest and disease resistance attributes of improved varieties and technical guidance given by extension agents resulted in the higher adoption of modern varieties by the respondents.

Ghimire *et al.* (2015) conducted a study in four districts of Central Nepal to determine the key factors associated with adoption of the improved high yielding rice varieties. The probability of adoption of new improved rice varieties (NIRVs) by farmers at farm level was determined by using probit model. It was found that 68 per cent of the sample households adopted NIRVs and there was a significant difference in age and education of the household head between adopters and non-adopters. The adopter farmers had higher farm size than the non-adopters, the adopting households also differed than non-adopters in land type. Majority of NIRVs adopters had access to improved seeds and extension services compared to non-adopters. It was reported that education was an important factor in deciding adoption behaviour of farmers. Propensity to adopt NIRVs by farm households increased with the level of education of household

head. Farm size also has a positive relationship in adopting NIRVs, The availability of extension services also played a significant role in adoption of NIRVs among farm households, adoption of NIRVs also increased with increase in the yield potential of the NIRVs variety. Acceptability of the grain in the market by consumers had positive and significant impact on the adoption of NIRVs. It was concluded that yield potential and acceptability were significant factors in explaining adoption behaviour of the farmers.

To determine the sources of information to the farmers about a modern variety and factors affecting the adoption of modern rice varieties in Bangladesh a study was conducted by Tiongco and Hossain (2015). Varietal adoption factors were determined and found that about 57.8 per cent of households depended on agricultural extension staff for the source of information about the modern varieties followed by other farmers (27.6 per cent), relatives and friends (6.2 per cent), fertilizer dealer (3.2 per cent) and television (1.9 per cent). It was reported that irrigation facilities such as tubewell in both aman and boro season, sources of seeds such as farmers own harvests and other farmers harvests, larger farm size increased the rate of MV adoption, whereas environmental conditions and agro ecological factors such as saline-affected areas and high land, very low land respectively having a negative relationship with the MV adoption. The study stated that higher yield, good quality of grain and resistance to pests considered by the farmers as the most important varietal preference characters of MVs in the study area.

2.4. Marketing channels of paddy varieties

Rajagopal (1986) proposed a study to identify different marketing channels for paddy sale in Madhya Pradesh. He identified four different marketing channels, viz. one which is selling the produce of farmers to consumers through commission agents or brokers to traders, second channel to the processing units from brokers, third one directly selling by farmers to marketing cooperatives and fourth one directly selling by farmers in regulated markets.

A study was conducted by Rajagopal (1990) in Chhattisgarh and Madhya Pradesh to identify different marketing channels prevailing in study area and

identified four different channels in paddy marketing by paddy growers Firstly, through commission agents/brokers, second channel through agents to rice millers, third channel through cooperative market and fourth channel through selling in regulated markets.

A study was conducted in Orissa to determine different marketing channels of paddy by Mohapatra *et al.* (1998). They found three different channels of marketing and the first channel in which produce directly moves from producer to consumer, second channel wherein produce moves through retailer before it reaching to consumer from producer and third channel in which two different channels were identified between producer and consumer they are trader and retailer.

Sajjad *et al.* (2008) found two paddy marketing channels in Pakistan. The first channel involves wholesalers and retailers between producer and consumer. Second channel involves village trader, wholesalers and retailer between producer and consumer.

Shelke *et al.* (2009) identified three paddy marketing channels in Maharastra, the first channel was from producer to consumer through commission agents, wholesalers or rice millers and retailers. Second channel from producer to consumer through commission agents, wholesalers or rice millers and fair price shops and third channel in which retailers mediate between producer and consumer.

Parshuramkar *et al.* (2014) reported that there existed three different marketing channels in Maharastra and the first channel was from producer directly to consumer and second channel contains two or more intermediates between producer and consumer involving rice miller and retailer. In third channel three more intermediates were observed viz village trader, rice miller and retailer. In last channel they identified three more channel viz wholesaler, rice miller and retailer.

Soe *et al.* (2015) conducted a study in Myanmar to identify different channels for selling paddy and reported on three different marketing channels. First channel directed from farmer to broker or commission agent, second channel

from collectors or traders from farmers and third channel involving selling of produce directly to the rice millers by farmers.

Materials and methods

3. Methodology

In this chapter, a brief description of the study area and the research design followed in the present study including sampling procedures, the method of data collection and tools of analysis are discussed. The section enables the readers to evaluate the work performed and permit them to replicate the study if needed.

3.1 Area of the study

The study was undertaken in the major rice growing tracts of Palakkad and Alappuzha district of Kerala, Mysore and Mandya districts of Karnataka. The present study attempts a comparative economic analysis of KAU rice varieties with local non-KAU varieties, varietal adoption and the specific reasons for adoption of KAU varieties in Kerala and Karnataka.

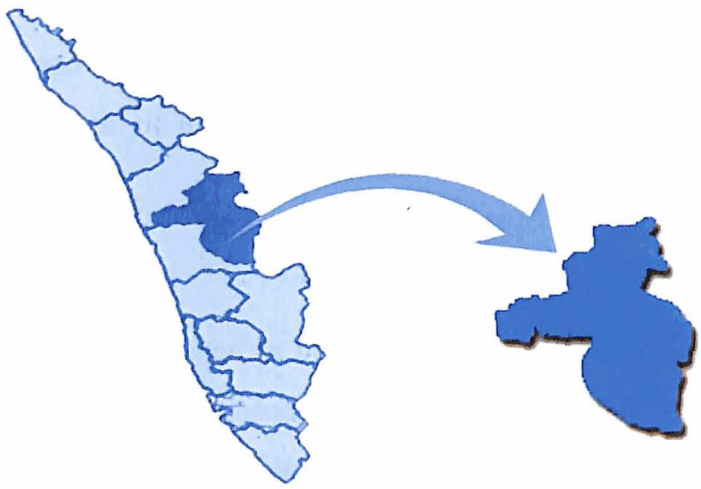
3.1.1 Palakkad district

Palakkad is commonly called as gateway to Kerala due to the Palakkad gap, in the Western ghats. The district is spread over an area of 4,480 km^2 which represents 11.5 per cent of the state's total area. As per 2011 census, population of Palakkad was reported as 2,810,892. The district is also known as 'Granary of Kerala' and agriculture is the main source of livelihood of people in the district. The district occupies first position in the state with 42 per cent of total area cultivation under paddy. The important agricultural crops grown in the district are paddy, coconut, rubber, pulses, arecanut, tapioca, ginger, groundnut, sugarcane, cotton etc.

3.1.1.1 Location

Palakkad district is located between 10° 46' 21" North Latitude and 76° 39' 5" East Longitude. It is surrounded by Malappuram on the north west, Thrissur on the south west, The Nilgiris on the north east and Coimbatore on the eastern side.

Fig 3.1 Map of the study area: Palakkad



3.1.1.2 Topography and climate

Palakkad generally has a tropical wet and dry climate. Temperature remains moderate throughout the year except in the month of March and April which are identified as hottest months. A major portion of the rainfall received during South west monsoon period. March is recorded as the hottest month in the district with 37.3°C. The lowest temperature in the district was recorded in July (22.5°C). Total annual rainfall of the district was recorded as 83 inches during the year 2015.

3.1.1.3 Demographic features

As per 2011 census, the population of the district is 2,810,892 with 1,359,478 males and 1,450,456 females. The gender ratio in the district is 1067 females for every 1000 males. The population density in the district is reported as 627 persons per square kilometre. The average literacy rate of the district was found as 89.31 per cent.

3.1.2 Alappuzha district

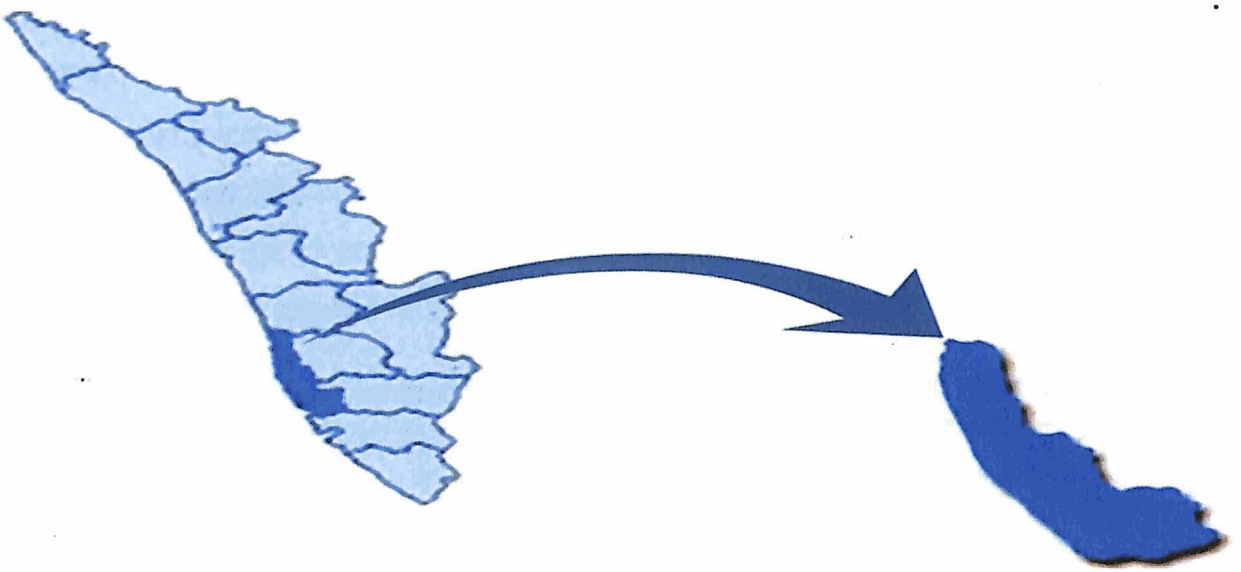
Alappuzha district is the smallest district in Kerala. It is commonly called as "Venetian Capital of Kerala". The district is spread over an area of 1414 km^2 constituting 3.64 per cent of the total state area. As per 2011 census, the population

of the district was estimated as 21,09,60. Agriculture is the major occupation in the district. Kuttanadu, in Alappuzha is famous for cultivation of paddy on the backwaters of Kerala and also regarded as the 'Rice bowl of Kerala'. The important cultivating crops are crops of the district are paddy, tapioca, mango, jack and papaya.

3.1.2.1 Location

Alappuzha district is situated in between 9° 05' and 9° 54' North latitudes and 76°17' 30" and 76° 40' East longitudes. The district is bounded by Kochi and Kanayannur taluks of Ernakulam district at north, Kottayam and Pathanamthitta districts in the east, Kollam District in the south and Lakshadweep (Arabian) sea in the west.

Fig 3.2 Map of the study area: Alappuzha



3.1.2.2 Topography and climate

Alappuzha is a sandy strip of land that is intercepted by lagoons, rivers and canals. There is no forest area reported in this district, nor any mountain or hilly terrain. The climate is hot and humid in the coastal belt while the interior is comparatively cooler. The month of May is reported as the hottest with 32^0 C while the average temperature is around 25^0 C. July is reported as coolest month with 23^0 C. The average rainfall received by the district is 2763 mm during 2015.

3.1.2.3 Demographic features

As per census 2011, the district population is 21,09,160 and ranks 9th among all the districts in the state. The population density of the district is 1492 persons per Sq. kilometre. The sex ratio in the district is 1079 females for every 1000 males. The average literacy rate of the district is 93.4 per cent.

The land utilization pattern in Palakkad and Alappuzha districts are presented in the Table 3.1. The net sown area in Palakkad and Alappuzha accounts about 43.95 and 58.25 per cent of the total geographical area respectively. The forest area which accounts about 30.44 in Palakkad and zero per cent in Alappuzha of the total geographical area and land used to non-agricultural purpose accounts about 10.28 and 16.45 per cent to the total geographical area in Palakkad and Alappuzha districts respectively.

Table 3.1. Land utilization pattern in Palakkad and Alappuzha (Area in hectares)

Particulars	Palakkad	Alappuzha
Geographical area	447584(100.00)	141011(100.00)
Forest	136257(30.44)	0(0.00)
Land put to non- agricultural uses	46010(10.28)	23198(16.45)

Barren and uncultivable land	1912(0.43)	9(0.006)
Permanent pastures and other grazing land	1(0.0002)	-
Land under miscellaneous tree crops	884(0.20)	78(0.06)
Cultivable waste	23764(5.31)	16421(11.65)
Fallow other than current fallow	15486(3.46)	3190(2.26)
Current fallow	10819(2.42)	3120(2.21)
Marshy Land	-	34(0.02)
Still Water	15340(3.43)	12457(8.83)
Water Logged Area	-	332(0.24)
Social Forestry	379(0.084)	39(0.028)
Net area sown	196732(43.95)	82133(58.25)
Area sown more than once	103890(23.21)	21002(14.89)
Total cropped Area	300622(67.16)	103135(73.14)

Source: Agricultural Statistics 2014-2015, Department of Economics and Statistics, Government of Kerala.

Note: Figures in parentheses indicate per cent to geographical area

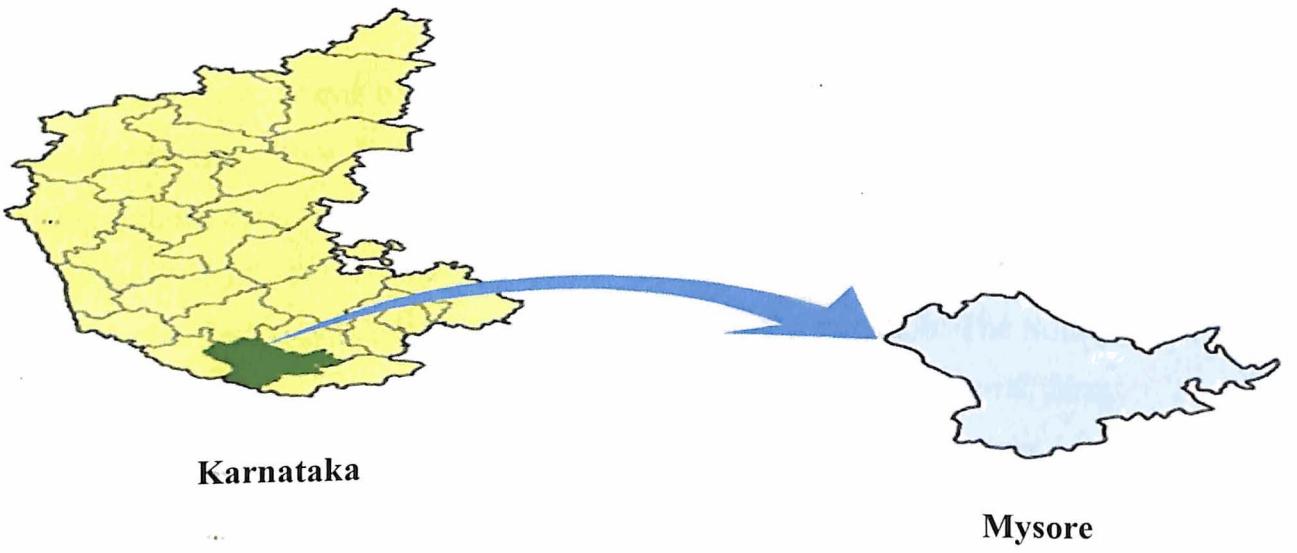
3.1.3 Mysore district

Mysore is commonly known as the "City of Palaces" and it is located at southwest of the state capital Bangalore. As per 2011 national census of India it is the second most populous city in the state of Karnataka with a population of about 887,446. Mysore district is spread across an area of 128.42 km^2. The major source of income for the people of this district is agriculture. Out of 676382 ha of total geographical area about 342852 ha is cultivable. The main crops grown in the district are paddy, jowar, ragi, maize, horsegram, cowpea, tobacco and cotton.

3.1.3.1 Location

Mysore district is situated between 12.30° North latitude and 74.65° East longitude at an average altitude of 770 metres. The district is bounded by Tamil Nadu to its southeast, other districts like the Kodagu to its west, Mandya to its north, Hassan to its northwest and Bangalore to its northeast.

Fig 3.3 Map of the study area: Mysore



3.1.3.2 Topography and climate

Mysore district has a tropical wet and dry climate with a four different seasons such as Cold Weather season (January- February), Hot Weather season

(March- May), Southwest Monsoon season (June- September) and North-East Monsoon (October- December). The climate is generally mild and cool throughout the year. In the period from March to May, there is a continuous rise in temperature. April is recorded as the hottest month with the mean daily maximum temperature at 34.5°C and minimum at 21.1°C. There is gradual reduction in the day and night temperature by the beginning of November and January is the coldest with a maximum temperature of only 11°C. The average annual rainfall in the district was recorded between 600 mm and 900 mm in 66 years out of the 85 years.

3.1.3.3 Demographic features

The population of Mysore district as per the 2011 census is reported as 887,446 with 443,813 males and 443,633 females. The gender ratio in the district is 1000 females for every 1000 males. The population density in the district is reported as 6,910.5 persons per square kilometre. As per the census 2011 the literacy rate of the city is 86.84 per cent, which is higher than the state's average of 75.6 per cent.

3.1.4 Mandya district

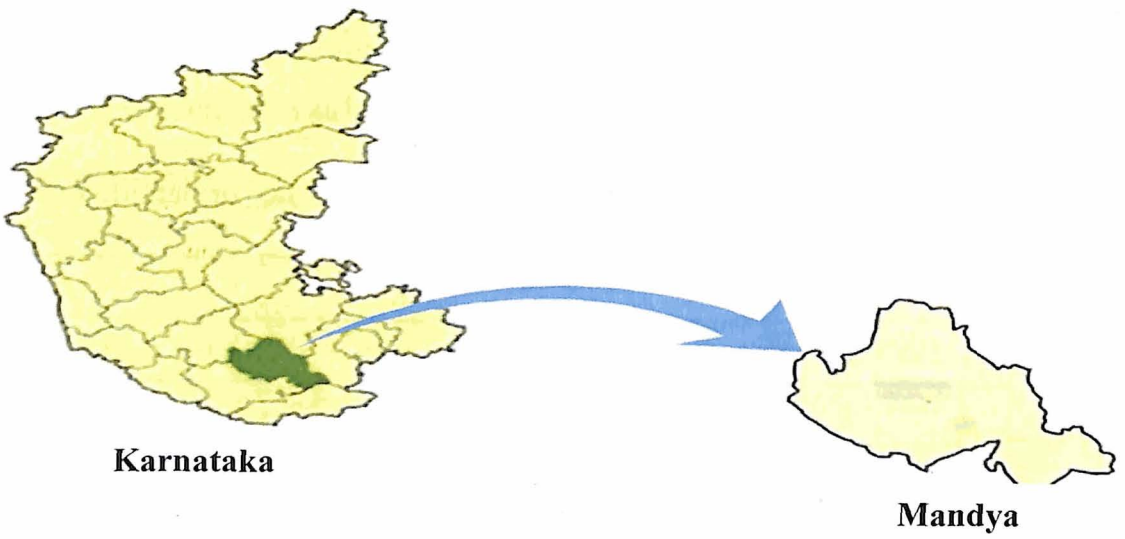
Mandya is a prominently agriculture based district formed during 1939. The district is also known as one of the sugar and paddy bowls of India. The district is the land of art and culture. Drama is a passion of most people of the district. The total geographical area of the district is 4,98,244 ha, out of which the cropped area accounts for 2,53,067 ha. About half of the agricultural land in the district is depends on two rivers such as Cauvery and Hemavathi for irrigation. The South-West Monsoons is the main source of water for remaining agricultural land. Agriculture is the main occupation of people in the district. Paddy and sugar cane are the most important crops of the district. And other important agricultural crops are ragi and horsegram.

