

**MARKET ACCEPTANCE AND PREFERENCE TOWARDS
TECHNOLOGICAL ATTRIBUTES IN PIGEONPEA IN N-E
KARNATAKA REGION**

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By

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CERTIFICATE

This is to certify that the thesis entitled “**MARKET ACCEPTANCE AND PREFERENCE TOWARDS TECHNOLOGICAL ATTRIBUTES IN PIGEONPEA IN NEK REGION**” submitted by Mr. **DINESH T. M.**, for the degree of **MASTER OF SCIENCE (AGRICULTUR E) in AGRICULTURAL ECONOMICS** to the University of Agricultural Sciences, Raichur is a record of research work done by him during the period of his study in this university under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

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AFFECTIONATELY DEDICATED

TO

MY BELOVED PARENTS

SRI. MUNICHOWDAPPA T.A

SMT. NARAYANAMMA

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(DINESH T.M.)

LIST OF ABBREVIATIONS USED

Abbreviation	:	Expansion
ha	:	Hectare
ac	:	Acre
q	:	Quintal
t	:	Tones
%	:	per cent
₹	:	Rupees
/	:	Per
N	:	Sample size
No.	:	Number
Fig.	:	Figure
OLS	:	Ordinary least square

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I. INTRODUCTION

Red gram or pigeonpea (*Cajanus cajan* (L) mill.sp.) is one of the major pulse crop of tropics and sub-tropics and owed with several unique characters. It ranks second important pulse crop next to bengalgram. It finds an important place in farming systems adopted by small holding peasants in large number of developing countries. Pigeonpea is considered to be origin of Peninsular India. It is a perennial shrub and a short annual crop in India and as a perennial in many other countries, where pods are harvested at regular interval. The crop has deep root system and hence highly drought tolerant. More than 350 vernacular names of red gram have been recorded. However, it is commonly called as Tur, Arhar, Toovar, Toor, Togari, Gango pea and No eye pea. It is mostly consumed as split dal and also consumed as vegetable in many countries. Pigeonpea is of dietary importance with seed protein content of about 21 per cent, which is highest among legumes. The production of pulses has been identified as the thrust area considering the dietary, economic and other associated factors. Indian rural economy is basically considered to be a crop economy. In India, agriculture and other allied activities contribute significantly to the Gross Domestic Product (GDP), which is accounting nearly 13.5 per cent of the total GDP.

Pulses occupy an important place in Indian agricultural economy as they are rich sources of proteins and constitute 10 to 15 per cent of India's foodgrain diet. Major portion of Indian population belongs to vegetarian group and every person on an average is required to consume 70 to 80 gm of pulses per day in order to maintain good health and physique, according to the recommendations of Indian council of medical research.

The crop is grown for its multiple benefits mainly by smallholder and is useful in providing household food security in the region. The crop provides highly nutritious food for human consumption (Amarteifio *et al.*, 2002) and fixes considerable amounts of atmospheric nitrogen (Mapfumo *et al.*, 1999), thus improving soil fertility. In addition, the Stover is used for fuelwood and building material in some of the rural communities (Silim *et al.*, 2005). Pigeonpea is also useful for controlling soil erosion in those areas prone to floods. The crop is also relatively tolerant to drought thus making it suitable for cultivation in the semi-arid agro-ecological conditions prevalent in the region.

The combinations of *Dal-Chawal* (pulse-rice) or *Dal-Roti* (pulse-wheat bread) are the main ingredients in the average Indian diet. The biological value improves greatly,

when wheat or rice is combined with pigeonpea because of the complementary relationship of the essential amino acids. It is particularly rich in lysine, riboflavin, thiamine, niacin and iron. In addition to being an important source of human food and animal feed, being a drought resistant crop, it is suitable for dry land farming and predominantly used as a sole crop in the study area.

In India, pigeonpea is consumed mostly in the form of decorticated split cotyledons known as dal, while in other semi-arid tropical countries of the world such as the Caribbean Islands, it is consumed in the form of green peas. Although increasing the yield and its stability are of obvious priority, grain quality also deserves consideration in breeding programs. The grain quality has several components, including nutritional quality, anti-nutritional factors, digestibility and bioavailability of nutrients, cooking quality, consumer acceptability and storage stability.

Farmer's preference is the most crucial yet the least recognized factors in technology generation and transfer process. When we say preference, the natural question is whose preference? we argue that the preference of all key players in the value chain of pigeonpea production matters equally. Farmers would have a dual role in preference analysis as they are mostly producers and consumers. The conventional approach of technology design had failed to address the needs, priorities and preferences of the small and marginal farmers who operate in a complex, diverse and risk prone production situations. It happened because technology developed on research stations had poor goodness-of-fit with actual farm condition. The technology was developed without farmer participation and understanding their needs. Therefore, identification and use of farming situation specific interventions shall have greater implications in enhancing system's productivity as a consequence, the rate of adoption of new varieties (variety replacement rate) and their area coverage (seed replacement rate) remain dismal, particularly in the case of legumes in rainfed marginal environments; thus depriving the resource poor farmers of the benefits of public investments made in variety research and development. By responding closely to farmers' concerns and conditions, researchers can develop technologies that are fit to the local conditions.

The major part of pulse produced in India is converted into *dal*. Many products are made from whole or dehusked pulses. Roasted pulses, pulses flour, 'sattu', sprouts, fermented product *etc.*, are quite commonly produced in domestic market on commercial

basis to cater the requirement of consumer. For most of the pulse based product, dehusking is an essential operation. It improves textural and culinary properties of the grain.

Status of pulse industry in India

India accounts for 90 per cent of world output with an area of 4.42 million hectares and production of 3.07 million tonnes of pigeonpea. In India pigeonpea is mainly grown in Maharashtra, Madhya Pradesh, Rajasthan, Uttar Pradesh, Andhra Pradesh and Karnataka. Madhya Pradesh is the leading producer in pigeonpea.

Pulse processing industry is one of the major agro processing industries in India. Out of the total production of 13.19 million tonnes of pulse in the country, 75 per cent is processed by *dal* mills. There were about 2000 *dal* mills in the country in 1972. The numbers grew steadily to 6000 units in 1982, 12000 units in 1995 and 14000 units during the year 1999-2012.

Most of the *dal* mills in the country are concentrated in selected pockets of the country *i.e.*, pulses producing areas such as Indore (Madhya Pradesh), Jalgaon, Akola, Nagpur (Maharashtra) and Kalaburagi (Karnataka) and also in and around major consumption centers such as Kolkata, Mumbai, Chennai, Hyderabad and Delhi. Majority of processing units are of traditional ones. Moreover, the yield of dehusked and splitted pulses in traditional mills is about 65-70 per cent in comparison to 88-89 per cent maximum potential recovery of splits. Thus, there is excessive loss of pulse cotyledons and embryos in the form of brokens and powdered grains (5- 15%) (Anon., 2012).

Status of pulse industry in karnataka

In Karnataka, pigeonpea was grown in an area of 6.66 lakh hectares with a production of 4.69 lakh tonnes during 2012-13. It is largely grown in the northern part of the state especially in Kalaburagi district, which is called as "*Pulse bowl*" of Karnataka. Kalaburagi district occupied an area of 3, 70,523 hectares with a production of 1, 80,222 tonnes during 2012-13 (Anon., 2012).

However, with all these advantages yet the cultivation of pulse crops has been concentrated in the marginal dry lands. As a result from the pulse production activities the desired yield levels are not being obtained in India, this situation has created a mismatch between demand and supply and situation has forced to import pulses from Australia and

other countries at a huge cost. In order to address the short supply- production bottleneck, there is a need to motivate the farmers to cultivate the pulses in well-endowed situation in order to step-up the country's pulse production. These pulse crops also combined as mixed or relay crop along with other main components of the cropping system, which ensures in providing supplementary income to the growers and also in sustaining levels of pulse production as accomplished by market demand.

Long history of pulses processing exist in and around Kalaburagi town with 308 registered units in the district operating across different scales. The *dal* mills are located in two industrial area *i.e.*, one is at Kapnoor industrial area and another one is at Nandur industrial area. The Kapnoor industrial area has three divisions *i.e.*, Kapnoor industrial area-I, Kapnoor industrial area-II, Kapnoor industrial area-I and-II A and these units are distributed 86, 156 and 11 respectively. Whereas, in Nandur industrial area totally 55 *dal* mills are located. Recent establishment of several large units with latest import machinery like buller and sortex, although they have not started working to their full capacity. At the same time there is evidence of distress among some of the smaller mills due to problem of procurement as well as working capital (Anon., 2012).

Most of the pigeonpeas that are grown in India are first processed and only the *dal* samples enter the market channels for consumer use. Therefore for pigeonpea utilization, milling and processing characteristics of whole seed, as well as the consumer's preferences, are important. What quality attributes is important in explaining price variation in the market? answers to these questions sharpen the focus of pigeonpea improvement by the scientists on quality attributes demanded by consumers.

Specific objectives of the study:

1. To know the socio economic status of stake holders in the study area
2. To identify the technological attributes of pigeonpea preferred by stake holders
3. To determine the most preferred technological attributes of pigeonpea as perceived by stakeholders
4. To document the constraints opined by the stakeholders among existing cultivars

Hypotheses

1. Socio- economic factors have a bearing on the requirement of technology
2. Technological attributes preferred by stakeholders are different
3. Popular pigeonpea varieties preferred by traders, processors and consumers have specific traits

Scope of the study

Although the agricultural sector has been actively responding to consumer demand by attempts to produce more food, the failure rate of an increase in food supply still remains high. The agricultural sector with its myriad problems has been criticized in this regard for not knowing their customers. To fill this gap, this study examines the consumer, farmer, miller characteristics associated with the purchase of pigeonpea. Knowledge of these characteristics and factors can be used as guide in developing marketing programmes for products. The study examines not only consumers', farmers and millers demographic factors but also external factors using a primary data of 60 households, 60 farmers and 30 millers.

This study also reports results from a rapid appraisal survey of farmers preferences for growing and consumption of pigeonpea and of traders and millers survey on pigeonpea trade and processing. Information on production, varietal preference, storage, processing and utilization of pigeonpea can be used for development of upcoming varieties.

Limitation of the study

The results of the study cannot be generalized (beyond the limits of the study area) in Karnataka state as a whole.

Presentation of the study:

The study has been presented in seven chapters. In Chapter-I, the nature and importance of the research problem, specific objectives of the study have been depicted. Chapter-II deals with the review of the past studies related to the study.

Chapter-III gives an overview of the study area, the nature and sources of data, analytical tools employed for evaluating the objectives and interpreting the results and

various concepts used in the study. The results of the study have been presented through a variety of tables in Chapter-IV. A critical discussion of the results obtained has been depicted in Chapter-V.

A brief summary of the overall results and the main findings of the study have been presented in the Chapter-VI along with the policy implications that emerged from the findings of the study. Chapter-VII includes the list of the referred books, research papers and journals in the study.

II. REVIEW OF LITERATURE

Keeping in view the objectives formulated for the present study, the available previous research studies were reviewed and presented under the following headings

2.1 Consumer preference for attributes

2.2 Farmers preference for varietal traits

2.3 Millers preference for attributes

2.4 Constraints of stakeholders

2.1 Consumer preference for attributes

Lee and Kim (2003) identified the patterns of rice consumption and analyzed rice consumption behavior at home and away from home using a consumer survey. The results indicated that 44.5% of the consumers surveyed said that they would never buy imported rice and 43.5% of the consumers who were willing to buy imported rice said that they would buy it only if the imported rice was cheaper and of high quality. The result implied that consumers had a significant preference for domestic rice.

Shobha (2003) used conjoint measurement to determine farmer's decision to adopt a particular variety of finger millet. A preference model was constructed based on attributes like duration, yield, height, ear type, cooking quality, fodder quality that allowed for interactions between attributes to be estimated. Respondents generally preferred short duration with high yield, semi compact ear type and higher fodder quality of finger millet.

Tomlins *et al.* (2004) conducted a study on urban consumer preferences and sensory evaluation of locally produced and imported rice in West Africa. Parboiled rice produced in Ghana was of poor quality and was being overtaken by imported rice. This study sought to investigate consumer preference and relate sensory attributes with consumer acceptability of rice. The majority of consumers preferred imported raw and parboiled rice to that produced locally. Acceptability was influenced by location and gender. Individual preferences of consumers varied and four different segments of consumers with similar liking of the rice samples were identified. The largest three segments (86% of consumers) preferred the imported rice but differed in their preferences

for the local rice. A niche segment (14%) mostly preferred traditional local rice. Regression models to predict consumer preference from the sensory panel scores were based on either brown colour of the cooked rice or unshelled paddy in the uncooked form. The models were suitable for three of the consumer segments representing 86% of the consumers.

Kubendran and Vanniarajan (2005) studied the change in consumption pattern of rural and urban consumers. If income and urbanization increased among consumers, the percentage of income spent on consumption of milk would also increase. The urban consumer's preferred mostly branded milks compared to rural consumers. The most significant factors influencing buying decisions were accessibility, quality, regular supply, door delivery and mode of payment.

Lim *et al.* (2005) conducted a survey of fruit consumers (n=300) in Korea Republic, which revealed that buying patterns of local fruits differed according to consumer preferences as well as season. The most preferred local fruits were apple, grapes, pears and mandarins. Apple was most preferred during spring and fall, grapes in summer and mandarins in winter. In the case of imported fruits, consumers preferred oranges and bananas. The choice of imported fruits mainly depended on their flavor and the buyers' curiosity.

Ramasamy *et al.* (2005) in their study suggested that the buying behavior of instant food products was strongly influenced by awareness and attitude towards the product. Commercial advertisements over television was said to be the most important source of information, followed by displays in retail outlets. Consumers built opinion about a brand on the decision making process. A large number of respondents laid emphasis on quality and felt that price was an important factor, while others attached importance to image of the manufacturer.

Shreya (2005) in her study on customer behavior mentioned that there was a wide variation in consumer's behavior as far as food was concerned. Demography played an important role and in urban areas consumers had different buying habits as compared to consumers in rural areas. Similarly, high income group buying pattern was quite different from low or middle-income group.

Wszelaki (2005) analyzed the consumer liking and descriptive analysis of six varieties of organically grown edamame-type soybean. The taste of sayamusume was liked significantly better than all varieties except Kenko and Sapporo Midori. Kenko was also rated higher than Sapporo Midori, Misono Green, and Early Hakucho for pod appearance. The texture of Misono Green was liked less than that of all other varieties except White Lion. In the descriptive analysis, Kenko was rated significantly sweeter than all other varieties except Sapporo Midori. White Lion was rated as significantly lower in chewiness than all other varieties. Beaniness and nuttiness could not be consistently differentiated among varieties.

Banumathy and Hemameena (2006) conducted a study to analyze the brand preference of soft drinks in the global environment in Virudhunagar district of Tamil Nadu. The results indicated that the brand preference among the consumers was related to personal attributes like age, educational qualification, occupational status and monthly income. They concluded that after globalization most of the respondents preferred international brands. Orange taste was the one which was preferred the most. They suggested that by effective advertising, improving the quality by keeping a check on the taste and prices could promote demand for a particular brand.

Maruthamuthu *et al.* (2006) conducted a study on consumer behavior and brand preference of britannia biscuits. The study revealed that 41 per cent of the respondents purchased for brand image, 31 per cent for quality and 24 per cent for its low prices while 12 per cent of the respondents preferred it for its availability. It also indicated that 21 per cent of the respondents were influenced by parents to make purchase decisions, 49 per cent by children, 21 per cent and 9 per cent of the respondents were influenced by friends and neighbors respectively. They suggested that introduction of new product line and offering gifts kept the sale constant. Also, introduction of hygienic and attractive packaging without increasing the price may attract more consumers.