3.1.4.1 Location

Mandya district is located in the south east of Karnataka between north latitude 12°13' to 13°04' N and east longitude 76°19' to 77°20' E at an altitude of

762 to 914 meters from the mean sea level. The district is surrounded by Tumkur district in the northeast, Ramanagar district in the east, Chamrajnagar district in the south, Mysore district in the west and southwest and Hassan district in the northwest.

Fig 3.4 Map of the study area: Mandya



3.1.4.2 Topography and climate

Mandya district is a sub-tropical region with temperature regimes varying from 16^0 and 35^0 C. April is reported as the hottest month in the district and the temperature starts to drop considerably with the southwest monsoon in June. December is reported has the coldest month in the district. The average rainfall of the district is reported as 691.2 mm. Rainfall in the district varies from 742 to 670.6 mm. The rainy season is mostly confined to the period from April to November. The district receives rainfall both in the south-west and the retreating monsoon seasons. The heaviest rainfall in the district occurs in the post-monsoon month of October. It is reported that on an average, the district is having 45 rainy days in a year.

3.1.4.3 Demographic features

As per 2011 census, the total population of the district was reported as 18,05,769. The density of population is 363 persons per square km and the sex ratio is 995 females per 1000 males. The urban population of the district is about

17.08 per cent of the total population and the average literacy rate of the district was 70.40 per cent in 2011.

The land utilization pattern in Mysore and Mandya are presented in the Table 3.2. The net sown area in Mysore and Mandya districts accounts about 50.70 and 36.02 per cent to the total geographical area respectively. The forest area accounts for 9.29 and 4.74 per cent respectively and the land used to non - agricultural purpose accounts about 11.12 and 20.46 per cent to the total geographical area in both the districts.

Table 3.2. Land utilization pattern in Mysore and Mandya (Area in Hectares)

Particulars	Mysore	Mandya
Geographical area	676382(100)	522809(100)
Forest	62851(9.29)	24765(4.74)
Land put to non- agricultural uses	75209(11.12)	106990(20.46)
Barren and uncultivable land	45018(6.66)	77432(14.81)
Cultivable waste	21407(3.16)	-
Permanent pasture	46808(6.92)	-
Trees and groves	5871(0.87)	-
Current fallow	41823(6.18)	125312(23.97)
Fallow other than current fallow	34451(5.09)	-
Net area sown	342908(50.70)	188310(36.02)
Area sown more than once	146552(21.67)	-
Total cropped Area	489460(72.36)	224230(42.89)

Source: 1. Mysore district statistics at a glance 2015, Directorate of Economics and Statistics, Karnataka.

2. Mandya district human development report 2014, Department of Planning, Programme Monitoring and Statistics, Karnataka.

Note: Figures in parenthesis indicate per cent to the total geographical area

3.1.5 Selection of the study area

According to the survey conducted by Department of Economics and Statistics, in 2014-15, the total area under paddy cultivation in Kerala during the agricultural year 2014-15 is reported as 1,98,159 ha. Among this Palakkad and Alappuzha are the major rice growing districts of Kerala accounting about 41.84 per cent and 17.37 per cent respectively of the total area under rice cultivated in the state. In Karnataka the total area under paddy cultivation was reported as 12,79,247 ha in 2012-13. Among them Mysore and Mandya are the major rice growing districts of Karnataka accounting about 6.96 per cent and 3.92 per cent respectively of the total rice growing area of the state and these districts in both the states having a larger area under the KAU rice varieties such as Jyothy and Uma. Therefore these four districts are considered as prominent in rice cultivation and were purposively selected for the study.

3.1.6 Selection of paddy varieties

The KAU varieties such as Jyothi and Uma were selected because they are the most popular varieties among the rice farmers in the study areas. The popular non-KAU varieties adopted by the farmers are BR 2655, IR 64, Jaya, Tanu and MTU 1001 in Karnataka and Mahamaya, PC1 and TKM 9 in Kerala.

3.2 Sampling design

The present study is based on primary data collected from the sample of 160 farmers. List of paddy growing farmers were collected from the Karnataka State Seed Corporation, Kerala State Seed Development Authority, Raitha Samparka Kendra, Krishi bhavans. Simple random sampling was used for the selection of the samples. About 40 farmers each cultivating at least one acre of paddy and adopting KAU varieties and 40 farmers cultivating a local popular non-KAU variety will be randomly selected and surveyed from the selected farmers in each state.

3.2.1 Collection of the data

The primary data were collected from selected sample farmers through personal interview method using a pre tested interview schedule. The survey was conducted from January 2016 to May 2016. Data related to the socio-economic condition of the farmers, yield, cost and returns from paddy, sources of the seed, important factors responsible for growing the variety, year of starting of cultivation of the variety were collected. Secondary data were also collected from the various Agricultural Departments, State Seed Corporations, published and unpublished sources.

Fig 3.5 Distribution of samples in Kerala

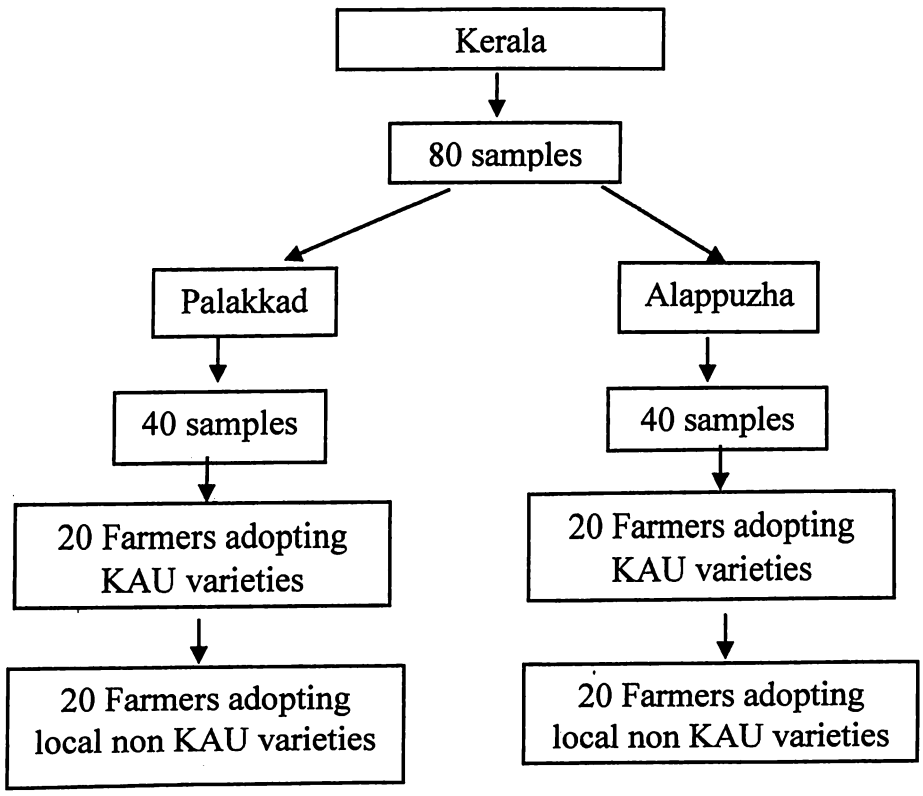
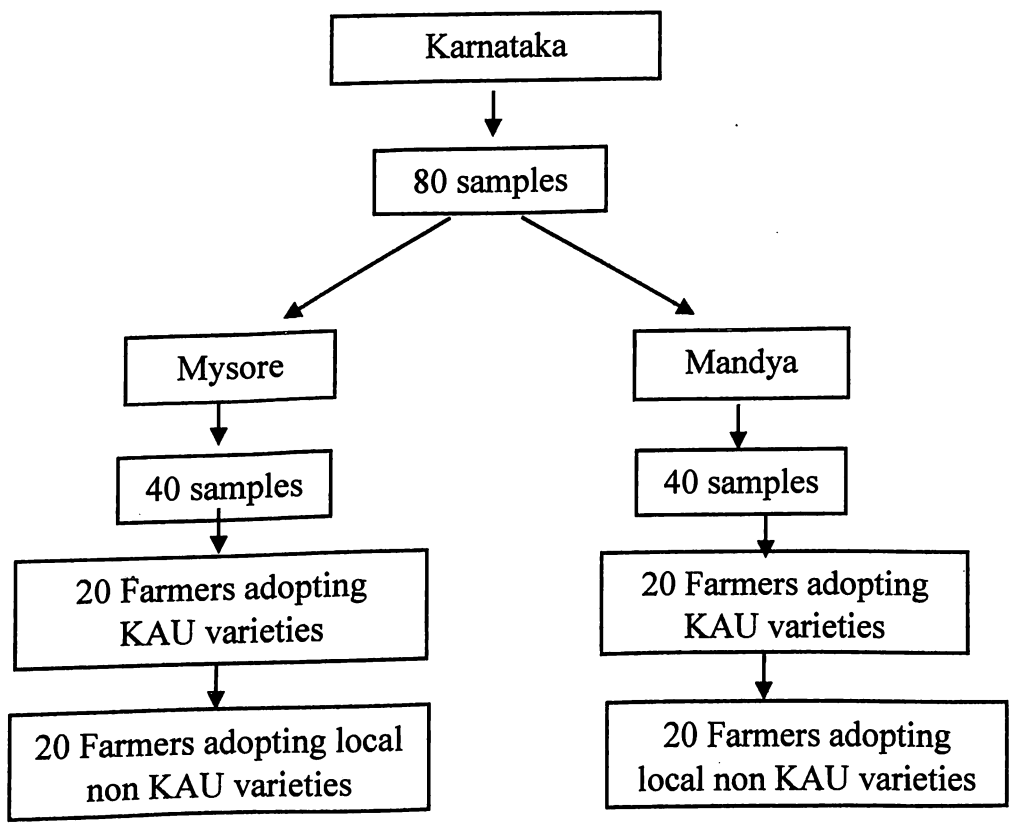


Fig 3.6 Distribution of samples in Karnataka



3.3 Analysis of data

3.3.1 Method of estimation of cost

3.3.1.1 Cost concepts: The cost concepts used by Commission on Agricultural Costs and Prices (CACP) of government of India for farm management studies are cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3 (CSO, 2008). These concepts are used in the present study and the important concepts are defined as follows.

The structure of different costs and their components

(1) Cost A_1 includes
   a. Cost of human labour (casual and permanent)
   b. Cost of hired bullock power
   c. Cost of owned bullock power
   d. Cost of hired machine power
   e. Cost of seeds (both farm produced and purchased)
   f. Cost of manures (owned and purchased)
   g. Cost of fertilizers
   h. Cost of plant protection chemicals
   i. Cost of weedicides
   j. Irrigation charges
   k. Land revenue
   l. Depreciation on farm implements and farm buildings
   m. Interest on working capital
   n. Miscellaneous expenses

(2) Cost A_2 = Cost A_1 + Rent paid for leased in land

(3) Cost B_1= Cost A_1+ interest on the value of owned fixed capital assets (excluding land)

(4) Cost B_2= Cost B_1 + Rental value of owned land (less land revenue) and rent paid for leased in land

(5) Cost C_1= Cost B_1 + imputed value of family labour

(6) Cost C_2 (Cost of cultivation) = Cost B_2 + Imputed Value of Family labour

(7) Cost C_3= Cost C_2+ 10 percent of cost C_2 (to account for managerial input of the farmer)

3.3.1.2 Criteria for imputation of various input costs:

The criteria for imputation of various input costs are summarized in table 3.3.

Table 3.3. Imputation criteria for of various input costs

Sl. No.	Items	Criteria
1.	Family Labour	On the basis of the actual market price, prevailing in the study areas for each cultural operations
4.	Implements	Depreciation and charges on account of minor repairs.
5.	Farm Produced Manure	Calculated at rates prevailing in the study region
6.	Rent of owned land	Estimated on the basis of prevailing rents in the village for identical type of land or as reported by the sample farmers subject to the ceiling of fair rents given in the land legislation of the concerned state.
7.	Interest on owned fixed capital	Interest on present value of fixed assets charged at the rate of 10 per cent per annum.
8.	Interest on working capital	Interest is charged at the rate 7.5 per cent per annum on the working capital for the period of crop.
9	Main products and by-products	Imputed on the basis of post- harvest prices prevailing in the selected villages.

3.3.2 Impact assessment of KAU varieties – Partial budgeting technique

In order to assess the impact of KAU varieties on the productivity in both the states, partial budgeting technique was employed.

Partial budgeting is a statement of anticipated changes in costs, returns and profitability for a minor modification. When a farmer contemplates few modifications or minor changes in the existing organization of the farm business, partial budgeting technique is employed. It consists of four important element such as added costs, added returns, reduced returns and reduced costs.

Added costs: Additional costs are incurred, if the proposed modification is the introduction of a new enterprise or increase in the size of the existing enterprise.

Added returns: Additional returns could be received when the proposed modification is the addition of a new enterprise, or increase in the size of the existing enterprise or adoption of technology that results in higher productivity.

Reduced returns: Decrease in the returns is observed when the proposed modification involves the elimination of an existing enterprise or reduction in the size of the existing enterprise.

Reduced costs: Decrease in the costs is found when the proposed modification involves the elimination of existing enterprise or reduction in the size of the enterprise or adoption of a technology that uses fewer amounts of resources.

Net Change in income = (Added returns + Reduced costs) – (Added costs + Reduced returns)

3.3.3 Resource productivity in paddy cultivation- Production function approach

The production function approach was used to estimate the effects of independent variables on the dependent variable in paddy cultivation in both the States. For this purpose Cobb-Douglas form of production function was used. Cobb-

Douglas Production function analysis provides us with the elasticities in the use of inputs.

3.3.3.1 Model specification of Cobb-Douglas production function for paddy cultivation in Karnataka:

$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} e^{\mu}$

Where, Y= Total yield (kgs)

X_1= Total area under paddy cultivation (ha)

X_2 = Total amount of chemical fertilizers applied (kgs)

X_3 = Total amount of seeds used (kgs)

X_4 = Total labour use (man days)

μ = Random-error

The ordinary least square (OLS) approach was used for estimating the above Cobb-Douglas production function after converting it into log-linear form and it is given as

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \mu$$

3.3.3.2 Model specification of Cobb-Douglas production function for paddy cultivation in Kerala:

$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} e^{\mu}$

Where, Y= Total yield (kg)

X_1= Total area under paddy cultivation (ha)

X_2 = Total amount of chemical fertilizers applied (kg)

X_3 = Total amount of seeds used (kg)

X_4 = Total labour use (man days)

μ = Random-error

The ordinary least square (OLS) approach was used for estimating the above Cobb-Douglas production function after converting it into log-linear form and it is given as

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + \mu$$

3.3.3.3 Returns to scale

Returns to scale (RTS) reflect the change in output as a result of a given proportionate change in all the factors of production or inputs simultaneously. RTS can be found out by estimating the total elasticity of production (e) and total elasticity of production measures the proportional change in output resulting from a unit proportional increase in all inputs. Total elasticity of production was equal to the sum of the all the partial production elasticities.

When the total elasticity of production is equal to 1, it indicates constant returns to scale when it is greater than 1, it refers to increasing returns to scale and when it is less than 1, it indicates decreasing returns to scale.

3.3.4 Factors affecting the adoption of KAU varieties

In order to identify the important factors affecting the adoption of KAU varieties in Kerala and Karnataka probit model was used. To explain the probit model, the decision of the i^{th} farmer to adopt the KAU (Jyothi or Uma) rice varieties or not, depends on an unobservable utility index I_i (also known as a latent variable), that is determined by the number of the explanatory variables X_i included in the model in such a way that the larger the value of the index I_i, the greater the probability of a farmer adopting a variety. It is given as

$I_i = \beta_1 + \beta_2 X_i$ where X_i= Explanatory variable(s)

3.3.4.1 Model specification for Kerala and Karnataka KAU rice variety growing farmers

$$P_i = P(Y=1/X_i) = P(I^*_i \leq I_i) = p(Zi \leq \beta_1 + \beta_2 X_{2i} + \ldots\ldots + \beta_6 X_{6i} + U_i) = F(\beta_1 + \beta_2 X_{2i} + \ldots\ldots + \beta_6 X_{6i} + U_i)$$

$P_i = P(Y=0/X_i) = P(I^*_i > I_i) = p(Zi > \beta_1 + \beta_2 X_{2i} + ... + \beta_6 X_{6i} + U_i) = F(\beta_1 + \beta_2 X_{2i} + ...+\beta_6 X_{6i} + U_i)$

Where $P(Y=1/X_i)$ means the probability of the i^{th} farmer adopting a KAU rice variety at given values of the explanatory variables.

$P(Y=0/X_i)$ means the probability of the i^{th} farmer not adopting a KAU rice variety at given values of the explanatory variables.

I^*_i = Threshold level of the index of i^{th} farmer

I_i = Utility index or latent variable of i^{th} farmer

X_{2i} = Education of the i^{th} farmer in years

X_{3i} = Age of the i^{th} farmer in years

X_{4i} = Area of the i^{th} farmer in ha

X_{5i}= Member of the farmers organization of i^{th} farmer (dummy)

X_{6i} = Annual income of i^{th} farmer in Rs

U_i = Error term

Z_i = Standard normal variable, i.e., $Z \sim N(0, \sigma^2)$

F is the standard normal CDF.

3.3.5 To identify specific reasons for adoption of KAU varieties in Karnataka and Kerala

To identify the specific reasons for adoption of KAU varieties in Karnataka and Kerala, Garrett ranking technique was used. In the first step, specific reasons for adoption of KAU varieties in study area were identified and then respondents were asked to rank the identified reasons. In the Garrett ranking technique the rank allotted to specific reasons were transformed into percentage using the formula:

Per cent position = $100(R_{ij} - 0.5)/ N_j$

Where, R_{ij} = Rank given for i^{th} factor by j^{th} individual

N_j = Number of factors ranked by j^{th} individual

Here 0.5 is subtracted from each rank because the rank is an interval on a scale and its midpoint best represents the interval. Then, the percentage positions were transformed into scores on a scale of 100 points referring to the table given by Garrett and Woodworth (1969). From the score so obtained, the mean score level was derived and reasons were ranked based on the mean score level.

Results and Discussion

4. RESULTS AND DISCUSSION

In this chapter, analysis of the primary data collected from the rice growers in Kerala and Karnataka region have been described. The results obtained are presented under the following sub headings.

4.1 Socio-economic characteristics of the sample farmers

4.2 Economics of cultivation of rice in Karnataka and Kerala

4.3 Impact assessment of KAU varieties

4.4 Resource productivity in rice cultivation

4.5 Specific reasons and factors affecting adoption of KAU varieties

4.6 Economic of seed production in rice of KAU varieties

4.7 Marketing channels of KAU varieties

4.1. Socio-economic characteristics of the sample farmers

4.1.1 Age of the respondents

Age of the farmers is one of the major factors determining the understanding about improved technologies and their behaviour towards their adoption of improved technologies. The age-wise distribution of the sample farmers is presented in Table 4.1. In the present study, the respondents were classified into four different categories based on the age as less than 30 years, 30-40 years, 40-50 years and more than 50 years. It is clearly evident that maximum respondents belonged to age group of above 50 years in both the states. In sample farmers growing KAU varieties, about 77.5 per cent respondents in Kerala and 52.5 per cent respondents in Karnataka grouped under the above 50 years age group. Only 5 per cent respondents in both the states were of less than 30 years of age. In case of local non KAU varieties, about 60 per cent respondents in Kerala and 47.5 per cent respondents in Karnataka were more than 50 years category, while only 7.5 per cent of the farmers in Karnataka were less than 30 years of age. No farmers in Kerala were of less than 30 years of age.

The results shows that involvement of elderly group in rice cultivation is greater than that of other age groups respondents in both the states.

Table 4.1. Age-wise distribution of the sample respondents

(in Numbers)

Age	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
<30 years	2(5.0)	2(5.0)	3(7.5)	0(0.0)
30-40 years	11(27.5)	2(5.0)	6(15.0)	1(2.5)
40-50 years	6(15.0)	5(12.5)	12(30.0)	15(37.5)
> 50 years	21(52.5)	31(77.5)	19(47.5)	24(60.0)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to total

4.1.2 Educational status

Education helps the farmer to get aware about a new or improved technology which further enables the adoption of a technology by them (Foltz, 2003). Educational status of the respondents is presented in Table 4.2. It is observed that, the literacy level among farmers growing KAU varieties was high in Kerala. About 97.5 per cent respondents in Kerala were educated but it was 82.5 per cent in Karnataka. Similarly among farmers growing local non KAU varieties, maximum literacy level was observed in Kerala (87.5 per cent) while it was only 62.5 per cent in Karnataka. The result indicated that farmers growing KAU varieties were well informed due to higher education level compared to their counterparts who cultivated non-KAU rice varieties. The result also pointed out rice growers in Kerala were more educated than those of Karnataka.

Table 4.2. Educational status of sample respondents

(in Numbers)

Education	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
Illiterate	7(17.5)	1(2.5)	15(37.5)	5(12.5)
Upto 9th standard	1(2.5)	0(0.0)	10(25.0)	8(20.0)
SSLC	14(35.0)	7(17.5)	9(22.5)	17(42.5)
Plus two	8(20.0)	20(50.0)	4(10.0)	7(17.5)
Graduate level	10(25.0)	12(30.0)	2(5.0)	3(17.5)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to the total

4.1.3 Experience in rice cultivation

Experience of respondents in both states in cultivating rice was studied. Based on the experience in rice cultivation, the farmers were categorised in to three categories such as less than 10 years, 10-25 years and more than 25 years of experience (Table 4.3). The results showed that in Kerala among 80 respondents 59 respondents were practicing rice farming for more than 25 years while 18 respondents had an experience of 10-25 years. However in Karnataka among 80 farmers surveyed, 40 farmers had an experience of over 25 years in rice cultivation while 20 respondents had less than 10 years experience. The result indicated that, both the states are traditional pockets growing rice and farmers have taken up rice cultivation for quite longtime.

Table 4.3. Experience of sample respondents in rice cultivation

(in Numbers)

Years of experience	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
<10 years	11(27.5)	2(5.0)	9(22.5)	1(2.5)
10-25 years	8(20.0)	4(10.0)	12(30.0)	14(35)
>25 years	21(52.5)	34(85.0)	19(47.5)	25(62.5)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to the total

4.1.4 Awards won and membership in organizations

Rice farmers have been facilitated with several awards instituted by different agencies. Organizational membership of the farmers helps the easy and faster accessibility to new or improved technologies and further adoption by them (Tura *et al.*, 2010). The distribution of the respondents based on the awards won and the membership in the organizations is presented in Table 4.4. Results indicated that, about 95 per cent respondents in Kerala and 75 per cent respondents in Karnataka cultivating KAU varieties had membership in different organizations. However, only 65 per cent of respondents in Kerala and 37.5 per cent respondents in Karnataka who were cultivate local non KAU varieties had membership in various organizations. The result pointed out that, the existence of higher organizational membership among the respondents growing KAU varieties as compared to those farmers growing non KAU varieties in both states. With respect to the awards won, both the states had equal (27.5 per cent) sample respondents who had won awards for their best practices in rice cultivation.

Table 4.4. Awards won and membership in organizations of the sample respondents

(in Numbers)

Particulars		KAU varieties		Local non KAU varieties	
		Karnataka	Kerala	Karnataka	Kerala
Membership in organizations	Yes	30(75.0)	38(95.0)	15(37.5)	26(65.0)
	No	10(25.0)	2(5.0)	25(62.5)	14(35.0)
Awards won	Yes	7(17.5)	3(7.5)	4(10.0)	8(20.0)
	No	33(82.5)	37(92.5)	36(90.0)	32(80.0)

Note: Figures in parentheses represent the per cent to the total

4.1.5 Land holdings

The details on the size of the holdings by the sample respondents are presented in the Table 4.5. Majority of the respondents in both the states had a holding size of 1-2 ha of land. About 55 per cent respondents in Karnataka and 40 per cent respondents in Kerala growing KAU varieties had a land holding size of 1-2 ha. Over 27.5 per cent of farmers in Karnataka and 32.5 per cent in Kerala had a land holding size more than or equal to 2 ha category. Whereas in local non KAU varieties, 55 per cent and 45 per cent respondents in Karnataka and Kerala respectively grouped under the category of 1-2 ha while 7.5 per cent and 27.5 per cent respondents had land holdings of greater than or equal to 2 ha in Karnataka and Kerala respectively. This proved that KAU varieties occupied more acreage compared to local non KAU varieties in both the states among respondents having a more than or equal to 2 ha of land.

Table 4.5. Details on the size of the holdings of the sample respondents

(in Numbers)

Land ownership	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
<1 ha	7(17.5)	11(27.5)	15(37.5)	11(27.5)
1-2 ha	22(55.0)	16(40.0)	22(55.0)	18(45.0)
≥ 2 ha	11(27.5)	13(32.5)	3(7.5)	11(27.5)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to the total

4.1.6 Annual household income

Income of respondents from different sources plays an important role in determining the economic conditions of the respondents. The classification of respondents based on annual household income is presented in Table 4.6. It is observed that 47.5 per cent of respondents in Karnataka growing KAU varieties and 72.5 per cent respondents growing local non KAU varieties had an annual income of less than ₹50000. Only 12.5 per cent and 10 per cent respondents growing KAU varieties and local non KAU varieties respectively had an annual income of more than or equal to ₹200000. In Kerala, 12.5 per cent and 25 per cent respondents respectively growing KAU and non KAU varieties belonged to the annual income of less than ₹50000 income group and twenty-five per cent and 12.5 per cent of the respondents who cultivated KAU and non-KAU varieties respectively belonged to the annual household income greater than two lakh rupees. The results showed that farmers growing KAU varieties in both the states

earned a higher annual household income compared to farmers cultivating non-KAU varieties.

Table 4.6. Distribution of the sample respondents according to average annual income

(in Numbers)

Average annual income (in ₹)	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
<50000	19(47.5)	5(12.5)	29(72.5)	10(25.0)
50000-100000	9(22.5)	15(37.5)	5(12.5)	17(42.5)
100000-200000	7(17.5)	5(12.5)	2(5.0)	8(20.0)
>200000	5(12.5)	10(25.0)	4(10.0)	5(12.5)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to the total

4.1.7 Source of income

The sample respondents were classified into two groups based on income source and presented in Table 4.7. In Kerala, among 80 respondents, 65 respondents relied solely on income from farm source whereas 15 respondents were dependent on both farm and non-farm sources for their income. In Karnataka, 66 respondents obtained their income solely from farm source while the remaining 14 respondents drew their income from both farm and non-farm sources. The result revealed that farm revenue was the sole income for most of the respondents, while a small proportion of the farmers depended on other nonfarm occupation along with agriculture in both the states.

Table 4.7. Details of the source of income of sample respondents (in Numbers)

Source of income	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
Farm income alone	31(77.5)	29(72.5)	35(87.5)	36(90.0)
Farm income and nonfarm occupation	9(22.5)	11(27.5)	5(12.5)	4(10.0)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to the total

4.1.8 Average annual household expenditure

The classification of respondents on the basis of average annual household expenditure is given in Table 4.8. In state of Kerala higher number of respondents fell under the category of annual household expenditure between ₹50000-₹100000. This included those growing KAU and local non KAU variety cultivation which was about 42.5 per cent and 40 per cent respectively. Respondents of Karnataka mainly grouped under the category of less than ₹50000. Sixty per cent and 75 per cent of these were farmers growing KAU and local non KAU variety respectively. It was evident that farmers adopting KAU varieties possessed higher annual household expenditure as compared to those growing non KAU variety in both the states. It also pointed out that standard of living of farmers in Kerala was higher than their counterparts in Karnataka.

Table 4.8. Distribution of sample respondents according to average annual household expenditure

(In Numbers)

Average annual household expenditure	KAU varieties		Local non KAU varieties	
	Karnataka	Kerala	Karnataka	Kerala
<50000	24(60.0)	8(20.0)	30(75.0)	11(27.5)
50000-100000	7(17.5)	17(42.5)	6(15.0)	16(40.0)
100000-200000	5(12.5)	8(20.0)	2(5.0)	10(25.0)
>200000	4(10.0)	7(17.5)	2(5.0)	3(7.5)
Total	40(100.0)	40(100.0)	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to the total

4.1.9 Year of adoption of KAU variety

The respondents were classified on the basis of year of adoption of KAU varieties and presented in Table 4.9. In Kerala, among 40 respondents, 27 respondents were adopted KAU varieties between the years 2005-2010 followed by 6 respondents who adopted them between the years 2000-2005. Whereas in Karnataka highest number of respondents adopted KAU varieties after 2010 followed by 12 respondents in the years 2000-2005.

Table 4.9. Distribution of sample respondents according to year of adoption of KAU varieties

(in Numbers)

Years	Karnataka	Kerala
Before 2000	3(7.5)	3(7.5)
2000-2005	12(30.0)	6(15)
2005-2010	11(27.5)	27(67.5)
After 2010	14(35.0)	4(10)
Total	40(100)	40(100)

Note: Figures in parentheses represent the per cent to the total

4.1.10 Access to seed source

The details of sample respondents based on access to seed source are presented in the following Table 4.10. In Karnataka, about 50 per cent of respondents depend on seed corporations (Karnataka State Seed Corporation Limited and National Seed Corporation). This was mainly because these were the main organizations involved in the seed production and sales of KAU varieties such as Jyothi and Uma in the region of study and secondly farmers had good access to these organizations due to close proximity. About 25 per cent respondents depended on cooperative societies and 22.5 per cent depend on own domestic source for KAU variety seeds. Due to high demand for KAU varieties, farmers sell major portion of their produce immediately after harvest. During next season the farmers purchase seeds from the above mentioned sources. In case of local non KAU varieties about 45 per cent farmers saved the produce for domestic use since local non KAU varieties were mainly grown for consumption purpose. They retain a limited quantity of these for use as seed in the next season. Of the respondents remaining, 25 per cent and 17.5 per cent of farmers respectively depended on cooperative societies and seed corporations for seeds. In Kerala more than 42 per cent farmers depended on Krishibhavan for seed. This was because in Krishibhavan farmers are provided seeds and fertilisers at subsidised rates. Of the remaining respondents 37.5 per cent depended on National Seed Corporations while 20 per cent were depended on on-farm saved seeds. As in the case of Karnataka, in Kerala also KAU varieties were in high demand in both domestic and export markets. Therefore farmers were retaining only a small quantity of seeds but sold most of their produce. Farmers mainly depend on government agencies for their seed requirement. However, in case of local non KAU varieties more than 70 per cent of farmers depended on seed exchange between local farmers while 30 per cent depended on on-farm saved seeds. This is mainly because important local non KAU varieties like Mahamaya and TKM 9 presently grown are not indigenous to the state and many Kerala farmers have procured these seeds from other states and distributed locally. Hence larger number of respondents depended on local farmers for non KAU varieties.

4.10. Details of sample respondents according to access seed source (in Numbers)

States	**Karnataka**		**States**	**Kerala**	
Sources/Category of farmers	KAU varieties	Local non KAU varieties	Sources/Category farmers	KAU varieties	Local non KAU varieties
Seed Corporations	20 (50.0)	7(17.5)	National Seed Corporation(NSC)	15(37.5)	0(0.0)
Cooperatives	10(25.0)	10(25.0)	Krishibhavan	17(42.5)	0(0.0)
Private source	1(2.5)	5(12.5)	Local exchange	0(0.0)	28(70.0)
Farm saved seeds	9(22.5)	18(45.0)	Farm saved seeds	8(20.0)	12(30.0)
Total	40(100.0)	40(100.0)	Total	40(100.0)	40(100.0)

Note: Figures in parentheses represent the per cent to total

4.1.11 Share of area under KAU and local non KAU varieties of sample farmers in ha

The distribution of area under KAU and local non KAU varieties among sample farmers is explained in the Table 4.11. The total area cultivated by the sample respondents in Karnataka was 109.60 hectares of which about 58 per cent of area fall under KAU varieties and remaining 42 per cent under local non KAU varieties. Whereas in case of Kerala, the gross area under sampled rice cultivation was 156.57 hectares of which about 58 per cent of area grouped under KAU varieties and 42 per cent of area under local non KAU varieties. Thus it is clear that area under KAU varieties was more in both states compared to the local non KAU varieties.

Table 4.11. Share of area under KAU and local non KAU varieties of sample farmers in ha

States / Particulars	Karnataka	Kerala
Area under KAU varieties	63.78 (58)	91.07(58)
Area under local non KAU varieties	45.82(42)	65.50(42)
Total area	109.60(100)	156.57(100)

Note: Figures in parentheses represent the per cent to the total

4.2 Economics of cultivation of rice in Kerala and Karnataka

4.2.1 Cost A_1

The input wise cost of cultivation is given in Table 4.12. In both KAU varieties and local non KAU varieties, hired labour costs accounted for larger share in cost A_1 in both the states. In case of KAU varieties labour component accounted for 37.2 per cent in Karnataka, 40.2 per cent in Palakkad and 26.3 per cent in Alappuzha to the cost A_1. In Karnataka labours were used intensively on operations such as sowing, weeding, fertilizer application and harvesting, while in Kerala, except for harvesting and land preparation, there is

dependence on hired labour for all other operations as in Karnataka. Another important factor contributing to the higher share of labour component in Kerala as compared to Karnataka is the difference in labour wage that exists in the two states. It was found that in Kerala, the hired labour earns a daily wage of ₹572 per day which is more than national average of about ₹214 per day while in Karnataka average labour charge was only ₹240.24 per day (GOI, 2015) i.e. less that half the rate prevailing in Kerala. The report by the Government of Kerala (Economic survey, GOK, 2015) confirms this fact. Within Kerala, the labour cost component to cost A_1 is found to be high in Palakkad compared to Alappuzha. This is mainly because of the use of more labourers in Palakkad for sowing operation compared to Alappuzha. In Palakkad, farmers followed transplanting which require more labours compared to broadcasting method that was followed in Alappuzha. Machine labour charge is the second highest contributor to the total cost A_1 in both the states. It is found to be higher in Kerala when compared to Karnataka. This is mainly because the use of machine for land preparation and harvesting operations is more in the state compared to Karnataka. In case of Karnataka, farm machineries like tractor were mostly employed only for land preparation activities while some farmers still utilise animal labour for land preparation. However, in Karnataka tractor/tillers are used mainly for land preparation only. Comparison of Cost A_1 between KAU and non KAU varieties revealed that hired labour charges is higher in non KAU varieties cultivation compared to KAU varieties cultivation in both the states. This may be attributed to the use of more labour for weeding and plant protection operations in non KAU varieties as they were more susceptible to pest, disease and weed competition.