Tengpongsathon *et al.* (2006) studied consumer preference of rice-based products: cross cultural study between Thailand and Australia. The standard questionnaire used in both countries consisted of four sections on face-to-face interviewing on demographic, personal, attitudinal and preference rating data. 100 respondents from each country participated in this study. Comparison of qualitative data from demographic, personal, attitudinal profiles and quantitative data from preference rating data shown on preference

maps between Thais and Australian consumers showed differences between cultures in both countries. The results from each country can help food product developers to develop new rice-based products more successful in both countries.

Bhuvaneshwari (2007) made a comparative study of different markets for selected cut flowers in Bangalore. Conjoint analysis was conducted to determine the consumer's preference for the flowers and its attributes. Four important attributes were considered for this purpose, *viz.*, colour of the flower, and size of the flower, floral arrangement of the flower, stem length of the flower and the price of the flower. The results showed that the most important attribute was colour. The average importance attached to the colour was 33.4 per cent. Among the various colours available, red colour the most preferred colour, reflected by the high utility value attached to it (2.9).

Caleguer *et al.* (2007) studied the influence of various attributes (price, brand, colour and nutritional information) on consumer preference for a packed orange flavor soft drinks powder using a focus group approach. The purchasing preference of 107 participants was assessed for soft drinks powder: of high or low price, having packaging of yellow or orange colour, of known or unknown brand and containing orange juice powder labeled as with or without pulp, fiber and vitamin-c in the nutritional information. A conjoint analysis of the data showed that 63 per cent of consumers were influenced primarily by brand, for four per cent of the consumers price was the most important factor and colour was the main deciding factor for five percent of the consumer polled.

Padilla *et al.* (2007) carried out a study in Chile in order to evaluate consumer preference and willingness to pay for certified quality label on traditional food products, employing a conjoint analysis method. A total of 234 individuals were interviewed in two Chilean cities, Santiago and Talca. A homemade blackberry (*Rubus ulmifolius*) marmalade and three product attributes with their respective levels were chosen (price, quality label and jar appearance). Nine hypothetical product concepts were generated applying an orthogonal design. Respondent were asked to rank the product concepts according to their preferences. The results obtained through the conjoint model suggest that an "officially certified quality label" was the most important attribute influencing consumer choice behavior.

Tawanda *et al.* (2007) studied consumer acceptability of yellow maize products in Zimbabwe and analyzed the awareness and attitudes towards yellow maize products in

Zimbabwe and suggested intervention strategies that would ensure increased production and consumption of the crop, which was rich in provitamin A to help prevent the incidence of vitamin A deficiency prevalent among vulnerable groups. Data from 360 randomly selected rural and urban households showed that yellow maize was known to all but few were aware of its nutritional qualities or consumed it.

Amitha (2008) studied the consumer preference for selected dairy products in Bangalore city using conjoint analysis. Sample sizes of 200 respondents were chosen randomly from selected localities. The results of the study revealed that granular texture, well-cooked flavor, and golden brown colour and low price were the preferred attributes for ghee. For table butter, the quality preferences expressed by consumers were good spread ability, low salt content, price and colour.

Hein *et al.* (2008) compared three consumers' acceptance methods (9-point hedonic, labeled affective magnitude and unstructured line scale) and two consumer preference method (best-worst scaling and preference ranking) in terms of the results they generated and aspects of implementation. Consumers in Australia evaluated six samples in duplicate by acceptance ratings and preference ranking and 10 traits for best worst scaling. While all test methods detected a significant difference between samples ($p < 0.05$), a larger F-value or improved discrimination, was produced by best-worst scaling compared to acceptance methods. Significant pair-wise sample comparisons were also observed among the methods. Preference map of individual test methods further illustrated similar sample preference with regard to sensory properties of products.

Hu *et al.* (2009) examined the consumer acceptance and willingness to pay for three non-conventional attributes associated with six processed blueberry products through an in-store conjoint experiment survey. The results indicate heterogeneity in consumer preference and willingness to pay across product categories. Local products and organic formulations generally received positive willingness to pay across all products. This information had implications for blueberry growers and retailers who were trying to create and position value added products for maximum revenue.

Hugo and Simon (2008) conducted a study on comparing consumer preferences for color and nutritional quality in maize. Urban consumers' willingness to pay for yellow maize was estimated, using a semi-double-bounded logistic model, based on a survey of 600 maize consumers in Nairobi (Kenya) at posho mills, kiosks and supermarkets.

Consumers showed a strong preference for white maize. Only a minority would buy yellow maize at the same price as white maize, and fewer consumers in the posho mills (24%) and kiosks (19%) than in the supermarkets (34%) would do so. On average, consumers need a price discount of 37% to accept yellow maize. This discount was less at the posho mills (35%) and kiosks (37%) than in the supermarkets (48%). Consumers originating from Western Kenya had a lower preference for white, while those from Central Kenya had a stronger preference for fortified maize.

Behrens *et al.* (2010) evaluated the attributes towards food safety among consumers in the city of Sao Paulo, the major consumer market in Brazil. The results indicated that the preference for supermarkets over street markets, for the variety of foods, convenience and confidence in the safety assurance. On the other hand, the naturalness of the products in the street markets was the main reason for purchases in those places. Participants showed concerns with respect to food additives, hormones and pesticides – technological rather than natural hazards. Minimally processed and ready-to-eat foods were considered convenient products meeting the need for time/labour savings in the kitchen, although suspicion about wholesomeness and safety came up among consumers. They concluded the study by suggesting that Brazilian regulators should create more effective risk communication combining technical information with actual consumer perceptions of food risks.

Hakozaki *et al.* (2010) assessed consumer's preference for local rice in Brunei and consumer analysis was undertaken on preference for rice consumption in Brunei with the aim to study attributes of rice consumers are valued. It shows how it can yield invaluable information regarding consumer demand that can uniquely assists Brunei policy makers, particularly the government and farmers, in developing new domestic rice production, pricing and marketing strategies.

Suwansri *et al.* (2010) studied preference mapping of domestic/imported jasmine rice for U.S.-Asian Consumers. Three domestic and 12 imported commercial jasmine rice varieties were evaluated by a trained sensory panel and by 105 Asian families who lived in the State of Arkansas and results showed that consumers preferred imported over domestic products. According to consumers, the sensory characteristics most important to the acceptance of cooked Jasmine rice were, in order of decreasing importance, color, favor, aroma, stickiness and hardness.

Wang *et al.* (2010) examined consumer preference and willingness to pay for locally grown organic food products to make better production and marketing decisions. They presented the findings from a conjoint study on consumer valuation of major attributes of fresh apples (production methods, price, certification and product origin) the trade-offs between price and other attributes. They suggested that there is likely a significant niche market for locally grown organic apples and many consumers, especially people who had purchased organic food, are willing to pay significantly more for organic apples produced locally and certified by North-East Organic Farming Association (NOFA). They also suggested that there are significant difference in preferences between respondents who had not purchased organic food, although both groups showed a strong preference and willingness to pay for locally grown apples as compared with apples from other regions.

Mubeen *et al.* (2012) studied consumer perceptions about safflower oil. The revealed that the factors such as education, family size, income levels of the consumers have influence on the consumption of cooking oils. Majority of consumers are aware of safflower oil as a cooking medium, however, the usage is very low which can be attributed to various reasons, of which high price of the product vis-a-vis other cooking oils was the most important reason. Majority of consumers were using sunflower oil due to its taste, low cholesterol levels and the transparent colour. Majority of consumers purchase the product from the vicinity i.e. general stores/ Kirana stores. The major factors that influence the consumers in buying particular cooking oil are health benefits derived from the product, price, taste and suitability of various culinary items.

2.2 Farmers preference for varietal traits

Nagaratna and Tomer (1999) conducted a study on matrix analysis of farmer's preference for crops and varieties, The study revealed that wheat was the most preferred crop by the farmers because of its characters like staple food, good fodder yield and resistant to insect pests followed by ground nut because of good keeping quality, high profit and good yield. Pulses and rice crop shared third rank because of the duration of the crop followed by bengal gram and millets sharing fourth rank.

Audi *et al.* (2000) analyzed farmer participation in evaluation of improved pigeon pea varieties in Eastern Kenya. The results revealed that in Thavu, where the most desirable traits were good ratoonability and wilt resistance, NPP 670 and ICPL 87091

received the same overall rating under individual farmer assessment. In Karaba, where the most desirable traits were high yield, earliness, and large grains, NPP 670, ICP 6927, and ICEAP 00040 were rated as the best varieties in the short, medium- and long-duration groups, Kionyweni, where taste and cookability were the most desirable qualities, group and individual farmer evaluation established that ICEAP 00068 and ICEAP 00040 were the best varieties in the medium- and long-duration groups.

Gowda *et al.* (2000) conducted a study on participatory approach in varietal improvement: A case study in finger millet in India. The study revealed that the farmers selected GPU28 for normal planting in the second fortnight of July, GPU26 for delayed sowings till middle of August and VL 305 for planting in the second season crop. From the point of view of yield also, GPU 28 was superior, followed by GPU26. whereas VL 149 and 9002 were not preferred by the farmers.

Karuri *et al.* (2000) conducted a study on evaluation of dry mature pigeonpea seeds for processing and eating quality. The results revealed that soaking reduced cooking time by as much as 70%. The rate of water uptake increased with the temperature of the soaking water. With crude protein measuring above 20%, all four pigeonpea varieties are good sources of protein. Both soaking and cooking reduced the crude protein. Further, cooking destroyed some of the amino acids, thus reducing the biological value of the protein.

Kamanga (2002) analysed farmer experimentation to assess the potential of legumes in maize-based cropping systems in Malawi. Analysis revealed that the response of maize to residual nitrogen from the legumes was observed in all treatments. The maize-mucuna rotation produced the highest increase (over 100%) in maize yields, but would be difficult to practice where land is short. The mucuna-maize rotation was the most beneficial for improving soil fertility, followed by the groundnut/pigeon pea intercrop. Female farmers preferred pigeon pea systems for the food security they offer. Two years after the study, groundnuts and pigeon pea have been integrated into farming systems by farmers other than the original 22 participants. Seed availability, damage by animals, and labor shortages has constrained total adoption.

Sinja *et al.* (2004) analysed farmer perception of technology and its impact on technology uptake: the case of fodder legume in central Kenya highlands. Results showed that dry season tolerance and economy on land are most important characteristics of

fodder legumes to the farmers. It was also found that Calliandra and desmodium were more relevant to the farmers in the area than other fodders. Farmers' perception of the two fodders had a significant impact on their adoption. Consequently, it was recommended that before introducing a technology in an area, it is necessary that the farmers' perception of the technology to be analysed.

Uma *et al.* (2005) conducted a study on farmers preferences for selected attributes of potato in east khasi district of meghalaya, out of the six major attributes related to four identified potato cultivars, high yield was the most preferred attribute (64.17% respondents) for cv. Kufri Jyoti followed by good storability (65%), while late blight resistance (76.67%) was the least preferred attribute for this variety. Local cultivars were preferred most for their taste (69.17% respondents) followed by good market price (62.50%) and late blight resistance (73.33%). It could be hence inferred that farmers preferred the improved varieties mostly for higher yield, better keeping quality and relatively better market price.

Adeonah *et al.* (2007) analyzed farmers' perceptions and willingness to pay for metarhizium-based biopesticide to control cotton bollworms in Benin. Both organic and conventional cotton producers have expressed a significant interest in the use of *Metarhizium* to control *Helicoverpa* on cotton. Both types of farmers willing to pay more for any pest control product that would improve cotton product quality for higher cotton price. Three variables influencing farmers' willing to pay for biopesticides from *Metarhizium* were efficacy, agro-ecological zone and broad spectrum.

Ashan and Edward (2008) analyzed farmers' subjective valuation of subsistence crops: the case of traditional maize in Mexico. Econometric estimate show that Shadow prices are significantly higher than the market price for traditional but not improved maize varieties. They are particularly high in the indigenous areas of southern and south Eastern Mexico, indicating large de facto incentives to maintain traditional maize there.

Ajambo *et al.* (2010) analyzed producer and consumer preferences for maize and sorghum quality characteristics in Uganda. Results showed that maize farmers preferred varieties that were short, possessed high pest and disease resistance and were high yielding; while sorghum farmers preferred varieties whose yield was high and took three and half months to mature. Short plant height, yield and pest and disease resistance

influenced the price farmers were willing to pay for seed and this affected varietal selection.

Kamanga *et al.* (2010) analyzed farmer evaluation of phosphorus fertilizer application to annual legumes in Chisepo, Central Malawi. The results revealed that the application of P fertilizer significantly ($P = 0.05$) increased legume grain yields, particularly with velvet bean, and soyabean. However, use of P was not financially attractive and farmers were not interested to use P at the time. Farmers were more interested to maximize legume food production from their labour investment. Soyabean, groundnut and pigeonpea, grain legumes with high value as food, were considered to be priority crops by farmers over velvet bean, cowpea and Bambara groundnut.

Enid *et al.* (2011) assessed relative importance of common bean attributes and variety demand in the drought areas of Kenya. The findings of study revealed that varietal adaptation to environmental stresses should also strive to reduce the cooking time as well as enhance the keeping quality and grain colour for better benefits to the poor but trade-offs are feasible.

Zipora *et al.* (2011) studied the role of varietal traits in the adoption of improved dry land crop varieties: the case of pigeon pea in Kenya. The results indicated that the major pigeon pea varietal traits driving rapid adoption are drought tolerance, pest tolerance, and yield, ease of cooking, taste and price. Early maturity, a major focus of recent research, has no effect on farmers' adoption decisions. These findings imply that developers of improved crop varieties should pay attention to consumption and market characteristics in addition to production traits to increase technology uptake and satisfy farmers' multiple needs.

Katherine (2013) analysed the farmer preferences for wheat variety traits in Ethiopia a gender-responsive study. Conjoint analysis of their responses to 18 trait combinations revealed that the number of tillers was the most important attribute in the overall sample. However, cluster analysis revealed seven distinct respondent segments characterized by primary preferences for large grain, high yield/low-priced seed, white grain, small/red/lax grain, rust resistant seed, high-priced seed, and a typical segment that did not have primary preferences for any one trait but had balanced preferences for the expected trait levels. Segment membership was weakly correlated with gender, socio-economic status, usage factors, and constraints to production.

Maxwell *et al.* (2013) conducted a study on grain quality and determinants of farmers' preference for rice varietal traits in three districts of Ghana: Implications for research and policy. The results of the rankings revealed that high yield potential was the most preferred varietal characteristic and it was ranked first, The next most preferred varietal characteristic was good grain quality and it was ranked second, pests and diseases was the third most preferred varietal characteristic and was followed by resistance to abiotic stress the least preferred varietal characteristic.

Patricia *et al.* (2013) conducted a study on farmer's preferences for cassava variety traits: empirical evidence from Ghana. The empirical results showed that in-soil storage (longevity) and disease resistance are important attributes for farmers' choice of cassava varieties. Farmers have lower utility towards high productivity. Farmers are willing to forgo some extra incomes and yields in order to obtain a more disease and pest resistant varieties and increased longevity of matured roots in the soil. Among other things, age, gender, extension and years of farming experience, are the major factors causing household heterogeneity of cassava varieties preferences.

Tewodros and Meseret (2013) assessed production constraints, farmer's preferences and participatory on farm evaluation of improved forage technologies in selected districts of Southern Ethiopia. Based on farmers' evaluation, the performance of desmodium was the second place after rhodes grass in all tested districts. In all tested farmers' field, both desmodium and rhodes grass were the most vigorous, persistent and highly adapted species, and thus can be safely suggested for all tested districts. Based on the overall mean evaluation criteria, 33.05%, 49.34% and 17.73% of tested farmers were select desmodium, rhodes grass and alfalfa respectively.