4.12. Input-wise cost of cultivation (cost A_1) of KAU and local non KAU varieties (₹ ha^{-1})

	KAU varieties			Local non KAU varieties		
	Karnataka	**Palakkad**	**Alappuzha**	**Karnataka**	**Palakkad**	**Alappuzha**
Labour hiring charge	20004(37.2)	22796(40.2)	19887(26.3)	22165(38.7)	25037(41.7)	22344(37.2)
Machine labour charge	11146(20.7)	14646(25.8)	13046(23.8)	11521(20.1)	14311(23.8)	13521(22.5)
Nursery preparation	1803(3.4)	1024(1.8)	0	1778(3.1)	934(1.6)	0
Seeds	2539(4.7)	2482(4.4)	3408(6.2)	2140(3.7)	2410(4.0)	4648(7.7)
FYM	7168(13.3)	4767(8.4)	0	8327(14.5)	5586(9.3)	0
Fertilizers	5359(10.0)	4934(8.7)	4880(8.9)	5060(8.8)	5486(9.1)	5720(9.5)
Plant protection chemicals	1609(3.0)	1270(2.2)	1345(2.5)	1917(3.3)	1409(2.3)	1248(2.1)
Land revenue	339(0.6)	100(0.2)	200(0.4)	324(0.6)	100(0.2)	200(0.3)
Dewatering	0	0	3930(7.2)	0	0	3856(6.4)
Liming charges	0	0	4183(7.6)	0	0	4266(7.1)
Depreciation	275(0.5)	964(1.7)	271(0.5)	262(0.5)	818(1.4)	263(0.4)
Interest on working capital	3517(6.5)	3709(6.5)	3580(6.5)	3745(6.5)	3926(6.5)	3925(6.5)
Cost A_1	53758(100.0)	56691(100.0)	54729(100.0)	57240(100.0)	60017(100.0)	59990(100.0)

Note: Figures in parentheses represent the per cent to the total Cost A1

Share of the various components in cost A_1 in KAU and Local non KAU varieties

Fig. 4.1. Share of the various components in cost A_1 of KAU variety cultivation in Karnataka

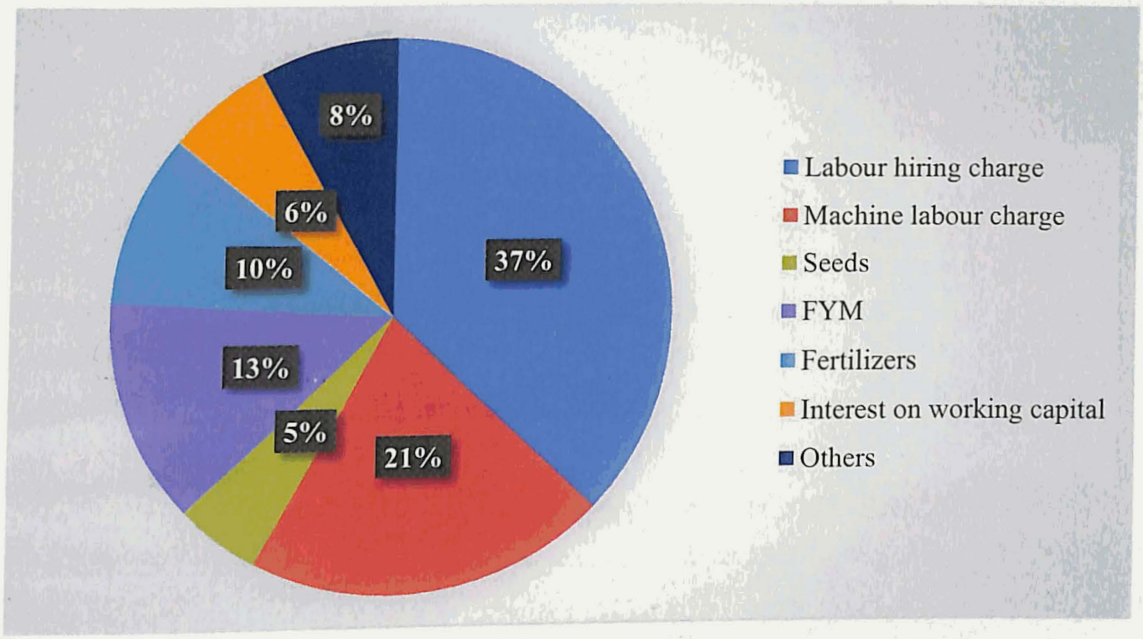


Fig. 4.2. Share of the various components in cost A_1 in local non KAU variety cultivation in Karnataka

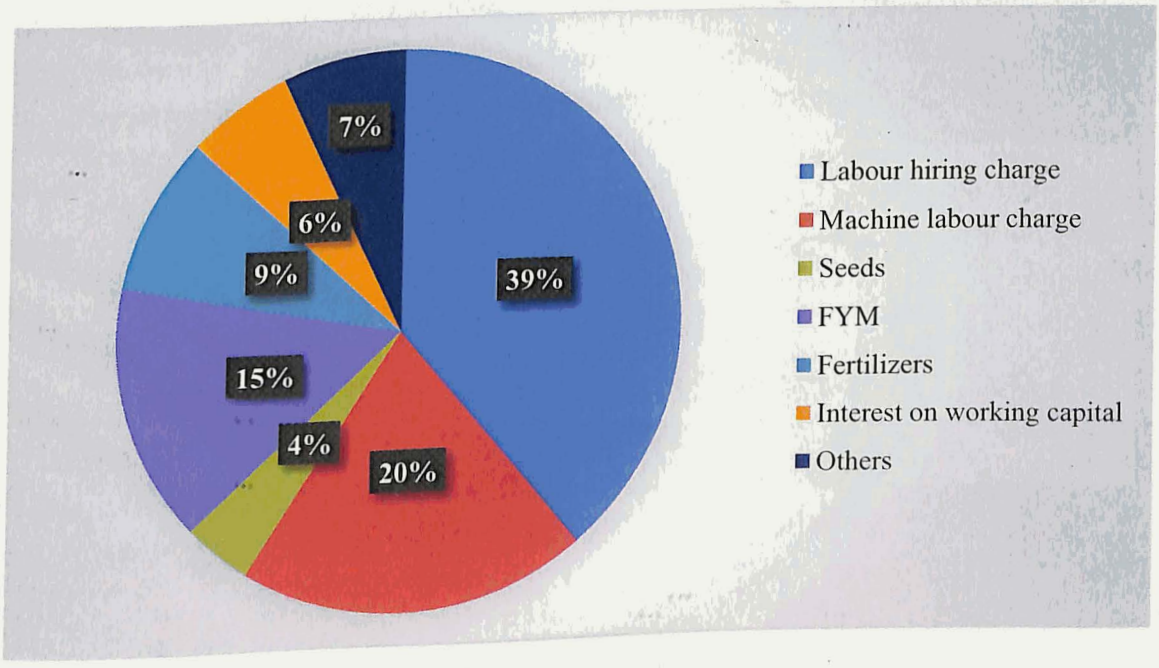


Fig. 4.3. Share of the various components in cost A_1 in KAU variety cultivation in Palakkad

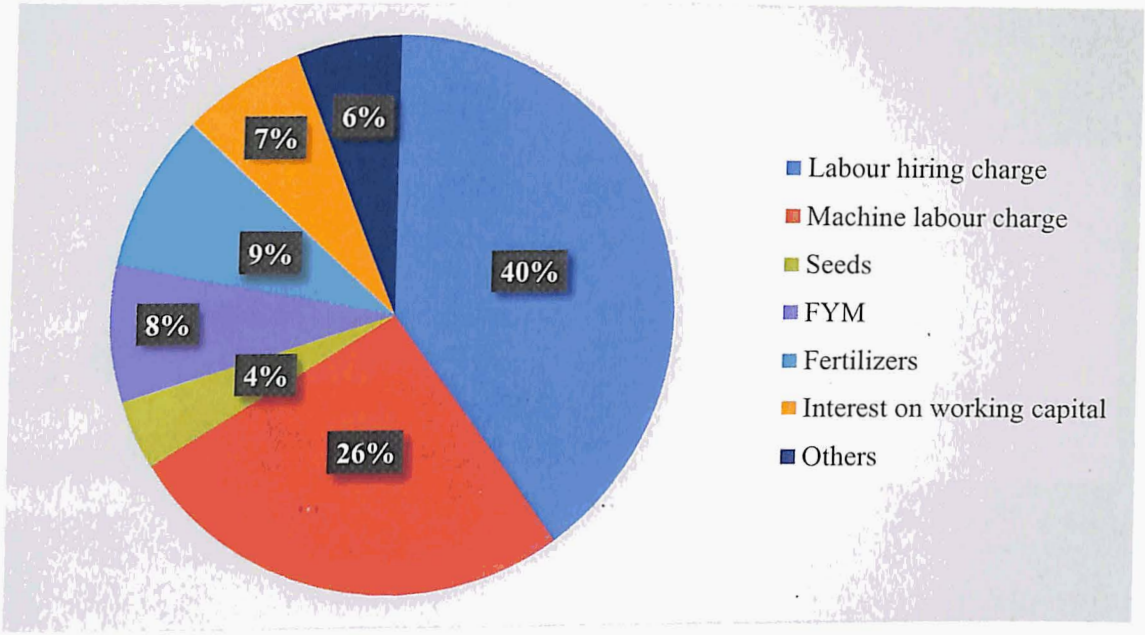


Fig. 4.4. Share of the various components in cost A_1 in local non KAU variety cultivation in Palakkad

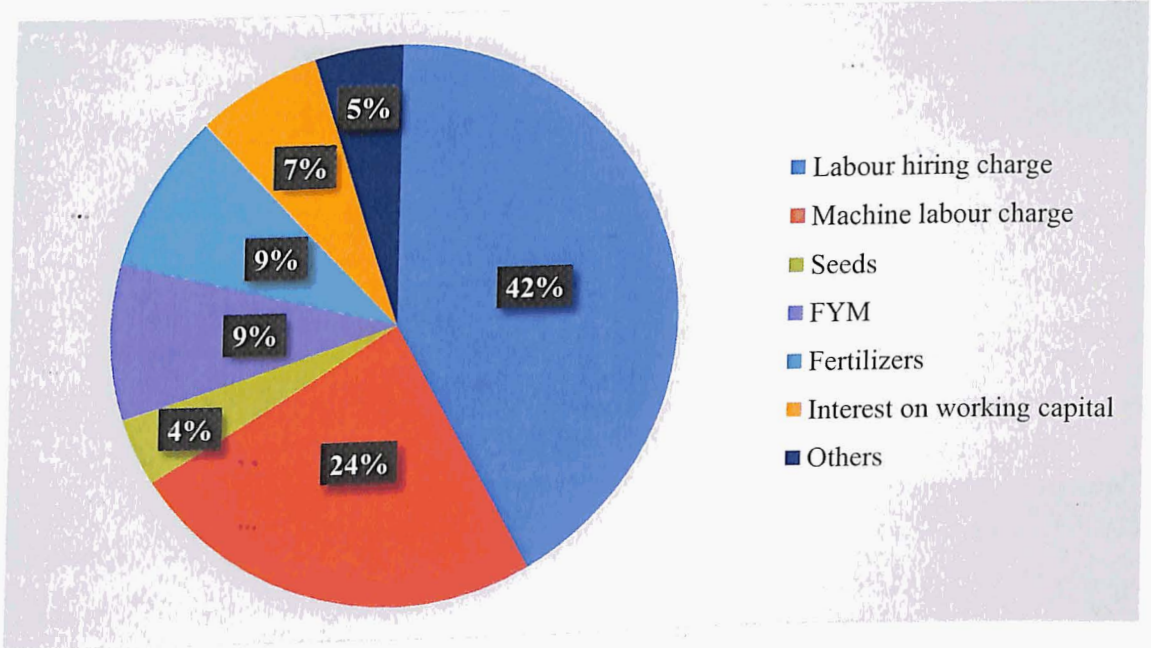


Fig. 4.5. Share of the various components in cost A_1 in KAU variety cultivation in Alappuzha

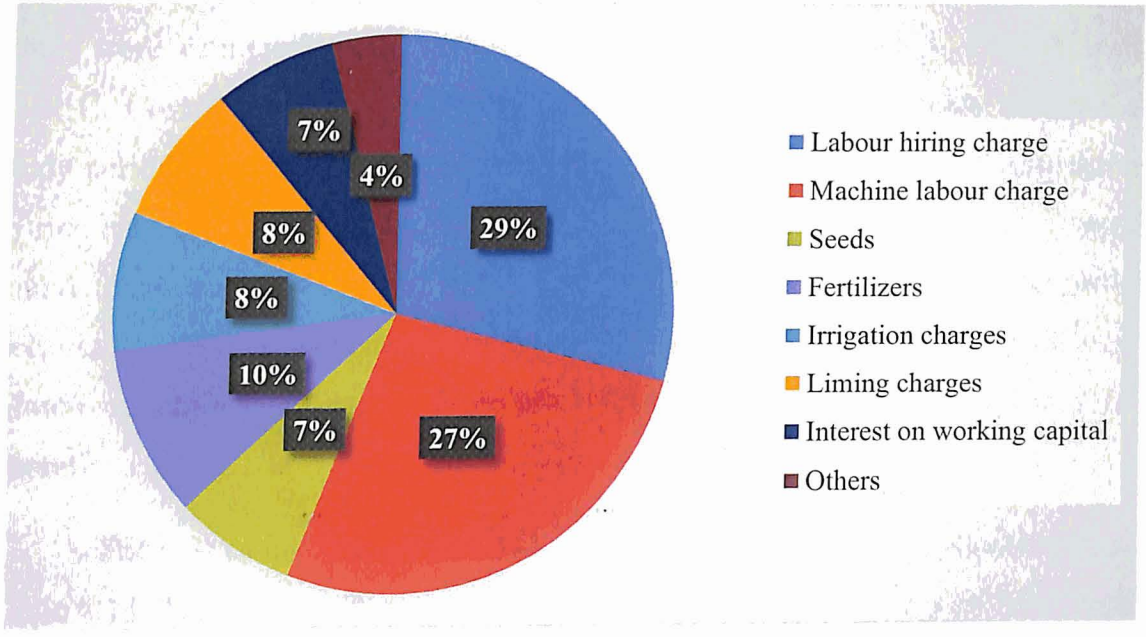
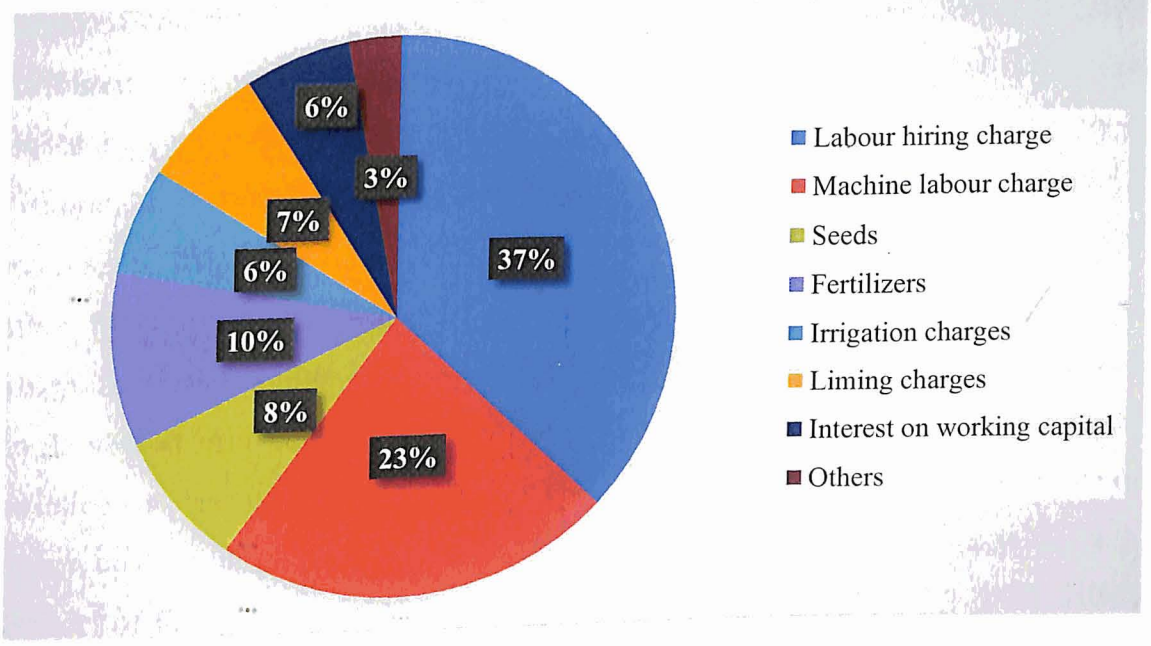


Fig. 4.6. Share of the various components in cost A_1 in local non KAU variety cultivation in Alappuzha



4.2.2 Estimation of cost of cultivation of rice

The cost of cultivation of KAU and local non KAU varieties in both the states were estimated using different cost concepts *viz.,* Cost A, Cost B, and Cost C. Cost A_1 and Cost A_2 were same in both the states because during the study period, the sample respondent farmers did not have leased land cultivation in rice hence rental value for the land was not considered. Cost B_1 and C_1 were found to be similar in KAU and local non KAU varieties in both the states because in both cases family labour was not used for any field operations. Moreover respondent farmers hired the labour on contract basis for all the field operations.

The cost of cultivation of KAU and non KAU rice varieties is presented in Table 4.13. The average cost of cultivation (Cost C_2) of KAU varieties was found to be lower in Palakkad compared to Karnataka and Alappuzha. However the cost incurred by farmers to grow KAU varieties up to Cost B_1 was lower in Karnataka compared to Palakkad and Alappuzha. This may be due to lower variable costs incurred. After Cost B_1, the Cost B_2, Cost C_2, Cost C_3 was found to be lower in Palakkad compared to Karnataka and Alappuzha. This change in trend could be attributed to the rental value of owned land in both the states and number of crops grown in a year. In Palakkad, farmers generally cultivate rice in three seasons, Viruppu, Mundakan and Punja. In this study, cost of cultivation was calculated for one season. Since rental value of land was considered for a year, hence, the rental value for Palakkad was apportioned. However for farmers in Karnataka and Alappuzha full amount was included because here farmers cultivate rice only in a single season in a year. Cost A_1 and cost A_2 in both KAU and local non KAU varieties was less in Karnataka than in Palakkad and Alappuzha mainly because of higher cost of labour in Palakkad and higher machine labour charge in both districts of Kerala. Commission for Agricultural Costs and Prices (CACP, 2015) also reported that the average cost A_2 (mainly included variable cost) was found to be higher in Kerala (₹36157 ha^{-1}) as compared to Karnataka (₹33089 ha^{-1}). Among the two districts in Kerala, cost of cultivation of KAU varieties was found

to be high in Alappuzha than in Palakkad. This may be due to the higher rental value of owned land in Alappuzha compared to Palakkad and accompanied by additional charges including charges on dewatering *viz.*, drain out the standing water from the main field occurs mainly due to the flood and liming charges had to be incurred by the farmers as acidic soils is a problem in Alappuzha (Kumari, 2011). However, Cost C_2 in case of local non KAU varieties was found to be higher than Cost C_2 of KAU varieties in both Karnataka and Kerala mainly because of higher variable costs incurred in cultivation of local non KAU varieties.

4.2.3 Cost of production of KAU and local non KAU rice varieties

The cost of production of KAU and Local non KAU varieties is given in Table 4.14. The average cost of production of KAU varieties in case of Karnataka was less when compared to Palakkad and Alappuzha districts of Kerala. This could be attributed to the higher yield realised in Karnataka than in Kerala and reduced cost of cultivation in the study area compared to Alappuzha. The cost of production based on cost A_1 of KAU varieties was comparatively high in Kerala compared to the Karnataka. This is mainly because of lower yield, higher machine labour charge and labour charge in Kerala. Labour usage for various operations like weeding and sowing account for major portion of cost of cultivation in case of Kerala and finally leads to an increase in the cost of cultivation and cost of production. CACP (2015), had reported that cost C_2 in Kerala (₹1403 per quintal) was found to be higher than Karnataka (₹1168 per quintal). Within Kerala, cost of production was found to be higher in Alappuzha compared to Palakkad since in Alappuzha yield realised was comparatively lower and coupled with higher cost of cultivation. However, in both the states, the cost of production of local non KAU varieties was comparatively higher than KAU varieties mainly because of lower yield realised in comparison to KAU varieties and higher cost of cultivation involved in the cultivation of local non KAU varieties.

Table 4.13. Cost of cultivation of KAU and local non KAU rice varieties (₹ ha^{-1})

Category of respondents/ Cost	KAU Varieties			Local non KAU Varieties		
	Karnataka	Kerala		Karnataka	Kerala	
		Palakkad	Alappuzha		Palakkad	Alappuzha
Cost A_1	53758	56691	54729	57240	60017	59990
Cost A_2	53758	56691	54729	57240	60017	59990
Cost B_1	53862	58044	54847	57340	60903	60094
Cost B_2	75731	73213	81915	76347	76031	85933
Cost C_1	53862	58044	54847	57340	60903	60094
Cost C_2	75731	73213	81915	76347	76031	85933
Cost C_3	83305	80535	90107	83981	83634	94526

Table 4.14. Cost of production of KAU and local non KAU rice varieties (₹/quintal)

Category of respondents/ Cost	KAU Varieties			Local non KAU Varieties		
	Karnataka	Kerala		Karnataka	Kerala	
		Palakkad	Alappuzha		Palakkad	Alappuzha
Cost A_1	908	1004	1087	1000	1066	1248
Cost A_2	908	1004	1087	1000	1066	1248
Cost B_1	909	1028	1089	1002	1082	1250
Cost B_2	1279	1297	1627	1334	1351	1788
Cost C_1	909	1028	1089	1002	1082	1250
Cost C_2	1279	1297	1627	1334	1351	1788
Cost C_3	1406	1427	1789	1467	1486	1966

4.2.4 Estimation of income measures

4.2.4.1 Yield (kg ha^{-1}) and income (₹ ha^{-1}) from rice

The average yield and average income from KAU and local non KAU varieties is presented in Table 4.15. From the table, the average yield of both grain and straw from KAU varieties in Karnataka was 5923 kg ha^{-1} and 3254 kg ha^{-1} respectively. In Palakkad and Alappuzha average grain yield was 5644 kg ha^{-1} and 5036 kg ha^{-1} respectively with an average straw yield of 2865 kg ha^{-1} in Palakkad district. It was evident that the average yield of KAU varieties was significantly higher in Karnataka than that in Kerala. However, in both states, the average yield of local non KAU varieties was found to be lower than that of KAU varieties. Results thus indicated that KAU varieties were superior than local non KAU varieties in terms of yield in both the states.

The average gross income from KAU varieties was ₹87477 ha^{-1} in Karnataka while it was ₹1,21,356 and ₹1,08,271 ha^{-1} in Palakkad and Alappuzha respectively. Although the average yield of KAU varieties was higher in Karnataka, the average gross income from KAU varieties was higher in Kerala compared to Karnataka. This is attributed to the low procurement price prevailing in Karnataka in comparison to Kerala. This result was evident with minimum procurement price of Jyothi as reported in Karnataka was ₹1510 per quintal (Department of Agricultural Marketing and Karnataka State Agricultural Marketing Board, 2016) however in Kerala was ₹2150 per quintal (SUPPLYCO, 2016). This result clarifies the fact that for every quintal of yield farmers of Kerala were getting ₹640 more than that of Karnataka farmers.

The average gross income from local non KAU varieties was found to be lower than KAU varieties in both the states. This is mainly because the average yield of local non KAU varieties was lower than KAU varieties in both the states and minimum procurement price of local non KAU varieties were lower than the KAU varieties in Karnataka. From this, it is clear that cultivation of KAU varieties is more profitable than local non KAU varieties.

Table 4.15. Average Yield (kg ha^{-1}) and Average income (₹ ha^{-1}) from KAU and local non KAU varieties

Category of respondents/ Particulars	KAU varieties			Local non KAU varieties		
	Karnataka	Kerala		Karnataka	Kerala	
		Palakkad	Alappuzha		Palakkad	Alappuzha
Average yield of rice (kg ha^{-1})	5923	5644	5036	5723	5629	4807
Average straw yield of rice (kg ha^{-1})	3254	2865	-	4536	3875	-
Average gross income from Rice (₹ ha^{-1})	87477	121356	108271	76025	121024	103355

4.2.4.2 Estimation of different income measures

In order to find out the relative profitability of rice varieties, the different income measures were worked out and presented in Table 4.16. It was found that in Palakkad, higher average gross income of ₹121356 ha^{-1} was obtained by cultivating KAU varieties followed by ₹121024 ha^{-1} by cultivating local non KAU varieties. Whereas in Alappuzha, average gross income of ₹108271 ha^{-1} and ₹103355 ha^{-1} was obtained by cultivating KAU and local non KAU varieties respectively this was comparatively lower than the average gross income in Palakkad. In Palakkad higher average yield per hectare of rice realised by cultivating KAU and local non KAU varieties was 5644 kg ha^{-1} and 5629 kg ha^{-1} respectively, whereas in Alappuzha it was lower amounting to 5036kg ha^{-1} and 4807kg ha^{-1} respectively.

In Karnataka average gross income obtained by cultivating KAU and local non KAU varieties was ₹87477 $ha^{-1}$and ₹76025 ha^{-1} respectively. The gross income in Karnataka was low in comparison with average gross income obtained in Kerala for both the varieties. This may also be due to the low procurement price prevailing in Karnataka compared to Kerala.

The farm business income in Kerala from KAU varieties was found to be higher in Palakkad compared to Alappuzha. Poor yield, higher variable costs such as seed cost, dewatering and liming charge is prevailing in Alappuzha may be the reason for such variations. However in Karnataka, even though the cost A_1 was less and average yield was higher than Palakkad and Alappuzha, the farm business income was found to be higher in Kerala because of higher procurement prices. The farm business income was found to be less for local non KAU varieties than KAU varieties in both the states. In Kerala it is mainly because of lower yield, higher labour cost required for weeding, fertilizer application and plant protection measures as well as high seed cost, during cultivation of local non KAU varieties. In Karnataka the low income during cultivation of non KAU varieties was mainly because of lower yield, lower procurement prices and higher labour cost in cost A_1.

The net income obtained by cultivating KAU varieties was also found to be higher in Palakkad, followed by Alappuzha and Karnataka. Higher rental value of owned land in cost B_2 component in Alappuzha and Karnataka may be the cause for this scenario. An other reason behind this may be lower yield and higher cost of cultivation in Alappuzha while in Karnataka it may be due to low gross income arising from lower procurement price prevailing in the state. This implies that cultivation of KAU varieties in Kerala is more profitable than Karnataka. The net income at cost C_2 obtained by cultivating local non KAU varieties was found to be negative in Karnataka and low in Alappuzha and Palakkad compared to the net income from KAU varieties. This was mainly because of lower yield, higher cost of cultivation in both the States. Lower price of local non KAU varieties over KAU varieties in Karnataka may also contribute the low net income in Karnataka.

The Benefit Cost Ratio at C_2 was found to be positive for KAU varieties in both the states. This implies that after including all the costs, the cultivation of KAU varieties seems to be profitable to the farmers in both the states, whereas in case of local non KAU varieties the B:C ratios found to be positive but it was less than their respective B:C ratio of KAU varieties in both the states.

The Benefit Cost Ratio at explicit cost level was found to be positive for KAU varieties in both the states. This implies that after including all the variable costs, cultivation of KAU varieties seems to be profitable in both the states. The B:C ratio was found to be higher in Palakkad, followed by Alappuzha and Karnataka. Whereas, in case of non KAU rice varieties, even though the B:C ratio was found to be positive but it was less than their respective B:C ratio of KAU varieties in both the states. This result clearly indicates that cultivation of KAU varieties is more profitable than local non KAU varieties in both the state

Table 4.16. Estimates of different measures of income (₹ ha^{-1})

Particulars / Category of respondents	KAU varieties			Local non KAU varieties		
	Karnataka	Kerala		Karnataka	Kerala	
		Palakkad	Alappuzha		Palakkad	Alappuzha
Average gross income (GI)	87477	121356	108271	76025	121024	103355
Farm Business Income (GI-cost A_1)	33719	64665	53542	18785	61007	43365
Net income at Cost C_2 (GI-cost C_2)	11746	48143	26356	-322	44993	17422
Benefit Cost Ratio (GI: C_2)	1.16	1.66	1.32	0.99	1.59	1.20
Benefit Cost Ratio at explicit cost level (G1 : A_1)	1.63	2.14	1.98	1.33	2.02	1.72

4.3 Impact assessment of KAU varieties: Partial budgeting technique

Partial budgeting technique was used to assess the impact of KAU varieties on productivity in both states and the estimated results are presented in Tables 4.17, 4.18 and 4.19.

4.3.1 Impact assessment of KAU varieties in Karnataka

The results obtained from partial budgeting are presented in Table 4.17. It was observed that in Karnataka net change in the income is found to be positive and was higher for KAU varieties. This is mainly because of the higher gross income of KAU varieties due to the higher marketing price of Jyothi and Uma. Department of Agricultural Marketing and Karnataka State Agricultural Marketing Board (DAMKSAMB, 2016) which reported that minimum procurement price of variety Jyothi in Karnataka (₹1510 per quintal) was high compared with other important local varieties such as IR64 (₹1400 per quintal), MTU-1001 (₹1300 per quintal) and Rajahamsa (₹1169 per quintal) and the other reason for higher net income may be due to the higher yield (5923 kg ha^{-1}) from KAU varieties as compared to non KAU varieties (5723 kg ha^{-1}). Lower variable cost involved in the cultivation of KAU varieties may be another reason for the higher change in the net income of KAU varieties over non KAU varieties.

4.3.2 Impact assessment of KAU varieties in Kerala (Palakkad)

The results obtained from partial budgeting are presented in Table 4.18. It was found that net change in the income is positive for KAU varieties in Palakkad. This might have attributed to the lower variable cost involved in the cultivation of KAU varieties as compared to non KAU varieties. In case of KAU varieties, labour hiring charges, fertilizers and plant protection charges accounted about 40.2 per cent, 8.7 per cent and 2.2 per cent respectively to the cost of cultivation (cost A_1) and it was about 41.7 per cent, 8.8 per cent and 2.3 per cent respectively to the cost A_1 in non KAU varieties.

4.3.3 Impact assessment of KAU varieties in Kerala (Alappuzha)

The results obtained from partial budgeting are presented in Table 4.19. It was observed that the net change in the income is found to be positive and higher for KAU varieties over non KAU varieties. This may be due to the higher gross income from KAU varieties. This is mainly because of higher yield obtained by cultivating KAU varieties (5036 kg ha^{-1}) as compared to non KAU varieties (4807 kg ha^{-1}). Another reason for the higher change in the net income may be due to the lower variable cost involved in the cultivation of KAU varieties over the local non KAU varieties. In case of KAU varieties, labour hiring charges accounted about 26.30 per cent to the cost A_1 component. Whereas it was about 37.20 per cent in case of non KAU varieties. It is mainly because of use of more labours in weeding and plant protection measures operations.

Hence these results confirm the fact that cultivation of KAU varieties was more profitable over the local non KAU varieties in both the states.

Table 4.17. Impact assessment of KAU varieties in Karnataka

Karnataka			
Costs (₹ ha^{-1})		**Benefits (₹ ha^{-1})**	
Particulars		**Particulars**	
Added costs		**Added returns**	
Nursery preparation	24.98	Gross income	11452.00
Seeds	398.95		
Fertilizers	299.21	Yield (kg ha^{-1})	200.00
Land revenue	14.21	Total	11452.00
Depreciation	12.89	**Reduced costs**	
Total	750.24	Labour hiring charge	2161.00
Reduced returns	Nil	FYM	1159.37
		Machine labour charge	375.00
		Plant protection chemicals	308.00
		Interest on working capital	227.78
		Total	4231.15
Added costs+ Reduced returns	750.24	**Added returns + Reduced costs**	15683.15
Net change = 14932.91			

Table 4.18. Impact assessment of KAU varieties in Kerala (Palakkad)

Kerala (Palakkad)			
Costs (₹ ha^{-1})		**Benefits (₹ ha^{-1})**	
Particulars		**Particulars**	
Added costs		**Added returns**	
seeds	71.88	Gross income	332.00
Machine labour charge	335.00	Yield (kg ha^{-1})	15.00
Nursery preparation	90.02	Total	332.00
Depreciation	146.00	**Reduced costs**	
Total	642.90	Labour hiring charge	2241.00
Reduced returns	Nil	FYM	819.21
		Fertilizers	552.03
		Plant protection chemicals	139.00
		Interest on working capital	217.00
		Total	3968.24
Added costs+ Reduced returns	642.90	Added returns+ Reduced costs	4300.24
Net change = 3657.34			

Table 4.19. Impact assessment of KAU varieties in Kerala (Alappuzha)

Kerala (Alappuzha)			
Costs (₹ ha^{-1})		**Benefits (₹ ha^{-1})**	
Particulars		**Particulars**	
Added costs		**Added returns**	
Plant protection chemicals	97.03	Gross income	4916.00
Dewatering charges	74.21	Yield (kg ha^{-1})	229.00
Total	171.24	Total	4916.00
Reduced returns (₹ ha^{-1})	Nil	**Reduced costs (₹ ha^{-1})**	
		Labour hiring charge	2457.14
		Machine labour charge	475.24
		Seeds	1240.02
		Fertilizers	840.31
		Liming charges	83.01
		Interest on working capital	345.42
		Total	5441.13
Added costs+ Reduced returns	171.24	Added returns + Reduced costs	10357.13
Net change = 10185.89			

4.4 Resource productivity in rice cultivation – Regression analysis

Cobb-Douglas production function fit to estimate the resource productivity in rice cultivation in both the States and the estimates are presented in Tables 4.20 and 4.21. The estimated Cobb-Douglas production function for rice cultivation in Karnataka was:

$$\ln Y = 8.880 + 1.114\ln X_1 + 0.062\ln X_2 - 0.106\ln X_3 - 0.028\ln X_4$$

It could be observed in Karnataka, that area was found to influence total yield positively at 1 per cent level of significance. The area under rice cultivation had an elasticity of 1.114 which shows that one per cent increase in the area under rice cultivation would increase the total yield by 1.114 per cent. This indicated that there is scope for improvement of production by increasing the area under cultivation in Karnataka. This result is supported by earlier workers (Abedullah *et al.,* 2007 and Kadiri *et al.,* 2014). They argued that area influenced the yield positively at one per cent level of significance. R^2 value was 0.928. R^2 explains the proportion of the variation in Y (dependent variable) as explained by the independent variables jointly and it is a non decreasing function of the number of explanatory variables present in the model. R^2 value was 0.928 which implies the independent variables included in the model could explain 92.8 per cent of the variation in the total yield. Returns to scale (RTS) reflect the change in output as a result of a given proportionate change in all the factors of production or inputs simultaneously. RTS can be estimated from the total elasticity of production (e). The RTS for rice cultivation in Karnataka was 1.042 which can be considered to be equal to 1. It implies that when there is a simultaneous 1 per cent increase in all the explanatory variables, will result in the same proportional increase in the yield.

The estimated Cobb-Douglas production function for rice cultivation in Kerala was: $\ln Y = 6.541 + 0.503 \ln X_1 + 0.200\ln X_2 + 0.005\ln X_3 + 0.221\ln X_4$

The labour use in man days in Kerala was found to influence total yield positively at five per cent level of significance. The labour use in rice cultivation

had an elasticity of 0.221 which indicated that one per cent increase in the labour use would result in an increase in total yield by 0.221 per cent. This indicated that there is scope for improvement of rice production in Kerala by increasing the use of human labour in cultivation. This could be attributed to a fact that in Kerala, due to the seasonal shortage of labours and high labour wages farmers opt to employ a limited number of labours for various intercultural operations like weeding and plant protection measures. However with the limited use of labours, the infestation of weeds, pest and diseases increases and ultimately leading to decrease in the yield. Hence higher use of labour in rice cultivation has a positive influence on total yield. This result is in consonance with earlier studies (Abedullah *et al.,* 2007 and Kadiri *et al.,* 2014). R^2 value was 0.794 which implied that the included independent variables in the model could explain 79.4 per cent of the variation in the total yield. RTS for rice cultivation in Kerala (0.93) was less than one. This indicated that a simultaneous one percent increase of all the inputs selected will give a corresponding yield increase by less than one per cent. Therefore the scope for further increase in the use of inputs is limited. The production function can be shifted upwards by using new technology especially new and improved varieties resistant to pests and diseases.

Table 4.20. Estimates of the Cobb-Douglas production function for rice cultivation in Karnataka

Variable	Unit	Co-efficient	't' value	Standard error
Constant	-	8.880***	8.562	1.037
Area	Hectares	1.114***	5.099	0.218
Fertilizer quantity	kg	0.062	0.536	0.115
Seed quantity	kg	-0.106	-0.795	0.133
Labour use	Man days	-0.028	-0.273	0.103
	R^2 = 0.928 , N= 80, Return to Scale = 1.042			

Note: *** denotes significant at 1% level of probability

Table 4.21. Estimates of the Cobb-Douglas production function for rice cultivation in Kerala

Variable	Unit	Co-efficient	't' value	Standard error
Constant	-	6.541***	4.644	1.409
Area	Hectares	0.503	1.597	0.315
Fertilizer quantity	Kg	0.200	1.372	0.146
Seed quantity	Kg	0.005	0.025	0.201
Labour use	Man days	0.221**	2.357	0.094
	R^2 = 0.794, N= 80, Return to scale= 0.93			

Note: *** denotes significance at 1 per cent level of probability, ** denotes significance at 5 per cent level of probability

4.5 Specific reasons and factors affecting adoption of KAU varieties

4.5.1 Reasons for adoption of KAU varieties- Garrett ranking technique

The specific reasons for adoption of KAU varieties are presented in the Table 4.22. In Karnataka high market price and high yield potential of KAU varieties were identified by the farmers as the important reasons for adoption of varieties with mean scores of 65.48 and 63.23 respectively. This is mainly because KAU varieties gave a higher yield to the tune of 5923 kg ha^{-1} and registered a higher market price of about ₹1510 per quintal as compared to local non KAU varieties. Other references also support this findings. DAMKSAMB (2016) reported that minimum procurement price of Jyothi variety in Karnataka (₹1510 per quintal) was high compared with other important local varieties such as IR64 (₹1400 per quintal), 1001(₹1300 per quintal) and Rajahamsa (₹1169 per quintal). Kumari (2011) also reported Jyothi and Uma were prominent and high yielding varieties both in Kerala and Karnataka.

Higher tillering capacity of the crop was identified as the third major reason for adoption of KAU varieties. Resistance to pest and diseases were ranked

the least as the reason for adoption of KAU varieties by the farmers. KAU (2011), had reported that Jyothi is moderately tolerant to BPH and blast and Uma is resistant to BPH and gall midge. However, variety Jyothi has been identified to be susceptible variety for blast disease.