Anne *et al.* (2014) examined the role of varietal attributes on adoption of improved seed varieties: the case of sorghum in Kenya. The results on the perception of farmer's variety attributes revealed that improved varieties had desirable production and marketing attributes while the local varieties were perceived to have the best consumption attributes. Evidence further indicated that the major sorghum variety attributes driving rapid adoption are taste, drought tolerance, yield, ease of cooking, and the variety's ability to fetch a price premium.

Borthakur *et al.* (2014) conducted a study on farmer's preference of rice varieties, and the study revealed that among high yielding varieties high yield got highest mean

score followed by low cost benefit ratio and fertilizer response. In case of traditional varieties resistance to insects and pests got the highest mean score and followed by resistance to diseases and high input costs.

Clinton *et al.* (2014) in their study on a look at the variations in consumer preferences for farmers' markets attributes. The study revealed that the ease of movement between vendors, availability of rest rooms, access to covering or shade, is the most important attribute, while the least important is the availability of seating.

Olusegun *et al.* (2014) analysed factors influencing adoption decisions of maize farmers in Nigeria. The results suggested that farm size, education level of farmers and access to extension services would significantly influence adoption of improved maize varieties. The results also indicate that farmers across the entire agro-ecological regions of country share some negative sentiments regarding adoption of improved maize varieties. Renewed emphasis on interventions that would enable farmers gain more access to farmland and promote formal education and extension service are advocated.

2.3 Millers preference for attributes

Frank *et al.* (2002) eliciting and valuing market preference with traditional food crops: the case of chickpea in India. Results revealed that for desi chickpea factors influencing price are shape, colour, seed weight, recovery and foreign matter content. For kabuli chickpea important factors are foreign matter content and seed weight. The chemical quality characters like ash and protein content appear to be unimportant in influencing price.

Peterson *et al.* (2004) examined traders WTP for domestic and imported rice using a choice experiment in Japan. The results indicated that the market retail price of imported rice is higher than the average trader's valuation. Traders were particularly concerned about the safety and price of imported rice, and these factors drastically reduced traders WTPs.

Renee *et al.* (2005) in their study on effects of product origin on millers' choice of imported wheat for noodle market segments in Japan and South Korea. Revealed that millers in Japan appeared to be more sensitive to small price changes than were millers in South Korea, apparently because of differences in the trading systems of the two nations. The responses of millers differ to several quality factors of wheat. In general, Japanese

millers seem to exhibit more stringent quality requirements for their wheat purchases. Millers in both the markets place a higher value on wheat originating from Australia, compared to wheat of either U.S. or Canadian origin, in their choice decisions of wheat for noodle making.

Ghadge *et al.* (2008) studied the effect of processing methods on qualities of instant whole legume: pigeon pea. The results showed that, the cooking time of processed whole pigeon pea was found to be reduced significantly compared to cooking of raw pigeonpea to 14 min by using precooking, frozen storage and drying it by cabinet drying process. Further the effects of these processing methods on physical characteristics of instant whole pigeonpea suggest that the water absorption and the sedimentation value were higher and bulk density was lower compared to raw pigeonpea which indicates selectively lower damage to protein and starch during cabinet drying. The proximate composition of prepared instant whole pigeonpea by different methods indicates that there were no major changes except to moisture and total ash content.

Karina *et al.* (2009) analyzed the Mexican millers' demand for hard red winter wheat Mexican millers. Study showed that Mexican millers are willing to pay premiums for increases in grain quality factors such as test weight, protein content, falling number, and dough strength/ extensibility characteristics given by farinograph stability and P/L ratio.

Diako *et al.* (2010) studied trader's perceptions, knowledge and preferences for aromatic rice types in Ghana. A survey of 390 rice traders was conducted in Accra, Ghana to ascertain trader's perceptions, knowledge and preferences for aromatic rice as a basis for quality improvement of local rice. Results showed that most traders (94.9%) were more familiar with imported rice and this was reflected in their patronage patterns. While the appearance of raw rice (Friedman rank mean = 2.86) was critical to traders choice.

Henry (2010) studied trader's preference for imported rice in Nigeria. The goal of this research was to develop a theoretically consistent procedure for identifying and estimating the relative contributions of habit persistence and perceived quality differentials in explaining trader preference for particular product varieties, and applies this procedure to demand for imported and domestically produced rice in Nigeria. Using annual time series data from 1961 to 2006, results indicated that habit persistence and

perceived quality differences both play an important role in explaining trader's preference for imported rice in Nigeria.

Jaehong and Shida (2010) studied South Korean millers' preferences for the quality characteristics of hard white wheat that is used in producing all-purpose flour. The study elicited South Korean millers' preference and willingness to pay for the quality characteristics of hard white wheat that is used in producing all-purpose flour. It specified seven attributes, test weight, moisture, and price significantly affect South Korean millers' utility but protein contents, ash, dockage, and falling number does not. South Korean millers are more willing to pay to change the quality characteristics related to the milling yields and profitability, such as test weight, moisture and dockage. But their willingness-to-pay for protein content is not as big as common expectation.

Gaudiose *et al.* (2012) analyzed behaviour and performance of traders in the gum arabic supply chain in Senegal: Investigating oligopsonistic myths. The computed index was found too low to have any influence on margins and hence oligopsonist powers could not be confirmed. Instead traders' margins depend on costs, risk and uncertainty that they face. Consequently, traders were not found exploitative; their power is derived from access to capital and market characteristics.

2.4 Constraints of stakeholders

Naik (1998) while studying economics of farming systems in Uttara Kannada district identified the problems faced by the farmers in all three agricultural regions of the district. He classified the problem broadly into production, financial, marketing and infrastructural/extension problems. The major problems faced by the farmers in the production front were shortage of labours during peak season, non-availability of chemicals and fertilizers and non-availability of improved breeds of livestock. Exploitation by commission agents and traders were the major constraints under marketing while, lack of extension facilities was the main amongst the infrastructural/extension constraints.

Vivekanand (1999) opined that agricultural development in Karnataka state had been hindered by problems such as weak research-extension network, regional imbalances, and stagnation in area under high yielding varieties *etc.*

Ganesh (2000) classified the problems faced by the farmers under four groups viz. production, financial, infrastructural, and marketing problems in Gazani lands of Karnataka. With respect to the production problems, majority of the farmers complained of non-availability of better variety seeds and fingerlings. Regarding financial problems, lack of funds for purchase of improved inputs was major problem. Extension problems included non-availability of package of practices. The important problem was absence of market regulation and information

Chandrashekhar *et al.* (2001) listed production constraints faced by growers in the order of importance. They were lack of technical guidance, more pest and diseases, high cost of fertilizers, high cost of plant protection chemicals, non-availability of seed materials and non-availability of fertilizers in time.

Gaddi *et al.* (2002) revealed in their study on yield gaps and constraints in the production of rabi sorghum in Bijapur and Gulbarga districts of Karnataka that the suboptimal use of plant nutrients, human labour and bullock labour on farmers' field vis-à-vis demonstration plots were the major factors conditioning yield gap. Substandard and costly chemical fertilizer and plant nutrients, labour shortage, non-availability of desired variety seed, unfavorable climatic conditions and incidence of pest and diseases limited sorghum productivity on farmers' fields.

Nguyen and Baldeo (2006) studied constraints faced by the farmers in rice production and export. Under technical constraints, it was found that diseases (sheath blight, blast, and stem rot); pests; lack of proper varieties; post-harvest technology constraint; storage problems were the most serious constraints perceived by large percentage of respondents. Fertilizer problems; plant protection constraints; weed problems; lack of labours and poor processing were found to be other constraints as perceived by farmers. In case of socio-economic constraints, the study found that poor infrastructures; high cost of inputs; credit problems; low rice price; inadequate inputs and lack of trainings were the most important constraints as perceived by large percentage of farmers.

Uwagboe *et al.* (2010) analyzed the constraints of farmers in cashew production. Majority (70%) of the respondents in the study area ranked inadequate capital (finance) as the most severe constraint while lack of storage facilities was ranked by few (5.50%) of the respondents. This could be attributed to difficulty in obtaining loan from the banks

due to collateral while storage facilities constraint could be attributed to the fact that the cashew farmers in the study area do not store their produce for processing.

Godwin *et al.* (2011) evaluated the constraints and opportunities of maize production in the west region of Cameroon for sustainable development. The study found that most maize farmers in the study area were small scale farmers and are full time farmers, the major maize production constraints was poor access to credit facilities, resource availability, market facility, inadequate storage.

Lal *et al.* (2011) analyzed the constraints perceived by the farmers in adoption of potato technology. It was found that involvement of middle man, cheating by the traders, low sale price of potato, shortage of electricity, gluts, poor quality and adulterated fungicides, lack of cold storage facilities, low risk bearing ability of the potato framers, lack of motivation from state department of agriculture and state department of horticulture and unavailability of good quality potato seed to the farmers were the most serious constraints.

Usha (2011) conducted a study on possibilities and constraints of increasing production of pulses and impact of National Food Security Mission on pulses in Haryana. It was noticed that availability of improved variety seeds was awarded lower rank by most of the growers. Further, these are expensive and need larger doses of other expenses such as fertilizers, pesticides etc. The inadequate pest resistance of improved seeds was highlighted by majority of gram growers (88 per cent in Bhiwani and 84 per cent in Mahendragarh). Second, most important problem faced by the gram growers was less than expected yield from growing improved seeds.

Haruna (2012) conducted an analysis of the constraints in the tomato value chain. The results found that the major problems confronting the tomato value chain were found to be low prices, price volatility, lack of access to credit, poor quality of tomatoes, inadequate storage and warehousing facilities, inadequate transportation facilities, dispersed nature of source of supply, high interest rate and lack of adequate information. While farmers ranked low price as their most worrying constraint, poor quality of Ghana produced tomatoes was ranked as the most pressing constraint of wholesalers and retailers.

Jeewan *et al.* (2012) studied on constraints faced by tomato growers in use of improved tomato production technology. A critical examination of the study revealed that financial constraints possessed the first position as perceived with by the respondents. Similarly, technical constraints got second position and third position and fourth position awarded to educational constraints, marketing constraints, respectively. Input constraints were perceived at last position.

Egbadzor *et al.* (2013) studied farmers' key production constraints and traits desired in cowpea in Ghana. Of the total six problems three top constraints namely, drought, insect pests attack and cyprus infestation were identified at the two locations of the PRA. Mould and problem of preservation were additionally mentioned at Avenorpedo. While only harvesting problem was added at the Ohawu.

Makarau *et al.* (2013) analyzed farmers' constraints to vegetable production in Jaba local government area of Kaduna State, Nigeria. The major constraints of vegetable production were farm size (96.00%, 1st), land tenure problems (68.00%, 2nd), inadequate tractor hiring services (34.40%, 3rd) amongst others. It was recommended that farmers should be sensitized to explore this area of agriculture given its economic viability, farmers to be encouraged to form cooperative societies to ease access to credit facilities from financial/lending institution and Government to revitalize the tractor hiring service units in the state with the view to reduce or minimize farmers over reliance on manual labour to enhance production in Jaba local Government area and the state in general.

Shafiqul *et al.* (2013) conducted a study on adoption of Bari Mung varieties and its constraints to higher production in southern region of Bangladesh. The study revealed that the first and the foremost constraint for adoption of improved mungbean in all areas was insect infestation (89%). The second highest constraint was insecticides not working properly (67%) might be due to adulterations. The third constraint was lack of training (65%) about improved mungbean cultivation. The fourth constraint was high price of insecticides (63%). Lack of labour (54%), lack of optimum moisture (44%), lack of good seed (42%) and diseases infestation (30%) were also opined to be the constraints to mungbean cultivation.

III. METHODOLOGY

This chapter deals with the description of the study area, sampling techniques adopted, method of survey, nature and sources of data and various tools and techniques employed in analysing the data. The important concepts of the study are clearly defined to facilitate clear understanding of the issues related to the present study.

The methodology has been presented as follows:

- 3.1 Description of the study area
- 3.2 Nature and sources of data
- 3.3 Sampling framework and database
- 3.4 Analytical techniques employed
- 3.5 Concepts and terms used in the study

3.1 Description of the study area

The present study was conducted in Kalaburagi district of Karnataka state during 2014-15, which is the largest producer of pigeonpea and contributes 50.68 per cent of state production and having 278 pigeonpea processing units. The Kalaburagi district falls under the North Eastern Transitional Zone (Zone-1) partly and North Eastern Dry Zone (Zone-2) of Karnataka state. It lies between $17^{\circ} 10^1$ and $17^{\circ} 45^1$ N latitude and $77^{\circ} 10^1$ and $77^{\circ} 45^1$ E longitudes, with the geographical area of 10,954 sq. km. The district is bounded on the west by Vijayapur district of Karnataka and Solapur district of Maharashtra; on the north, it is bounded by Bidar district of Karnataka and Osmanabad district of Maharashtra state; on the south and the east, it is bounded by Yadgir district of Karnataka and Rangareddy district of Andhra Pradesh respectively. The district economy depends mainly on agriculture which contributes about 31.70 per cent of district income and provides employment to 67 per cent of the population.

3.1.1 Population and demography of the district

The district spreads in seven taluks with 10 towns, 32 hoblies and 220 gram panchayaths and 918 inhabited villages. The population of the district as per 2011 census was 21,74,742 and has a sex ratio of 935 of females for every 1000 males. The population growth rate over the decade (2001-2011) was 21.13 per cent. Out of total population in

the district, 14,85,176 were in rural areas and the rest 6,89,566 were in urban and semi urban areas, the overall population density of the district being 197 per sq. km. Kalaburagi has an average literacy rate of 51.00 per cent. The district has seven taluks viz. Aland, Afzalpur, Chincholli, Chittapur, Jewargi, Kalaburagi, and Sedam. The general features of the district are given in Table 3.1.

3.1.2 Climate, rainfall and soil type

The weather in Kalaburagi district comprises of three main seasons. The summer spans from late February to mid June, followed by the south west monsoon, which spans from late June to late September (then followed by dry winter weather until mid January). Barring the hot summer months, the salubrious weather of Kalaburagi makes a visit to this historical city a pleasant one. Temperatures during different seasons ranges from 38⁰ to 44⁰ C in summer, 27⁰ to 37⁰C in monsoon and 11⁰ to 26⁰ C in winter. The soils of the district are deep to very deep black, medium black, sandy loam and are light textured soils, whereas some parts are having light black, red and black sandy soils. The soils are varied in the zone which facilitates growing of variety of crops in both *kharif* and *rabi* seasons. The important crops grown in the district are pigeonpea, greengram, blackgram, bengalgram, jowar, bajra, wheat, groundnut, sunflower, sesamum and cotton. The agro climatic conditions are best suited for pulse crops cultivation. The total area under the cultivation of pigeonpea in Kalaburagi district is 3.7 lakh ha.

3.1.3 Land utilization pattern

The net sown area accounted for 8,32,584 hectare of total geographical area. Around 35,316 ha of area were covered under forest. Land put to non- agricultural uses had a share of 41,420 ha. Current fallow, fallow other than current fallow and cultivable waste land accounted for 1, 09,224 ha, 6,785 ha and 9,417 ha respectively. Barren and uncultivable land occupied around 35,113 ha and permanent pastures and other grazing land formed 25,855 ha of total geographical area. Out of total geographical area, 1,10,694 ha was brought under cultivation, which includes area sown more than once. Area under cereals (paddy, jowar, bajra, maize, wheat, other cereals & minor millets) was 2,55,386 ha, area under pulses (gram, tur, other pulses) was 5,92,894 ha, area under oilseeds (groundnut, sunflower and oilseeds) was 1,63,603 ha and area under commercial crops (sugarcane, cotton) was 11,704 hectare.

Table 3.1. General features of Kalaburagi district

Sl. No.	Particulars	Numbers
1	Total geographical area (Sq. Kms.)	10,954
2	Total population (No.)	21,74,742
	i) Urban Population (No.)	14,85,176
	ii) Rural Population (No.)	6,89,566
3	Population density (persons/sq. km)	197
4	Literacy rate (%)	51.00
5	Total area (ha)	10,94,120
6	Forest area (ha)	35,316
7	Non- agriculture (ha)	38,420
8	No. of industrial area	04
9	Total <i>dal</i> mills	308
10	Number of <i>dal</i> mills working	276
11	Number of traditional <i>dal</i> mills	262
12	Number of modern <i>dal</i> mills	14
13	Per cent of modern <i>dal</i> mills	5.07

Note: Kalaburagi District at a Glance, 2012-13

3.2 Nature and sources of data

3.2.1 Primary data

For evaluating the specific objectives designed for the study, primary data were collected from the pigeonpea processors, farmers and consumers analysed for socio economic status, preference for technological attributes, varieties and also analysed for the constraints faced in existing varieties.

Information on the following aspects were collected from 150 respondents and are as follows.

1. General information from the individual respondents regarding their social, economic and demographic characters like age, education status, occupation, monthly income, family size and type.
2. Attributes influencing the preference of pigeonpea by different stake holders.

3.3 Sampling framework and database

3.3.1 Sampling framework

3.3.1.1 Selection of district

Kalaburagi district of Karnataka state was purposively selected for the study as it is the largest producer of pigeonpea and contributes 50.68 per cent of state production and having 278 pigeonpea processing units. Major pulses grown in the district are pigeonpea, blackgram, chickpea and greengram. Kalaburagi is popularly called as “*pulse bowl*” of Karnataka. Many *dal* mills are established in and around Kalaburagi city and even in the taluk also. Kalaburagi is known for production of the country’s best quality tur *dal*. Its recognition as *dal* mill industry belt was another consideration for the selection of the district.

3.3.1.2 Selection of farmers

Sample farmers were selected randomly from the Kalaburagi and Jewargi taluks of Kalaburagi district. 60 samples were selected randomly from this region (Table 3.2).

3.3.1.3 Selection of consumers

For selection of sample consumers, consumers were divided into rural and urban consumers. 30 consumers were chosen randomly from urban locations, while 30 from rural locations.

3.3.1.4 Selection of millers

Around 300 *dal* processing units are established in Kalaburagi district and majority (254) of them are in Kalaburagi city. Therefore, selection of millers were confined to Kalaburagi city only. 30 millers were selected randomly for analysis from Kalaburagi district.

3.4 Analytical tools/techniques employed

For the purpose of fulfilling the specific objectives of the study, the data were analysed by using following techniques.

3.4.1 Tabular analysis

The data collected were presented in tabular form to facilitate easy comparison. This technique of tabular presentation was employed to study the general and socio-economic characteristics of sample farmers, consumers and millers, and preference of pulse with simple statistical tools like averages and percentages.

Table 3.2. Distribution of sample respondents in the study area

Sl. No.	Location	Respondent type	Sample size
1	Kalaburagi urban	Consumer	15
2	Kalaburagi rural	Consumer	15
3	Jewargi urban	Consumer	15
4	Jewargi rural	Consumer	15
5	Kalaburagi	Farmer	30
6	Jewargi	Farmer	30
7	Kalaburagi	Pigeonpea dal miller	30

3.4.2 Conjoint Analysis

Conjoint analysis is a versatile marketing research technique that can provide valuable information for new product development, forecasting, market segmentation, pricing decisions, advertising, distribution, competitive analysis and repositioning.

It is a technique used in assessing consumer's value judgments. Hence, in the present study, it was used to measure the consumer's, farmers and pigeonpea miller's preference for the pigeonpea quality attributes. Of late, conjoint analysis is finding increasing application in the field of market research and wider management decision-making.

One of the important requirements for conjoint analysis is the identification of critical attributes to describe the preferences for pigeonpea and the specific and feasible levels of these attributes. On the basis of the objective attributes and then respective levels with orthogonal variables 18 cards were developed. The respondent were first asked to rank the set of profiles, or cards according to his or her preference. On each of these profiles, all factors of interest are represented and a different combination of factor levels appears. The task of respondents was to rank each profile from the most to the least preferred. From these rankings or scores, conjoint analysis derives utility scores for each factor level. These utility scores, analogous to regression coefficients are called part-worths and can be used to find the relative importance of each factor.

Using conjoint analysis, what pigeonpea attributes is important or unimportant to the stakeholders are analyzed. What level of pigeonpea attributes are the most or least desirable to the stakeholders? Answers to these questions are of crucial importance in the purchase and consumption of pigeonpea.

The virtue of conjoint analysis is that it asks the respondent to make choices in the same fashion as the consumer presumably does-by trading off features, one against another. There are two general approaches in collecting data for conjoint analysis-the two-factor-at-a time trade off method and the multiple factor full concept method. With the tradeoff method, respondents are asked to rank the cells of a series of matrices, each matrix crossing the level of one factor with the level of another.

The two-factor-at-a-time is hardly ever used today. The full concept method is considered a more realistic because all factors are considered at the same time. In the full

concept method, the respondent is asked to rank order or score a set of profiles, all factors of interest are represented and a different combination of factor level (features) appears. The respondent's task is to rank each profile from most preferred to least preferred. From these rankings or scores, conjoint analysis derives utility scores for each factor level. These utility scores, analogous to regression co-efficient are called "part-worths" and can be used to find the relative importance of each factor. Such information can be very useful when deciding which combination of factor levels is best for a new product or service and when predicting various outcomes, such as sales, given certain combinations of factor levels.

These attributes and levels resulted in 18 profile solutions. Since, the number of all possible combinations of these 5 attributes was too large for evaluation, a computer software package, 'SPSS' (Statistical Package for Social Sciences) was employed to select a subset of 18 pigeonpea profiles which represent the most likely ones. Each profile was described on a separate card called plan cards. The respondents who consumed that pigeonpea were interviewed. Each respondent was shown a randomly mixed set of 18 plan cards and was asked to rank them accordingly to their own perception. The ranks provided by them to these 18 cards were noted down. For each attribute/respondent, part-worth as well as relative importance of each attribute was estimated using conjoint analysis.

In this study, the additive conjoint model was used instead of other forms like the interactive and the multiplicative models. The model has been formulated as:

$$Y = \sum_{i=1}^n \sum_{j=1}^m V_{ij} X_{ij}$$

Where,

Y = The consumers overall evaluation of the product alternative

V_{ij} = Part worth associated with 'j' (1,2,3,m) of attributes 'i' (1,2,n)

X_{ij} = Dummy variable representing the preference of the jth level of ith attribute

Table 3.3. Attributes and its levels considered for pigeonpea consumer for conjoint analysis

Sl. No.	Attributes	Levels
1	Dal appearance	Unpolished Polished
2	Type	Unbranded Branded
3	Cooking time	More Less
4	Boiled dal	Broken Intact
5	Price	₹ 85-90 ₹ 80-85 ₹ 75-80
6	Keeping quality	8-10 hrs 10-12 hrs

For this study, profile describing alternatives was constructed by combining levels of five attributes. The attributes and their levels were identified through discussions with the consumers during the survey and also on consultation with marketing specialists.

Table 3.4. Attributes and its levels considered for pigeonpea farmers for conjoint analysis

Sl. No.	Attributes	Levels
1	Crop duration	140-160 days >160 days 120-130 days
2	Plant height	Medium Short
3	Resistance to	Helicoverpa Wilt
4	Output price	₹ 5000-6000 ₹ >6000
5	Grain yield	5-6 Q >6 Q

Table 3.5. Attributes and its levels considered for pigeonpea millers for conjoint analysis

Sl. No.	Attributes	Levels
1	Seed shape	Round Oval
2	Moisture content	10-12% 8-10%
3	Seedcoat	Thick Medium Thin
4	Dal hardness	Semi hard Hard
5	Price	₹ 5000-6000 ₹ 4500-5000 ₹ 4000-4500
6	Recovery per cent	65-72% >72%

3.4.3 Garrett's ranking technique:

The different attributes of pigeonpea were ranked by the farmers and processors. These ranks were analyzed through Garrett's ranking technique. The attributes of pigeonpea preference by farmers and millers are depicted in table 3.5.

Garrett's ranking technique gives the change of orders of constraints into numerical scores. The major advantage of this technique as compared to simple frequency distribution is that here constraints are arranged based on their importance from the point of view of respondents.

Garrett's formula for converting ranks into per cent was given by

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

Where, R_{ij} = rank given for i^{th} factor (constraint) by j^{th} individual

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

The relative position of each rank obtained from above formula was converted into scores by referring to the table given by Garrett (transmutation of orders of merit into units of amount or scores) for each factor; scores of all individuals were added and then divided by the total number of respondents for the specific factor (constraint) attributes presented in Table 3.6, 3.7.

Table 3.6. Attributes considered for analysing constraints of dal millers

Sl. No.	Attributes
1	High moisture content
2	Low dal recovery per cent
3	Thicker seed coat
4	High broken percentage
5	Uneven size of grains
6	Higher per cent of immature seeds
7	Breaking of edges during processing

Table 3.7. Attributes considered for analyzing constraints in existing pigeonpea varieties

Sl. No.	Attributes
1	Long duration of variety
2	Highly susceptible to pest and diseases
3	Higher flower drop
4	Lesser resistant to drought
5	Lesser resistant to lodging
6	Higher input cost

3.5 Concepts and terms used in the study

Part-worth functions: The part-worth functions or utility functions describe the utility consumers attach to the levels of each attribute.

Relative importance weights: Indicates which attributes are important in influencing consumer choice.

Attribute levels: The attribute levels denote the values assumed by the attributes.

Full profiles (complete profiles): are constructed for all the attributes by using the attribute levels specified by the design.

Fractional factorial designs: These are designs employed to reduce the number of stimulus profiles to be evaluated in the full profile approach.

Installed capacity: Production capacity of plant based either on its rated (name plate) capacity or actual (practically determined) capacity.

Capacity Utilization: Capacity utilization is the extent to which an enterprise or a nation actually uses its installed productive capacity. It is the relationship between actual output that 'is' actually produced with the installed equipment, and the potential output which 'could' be produced with it, if capacity was fully used.

Raw material (Pigeonpea): The dried whole pigeonpea seeds are the raw material used for processing. The processor purchase redgrm from Gunj market. Sometimes the processor also purchases raw material directly from farmers.

Cleaning and grading: The procured raw material should be free from pebbles, stubs, soil particles, sand, metallic particles, etc. Therefore, it is passed through a cleaning machine. The cleaned seeds are graded based on size by grading equipment based on size of gram.

Oil treating: Pigeonpea seeds are treated with oil which helps to loosen the husk and release cotyledon layer binding from seeds.

Drying: After oil treatment the seeds are heaped up left over night, then spread out for drying either under sun for 1 or 2 days or by means of mechanical drier.

Dehulling: Removing the hull/speed coat from pigeonpea seeds and splitting the seeds into its dicotyledonous components.

Separating: Separations of the parts of broken grains, husk and powder from dal.

Polishing: Polishing is the removal of members from the *dal* it provides shining to split grains.

IV. RESULTS

In consonance with the objectives of the study, the data collected from different categories of pigeonpea respondents were analysed and the results of the study are presented under the following headings.

4.1 Socio-economic status of the stake holders

4.1.1 Socio-economic status of the sample farmers

4.1.2 Cropping pattern of the sample farmers

4.1.3 Socio-economic characteristic of the dal millers

4.1.4 Socio-economic status of the sample consumers

4.2 Technological attributes of pigeonpea preferred by stake holders

4.2.1 Physical and cooking quality parameters of pigeonpea varieties grown by farmers

4.2.2 Recovery per cent of locally cultivated pigeonpea varieties

4.2.3 Distribution of pigeonpea varieties grown by farmers

4.2.4 Technological attributes of pigeonpea preferred by farmers

4.2.5 Technological attributes of pigeonpea preferred by pigeonpea dal millers

4.2.6 Technological attributes of pigeonpea dal preferred by consumers

4.3 Most preferred technological attributes of pigeonpea as opined by stake holders

4.3.1 Pattern of attributes of pigeonpea determining farmers varietal preferences

4.3.2 Pattern of attributes of pigeonpea determining millers quality/varietal preferences

4.3.3 Pattern of preference of attributes by urban and rural consumers

4.4 Constraints opined by the stakeholders among existing varieties

4.4.1 Constraints opined by the farmer among the existing varieties

4.4.2 Constraints opined by the millers while procuring pigeonpea

4.1 Socio-economic status of the stake holders

4.1.1 Socio economic status of the sample farmers

The general socio-economic features of the sample farmers pertaining to age, type, size of family, educational status, size of farm, farm income, *etc.* are summarized and presented in Table 4.1.

The age of the sample farmers clearly indicated that majority (41.67 %) of them were aged more than 50 years, followed by 40-50 years (28.33%) and young farmers less than 40 years (31.10%) respectively. It is interesting to note that the educational status of sample farmers was good with 45 per cent were up to secondary, 16.67 per cent of them went to college and above and 38.33 per cent of them were either illiterates (13.33%) or primary (25.00%) drop outs. The average size of the farm of the sample farmers was found to be relatively large in rainfed condition with 8.65 acres than in irrigated conditions with 1.65 acres. The occupational status of sample farmers were found to be majority (100%) as agriculture and only 8 per cent of farmers following subsidiary occupation. The major source of irrigation among the sample farmers were bore well (35.71%) followed by canal (25.00%) and openwell (21.43%). It is worth noting that nearly 68 per cent of sample farmers were having only less than ₹ 23,125 income per annum per household. It was observed that 41.67 per cent sample farmers had middle level of income (₹ 11,375 to 23,125) followed by 27.66 per cent farmers had low level income (₹ <11,375).

4.1.2 Cropping pattern of the sample farmers

As indicated in the Table 4.2, the *kharif* crops accounts for 78.26 per cent of the total cropped area followed by horticultural crops (13.28%) and *rabi* crops (8.46%) respectively.

The cultivation of pigeonpea (54.62%) and cotton (14.82%) in *kharif* season and bengalgram (4.58%) in *rabi* season were the major crops grown in the study area. This clearly indicated the predominance of pulses *viz.* pigeonpea and bengalgram cultivation in the study area. Whereas, horticultural crops covered less area (13.26%) under cultivation in the study area comprising of banana (5.78%) and lime (5.64%) respectively.