In Kerala high yield potential and resistance to diseases were identified as a important factors for continued cultivation of KAU varieties with a mean score of 66.72 and 64.70 respectively. (Kumari, 2011) had reported that varieties Jyothi and Uma are identified as high yielding and most popular variety in Kerala and Uma, have been found to be resistant to gall midge which is a problematic pest in Kuttanad. The average yield of KAU varieties in Palakkad and Alappuzha was 5644 kg ha^{-1} and 5036 kg ha^{-1} proving that farmers could obtain good yield by cultivating KAU varieties as compared to local non KAU varieties.

Locational suitability was identified as the third important factor by the farmers for adoption of KAU varieties. Kerala Agricultural University (KAU, 2011) recommended that Uma and Jyothi are best suited for Kuttanad and Transplanted areas. High market price were identified as fourth important factor leading to varietal adoption. Since Jyothi variety has better demand for export, it has good market price in both government purchase and local or private purchase.

In Palakkad, varieties PC1 and PC2 were not purchased by the government procuring agencies like Supplyco. These varieties had poor demand in private markets. This is one of the important reasons identified for non adoption of local non KAU varieties.

The better preference for consumption and higher tillering capacity of KAU varieties were identified as a fifth and sixth factors by farmers. In Kerala most of the farmers sell a major portion of their produce in the market because of good market price of rice (₹21.50 per kg government procurement price) and retain only a small quantity for consumption. Hence, consumption factor was cited as the fifth factor to adopt KAU varieties. Farmers preference for short duration varieties in Palakkad due to cultivation in two to three seasons was the

last factor which attributed to KAU variety cultivation. Hence they rated short duration as one of the reason for their adoption of the KAU varieties.

4.22. Reasons for adoption of KAU varieties in Karnataka and Kerala

Reasons/States	Growing KAU varieties	
	Karnataka	Kerala
High market price	1(65.48)	4(51.95)
High yield potential	2(63.23)	1(66.73)
Resistance to pest and diseases	4(29.98)	2(64.70)
High tillering capacity	3(41.33)	6(39.28)
Short duration	-	7(24.70)
Consumption purpose	-	5(48.28)
Locational suitability	-	3(55.15)

Note: Figures in parentheses represent Garret score for adoption reasons

4.5.2 Factors affecting varietal adoption – Probit analysis

Probit model was fit to find out the factors affecting adoption of KAU rice varieties in Kerala and Karnataka and the estimated results are presented in Tables 4.23 and 4.24.

4.5.2.1 Factors affecting adoption of KAU varieties in Kerala

The results obtained from probit analysis are presented in Table 4.23. It is observed that organizational membership and annual income was positively significant at one per cent level. Farmer's membership in an organization was found to have a positive influence on adoption of KAU varieties. Among the 80 farmers surveyed in Kerala, 64 (80 per cent) were members of an organization called Padasekhara Samithi. This is an organization of the farmers for promoting rice cultivation in the state. Among the 40 farmers growing KAU varieties,

38 (95 per cent) were members of this organization. Majority of the farmers in each of the Padasekhara Samithis cultivate the same variety season after season because it is a government initiated programme and seeds and fertilizers are distributed at subsidized rates through Krishi Bhavans. The farmers grow rice in a group, adopting same variety to facilitate easy cultural and management practices. Since Jyothi and Uma are high yielding varieties in Palakkad and Alappuzha, (Kumari, 2011) most of the Krishi Bhavans distribute these varieties to Padasekhara Samithis for cultivation. Therefore, it may be concluded that as the number of Padasekhara Samithis increases, adoption of KAU varieties will also increase. Annual income was another factor found to be have a positive influence on adoption of KAU varieties. Among 80 respondents surveyed in Kerala, 61 (76.25 per cent) were having annual income of more than ₹50000. Among 40 respondents growing KAU varieties 32 (80 per cent) respondents were having an annual income of more than ₹50000. Awareness about variety is more among rich farmers compared to small and marginal farmers. Hence we can conclude that farmers having an higher annual income, adopted KAU varieties faster than farmers having an lower annual income.

4.5.2.2 Factors affecting adoption of KAU varieties in Karnataka

It could be observed from Table 4.24. That among the number of variables included in probit model education, annual income and organizational membership were positively significant at five per cent level of significance and area at ten per cent level of significance. Education influences the adoption of KAU varieties positively. Among the 40 farmers growing KAU varieties in Karnataka, 33 (82.5 per cent) were literate which confirms the observation that with increase in the educational level of farmers, probability to adopt KAU varieties will also increase. This result is supported with earlier studies of (Foltz, 2003) who argued that education plays an important role in gathering information about technologies and its subsequent adoption. Similarly educated farmers can perceive earlier than others (Ghimire *et al.*, 2015, Kassie *et al.*, 2011; Asfaw *et al.*, 2012).

As in the case of Kerala, in Karnataka also farmers who were members of organizations like Karnataka State Seed Corporation (KSSC) and other farmers organization were positively influenced into adopting of KAU varieties. Among the 40 farmers growing KAU varieties, 31 (77.5 per cent) were members of organizations like KSSC and cooperatives. These farmers are supplied with seeds, information about improved and high yielding varieties and field level assistance by technical experts. Hence as the organizational membership increases, probability to adopt KAU varieties will also increase. This correlate with the investigation by Kijima and Sserunkuuma (2003) and Tura *et al.* (2010) who opined that as members of organization, the farmers' accessibility to information becomes easier and faster which encourages adoption of improved varieties.

Table 4.23. Estimates of the probit model for adoption of KAU varieties in Kerala

Variables	Unit	Co-efficient	Std. Error	Z-value
Constant	-	-3.008**	1.531	-1.965
Education	Years	0.088	0.057	1.530
Age	Years	0.012	0.022	0.525
Area	Hectare	-0.023	0.058	-0.390
Annual income	Rupees	0.001***	0.001	2.619
Organizational membership dummy	=1 if member of any organization =0 if non-member of organization	1.079***	0.362	2.978
$X^2 = 0.771$ significance of $X^2 = 0.379$, N= 80				

Note: *** denotes significance at 1 per cent level of probability, ** denotes significance at 5 per cent level of probability and * denotes significance at 10 per cent level of probability

Table 4.24. Estimates of the probit model for adoption of KAU varieties in Karnataka

Variables	Unit	Co-efficient	Std. Error	Z-value
Constant	-	-2.82	0.808	-3.49
Education	Years	0.069**	0.033	2.085
Age	Years	-0.013	0.017	-0.759
Area	Hectare	0.467*	0.266	1.759
Annual income		0.001**	0.001	-2.120
Organizational membership dummy	=1 if member of any organization =0 if non -member of organization	0.759**	0.352	2.153
$X^2 = 0.940$ significance of $X^2 = 0.058$, N= 80				

Note: *** denotes significance at 1 per cent level of probability, ** denotes significance at 5 per cent level of probability and * denotes significance at 10 per cent level of probability

Area was another factor that was found to influence varietal adoption positively. Among the total area of 109.60 ha under rice cultivation in the study region, area of about 63.78 ha (58 per cent) is under the KAU variety cultivation. As area under crop increased, probability of adopting KAU varieties also increased. This result was supported by Tura *et al.* (2010) who revealed that the probability of adoption of improved maize varieties increase with increase in size of farm land. Similarly as size of rice farm increases, probability of adopting improved rice varieties also increases (Saka *et al.*, 2005). A study by Ghimire *et al.* (2015) also argued that farm size has a positive and significant influence on the probability of adoption of improved rice varieties. Annual income was also identified as a significant variable and found to be having a positive influence on adoption of KAU varieties. Among 40 respondents growing KAU varieties 21(52.5 per cent) respondents were having an annual income of more than ₹50000. Awareness about variety is more among higher income

farmers compared to farmers with lower income. Hence we can conclude that farmers having a higher annual income, adopting KAU varieties faster than farmers having an lower annual income.

4.6 Economic of seed production in rice of KAU varieties

4.6.1 Cost of seed production of KAU varieties

The cost of seed production of KAU varieties in Karnataka and Kerala were given in the following table 4.25. The average cost of cultivation (cost C_2) of seed production of KAU varieties were found to be higher in Karnataka compared to Kerala. It is mainly due to higher rental value of the owned land in Karnataka compared to Kerala. However cost A_1 was found to be higher in Kerala compared to Karnataka because of the higher variable costs as a result of higher requirement of labourers for weeding and roughing operations, higher machine labour cost in Kerala compared to Karnataka. However the cost of production were also found to be high in Karnataka compared to Kerala mainly because of higher cost of cultivation and lower seed yield realised in Karnataka compared to Kerala. The cost of production based on cost A_1 to cost B_1 was found to be less in Karnataka compared to Kerala because of lower variable costs found in Karnataka.

4.25. Cost of seed production of KAU varieties

Particulars	Cost of cultivation (₹ ha^{-1})		Cost of production (₹ per quintal)	
States/costs	Karnataka	Kerala	Karnataka	Kerala
Cost A_1	58694	65520	953	1053
Cost A_2	58694	65520	953	1053
Cost B_1	58797	66827	954	1074
Cost B_2	88176	86355	1431	1388
Cost C_1	58797	66827	954	1074
Cost C_2	88176	86355	1431	1388
Cost C_3	96993	94991	1574	1527

4.6.2 Input-wise cost of seed production in cost A_1

The share of various inputs in cost A_1 is given in Table 4.26. The labour cost accounted for major share in cost A_1 in both states, amounting to 39.31 per cent and 50.50 per cent in Karnataka and Kerala respectively. In Kerala labour cost contributed more than 50 per cent to the total cost A_1 with an amount of ₹33089. Input cost in Karnataka and machine labour cost in Kerala constituting 29 per cent and 22 per cent in Karnataka and Kerala respectively were found to be next to labour cost. The input cost was found to be higher in Karnataka (29 per cent) than in Kerala (18.45) mainly because the seed producing farmers in Kerala are supplied seeds at free of cost by Kerala State Seed Development Authority (KSSDA). In Karnataka farmers generally purchase the seed at prevailing rate. In addition to this farmers in Karnataka incur expenditure on field inspection, seed testing, processing, registration, courier and sample bag expenditure while in Kerala all these facilities are free of cost.

4.26. Input-wise cost of seed production in cost A_1 component

Category of respondents/Particulars	Karnataka	Kerala
Nursery preparation	1925(3.28)	627(0.96)
Input cost	17022(29.00)	12087(18.45)
Labour cost	23074(39.31)	33089(50.50)
Machine labour cost	9942(16.94)	14438(22.04)
Other costs	4453(7.59)	5278(8.06)
Inspection charge	371(0.63)	0
Seed testing charge	150(0.26)	0
Processing and inspection charge	1602(2.73)	0
Registration, courier and Sample bag charge	155(0.26)	0
Cost A1	58694(100)	65520.01(100)

Note: Figures in parentheses represent the per cent to the total

Fig. 4.7. Cost of seed production of KAU varieties in Kerala and Karnataka

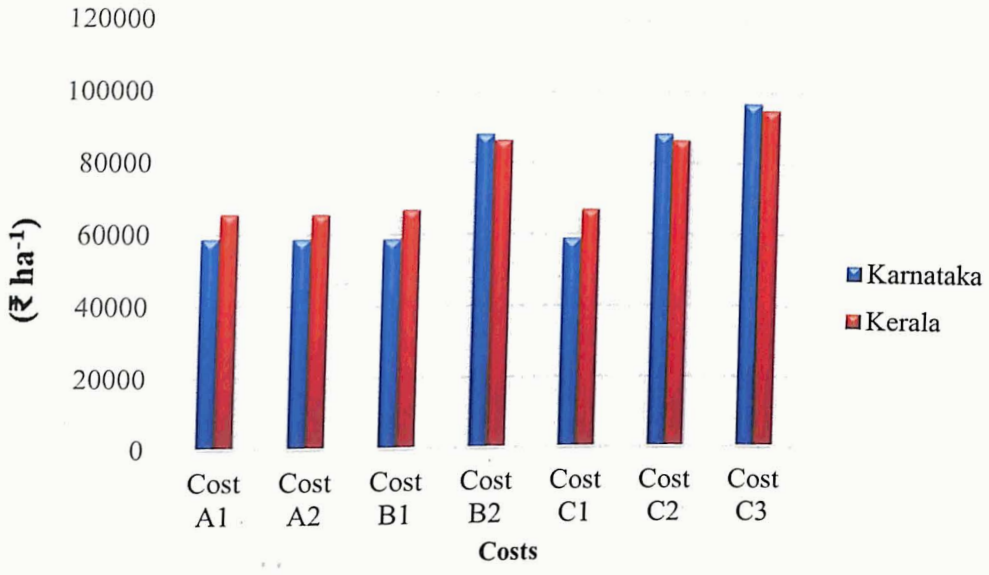


Fig. 4.8. Input-wise cost of seed production in cost A_1 in Karnataka

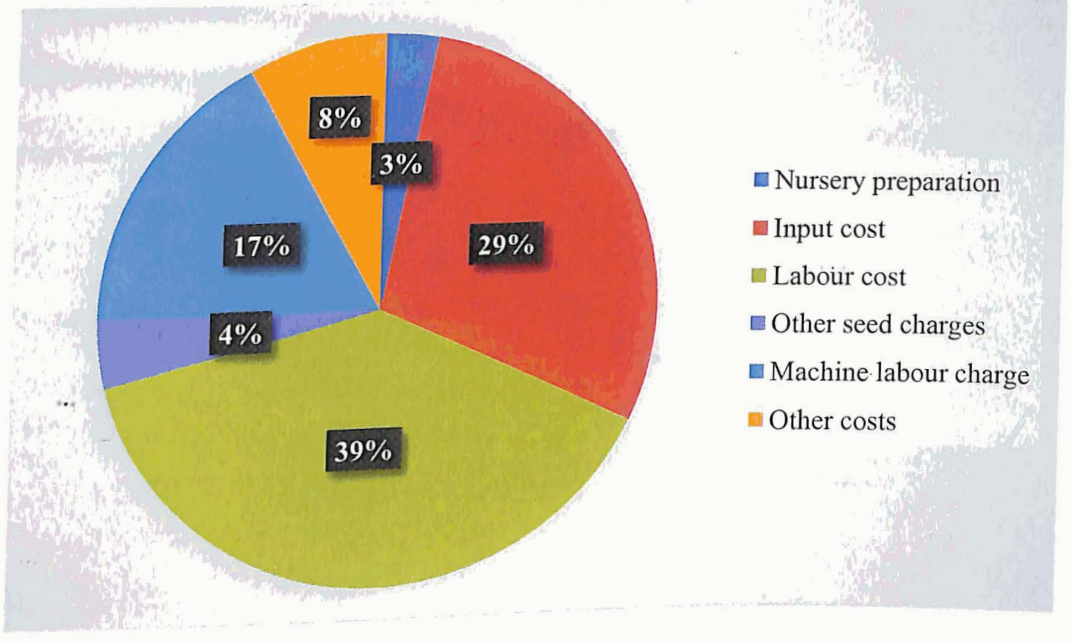
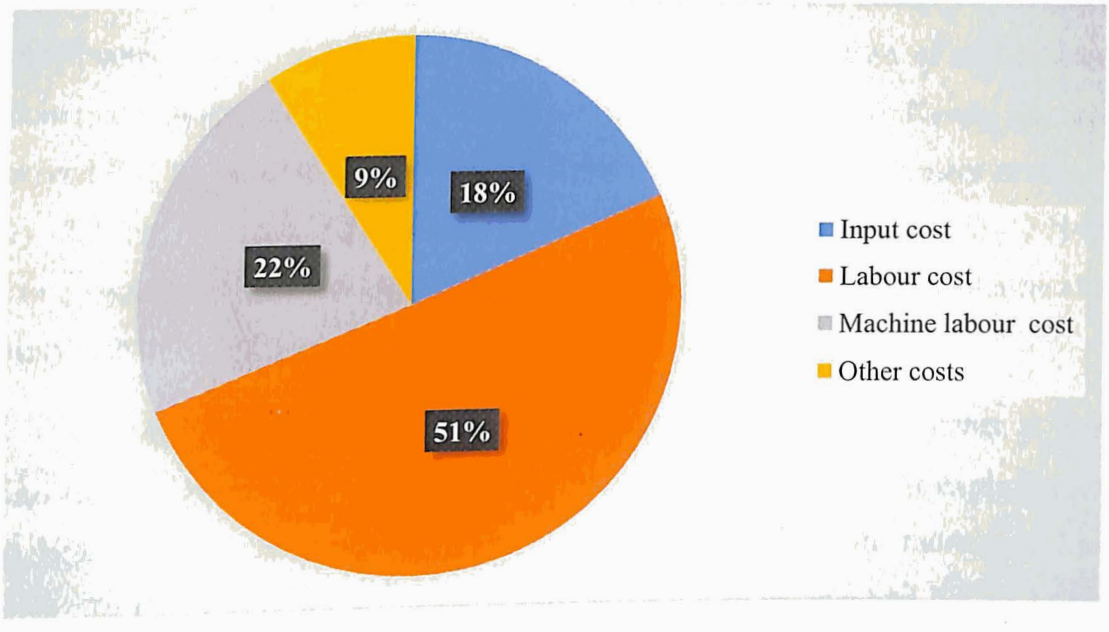


Fig. 4.9. Input-wise cost of seed production in cost A_1 in Kerala



4.6.3 Analysis of different income measures for seed production (₹ ha^{-1})

To analyse the profitability of seed production different income measures were calculated. The results are present on Table 4.27. The average yield of seed was found to be marginally higher in Kerala compared to Karnataka. The average gross income was found to be higher in Kerala mainly because of higher seed procurement price prevailing in Kerala compared to Karnataka. Kerala farmers received ₹30/kg of seed (KSSDA, 2014) whereas in Karnataka farmers received only ₹20/kg of seed (Karnataka State Seeds Corporation Limited, 2014). Farm business income was also found to be high in Kerala compared to Karnataka mainly due to higher gross income.

Net income at cost C_2 was found to be positive in both the states. It was found to be high in Kerala than in Karnataka. Benefit-cost ratio at explicit cost was found to be positive and equal to 2 in Karnataka while it was more than 2 in Kerala. This was because of lower variable cost in Karnataka and higher gross income in Kerala.

4.27. Estimates of different income measures for seed production (₹ ha^{-1})

Particulars/States	**Karnataka**	**Kerala**
Average yield (Kg/ha)	6160	6223
Average gross income (GI)	117513	156223
Farm Business Income (GI-cost A_1)	58819	90703
Net income at Cost C2 (GI-cost C_2)	29337	69868
Benefit Cost Ratio (GI: C_2)	1.33	1.81
Benefit Cost Ratio at explicit cost level (G1 : A_1)	2.00	2.38

4.7 Marketing channels of KAU varieties

Marketing channels are routes through which agricultural products move from producers to consumers or the chain of intermediaries through various commodities pass from producers to consumers constitute their marketing channels.