Table 4.1. Socio-economic status of sample farmers

Sl. No.	Particulars	Unit	No.	Per cent
			60	100
1	Age			
	a. < 30 years	No.	4	06.67
	b. 30 to 40 years	No.	14	24.43
	c. 41 to 50 years	No.	17	28.33
	d. > 50 years	No.	25	41.67
2	Average Family size	No.	7	
3	Education			
	a. Illiterate	No.	8	13.33
	b. Primary	No.	15	25.00
	c. Secondary	No.	27	45.00
	d. College and above	No.	10	16.67
4	Average size of land holding			
	a. Rainfed	acres	8.65	
	b. Irrigated	acres	1.65	
	c. Leased in	acres	0.26	
	d. Leased out	acres	-	
5	Occupation			
	a. Main (Agriculture)	No.	60	100
	b. Subsidiary	No.	5	8.333
6	Source of Irrigation			
	a. Open well	No.	6	21.43
	b. Bore well	No.	10	35.71
	c. Canal	No.	7	25.00
	d. Tank	No.	-	-
	e. Others	No.	-	-
7	House hold income			
	a. Low (up to ₹ 11375)	No.	16	26.66
	b. Middle (₹ 11376- 23125)	No.	25	41.67
	c. High (>₹ 23125)	No.	19	31.67

Table 4.2. Cropping pattern of the sample farmers

Sl. No.	Particulars	Area (acres)	Per cent
1	Field crops		
A	Kharif		
	Pigeonpea	387.00	54.62
	Cotton	105.00	14.82
	Bajra	20.50	2.89
	Sunflower	7.00	0.99
	Paddy	35.00	4.94
	Sub total	554.50	78.26
B	Rabi		
	Jowar	20.50	2.89
	Bengalgram	32.50	4.58
	Wheat	7.00	0.98
	Sub total	60.00	8.46
2	Horticulture crops		
	Banana	41.00	5.78
	Lime	40.00	5.64
	Chilli	13.00	1.83
	Sub total	94.00	13.28
	Grand total(1+2)	708.50	100

4.1.3 Socio-economic characteristics of dal millers

The socio-economic characteristics of *dal* mill owners are presented in Table 4.3. The average family size of the *dal* mill owners in the study area was 4 in small dal mills, 6 in medium and 7 in large dal mills respectively. The average age of *dal* mill owners were 47 years. An analysis of the educational status of the *dal* mill owners indicated that all the *dal* mill owners were literate. A large portion of the *dal* millers were educated up to college level (70.00%) followed by graduates and above (23.33%) and secondary level (10.00%). The average income of the small, medium and large millers were 27.50, 33.51 and 47.52 lakhs respectively. It is important to note that 80 per cent of *dal* mill owners are engaged in agriculture as a subsidiary occupation having an average income of ₹ 4.85 lakhs.

The per day installed processing capacity of the *dal* mills was 15, 20 and 30 tonnes processing capacity in small, medium and large size dal mills respectively.

4.1.4 Socio-economic status of the sample consumers

The general socio-economic features of the sample consumers pertaining to age, type of the family, size of family, educational status, income, *etc.* are summarized and presented in Table 4.4.

The age of the sample consumers clearly indicated that majority (77.00%) of them were middle aged between 36 to 50 years, followed by old aged (>50years) with around (30%) and (43%) in urban and rural respectively. Young consumers (<35 years) were around 25.00 per cent in both urban and rural regions. With regard to type of family, a considerable number (>85.00%) in urban, (70.00%) and in rural sample families were of nuclear type with less than five members in a family. Rural consumers had relatively higher number of joint families (30.00%). It is interesting to note that the educational status of sample consumers was very poor in rural (56.66%) consisting of illiterates (23.33%) and primary school (33.33%) dropouts. In case of urban regions the number of consumers with secondary (46.67%) and college and above (30.00%) was high compared to rural regions of the district. It is worth mentioning that 70 per cent of the consumers in urban had annual income of more than ₹ 23,126 per annum and similarly, 100 per cent consumers had annual income of more than ₹ 11,376. On the contrary, majority of rural

Table 4.3. Socio-economic characteristics of *dal* millers

Sl. No.	Particulars		Small (n=10)	Medium (n=10)	Large (n=10)
1	Family size (No.)		4	6	7
2	Education level of owners (No.)				
	a) Primary		-	-	-
	b) Secondary		1 (10.00)	-	1 (10.00)
	c) College		7 (70.00)	7 (70.00)	7 (70.00)
	d) College and above		2 (20.00)	3 (30.00)	2 (20.00)
3	Income from main occupation (₹ lakhs/annum)		27.50	33.51	47.52
4	Subsidiary occupation (No.)				
	a) Agriculture		7 (70.00)	9 (90.00)	8 (80.00)
5	Income from Subsidiary occupation	Agriculture (₹ lakhs/annum)	496428	372222	588125
6	Installed capacity (Tonnes/day)		15	20	30

Table 4.4. Socio-economic characteristics of sample consumers

Sl. No.	Particulars	Urban (n=30)		Rural (n=30)	
		No.	Per cent	No.	Per cent
1	Age of the respondent				
	a) <35	6	20.00	9	30.00
	b) 36-50	15	50.00	8	26.67
	c) >50	9	30.00	13	43.33
2	Type of family				
	a) Joint	4	13.33	9	30.00
	b) Nuclear	26	86.67	21	70.00
3	Family size				
	a) Male	3	59.85	3	54.02
	b) Female	2	40.15	3	45.98
4	Educational status of respondent				
	a) Illiterate	3	10.00	7	23.33
	b) Primary	4	13.33	10	33.33
	c) Secondary	14	46.67	11	36.67
	d) College and above	9	30.00	2	6.67
5	Household income				
	a) Low (<₹ 11,375)	-	-	6	20.00
	b) Middle (₹ 11,376-₹ 23,125)	9	30.00	14	46.67
	c) High (>₹ 23,125)	21	70.00	10	33.33

consumers (66.66%) had annual income of less than ₹ 23,125 and only 33.33 per cent of sample consumers had an income greater than ₹ 23125 per annum per household.

4.2 Technological attributes of pigeonpea preferred by the stake holders

4.2.1 Physical and cooking quality parameters of pigeonpea varieties grown by farmers

The results presented in Table 4.5 revealed that ICPL-87119 and BSMR-736 had long duration (190-200 days), TS-3R had 150-160 days of duration, whereas GC-11-39 suitable for short duration (125-130days) under irrigation condition. It is important to note that TS-3R and BSMR-736 had highest (11-12gm) 100 seed weight followed by ICPL-87119(10-10.5gm), ICP-8863(9-10gm), GC-11-39(9.5gm) and WRP-1(9gm) had lowest 100 seed weight. TS-3R, ICP-8863, ICPL-87119 and WRP-1 were found to be resistant to wilt whereas BSMR-736 was resistant to both wilt and sterility mosaic disease. The cooking quality of different pigeonpea varieties (Table 4.6) estimated in terms of increase in weight, volume and time taken for cooking clearly indicated difference in various parameters. However increase in weight was found to be more in ICPL-87119(295.00%) followed by TS-3R, Maruthi and WRP-1. In case of increase in volume, it was higher in Maruthi followed by TS-3R and WRP-1. On the other time taken for cooking was more in ICPL-87119 followed by TS-3R, Maruthi and WRP-1.

4.2.2 Recovery per cent of locally cultivated pigeonpea varieties

The recovery percentage of different locally cultivated pigeonpea varieties in processing unit is presented in Table 4.7. The recovery percentage of different locally cultivated varieties include TS-3R, Maruthi, Double moog and BSMR-736. Among which recovery percentage of main product is more in Maruthi (75%) followed by double moog (75%), BSMR-736 (68%) and TS-3R (60%) and while the recovery percentage of byproduct in TS-3R (40%) is more than the other varieties.

4.2.3 Distribution of pigeonpea varieties grown by farmers

A perusal of the Table 4.8 clearly indicated that in Kalaburagi majority (60%) of the farmers were growing TS-3R pigeonpea variety followed by ICP-8863 (16.6%), BSMR-736 (13.3%), local (10%) and ICPL-87119 (6.6%) respectively. Whereas in case of Jewargi, majority had opted for growing BSMR-736 (46.6%) followed by TS-3R (23.3%), local variety (20%), ICP-8863 (13.3%) and ICPL-87119 (6.6%), (Fig. 2).

Table 4.5. Physical parameters of pigeonpea varieties

Sl. No.	Varieties	Duration (days)	Yield (qtl./ac)	100 seed weight(gms)	Seed colour	Special features
1	TS-3R	150-160	4-5	11-12	Red	Resistant to wilt
2	ICP-8863 (Maruthi)	170-180	5-6	9-10	Red	Resistant to wilt
3	ICPL-87119 (Asha)	190-200	7-8	10-10.5	Red	Resistant to wilt
4	BSMR-736	190-200	7-9	11.5-12	Red	Resistant to wilt and SMD
5	WRP-1	160-165	5-6	9	White	Resistant to wilt
6	GC-11-39	125-130	3.5-4	9.5	Red	Irrigation condition

Source: ARS, Kalaburagi

Table 4.6. Cooking quality parameters of pigeonpea varieties

Sl. No.	Variety	Increase in weight (%)	Increase in volume (%)	Time taken for cooking (min)
1	Maruthi	138.02	166.70	23
2	WRP-1	131.68	160.00	21
3	ICPL-87119 (Asha)	295.00	-	55
4	TS-3R	167.50	167.50	32

Source: ARS, Kalaburagi

Table 4.7. Recovery per cent of locally cultivated pigeonpea varieties

Sl. No	Variety	Recovery (%)	Main product (Kg)	By product	
				Chunni (Kg)	Bhusa (Kg)
1	TS – 3R	60	60	25	15
2	Maruthi	75	75	15	10
3	Double Moog	70	70	18	12
4	BSMR-736	68	68	20	12

Table 4.8. Distribution of pigeonpea varieties grown by farmers

Sl. No.	Variety name	Kalaburagi (n=30)		Jewargi (n=30)	
		No.	Per cent	No.	Per cent
1	TS-3R	18	60.00	7	23.33
2	ICP-8863 (Maruthi)	5	16.66	4	13.33
3	ICPL-87119 (Asha)	2	06.60	2	06.60
4	BSMR-736	4	13.32	14	46.66
5	Local	3	10.00	6	20.00

Note: Total may not add up to 30 because of multiple responses

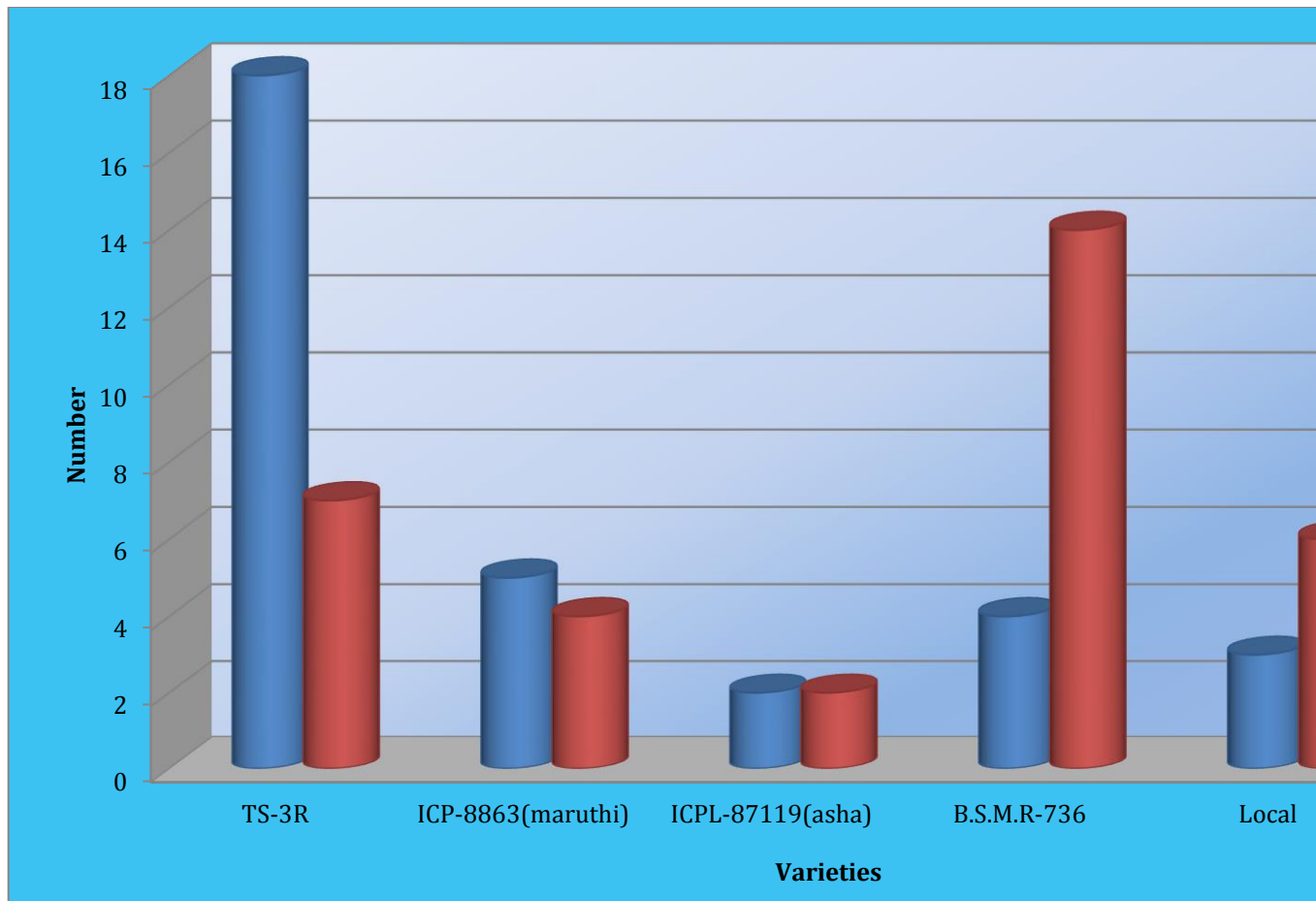


Fig. 2: Distribution of pigeonpea varieties grown by farmers

4.2.4 Technological attributes of pigeonpea preferred by farmers

The results presented in Table 4.9 revealed that yield was found to be the first consideration (91.66%) in preferring pigeonpea by the farmers. This was followed by ability to earn premium price (85.00%), resistant to pests and diseases and drought tolerance. Colour of seed and determinate type of flowering was found to be the least preferred attribute by the pigeonpea farmers.

4.2.5 Technological attributes of pigeonpea preferred by pigeonpea dal millers

The results presented in Table 4.10 revealed that the dal recovery rate was found to be most important (100%), followed by moisture content (83.33%), seed size (83.33%) and thickness of seed coat. Test weight and percentage of immature seed was found to be the least important attributes to dal millers.

4.2.6 Technological attributes of pigeonpea *dal* preferred by consumers

The result presented in Table 4.11 revealed that price of dal (93.33%) was found to be the first consideration in preferring pigeonpea *dal* by consumers. This was followed by cooking time (68.33%), flavour after cooking (60.00%) and free from husk (58.33%). Shape and milling operation of dal was found to be least preferred by consumer.

4.3 Most preferred technological attributes of pigeonpea as opined by stake holders

4.3.1 Pattern of attributes of pigeonpea determining farmers varietal preferences

Results of conjoint analysis

Farmer's decision to adopt particular variety of pigeonpea is largely influenced by its attributes like duration, height, resistance, price, yield *etc.* Hence, an attempt was made to elicit the kind of preference that farmers had towards the varietal characteristics of pigeonpea.

Plan cards were administered to sample farmers according to the sampling procedure. The respondents were asked to score the cards. Average partworth's and the relative importance of the attributes are presented in Table 4.12. A higher positive or lower negative partworths denotes, *ceteris paribus*, a higher perceived utility.

For each respondent, the part worth was estimated using OLS regression analysis. The fit of the additive model to the individual data was good. The Pearson's rank

Table 4.9. Technological attributes of pigeonpea preferred by the farmers

Sl. No.	Attributes	No. of respondent	Per cent
1	Yield	55	91.66
2	Ability to earn premium price	51	85.00
3	Resistant to pests and diseases	38	63.33
4	Drought tolerance	38	63.33
5	Resistant to fog	31	51.00
6	Duration	30	50.00
7	Cooking quality	27	45.00
8	Plant height	27	45.00
9	Good branching	21	35.00
10	Colour of seed	16	26.66
11	Determinate flowering	3	5.00

Table 4.10. Technological attributes of pigeonpea preferred by the *dal* millers

Sl. No.	Attributes	No. of respondent	Per cent
1	<i>Dal</i> recovery per cent	30	100.00
2	Moisture content of seed	25	83.33
3	Seed size	25	83.33
4	Seed coat	22	73.33
5	Seed colour	19	63.33
6	Purchase price	19	63.33
7	Seed shape	16	53.33
8	Foreign matter content	16	53.33
9	Test weight of seeds	11	36.67
10	Percentage of immature seeds	6	20.00

Table 4.11. Technological attributes of pigeonpea preferred by consumers

Sl. No.	Attributes	No. of respondents	Per cent
1	<i>Dal</i> price	56	93.33
2	Cooking time	41	68.33
3	Flavour after cooking	36	60.00
4	Free from husk	35	58.33
5	Brand	32	53.33
6	Cooked <i>dal</i> intact	31	51.67
7	Polished <i>dal</i>	31	51.67
8	Colour of <i>dal</i>	24	40.00
9	Uniform size of <i>dal</i>	19	31.67
10	Milling operation followed	15	25.00
11	<i>Dal</i> shape	14	23.33

Table 4.12 Correlation between farmer preferences of pigeonpea in Kalaburagi

Particulars	Correlation co-efficient
Pearson's rank correlation	0.661*
Kendall's tau correlation	0.502*
Constant	1.215

Note:* Significant at 1 per cent level

correlation test value was 0.661(significant at 1%), this gives us strong confidence in the suitability of the additive model. The Table 4.13 revealed that among all the attributes studied in pigeonpea variety, price and duration attributes of the variety were most important in deciding farmer's adoption of the particular variety. Price of the particular variety was found to have the greatest influence accounting for 26.79 of relative importance, more than ₹ 6000 were most preferred (utility 1.8750) and ₹ 5000-6000 were preferred least (utility 1.8750). Height of the cultivar has the least importance of 8.93 per cent.

Duration of the variety was found to have greater influence accounting for 25.00 per cent of relative importance, short duration varieties were most preferred (utility 1.9167) and long duration varieties were preferred least (utility,-0.333). Yield and resistance to pests and diseases of the cultivar has a strong influence on the farmers accounting for 19.64 per cent preferred next to the duration. Cultivar with resistance to wilt most preferred (utility, 1.3750) and helicoverpa were least preferred. Yield of the variety also having same relative importance of 19.64 per cent with 5-6Q yield having the utility of 1.3750, whereas 6-7Q yield having a utility -1.3750 (Fig. 3).

4.3.2 Pattern of attributes of pigeonpea determining millers quality/variatal preferences

Results of conjoint analysis

Miller's decision to purchase a particular quality/variety of pigeonpea variety is largely influenced by its attributes like seed shape, moisture, seed coat, dal, price, recovery *etc.* Hence, an attempt was made to elicit the kind of preference that millers have towards the quality/variatal characteristics of pigeonpea.

Plan cards were administered to sample millers according to the sampling procedure. The respondents were asked to score the cards. Average partworth's and the relative importance of the attributes are presented in Table 4.14. A higher positive or lower negative partworths denotes, *ceteris paribus*, a higher perceived utility.

For each respondent, the part worth was estimated using OLS regression analysis. The fit of the additive model to the individual data was good. The Pearson's rank correlation test value was 0.892 (significant at 1%), this gives us strong confidence in the suitability of the additive model. The Table 4.15 revealed that among all the attributes

Table 4.13. Attributes of pigeonpea most preferred by the farmer

Sl. No.	Attributes	Levels	Utility value	Relative importance (%)
1	Crop duration	140-160 days	-0.3333	25.00
		>160days	-1.5833	
		120-130days	1.9167	
2	Plant height	Medium	-0.6250	8.93
		Short	0.6250	
3	Resistance to	Helicoverpa	-1.3750	19.64
		Wilt	1.3750	
4	Output price	₹ 5000-6000	-1.8750	26.79
		₹ >6000	1.8750	
5	Grain yield	5-6 Q	1.3750	19.64
		>6 Q	-1.3750	

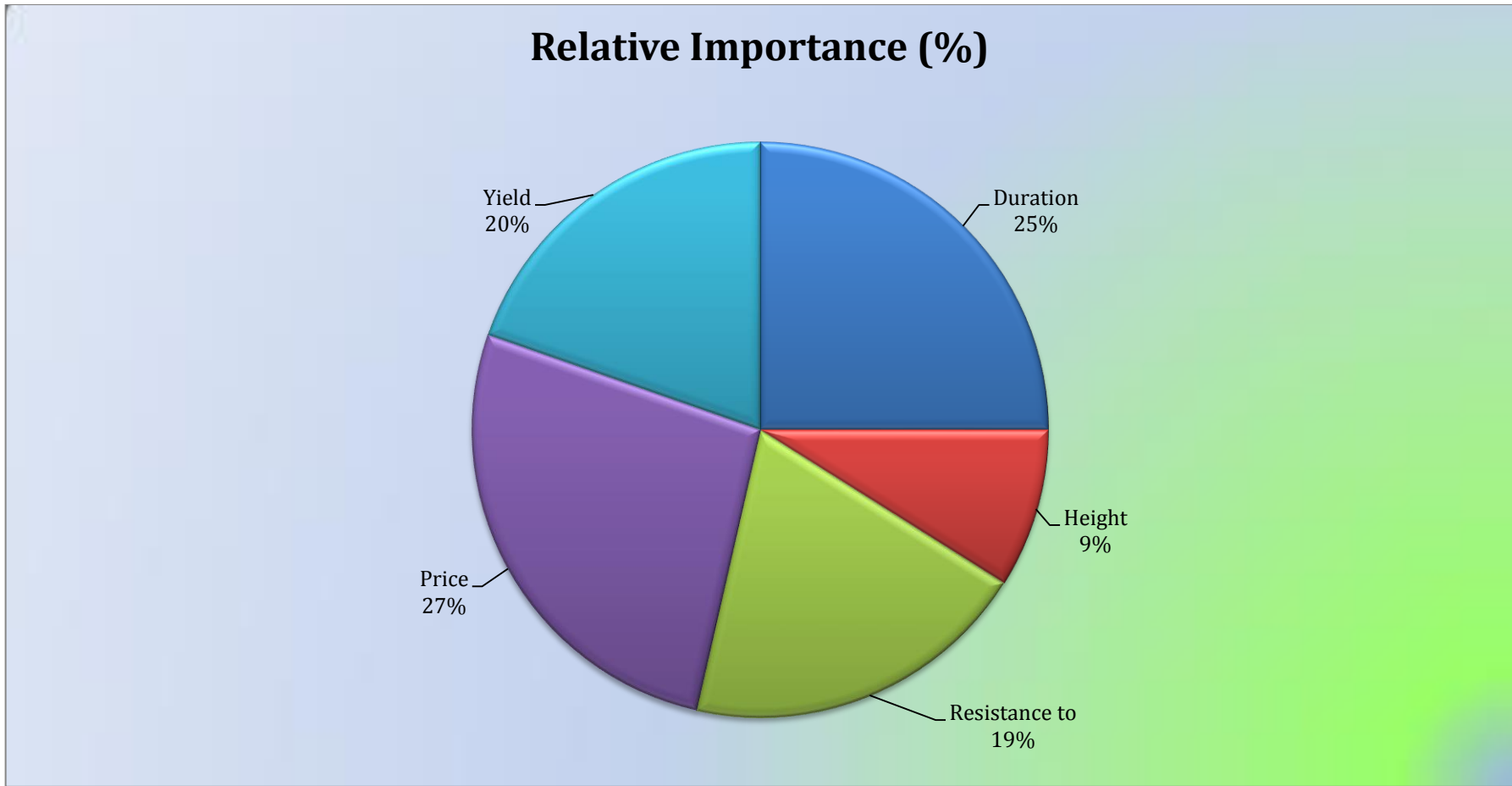


Fig. 3: Relative importance of pigeonpea preference by farmer

Table 4.14. Correlation between millers preference of pigeonpea in Kalaburagi

Particulars	Correlation co-efficient
Pearson's rank correlation	0.892*
Kendall's tau correlation	0.729*
Constant	0.872

Note:* Significant at 1 per cent level

Table 4.15. Attributes of pigeonpea most preferred by millers

Sl. No.	Attributes	Levels	Utility	Relative importance (%)
1	Seed shape	Round Oval	1.2500 -1.2500	13.61
2	Moisture content	10-12% 8-10%	-3.000 3.000	32.65
3	Seedcoat	Thick Medium Thin	1.1667 1.9583 -0.7917	17.01
4	<i>Dal</i> hardness	Semi hard Hard	1.3750 -1.3750	14.97
5	Price	₹ 5000-6000 ₹ 4500-5000 ₹ 4000-4500	0.1667 -0.4583 0.2917	4.08
6	Recovery per cent	65-72% >72%	-1.6250 1.6250	17.69

studied in pigeonpea, moisture and recovery attributes of the pigeonpea variety were most important in deciding miller's preference towards particular quality/variety in market during purchasing decisions. Moisture content of the grain was found to be the greatest influence accounting for 32.65 per cent of relative importance, grains having 8-10 per cent of moisture were most preferred (utility, 3.000) and grains having 10-12 per cent moisture were preferred least (utility-3.000), price of the dal has the least importance of 4.08 per cent.

Recovery percentage of the grain was found to have strong influence on the millers accounting for 17.69 per cent of relative importance with more than 72 percent having the utility of 1.625, 65-72 per cent of recovery having the utility of -1.625. Seed coat and *dal* with relative importance of 17.01 and 14.97 per cent respectively were preferred next to recovery. Cultivars with medium seed coat are most preferred, followed by thick and thin seed coat were least preferred. Also *dal* with semi hardness was most preferred (utility 1.375). Next to *dal*, seed shape has a relative importance value of 13.61 per cent. Grain having round shape preferred most with utility 1.2500 (Fig. 4).

4.3.3 Pattern of preference of attributes by urban and rural consumers

Results of conjoint analysis

The important attributes of pigeonpea determining consumer preferences studied in Kalaburagi urban and rural were *dal* (unpolished, polished), type (unbranded, branded), cooking time, boiled *dal*, price and keeping quality. For each respondent, the partworths were estimated using OLS regression analysis. The fit of the additive model to the individual data was good. In case of urban area, Pearson's rank correlation value with 0.941 was significant at 1 per cent level, similarly the Kendall's correlation value with 0.812 was also found to be significant at 1 per cent level. Whereas, in case of rural area Pearson's rank correlation value with 0.882 was significant at 1 per cent level similarly, the Kendall's correlation value with 0.723 was also found to be significant at 1 per cent level. This gives strong confidence in the suitability of the additive model.

The relative importance of the part worth functions were compared across different attributes within segments in order to arrive at the relative importance of each attribute. Average partworths and the relative importance of the attributes for Kalaburagi urban and rural are presented in Table 4.16 and 4.18 respectively.

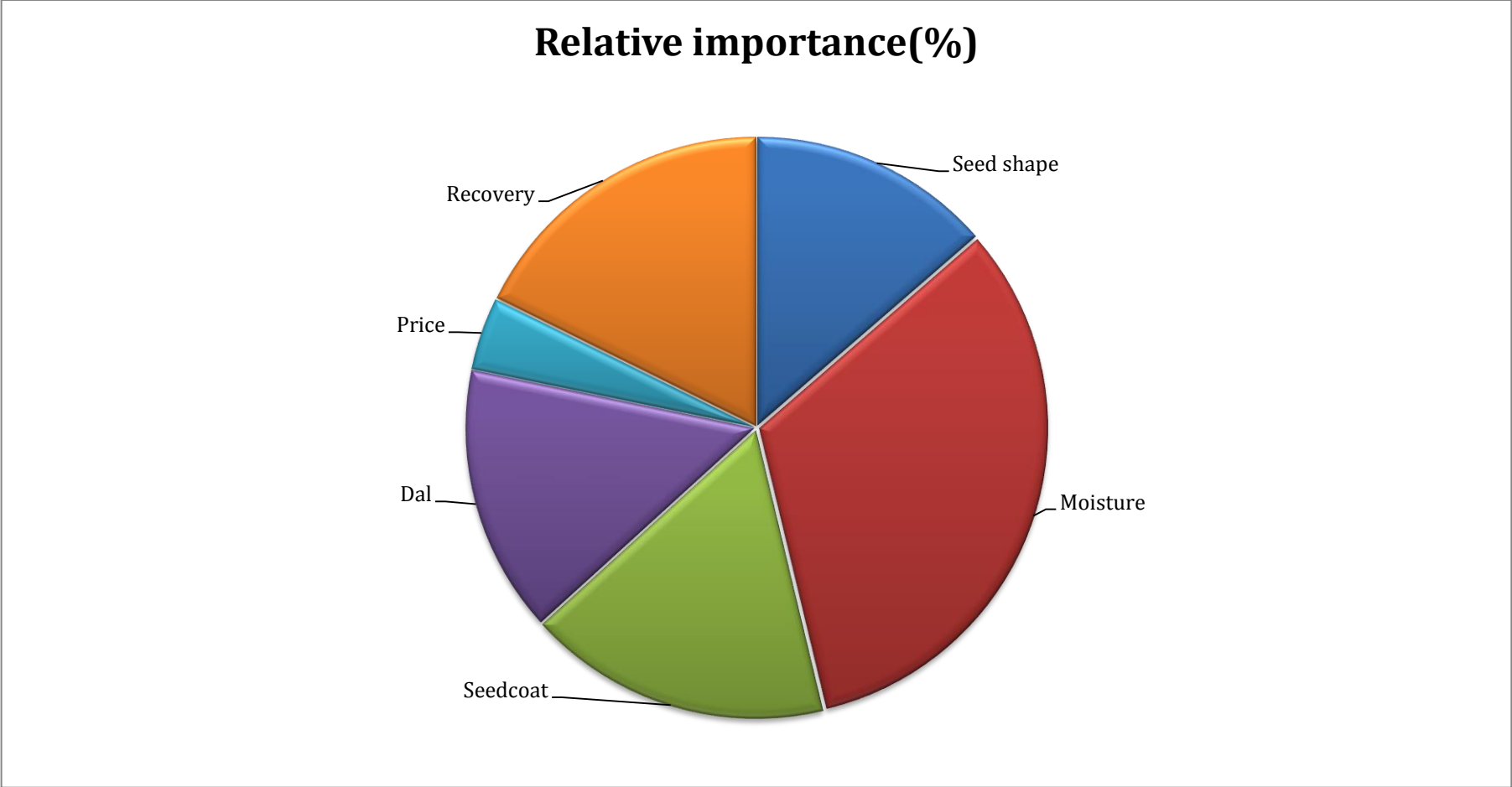


Fig. 4: Relative importance of pigeonpea preference by miller

Table 4.16. Correlation between urban consumer preferences of pigeonpea *dal*

Particulars	Correlation co-efficient
Pearson's rank correlation	0.941*
Kendall's tau correlation	0.812*
Constant	0.5818

Note:* Significant at 1 per cent level

Table 4.17. Attributes of pigeonpea *dal* most preferred by the urban consumer

Sl. No.	Attributes	Levels	Urban respondent (n=30)	
			Utility	Relative importance (%)
1	<i>Dal</i> appearance	Unpolished Polished	-2.3750 2.3750	24.68
2	Type	Unbranded Branded	-2.8750 2.8750	29.87
3	Cooking time	More Less	-1.5000 1.5000	15.58
4	Boiled <i>dal</i>	Broken Intact	-0.5000 0.5000	5.19
5	Price	₹ 85-90 ₹ 80-85 ₹ 75-80	-1.0000 1.2500 -0.2500	11.69
6	Keeping quality	8-10 hrs 10-12 hrs	-1.2500 1.2500	12.99

Table 4.18. Correlation between rural consumer preferences of pigeonpea *dal*

Particulars	Correlation co-efficient
Pearson's rank correlation	0.882*
Kendall's tau correlation	0.723*
Constant	0.8096

Note:* Significant at 1 per cent level

Among all the attributes studied in pigeonpea in Kalaburagi urban (Table 4.17), type (branded, unbranded) were found to be most important and first consideration of consumers, accounting for 29.87 per cent of relative importance with branded pigeonpea having the utility of 2.87. *Dal* (Polished, Unpolished) had a strong influence on consumer's preference after type in urban area accounting for 24.68 per cent of relative importance with polished having the utility of 2.37. Cooking time formed the third most important factor having a relative importance of 15.58 per cent. Followed by keeping quality (12.99%), price (11.65%) and boiled dal had the least importance at 5.19 per cent.