4.7.1 The marketing channel identified in Karnataka were

In Karnataka there are four different marketing channels of KAU varieties were identified and they are

Channel 1: Farmer - Rice Millers - Kerala rice market - Wholesaler/local trader- Retailer - Consumer

Channel 2: Farmer - Local traders - Kerala rice market - Rice millers - Retailers Consumer

Channel 3: Farmer - Kerala rice market - Wholesaler/Rice Millers/Local Agents – Retailers - Consumers

Channel 4: Farmer - APMC - Traders - Kerala rice market- Wholesaler /Rice millers/Local agents - Retailers - Consumers

Marketing channel identified in Kerala were

In Kerala there are four different marketing channels of KAU varieties were identified and they are

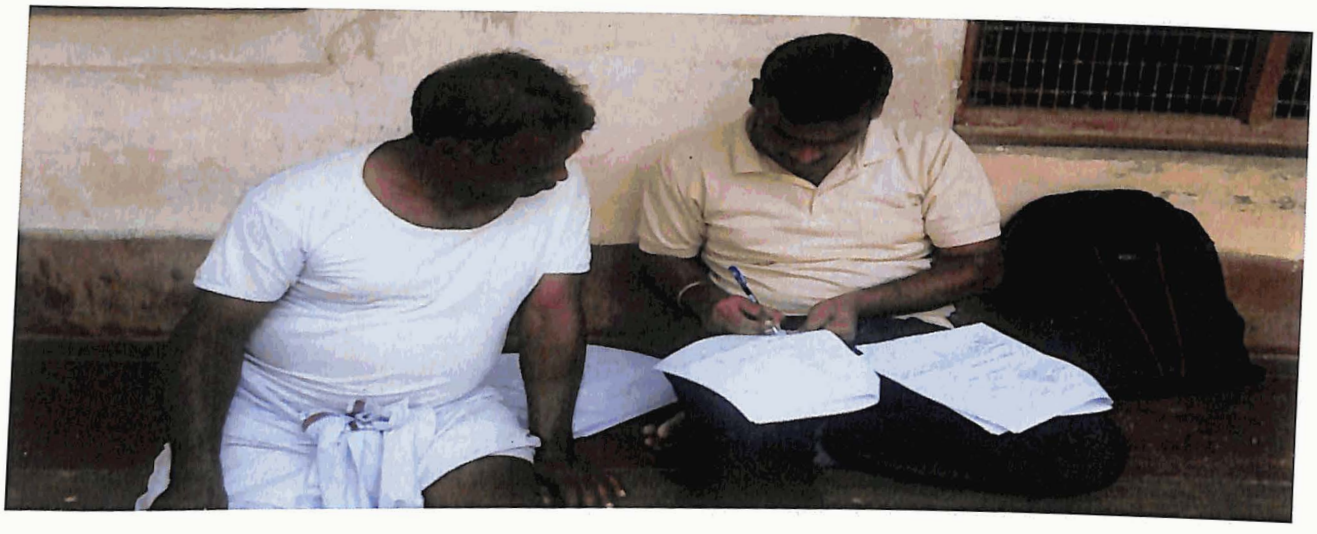
Channel 1: Farmer – Supplyco - Ricemillers - Public distribution system (PDS) - Consumers

Channel 2: Farmer - Ricemillers – Retailers- Consumers

Channel 3: Farmer – Local traders - Rice millers - Retailers- Consumers

In case of Karnataka, four different channels of markets were identified where rice millers, wholesalers, local traders/agents and retailers as market intermediaries between farmer and consumers.

In Kerala three different channels were identified where government agency like Supplyco, PDS, private agencies like rice millers, local agents and retailers act as an intermediaries between farmer and consumer.



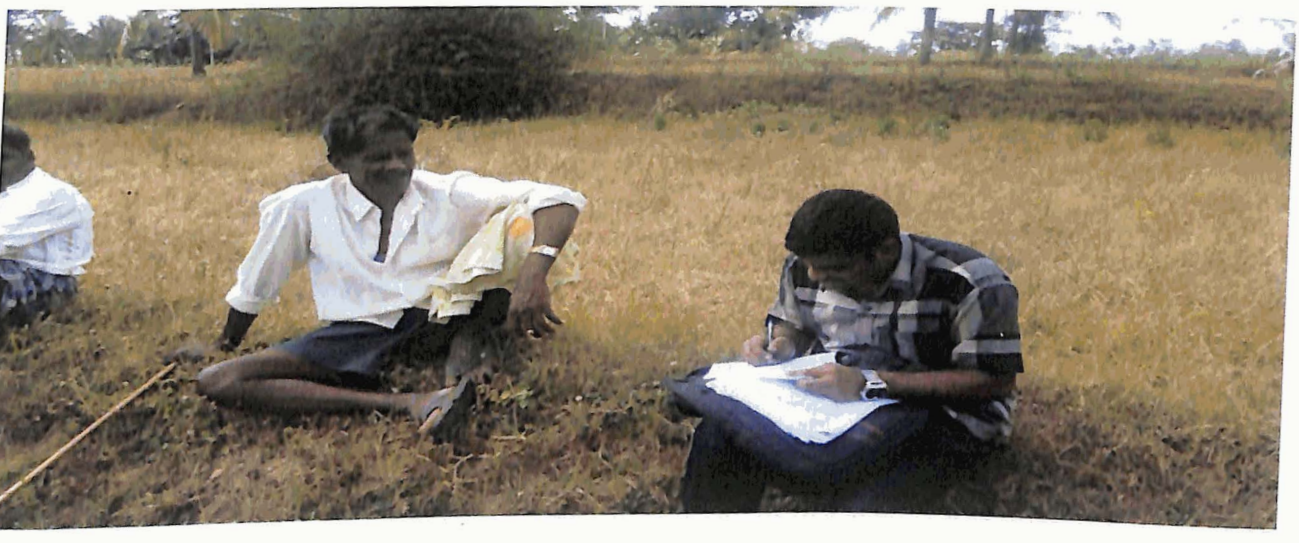


Plate 1 Survey of Karnataka farmers

Plate 2 Survey of Kerala farmers

Summary and conclusion

Summary and Conclusion

The present study entitled "Impact of prominent KAU rice varieties on the economic status of farmers in Kerala and Karnataka" was conducted in Kerala and Karnataka. The objectives of the study were to work out the costs and returns of prominent KAU rice varieties- Jyothi and Uma, to find out the relationship between varietal adoption and net farm income, to identify the specific reasons for adoption of KAU varieties and to assess the relative profitability of the KAU varieties in comparison with local non-KAU varieties in the states of Kerala and Karnataka.

The districts of Palakkad and Alappuzha of Kerala and the districts of Mysore and Mandya of Karnataka were purposively selected for the study as these districts in both the states are considered as prominent rice cultivating areas and are having a larger area under KAU rice varieties. The present study is mainly based on primary data collected from a sample of 160 farmers in Kerala and Karnataka. Forty farmers each cultivating at least one acre and adopting KAU varieties and 40 farmers cultivating a local popular non-KAU variety were randomly selected and surveyed in each state making a total sample size of 160 respondents. The primary data were obtained from selected sample farmers by personal interview method using a pre tested interview schedule. Data related to the socio-economic condition of the farmers, yield, cost and returns from rice, sources of seed, important factors responsible for adoption of the variety, year of initiation of cultivation of the variety were collected.

The analysis of the primary data referring to the socio-economic characteristics of the farmers include age, educational status, experience in rice cultivation, awards won and membership in any organizations, land ownership, annual family income, income source, average annual per capita expenditure and access to seeds. Age-wise, the respondents were distributed in to four different categories. In case of farmers growing KAU varieties, about 77.5 per cent respondents in Kerala and 52.5 per cent respondents in Karnataka fall under the

age category of above 50 years and only 5 per cent respondents in both the states were in the age group of age less than 30 years.

The literacy rate of farmers growing KAU varieties in Kerala and Karnataka were 97.5 and 82.5 per cent respectively, while, the literacy rate of farmers growing local non KAU varieties were 87.5 and 62.5 per cent in Kerala and Karnataka respectively. This result shows that rice growers in Kerala were more educated than those in Karnataka. Among the 160 respondents in both the states, 59 respondents from Kerala had an experience of greater than 25 years in rice cultivation, whereas, only 40 farmers were found to have an experience of greater than 25 years in rice cultivation in Karnataka. Regarding organizational membership of the farmers, about 95 per cent of respondents growing KAU varieties in Kerala and 75 per cent in Karnataka hold membership to some organizations. Whereas, only 65 per cent and 37.5 per cent respectively of local non KAU varieties cultivating respondents in Kerala and Karnataka, were members to some organizations. Approximately, The land holding size of 40 per cent farmers in Kerala and 55 per cent farmers in Karnataka growing KAU varieties was between 1-2 ha while 45 per cent farmers of Kerala and 55 per cent of farmers of Karnataka growing local non KAU varieties had a land holding size between 1-2 ha.

In Kerala, about 12.5 per cent and 25 per cent of respondents growing KAU and local non KAU varieties, respectively had an annual income of less than ₹50,000. However, in Karnataka, about 47.5 per cent and 72.5 per cent of respondents growing KAU and local non KAU varieties, respectively, had an annual income of less than ₹50,000. The results obtained reveal that in both the states, the farmers adopting KAU varieties were earning a higher annual income in comparison to those who took up local non KAU varieties. The study also showed that 65 out of total 80 respondents in Kerala and 66 out of total 80 respondents in Karnataka were dependent on farm income alone as their source of livelihood. In case of per capita annual expenditure, majority of the respondents in Kerala fall under the category of ₹50,000-₹1,00,000 in both KAU variety

cultivating as well as local non KAU variety cultivating categories, whereas, in Karnataka, higher number of respondents falls under the per capita annual expenditure category of below ₹50,000 in both KAU and local non KAU variety cultivating group of farmers.

In Karnataka, about 50 per cent of respondents depend on State Seed Corporations for the seeds of KAU varieties while in Kerala, more than 42 per cent of farmers depend on Krishibhavan for the seeds of the same

In the cultivation of both KAU and local non KAU varieties, hired labour costs accounted for larger share in cost A_1 in both the states. In case of KAU varieties labour component accounted for 37.2 per cent in Karnataka, 40.2 per cent in Palakkad and 26.3 per cent in Alappuzha to the cost A_1. Comparison of Cost A_1 between KAU and non KAU varieties revealed that hired labour charges is higher in non KAU varieties cultivation compared to KAU varieties cultivation in both the states. Machine labour charge is the second highest contributor to the cost A_1 in both the states. It was found to be higher in Kerala when compared to Karnataka. The average cost of cultivation (Cost C_2) of KAU varieties was found to be lesser in Palakkad (₹73,213 ha^{-1}) compared to Karnataka (₹75,731 ha^{-1}) and Alappuzha (₹81915 ha^{-1}). But cost incurred by farmers for growing KAU varieties up to Cost B_1 was found lesser in Karnataka compared to Palakkad and Alappuzha. Meanwhile, Cost B_1, Cost B_2, Cost C_2 and Cost C_3 were found to be lesser in Palakkad compared to Karnataka and Alappuzha. However, Cost C_2 in case of local non KAU varieties were ₹76347, ₹76031 and ₹85933ha^{-1}in Karnataka, Palakkad and Alappuzha, respectively, which was higher than Cost C_2 of KAU varieties in both the states. The average cost of production of KAU varieties in Karnataka (₹1279 per quintal) was less than in Palakkad (₹1297 per quintal) and Alappuzha (₹1627 per quintal). The cost of production considering cost A_1 of KAU varieties was comparatively high in Kerala compared to Karnataka. The average cost of production of local non KAU varieties in Karnataka (₹1334 per quintal) was lesser than in Palakkad (₹1351 per quintal) and

Alappuzha (₹1788 per quintal). However, in both the states, the cost of production of local non KAU varieties was comparatively higher than KAU varieties.

The average grain yield and straw yield from KAU varieties in Karnataka was 5923 Kg ha^{-1} and 3254 kg ha^{-1} respectively. Whereas, in Palakkad and Alappuzha average grain yield was found to be 5644 $kgha^{-1}$ and 5036 kg ha^{-1} respectively and average straw yield in Palakkad was 2865 kg ha^{-1}. This indicates that the average yield of KAU varieties was significantly higher in Karnataka than both the districts of Kerala. The average gross income from KAU varieties was ₹87,477 ha^{-1}in Karnataka while it was₹1,21,356 and ₹1,08,271 ha^{-1} respectively in Palakkad and Alappuzha. The average gross income from local non KAU varieties was ₹76,025ha^{-1} in Karnataka and ₹1,21,024 and ₹1,03,355 ha^{-1} in Palakkad and Alappuzha, respectively. The farm business income from KAU varieties in Palakkad (₹64,665 ha^{-1}) was higher than Alappuzha (₹53,542ha^{-1}) and Karnataka (₹33,719ha^{-1}). The net income obtained from cultivation of KAU varieties was found to be higher in Palakkad, followed by Alappuzha and Karnataka (₹48143ha^{-1}, ₹26356$ha^{-1}$and ₹11746ha^{-1}, respectively). The Benefit Cost Ratio at cost C_2 and explicit cost level were found to be positive for KAU varieties in both the states. This implies that after including all the costs, the cultivation of KAU varieties seems to be profitable to the farmers in both the states. Although the B:C ratios of local non KAU varieties were positive, it was less than the B:C ratio of KAU varieties in both states indicating a higher relative profitability due to cultivation of KAU varieties.

Cobb-Douglas production function was fitted to estimate the resource productivity in rice cultivation in both the States. In Kerala, labour use was identified as a significant factor affecting the yield positively while in Karnataka, it was the area under rice cultivation that positively influence the yield.

In Karnataka, high market price, high yield potential of KAU varieties, high tillering capacity of crop and resistance to pest and diseases were ranked as first, second, third and fourth reasons for adoption of KAU varieties by the farmers. However, in Kerala, high yield potential, resistance to diseases and pests,

locational suitability, high market price, consumption purpose, high tillering capacity and short duration of the crop were ranked first, second, third, fourth, fifth, sixth and seventh, respectively by the farmers as the reasons for adoption of KAU varieties.

Probit analysis was made to find out the factors affecting adoption of KAU rice varieties in Kerala and Karnataka. In Kerala, farmers' membership to organizations and annual income of the farmers were found to be having a positive influence on adoption of KAU varieties. Whereas, in Karnataka, education of the farmer and organizational membership and area were found to be the significant factors that are having a positive influence on the adoption of KAU varieties.

The average cost of cultivation (cost C_2) of seed production of KAU varieties were found to be higher in Karnataka (₹88,176ha^{-1}) compared to Kerala (₹86,355ha^{-1}) and cost of production were also found to be higher in Karnataka (₹1,431 per quintal) compared to Kerala (₹1,388per quintal). The labour cost, 39.31 per cent and 50.50 per cent in Karnataka and Kerala, respectively, accounted for the highest share in cost A_1. This was followed by input cost which constituted about 29 per cent and 18 per cent in Karnataka and Kerala, respectively, during seed production. The input cost was found to be higher in Karnataka than Kerala. This was because; in Kerala farmers are supplied with seeds free of cost by KSSDA whereas, in Karnataka, farmers generally purchase the seed at prevailing market rate. The average yield was found to be higher in Kerala (6223 Kg ha^{-1}) compared to Karnataka (6160 Kg ha^{-1}) and the average gross income was higher in Kerala (₹1,56,223 ha^{-1}) compared to Karnataka (₹1,17,513 ha^{-1}). The net income at cost C_2 was found to be positive for both the states, however, the amount was high in Kerala compared to Karnataka. BCR was found to be positive and above 1 for both the states. BCR at explicit cost was found to be positive and equal to 2 in Karnataka and above 2 in Kerala.

The marketing channels identified in Karnataka were:

Channel 1: Farmer - Rice Millers - Kerala rice market - Wolesaler /Local trader - Retailer - Consumer.

Channel 2: Farmer - Local trader - Kerala rice market - Rice millers - Retailers - Consumer.

Channel 3: Farmer - Kerala rice market – Wholsaler/Rice millers/Local agents - Retailers – Consumers.

Channel 4: Farmer - APMC - Middlemen - Kerala rice market - Wholesaler /Rice millers/Local agents - Retailers - Consumers.

The Marketing channels identified in Kerala were:

Channel 1: Farmer - Supplyco - Ricemillers - Public distribution system (PDS)- Consumers.

Channel 2: Farmer - Ricemillers – Retailers –Consumers.

Channel 3: Farmer – middlemen - Rice millers – Retailers - Consumers.

In case of Karnataka, four different market channels were identified where, rice millers, wholesalers, local traders/agents, commission agents and retailers serve as market intermediaries between farmers and consumers while In Kerala, three different channels were identified where government agency like Supplyco, PDS, private agencies like rice millers, local agents and retailers act as intermediaries between farmers and consumers.

Policy suggestions

In cultivation of both KAU and local non KAU rice varieties, labour cost accounts for the highest share in the cost A_1 in both the states. In Kerala, mechanisation is generally not followed for various agricultural operations except field preparation and harvesting while in Karnataka, machines are employed only for field preparation. For other agricultural operations *viz.*, sowing, weeding, harvesting etc. farmers depends on hired labourers, hence there is a lot of scope

for mechanization in rice cultivation. Use of farm machineries such as rice transplanter for transplanting seedlings, rice row seeder for direct sowing of seeds, seed cum fertilizer drill for both direct sowing and fertilizer application, weeder in weeding operations and thresher and winnower for post-harvest handling can successfully transform the rice cultivation, provided rice cultivation is taken up on co-operative basis due to the problem of fragmentation and small holding size.

Higher wage rate was found to be an important factor for the highest share of labour cost in cost A_1 in Kerala. In order to overcome this hurdle, initiatives can be taken by the government by integrating rice cultivation with Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA). Integration of MGNREGA with rice cultivation operations will help in providing adequate labour for rice cultivation while also reduce the problems of higher wage by sharing the wages of labourers between farmers and government in 50:50 or 25:75 ratios.

The result also showed that the younger generation was least interested in taking up rice cultivation in both the states. Therefore, initiatives can be taken to attract the younger generation towards rice cultivation by providing skills through training programmes, and conducting group discussions on mechanisation, adoption of HYV and innovation attitude towards rice cultivation thereby, making it a more profitable venture in the future.

It was also observed that although farmers in Karnataka were getting a higher yield by cultivating both KAU and local non KAU rice varieties as compared to Kerala. However, their gross as well as net income was less compared to Kerala farmers which may be due to the higher procurement price existing in Kerala. Similar problem is faced with respect to seed production also which raises the need for the Karnataka government to formulate some policy measures to increase the procurement price as well as to protect the rice farmers in the state against the risk of price fluctuations.