Whereas in case of Kalaburagi rural (Table 4.19), price were found to be most important and first deliberation accounting for 33.33 per cent of relative importance with more, medium and less price having the utility of -3.00, -0.5 and 3.5 respectively. Next to price, type (branded and unbranded) had a relative importance of 20.51 per cent. The individual utilities of unbranded, branded pigeonpea were 2.00 and -2.00, respectively. Cooking time had a strong influence on consumer's preference after type, accounting for 15.38 per cent of relative importance, with cooking time- less having the utility of 1.50, followed by dal (12.82%), boiled dal (11.54%) and keeping quality had the least important attribute with relative importance at 6.41 per cent, the individual utilities of 8-10 hrs. and 10-12 hrs. were -0.6250 and 0.6250 respectively (Fig.5).

4.4 Constraints opined by the stakeholders among existing varieties

4.4.1 Constraints opined by the farmers among the existing varieties

The constraints opined by the farmers in the existing pigeonpea varieties based on the different attributes were assessed by scoring and ranked using garret ranking and the results are presented in Table 4.20 and Fig. 6.

A perusal of table clearly revealed that long duration of pigeonpea varieties was found to be the major constraints with a mean score of 58.07, second major constraint was varieties susceptible to pest and diseases with a mean of 56.76, followed by more flower drop (55.39), less resistance to drought (50.54), less resistant to lodging (40.20) and high input requirement (39.03).

Table 4.19. Attributes of pigeonpea *dal* most preferred by rural consumers

Sl. No.	Attributes	Levels	Rural respondent (n=30)	
			Utility	Relative importance (%)
1	<i>Dal</i> appearance	Unpolished	1.2500	12.82
		Polished	-1.2500	
2	Type	Unbranded	2.0000	20.51
		Branded	-2.0000	
3	Cooking time	More	-1.5000	15.38
		Less	1.5000	
4	Boiled <i>dal</i>	Broken	-1.1250	11.54
		Intact	1.1250	
5	Price	₹ 85-90	-3.0000	33.33
		₹ 80-85	-0.5000	
		₹ 75-80	3.5000	
6	Keeping quality	8-10 hrs	-0.6250	6.41
		10-12 hrs	0.6250	

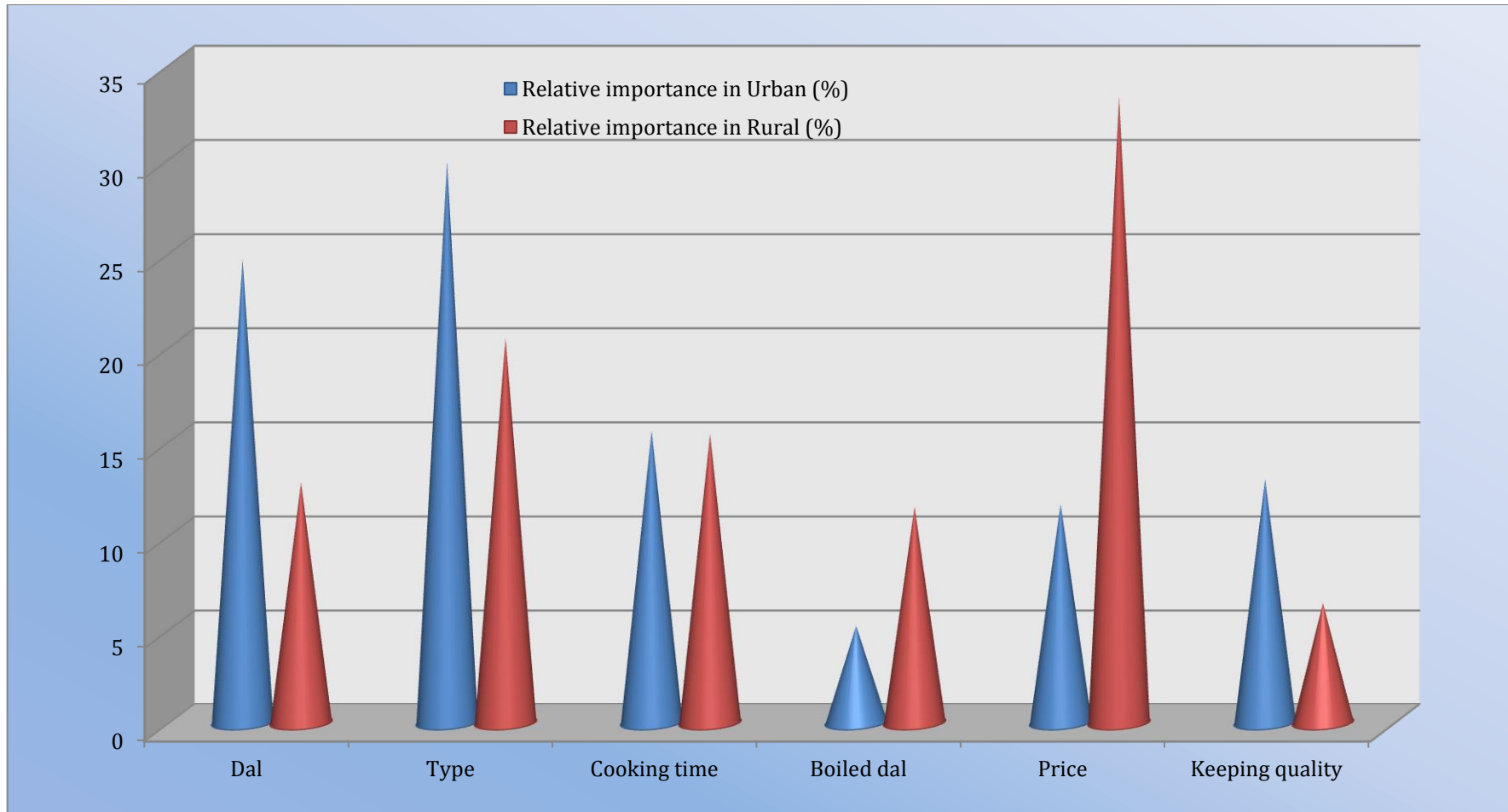


Fig. 5: Relative importance of pigeonpea preference by rural and urban consumer

Table 4.20. Constraints opined by the farmers about existing varieties

Sl. No.	Attributes	Total score	Garrett score	Rank
1	Long duration of variety	3503	58.07	1
2	Highly susceptible to pest and diseases	3412	56.76	2
3	Higher flower drop	3305	55.39	3
4	Lesser resistant to drought	3036	50.54	4
5	Lesser resistant to lodging	2418	40.20	5
6	Higher input cost	2326	39.03	6

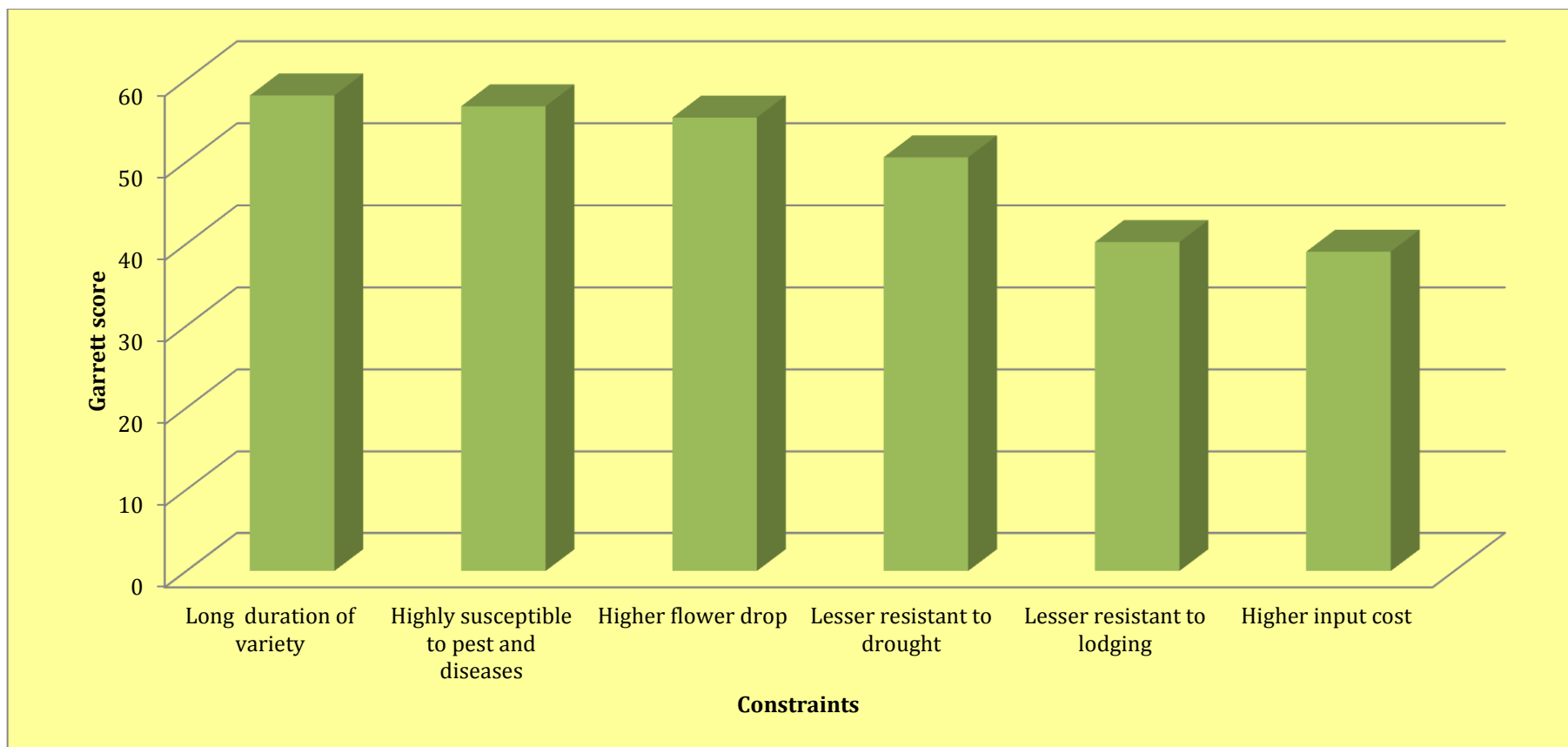


Fig. 6: Constraints opined by the farmers in the existing varieties

4.4.2 Constraints opined by the millers while procuring pigeonpea

The constraints opined by the millers in the existing pigeonpea varieties based on the different attributes were assessed by scoring and ranked using Garrett ranking and the results are presented in Table 4.21.

A perusal of table clearly revealed that high moisture content in the seed was the major constraint with a mean score of 62.93, second major constraint was low dal recovery with a mean score of 56.33 followed by thick seed coat (52.13), high broken percentages (51.66), uneven size of grains (47.33), high foreign matter (42.06) and breaking of edges during processing (39.63) (Fig. 7).

Table 4. 21. Constraints opined by the millers while procuring pigeonpea

Sl. No.	Attributes	Total score	Garrett score	Rank
1	High moisture content	1888	62.93	1
2	Low <i>dal</i> recovery per cent	1420	56.33	2
3	Thicker seed coat	1564	52.13	3
4	High broken percentage	1548	51.6	4
5	Uneven size of grains	1689	47.33	5
6	Higher per cent of immature seeds	1262	42.06	6
7	Breaking of edges during processing	1189	39.63	7

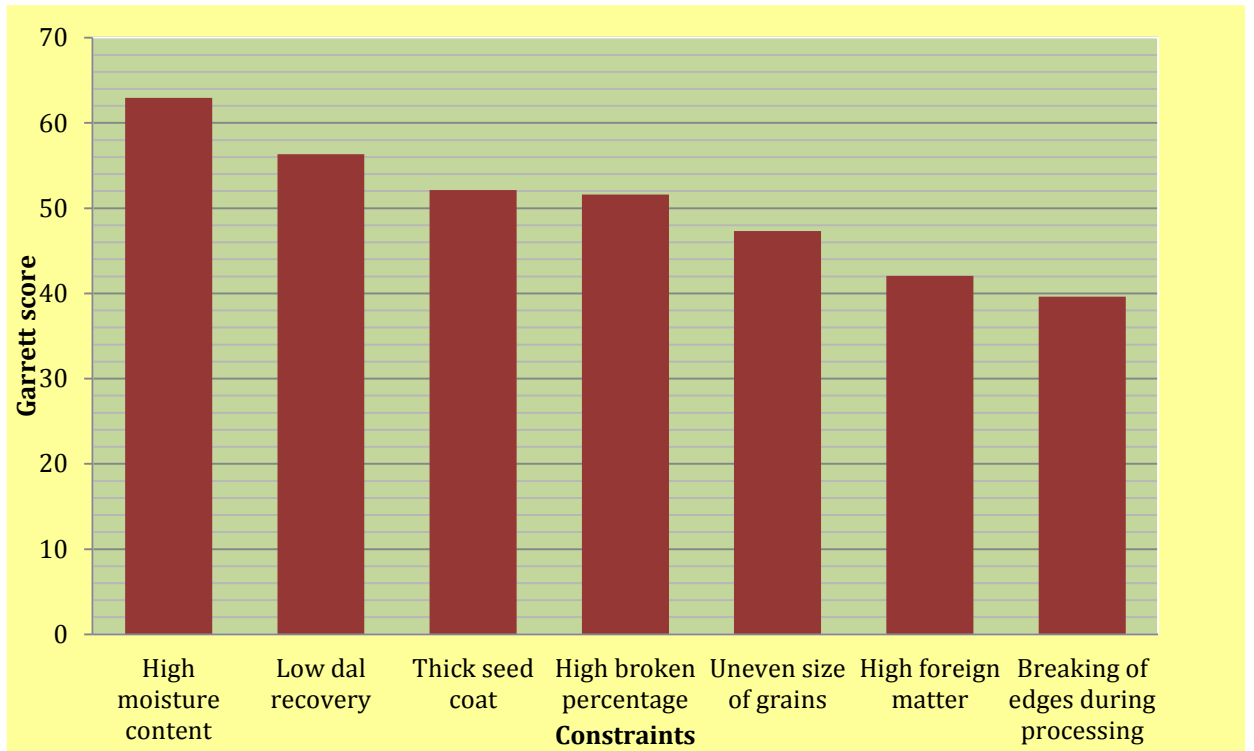


Fig. 7: Constraints opined by the millers during pigeonpea procurement

V. DISCUSSION

The results of the investigation presented in the previous chapter are discussed in the present chapter. The main focus here is to throw light on some of the causes responsible for the results noted in the last chapter. The results of the study are discussed under following broad headings.

5.5 Socio economic characters of the stake holders

5.6 Distribution of pigeonpea varieties grown by farmers in the study area

5.7 Pattern of pigeonpea varietal attributes by farmers

5.8 Pattern of pigeonpea attributes by *dal* millers

5.9 Pattern of attributes of pigeonpea by consumers

5.10 Constraints opined by the farmers in the existing varieties

5.11 Constraints opined by *dal* millers/ traders while procuring pigeonpea

5.1 Socio economic characteristics of the stake holders

The general socio-economic characteristics of the farmers had been studied. It was found that 86.67 per cent of farmers were educated. From this, it was concluded that the farmers in the study area had access to school and they had good knowledge of existing varieties, attributes and management of farm. It could be noted that 73.00 per cent of farmers belonged to middle and higher income levels and it can be said that they can purchase the new improved pigeonpea varieties.

The educational status of the *dal* millers revealed that almost all the *dal* millers were literate. However, majority of them were educated up to college (70.00%) followed by graduates and above (23.00%), secondary level (6.60%) and there are no illiterates implied that all the *dal* millers were well educated and had better knowledge about *dal* mills.

5.2 Distribution of pigeonpea varieties grown by farmers in the study area

It is clearly evident from the Table 4.8 that, majority of farmers (60.00%) had grown TS-3R pigeonpea variety in Kalaburagi area mainly due to resistant to wilt, large seed size which could fetch good price in the market, it would come to harvest early (150-160 days) and also had consistency in yield. The cooking quality parameters like increase

in weight, increase in volume and relative time taken for cooking might have contributed for popularity of TS-3R in Kalaburagi. It had well acceptability among farmers compared to other varieties. Whereas in the case of Jevargi, BSMR-736 variety grown by majority of farmers (46.6%) because in this area there is more problem of both wilt and sterility mosaic disease. BSMR-736 was found to be resistant to both wilt and sterility mosaic as indicated in Table 4.8 that 20 per cent of farmers had grown local varieties because of availability of seeds of previous season and good cooking characteristics of these varieties.

5.3 Pattern of pigeonpea varietal attributes by farmers

Pigeonpea is the most important pulse crop and important source of protein. It is grown in many states of India under diverse dry or irrigated land conditions. It has high level of regional or local adaptation. Although many improved cultivars have been released, farmer accepted only a few. Thus it became necessary to evaluate the pigeonpea varieties to arrive at the most preferred ideal variety.

Duration of the crop was by far the most important attribute to explain the varietal preference and short duration varieties (120-130 days) were most preferred, deriving the utility of 1.9167. As it was 160-180 days rainfed crop vulnerable to vagaries of rainfall, suffered serious shortage of moisture in end of season lead to formation of immature seeds and unfilled (shrivelled) seeds leading to formation of green *dal* which fetched low prices in the market. Farmer preferred the short duration varieties to achieve good yield with even minimum showers. GC-11-39 was having duration of 125-130 days but farmer were not aware of this variety and also it was suitable to irrigation condition. Desirable traits and varietal preferences for short and medium duration pigeonpea were site-specific as a reflection of local farmer problems need and management abilities. The analysis suggested that with increased commercialization, farmers preferences became more market-oriented, while in a subsistence production system, preferences were more related to cooking and eating qualities.

Resistant to wilt as an attribute was by far as greater importance (19.64%), because it affected the crop most. TS-3R and BSMR- 736 were resistant to fusarium wilt but other two species (verticillium and sclerotium) causing huge damage to farming community. Farmer had given less importance to helicoverpa because it could be easily managed by pesticide. Price and yield as an attribute bear more importance (47%), here farmer were of the view that yield of 5-6Q (utility, 1.3750) and price of more than ₹ 6000

were preferred. From this we can say that farmer preferred the variety which should give optimum yield and should fetch good price in the market. The results are on par with Parthasarathy *et al.* (1991).

The fit of the additive model to the individual data was good as revealed by the value of the Pearson's rank correlation which was 0.661. It was significant at 1 per cent level.

5.4 Pattern of attributes of pigeonpea preferred by *dal* miller

Pigeonpea undergoes processing before it is has taken for consumption. At this point it is important to elicit the preference of the *dal* millers so that it will indirectly increase the price of the farmers produce.

Pearsons rank correlation and Kendals correlation values for miller's preference of pigeonpea was found to be significant at 1 per cent level. It is clearly evident that majority of *dal* millers (32.65 %) preferred pigeonpea having moisture content of less than 10 per cent and it is also having highest utility of 3.00. If moisture content is above 10 per cent they have to again go for drying and they will also lose weight.

Recovery percent as an attribute was by far the most important attribute to explain the preference of miller. Most of the millers preferred variety having recovery percentage of more than 72 per cent because it had direct relationship with the returns of the miller. Maruthi variety was having highest recovery percentage (75%) followed by double moog (70%) as indicated in the Table 4.7.

Seed coat as an attribute bears more importance (17.01%) to the total preference. Medium seed coat is most preferred (utility 1.95) because if it is thick it will reduce the recovery percentage, if it has thin seed coat it will not detach easily. Millers prefer a variety which is having thin seed coat and which should detach easily so that it will increase the recovery percentage. Millers expressed a preference for flattish round pigeonpea that did not break on the roller, so that second quality *dal* would be reduced. Price as an attribute, miller had given least importance because they were operating in nearly perfect market condition so that they cannot influence price. The results are in line with Parthasarathy *et al.* (1991).

5.5 Pattern of attributes of pigeonpea determine preferences of consumers

Pearson's rank correlation and Kendall's correlation values for consumer preference of pigeonpea in both urban and rural areas of Kalaburagi was found to be significant at 1 per cent level (Table 4.17 and 4.19). It was clearly noticed (Table 4.16) that majority of consumers in urban areas preferred branded *dal* due to the higher level of income of the consumers as compared to rural area and they have presumption that branded pigeonpea *dal* would be clean from foreign matter and they did not have time to clean the *dal*. Consumers gave least preference to boiled *dal* may be because by seeing *dal* one cannot say whether it will be intact or broken after boiling. 24.68 per cent of consumers preferred polished *dal* because it appear nice in terms of color, shining etc. Cooking time was not much important because majority of urban households were using gas as cooking means, now almost all people are using pressure cookers for cooking it will substantially reduce the cooking time. Price also did not have much importance (11.69%) in urban because of their higher income levels and also because it is necessary good they will purchase whatever will be the price. Whereas in Kalaburagi rural price was considered most important attribute may be because majority of consumers belonged to middle income group and below poverty line in the rural area. Keeping quality was given least importance because they will cook two times a day. Almost 33 per cent of consumers in rural areas preferred unpolished and unbranded *dal*, which was due to Kalaburagi rural being a pigeonpea growing region, majority of consumers had grown pigeonpea and as such consumed their own grown pigeonpea *dal* and did not depend on the market for purchasing of pigeonpea. Non-producing consumers were purchasing hand milled *dal* because hand milled *dal* was of good taste and availability. Similar results were reported in wheat by Murali, (2012).

5.6 Constraints opined by the farmers in the existing varieties

Opinions of the sample respondents with regard to problems/constraints in the existing cultivars (Table 20) revealed that lack of resistance-susceptible to pest and diseases may be because of high magnitude and incidence of wilt, helioverpa and pod bug. Some of the farmers had opined that they have lost entire crop due to wilt. Apart from resistance, more flower drop was found to be another constraint and it may be because in pigeonpea only one per cent of the flower will set pod. Other parameters like

duration, drought tolerance need to be included in the breeding program. These results are in agreement with Chandrashekhar *et al.* (2001).

5.7 Constraints opined by *dal* millers/ traders while procuring pigeonpea

Opinion of sample respondents with regard to problems/constraints opined while procuring pigeonpea (Table 4.21) revealed that in general, moisture content was found to be the most important and prime consideration of millers because it leads to double cost may be in terms of higher moisture content would enhance weight loss of pigeonpea grain and increase the incidence of storage pests, need to incur additional cost of drying, handling *etc.* Apart from moisture content, low *dal* recovery, broken percentage and uneven size of grains was found to be another important constraints of pigeonpea opined by the *dal* millers. Mixing of immature seeds with the mature seeds lead to increase in percentage of green piece which reduce quality and also recovery. Due to this, millers had to go for sieving operation which otherwise would not break in the roller and add up cost to the miller. Due to uneven size of grains *dal* would lose its edges in the roller and become pieces leads to increase on second and third quality *dal* reducing the returns to the *dal* miller.

In fact, the price of pigeonpea produce was reflected by extent of moisture content and physical attributes of pigeonpea in a particular lot of the produce. It was commonly observed that the first step to test the quality of pigeonpea while procuring and determination of its price by checking its moisture content was by biting the grain and also by observing the grain by taking it to two palms and find out percentage of broken, immature seeds, foreign matter and roughly estimate the recovery percentage of *dal*.

However it was expressed by the majority of millers that these attributes could be managed with the modern/ advanced pigeonpea mills having sortex technology.

Therefore it was advised to the farmer that the pigeonpea produce should be offered for sale only after fully drying in the field for better market acceptability, similar results were obtained in wheat by Murali, (2012).

VI. SUMMARY AND POLICY IMPLICATIONS

Pigeonpea (*Cajanus cajan* (L) mill. *sp.*) is one of the major pulse crop of tropics and sub-tropics and owed with several unique characters. It ranks second important pulse crop next to bengalgram. It finds important place in farming systems adopted by small holding peasants in large number of developing countries. Pigeonpea is considered to be origin of peninsular India. It is mostly consumed as split *dal*, but also consumed as vegetable in many countries. Pigeonpea is of dietary importance with seed protein content of about 21 per cent, which is highest in the case of legumes. The productions of pulses have been identified as the thrust area considering the dietary, economic and other associated factors. Pulses occupy an important place in Indian agricultural economy as they are rich sources of proteins and constitute 10 to 15 per cent of India's food grain diet. Major portion of Indian population belongs to vegetarian group and every person on an average is required to consume 70 to 80 gm. of pulses per day in order to maintain good health and physique, according to the recommendations of Indian council of medical research.

In India, pigeonpea is consumed mostly in the form of decorticated split cotyledons known as *dal*, while in other semi -arid tropical countries of the world such as the Caribbean Islands it is consumed in the form of green peas. Although increasing the yield and its stability are of obvious priority, grain quality also deserves consideration in a breeding program. The grain quality of a crop has several components, including nutritional quality, anti-nutritional factors, digestibility and bioavailability of nutrients, cooking quality, consumer acceptability, and storage stability.

Farmer's preference is the most crucial yet the least recognized factors in technology generation and transfer process. When we say preference, the natural question is whose preference? We argue that the preference of all key players in the value chain of pigeonpea production matter equally. Farmers would have a dual role in preference analysis as they are mostly producers and consumer. The conventional approach of technology design had failed to address the needs, priorities and preferences of the small and marginal farmers who operate in a complex, diverse and risk prone production situations. It happened because technology developed on research stations had poor goodness-of-fit with actual farm condition. The technology was developed without farmer participation and understanding their needs. Therefore, identification and use of farming

situation specific interventions shall have greater implications in enhancing system's productivity. As a consequence, the rate of adoption of new varieties (variety replacement rate) and their area coverage (seed replacement rate) remain dismal, particularly in the case of legumes in rain fed marginal environments; thus depriving the resource poor farmers of the benefits of public investments made in variety research and development. By responding closely to farmers' concerns and conditions, researchers can develop technologies that are suitable to the local conditions. Keeping this in view investigation carried out to find out technological attributes of stakeholders in pigeonpea production, milling and consumption.

Specific objectives of investigation are

1. To know the socio economic status of stake holders in the study area
2. To identify the technological attributes of pigeonpea preferred by stake holders
3. To determine the most preferred technological attributes of pigeonpea as perceived by stakeholders
4. To document the constraints opined by the stakeholders among existing cultivars

Methodology

Sampling framework

For this study 150 sample respondents were selected randomly, out of which 60 consumers (30 each of urban and rural), 60 farmers and 30 processors. The study was confined to N-E region of Karnataka.

Database

The results of the study are based on both primary and secondary data collected during the study period. For evaluating the objectives of the study, necessary data relating to pigeonpea preference were obtained from the selected consumers, farmers and processors. The data relating to quality specifications of different pigeonpea varieties were obtained from farmers and ARS, Kalaburagi. Finally, the data relating to constraints in the existing varieties obtained from the farmers and millers.

Analytical techniques

In order to study the socio-economic characteristics of sample consumer's, farmers and millers and to identify the technological attributes of pigeonpea preferred by stake holders, tabular method with simple statistical tools like averages and percentages were used. To study the consumer, farmer and miller preference of pigeonpea, conjoint analysis was employed. To prioritise the constraints in the existing varieties, Garrett's ranking technique was used.

Major findings of the study:

The major findings of the current study are summarised below

1. Among the respondents, farmers were having higher age (>50 years) followed by consumers (36-50 years) and *dal* millers (47 years) indicated rich experience in their profession.
2. Pigeonpea (54.62%) and cotton (14.82%) were the major crops grown in *kharif* season whereas bengalgram (4.58%) and jowar (2.89%) were the major crops cultivated in the *rabi* season. However banana (5.78%) and lime were the important horticulture crops grown in the study area.
3. Almost all the stakeholders *viz.* farmers (86.67%), millers (100%) and consumers (76.67%) were educated and having good education background indicated better knowledge about pigeonpea cultivation and its management.
4. Majority of the sample consumers were living in nuclear family with an average income of ₹11376 -₹23125 per annum.
5. Higher recovery percentage of *dal* was noticed in Maruthi (75%) variety followed by locally cultivated double moog (70%), BSMR-736 (68%) and TS-3R (60%).
6. Among the varieties 60 per cent of respondents were cultivated TS-3R pigeonpea variety in Kalaburagi taluk, whereas BSMR-736 variety is become popular and cultivated by 46.6 per cent of the respondents in Jewargi taluk.
7. The yield (91.66%), ability to earn premium price (85%), resistance to pest, disease and drought tolerant (66.66%) were the important parameters considered for choosing variety for cultivation of pigeonpea.

8. However *dal* recovery per cent, moisture content of the produce, seed size and seed coat were the most parameters considered for purchasing pigeonpea from farmers, while *dal* price, cooking time, flavour after cooking and brand were the factors considered for purchasing pigeonpea *dal*.
9. Among the attributes considered by the farmers, higher price ($\text{₹} > 6000/\text{Q}$), with short duration of 120-130 days, resistance to wilt and higher yield ($> 6\text{Q}/\text{acre}$) were the most preferred attributes considered for cultivation of pigeonpea. The Pearson correlation co-efficient of 0.661 also indicated majority of the farmer's opined similar preference about selection of variety.
10. The most preferred attributes of *dal* miller for purchasing pigeonpea were lesser moisture content of the produce ($< 10\%$), higher recovery per cent ($> 72\%$), thinner seed coat and easily detachable from cotyledon. Further, 89 per cent of the opinions of the millers were similar about afore mentioned attributes as indicated by correlation co-efficient of 0.892.
11. Branded and polished *dal*, lesser cooking time and longer keeping quality of 10-12 hours were the most preferred attributes considered by urban consumers, while lesser price ($< \text{₹} 75/\text{kg}$), unbranded *dal*, lesser cooking time and unpolished *dal* were the most preferred attributes of rural consumers.
12. The existing pigeonpea varieties are highly susceptible to pest and diseases especially helioverpa and wilt, higher flower drop during the month of September were the major constraints in pigeonpea cultivation as perceived by the farmers. The existing varieties are of long duration and lesser resistance to drought and lodging with higher cost of inputs were the other impediments as expressed by the majority of the farmers. Among the processing constraints high moisture content with immature seeds, low *dal* recovery per cent and thicker seed coat were the major constraints as opined by the miller.

POLICY IMPLICATIONS:

1. The findings of the study suggested that, breeder should consider farmers preference of short duration crop, resistance to pests and disease especially heliCOVERPA and wilt and higher yield in one hand and higher recovery percentage, lesser moisture content with thin seed coat attributes on the other hand for developing suitable variety to meet out the expectations of farming community as well as traders-cum-millers.
2. In order to reduce moisture content and immature seeds to increase recovery per cent of *dal*, there is need to create awareness about production management practices. Further, appropriate extension methods may be adopted to educate the farmers on post-harvest management of pigeonpea.
3. The *dal* millers should use improved machinery and equipment's *viz.* buller and sortex grading machines to increase recovery percentage and better quality *dal* of longer keeping quality with reasonable price to satisfy ultimate consumer.

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