In both the states, high yield potential of KAU varieties found as an important reason for the adoption of these varieties, hence promotion of these high yielding varieties is necessary in order to create and develop awareness among the farmers by highlighting the high yielding ability of these varieties and for further expansion of area of these varieties in both the states. However, farmers in Karnataka have recently encountered problems like blasts disease in Jyothi variety. This calls for the agriculture scientists to take necessary and suitable measures to address the problem and to develop a new variant of Jyothi with resistance to blast disease.

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Appendices

APPENDIX I

Survey- questionnaire for KAU and local non KAU varieties farmers in Kerala and Karnataka

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, KAU (P.O.)

Vellanikara, Thrissur

Department of Agricultural economics

Impact of prominent KAU rice varieties on the economic status of farmers in Kerala and Karnataka

Survey- questionnaire for KAU and local non KAU varieties farmers in Kerala

I. SOCIO-ECONOMIC PROFILE OF FARMERS

1. Name & Address of the farmer:
2. Gender : Male/Female
3. Age : 20-30/30-40/40-50/>50
4. Religion : Hindu/Muslim/Christian/Others
5. Caste : SC/ST/OBC/OEC/Others
6. Education : Illiterate/LP/UP/HS/SSLC/HSS/Degree/PG
7. Marital Status : Married/Single/Widower/Widow/Divorced
8. Economic Status : BPL/APL
9. Employment Status :Self Employed/Wage Employment/Unemployed
10. No. of earning members of family: 1/2/3 & above
11. Monthly Income : <15000/15000-20000/20000-25000/25000-30000/ Above 30000
12. Source of income :
    Agriculture/Salary/Pension/Rent/Wages/Profit/Lease/Royalty/others
13. Land ownership : Below 50 cents/50-1acre/ 1-2/2-4/4-6/Above 6 acres
14. Farming or experience in rice cultivation: <10years/ 10-25years / >25 years
15. Type of House: Tiled/Concrete/others
16. Size of House : Small/Medium/Large/Extra large

17. Employed servant at house : Y/N

If yes a) No. of servants: - 1/2/>2

b) Type of employment - Full time/part-time

18. Do you own other house/other building than the living one : Y / N

If yes a) No. of buildings - 1/2/>2

b) Is it given on rent - Y/N

19. No. of Bank Accounts : 1/2/3 & above

20. Do you have a PAN : Y/N

21. Do you pay income tax : Y/N

If yes, how much per year (Rs.) - <10000/10000-20000/20000-40000/40000-60000/>60000

22. Do you have Debt(Agril.loan) : Yes/No

If Yes, a) approx. amount (Rs.) - <1 lakh/1-3lakh/3-6lakh/6-10lakh/>10 lakhs

b) Approximate. Term of debt - <3yrs/3-5yrs/5-10yrs/10-15yrs/>15 years

23. Are you member of any of the following : farmer organization/NGO/NABARD clubs /any other

II. Family Particulars:

Sl.No	Particulars	Relation-ship	M/F	Age	Education	Occupa-tion	Monthly Income	Earning member
1								
2								
3								
4								
5								
6								
7								
8								

III. DETAILS OF AWARDS / RECOGNITION, IF ANY RECEIVED

Sl.No.	Name of award	Year	Received from	Purpose	Remarks

IV. Land holding Details:

Sl. No	Type of land	Owned (in acres)	Leased in		Leased out		Total area (in acres)	Total value (₹)
			Area (in acres)	Value (₹)	Area (in acres)	Value (₹)		
1.	Dry							
2.	Irrigated							
3.	Garden							
	Total							

V. Details of irrigation

Sl. No	Sources	Area irrigated (in acres)	Market value	Remarks
1.	Bore well			
2.	Canal			
3.	Tank			
	Total			

VI. Cropping pattern : Dry /Irrigated

Season	Crop	Area	Age & variety	Main Yield /ac	Value (₹)	By product yld /ac	Value	Total value (₹)	Dry/ Irrigated
Kharif									
Rabi									
Summer									

VII. ASSETS POSITION

a. Farm assets

PARTICULARS	No.	Purchase value	Present value
A. Farm buildings			
1.Farm house			
2.Cattle shed			
3.Pump house			
4.Poultry shed			
B. Farm machinery & equipments			
Tractor			
Power Tiller			
Cultivator			
Disc Plough			
Bullock Cart			
M.B Plough			
Submersible Pump Set			
C. Intercultural implements.			
Spade			
Sickle			

b. Live stock enterprises.

Enterprises	No.	Purchase value	Present value	Maintenance cost	Income
Bullock					
Cow					
Buffalo					
sheep					
goat					
poultry					
others					
Total					

c).Household assets

Particulars	No.	Purchase value	Present value	Source of funding
T.V				
Refrigerator				
Fan				
Furniture				
Gold				
Transport Vehicles a. Two-wheeler b. Car c.others				

d). Financial status

Particulars	Amount	Remarks
Cash on hand		
Savings in bank		
Chit funds		
Advances made to others		
Others(specify)		

VIII. AVERAGE MONTHLY FAMILY EXPENDITURE (Amount in ₹)

Description	Weekly	Monthly	Yearly
Food (W)			
Clothing (Y)			
Education (Y)			
Medical (Y)			
Entertainment (M)			
Fuel (M)			
Electricity (M)			
Phone (M)			
Donation (Y)			
Loan repayment (M)			
Liquor/Tobacco (M)			
Travel (M)			
Newspaper (M)			

Rent (M)			
Internet (M)			
Other (M)			
Total			

1. **Are you cultivating KAU rice variety (Jyothi/ Uma) or local non KAU variety :**

a. **When did you start cultivating this variety: year**

b. **If yes, any specific reason for the adoption of this variety. YES/ NO**
If yes, give the reasons:

IX. Ranking of reason for adoption of KAU varieties

Reasons/States	**Reason for adoption of KAU varieties (Yes/no)**	**Rank**
High market price		
High yield potential		
Resistance to pest and diseases		
High tillering capacity		
Short duration		
Consumption purpose		
Locational suitability		

C .If you are cultivating the KAU rice variety or local non KAU variety the source of seeds : any government agency or private agency or any others, specify.

X. Costs and Returns

a. Crops:

Crop season: ----------, Variety: ----------. Area (Acres) ---------

Wage rate (₹/day) a) Men-------, b) Women------

c) Animal labour: -------

d) Machine power: ---------- ₹/hr

SL.No.	Particulars	Unit	Qty.	Rate	Value (₹)
I. Costs					
A) Variable Cost					
1	Seed/ Seedlings				
2	FYM				
3	Fertilizers a) b) c) d)				
4	Plant protection chemicals a) b) c) d)				
5	Labour a)Men b)Women c)Animal labour d)Machine labour				
B).Fixed cost					
1	Land revenue				
2	Irrigation charges				
3	Rental value of land				
4	Electricity charges				
5	Others				

II. Returns					
1	Rice Yield				
2	Straw Yield				
III Quantity Retained for home consumption					
	Rice				
	Straw				

XI. Information on input use and costs

Crop: Variety: Acres: Season:

Wage rate: Men: ₹/day, Women: ₹/ day, Machine labour: ₹/hr

Operations	Material input			Labour input						
				Human labour (No)			Machinery labour (hr)			Total cost
	Qty	Unit value	Cost 1	Family	Hired	Cost 2	Owned	Hired	Cost4	1+2+3+4
Ploughing										
Puddling										
Farm yard manure & applications										
Fertilizers & applications										
Cost of seeds										
Planting cost/sowing										
Irrigation										
Weeding										
Dewatering charge										
Liming charge										
PP measures & application										
Harvesting										
Threshing & Packing										

APPENDIX II

Survey- questionnaire for KAU and local non KAU varieties farmers in Kerala and Karnataka

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COLLEGE OF HORTICULTURE, KAU (P.O.)

Vellanikara, Thrissur

Department of Agricultural economics

Impact of prominent KAU rice varieties on the economic status of farmers in Kerala and Karnataka

Survey- questionnaire for KAU and local non KAU varieties farmers in Karnataka

I. SOCIO-ECONOMIC PROFILE OF FARMERS

1. Name & Address of the farmer:
2. Gender : Male/Female
3. Age : 20-30/30-40/40-50/>50
4. Religion : Hindu/Muslim/Christian/Others
5. Caste : SC/ST/OBC/OEC/Others
6. Education : Illiterate/LP/UP/HS/SSLC/HSS/Degree/PG
7. Marital Status : Married/Single/Widower/Widow/Divorced
8. Economic Status : BPL/APL
9. Employment Status :Self Employed/Wage Employment/Unemployed
10. No. of earning members of family: 1/2/3 & above
11. Monthly Income : <15000/15000-20000/20000-25000/25000-30000/ Above 30000
12. Source of income : Agriculture/Salary/Pension/Rent/Wages/Profit/Lease/Royalty/others
13. Land ownership : Below 50 cents/50-1acre/ 1-2/2-4/4-6/Above 6 acres
14. Farming or experience in rice cultivation: <10years/ 10-25years / >25 years
15. Type of House: Tiled/Concrete/others
16. Size of House : Small/Medium/Large/Extra large

17. Employed servant at house : Y/N

If yes a) No. of servants: - 1/2/>2

b) Type of employment - Full time/part-time

18. Do you own other house/other building than the living one : Y / N

If yes a) No. of buildings - 1/2/>2

b) Is it given on rent - Y/N

19. No. of Bank Accounts : 1/2/3 & above

20. Do you have a PAN : Y/N

21. Do you pay income tax : Y/N

If yes, how much per year (Rs.) - <10000/10000-20000/20000-40000/40000-60000/>60000

22. Do you have Debt(Agril.loan) : Yes/No

If Yes, a) approx. amount (Rs.) - <1 lakh/1-3lakh/3-6lakh/6-10lakh/>10 lakhs

b) Approximate. Term of debt - <3yrs/3-5yrs/5-10yrs/10-15yrs/>15 years

23. Are you member of any of the following : farmer organization/NGO/NABARD clubs /any other

II.Family Particulars:

Sl.No	Particulars	Relation-ship	M/F	Age	Education	Occupation	Monthly Income	Earning member
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Sl.No.	Name of award	Year	Received from	Purpose	Remarks

IV. Land holding Details:

Sl. No	Type of land	Owned (in acres)	Leased in		Leased out		Total area (in acres)	Total value (Rs)
			Area (in acres)	Value (Rs)	Area (in acres)	Value (Rs)		
1.	Dry							
2.	Irrigated							
3.	Garden							
	Total							

V. Details of irrigation

Sl. No	Sources	Area irrigated (in acres)	Market value	Remarks
1.	Bore well			
2.	Canal			
3.	Tank			
	Total			

VI. Cropping pattern : Dry /Irrigated

Season	Crop	Area	Age & variety	Main Yield /ac	Value (₹)	By product yld /ac	Value	Total value (₹)	Dry/ Irrigated
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Rabi									
Summer									

VII. ASSETS POSITION

a. Farm assets

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Pump house			
Poultry shed			
B. Farm machinery & equipments			
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Power Tiller			
Cultivator			
Disc Plough			
Bullock Cart			
M.B Plough			
Submersible Pump Set			
C. Intercultural implements.			
Spade			
Sickle			

b. Live stock enterprises.

Enterprises	No.	Purchase value	Present value	Maintenance cost	Income
Bullock					
Cow					
Buffalo					
sheep					
goat					
poultry					
others					
Total					

c).Household assets

Particulars	No.	Purchase value	Present value	Source of funding
T.V				
Refrigerator				
Fan				
Furniture				
Gold				
Transport Vehicles Two-wheeler Car others				

d). Financial status

Particulars	Amount	Remarks
Cash on hand		
Savings in bank		
Chit funds		
Advances made to others		
Others(specify)		

VIII. AVERAGE MONTHLY FAMILY EXPENDITURE (Amount in ₹)

Description	Weekly	Monthly	Yearly
Food (W)			
Clothing (Y)			
Education (Y)			
Medical (Y)			
Entertainment (M)			
Fuel (M)			
Electricity (M)			
Phone (M)			
Donation (Y)			
Loan repayment (M)			
Liquor/Tobacco (M)			
Travel (M)			
Newspaper (M)			
Rent (M)			

Internet (M)			
Other (M)			
Total			

1. **Are you cultivating KAU rice variety (Jyothi/ Uma) or local non KAU variety :**

a. **When did you start cultivating this variety: year**

b. **If yes, any specific reason for the adoption of this variety. YES/ NO**
If yes, give the reasons:

IX. RANKING OF REASON FOR ADOPTION OF KAU VARIETIES

Reasons/States	**Reason for adoption of KAU varieties (Yes/no)**	**Rank**
High market price		
High yield potential		
Resistance to pest and diseases		
High tillering capacity		
Short duration		
Consumption purpose		
Locational suitability		

C .If you are cultivating the KAU rice variety or local non KAU variety the source of seeds : any government agency or private agency or any others, specify.

X. Costs and Returns

a. Crops:

Crop season: ----------, Variety: ----------. Area (Acres) ---------

Wage rate (₹/day) a) Men-------, b) Women------

c) Animal labour: -------

d) Machine power: ---------- ₹/hr

SL.No.	Particulars	Unit	Qty.	Rate	Value (₹)
I. Costs					
A) Variable Cost					
1	Seed/ Seedlings				
2	FYM				
3	Fertilizers a) b) c) d)				
4	Plant protection chemicals a) b) c) d)				
5	Labour a)Men b)Women c)Animal labour d)Machine labour				
B).Fixed cost					
1	Land revenue				
2	Irrigation charges				
3	Rental value of land				
4	Electricity charges				
5	Others				
	II. Returns				
1	Rice Yield				
2	Straw Yield				

III Quantity Retained for home consumption					
	Rice				
	Straw				

XII. Information on input use and costs

Crop: Variety: Acres: Season:

Wage rate: Men: ₹ /day Women: ₹/ day Bullock labour: ₹ /aru Machine labour: ₹/hr

Operations	Material input			Labour input									Total cost
				Human labour (No)			Bullock labour (No)			Machinery labour (Hr)			
	Qty	Unit value	Cost 1	Family	Hired	Cost 2	Owned	Hired	Cost 3	Owned	Hired	Cost4	1+2+3+4
ughing													
ddling													
rm yard nure & plications													
tilizers & lications													
t of seeds													
nting t/sowing													
gation													
eding													
measures pplication													
vesting													
eshing & cing													

IMPACT OF PROMINENT KAU RICE VARIETIES ON THE ECONOMIC STATUS OF FARMERS IN KERALA AND KARNATAKA

by

Dhruthiraj B.S.
(2014-11-221)

ABSTRACT OF THE THESIS

Submitted in partial fulfillment of the requirement for the degree of

Master of Science in Agriculture

Faculty of Agriculture
Kerala Agricultural University

DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF HORTICULTURE
VELLANIKKARA, THRISSUR - 680 656
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2016

Abstract

The present study entitled "Impact of prominent KAU rice varieties on the economic status of farmers in Kerala and Karnataka" was conducted with the objectives of working out the costs and returns of prominent rice varieties, Jyothi and Uma, released from KAU, to find out the relationship between varietal adoption and net farm income, to identify specific reasons for adoption of KAU varieties and to analyze profitability of the KAU varieties in the states of Kerala and Karnataka by comparing with local non-KAU varieties cultivated by farmers.

The survey was conducted by collecting both primary data and secondary data. The area of study were major rice growing districts of Kerala (Palakkad and Alappuzha) and Karnataka (Mysore and Mandya).These districts were selected on the basis of prominence in adoption of rice varieties released from KAU. The primary data were collected by means of pre-tested interview schedule. The farmers in the study area were categorized into two groups on the basis of variety grown as: KAU variety adopting farmers and local popular non KAU variety adopting farmers. Forty farmers each cultivating at least one acre and adopting - KAU varieties and 40 farmers cultivating a local popular non-KAU variety were randomly selected and surveyed in each state making a total sample size of 160.

The cost- return structure was worked out both for KAU and non KAU variety production using cost concepts. The average cost of cultivation (cost C_2) of KAU varieties was found to be lesser in Palakkad (₹73,213 per hectare) compared to Karnataka (₹75,731 per hectare) and Alappuzha (₹81,915 per hectare) and in case of local non KAU varieties, the average cost of cultivation was₹83,981 per hectare, ₹83,634 per hectare and ₹94,526 per hectare in Karnataka, Palakkad and Alappuzha respectively. The net income obtained by cultivating KAU varieties was found to be higher in Palakkad (₹48,143 per hectare), followed by Alappuzha (26,356 per hectare) and Karnataka (₹11,746 per hectare).The benefit-cost ratio(BCR) at the C_2 and explicit cost level was found to be positive for KAU varieties in both the states. This implies that cultivation of KAU varieties was profitable for farmers in both the states.

Garrett ranking technique was used to determine the reasons for adoption of KAU varieties. The possible reasons for adoption of KAU varieties in Karnataka were identified as high market price, high yield potential, high tillering capacity and resistance to pests and diseases while in Kerala, farmers highlighted high yield potential, high market price, high tillering capacity, suitability to the location, consumption purpose, resistance to pests and diseases and short duration of the variety as major reasons for adoption. Probit model was used to find out the factors affecting adoption of KAU rice varieties. In Kerala, organizational membership and gross income of the farmers while in Karnataka, education, organizational membership, area and gross income of the farmers were identified as the major factors affecting the adoption of KAU varieties.

The average cost of cultivation (cost C_2) for seed production of KAU varieties was found to be higher in Karnataka (₹88,176 per hectare), compared to Kerala (₹86,355 per hectare). The average gross income was found to be higher in Kerala (₹1,56,223 per hectare) compared to Karnataka (₹1,17,513 per hectare). The net income at cost C_2 was found to be positive for both the states whereas the amount was found to be higher in Kerala as compared to Karnataka. The marketing channels identified in Kerala were Channel 1: Farmer- Supplyco - Rice millers- Public distribution system (PDS) - Consumers, Channel 2: Farmer - Rice millers - Retailers - Consumers and Channel 3: Farmer - Middlemen - Rice millers - Retailers - Consumers. The marketing channels identified in Karnataka were Channel 1: Farmer - Rice millers - Kerala rice market - Wholesaler/Local trader- Retailer - Consumer, Channel 2: Farmer - Local trader - Kerala rice market - Rice millers -Retailers - Consumer, Channel 3: Farmer - Kerala rice market - Wholesaler/Rice millers/Local agents - Retailers - Consumers, Channel 4: Farmer - APMC-middlemen - Kerala rice market - Wholesaler /Rice millers/Local agents - Retailers – Consumer.

For both KAU and non KAU rice varieties, labour cost accounted for highest share in the cost A_1 components in both the states; therefore, efforts have to be made for mechanizing paddy cultivation. Also initiatives have to be taken to attract the younger generation towards agriculture and more importantly paddy cultivation.