Original Research Article

Farmers' Preference and Adoption of Rice Varieties Grown in Hill Region of Assam Based on Varietal Attributes

ABSTACT

Aims: The present study was undertaken to enlist the rice varieties grown in Karbi Anglong district of Assam, India and to identify the most preferred varieties and the preference criteria as perceived by the rice growers at individual level.
Place and Duration of Study: Krishi Vigyan Kendra, Karbi Anglong, Diphu in the district of Karbi Anglong, Assam, between April 2018 and March 2019.
Methodology: We included 30 farmers who were non-respondent in the main study and 90 farmers in the main study. We used Participatory Rural Appraisal, Personal Interview Method and Interview Schedule.
Results: The study revealed that 18 rice varieties are normally grown by the farmers of Karbi Anglong for lunch and dinner making. Among 18 rice varieties *Gaya, Ranjit, Agarsali, Bordhan, Basuri* are the five most preferred rice varieties respectively. There are twelve quality parameters which were identified by the non respondent rice growers based on which farmers prefer a particular rice variety. The quality parameter in accordance with their preference are yield, suitability to land situation, duration, taste, planting time flexibility, after cooking quality, disease and pest resistance, fertilizer requirement, market demand, hunger chasing, draught resistance and cold resistance.

Key words: rice varieties, Karbi Anglong, Participatory Rural Appraisal, quality parameters

INTRODUCTION

Rice is the most important cereal crop in Assam. It covers 24.67 lakh ha of land with 5.28 lakh tonnes production during 2017-18(Statistical Handbook of Assam, 2018). Assam has six agro-climatic zones and each zone represents a wide range of agro-ecological situations. Rice is grown in all these six agro climatic zones covering hill slopes to deep water areas. *Sali* (winter rice) is dominant crop of the State covering 17 lakh hectares (71 percent of rice area) and contributing 73 percent of the total rice production. *Sali* rice in Assam has two classes- Normal *Sali* and Late *Sali*. Normal *Sali* rice includes coarse grain *sali* and slender grain *Sali* (*Lahi*), scented *Sali* (*Joha*), glutinous *Sali* (*Bora*), semi glutinious (*Chakua*). Late Sali includes Asra (water depth 100 cm) and Bao (deep water rice). They are though sown during March-April as normal Ahu crop but harvested during November-December along with other normal Sali crop. Boro rice (summer rice) is traditionally grown in low-lying areas during November to May and Ahu rice (Autumn rice) is sown during March-April and harvested during August-September. Among all these seasons, rice cultivated in Boro season has the highest productivity (2975 kg/ha) as compared to the Autumn and Winter rice (Statistical Handbook of Assam, 2018).

The area, production and productivity of rice in Assam is presented in Table 1 and productivity of rice in Karbi Anglong is presented in table 2. The total area under HYV rice in Karbi Anglong is 129330 ha with annual production of 241329.78 tonnes and average yield of 1866.33 kg/ha estimated during 2017-18 (Source: Directorate of Economics and Statistics, Govt. of Assam).

Table-1: Area, production and productivity statistics of rice in Assam (2017-18)

Rice classes	**Area (ha)**	**Production (Tonnes)**	**Productivity (Kg ha^{-1})**
Autum rice	154511	209349	1377
Winter rice	1878798	3883120	2098
Summer rice	408132	1191244	2975
Total Rice	2467136	5283713	2171

(Source: Statistical Hand Book of Assam,2018)

Table-2: Area, Productivity of rice in Karbi Anglong during 2017-18

Rice classes	**Area (ha)**	**Productivity (kg ha^{-1})**
Autum rice	11550	1551
Winter rice	114310	2142
Summer rice	3470	1906
Total Rice	129330	1866.33

(Source: Statistical Hand Book of Assam,2018)

In Karbi Anglong district, farmers generally grow four kinds of rice varieties, the varieties developed and recommended by Assam Agricultural University (AAU), the varieties which are local, the varieties which are developed and marketed by some company and the fourth type includes varieties which are brought by the farmers themselves from other states. Assam Agricultural University, Jorhat which is the only Agricultural University in the state has bred 55 rice varieties. Amongst these rice varieties, some of the Sali or winter rice varieties are *Ranjit, Bahadur, TTB-404, Gitesh, Prafulla, Jalashree, Disang, Dikhow , Kolong, Jalkunwari, Plabon, Keteki Joha, Aghoni Bora, Ranjit Sub-1, Bahadur Sub-1, Swarna Sub-1*. Autumn rice varieties include *Lachit, Luit* and *Chilarai* and *Bishnuprasad, Jyotiprasad, Jaymoti, Dinanath, Kanaklata* belongs to Summer rice varieties. *Swarnav, Padmapani, Padmanath* and *Panindra* are deep water rice varieties which are also developed by AAU.

The average productivity of rice in Karbi Anglong district(1866.33Kg/ha) is lower than the productivity of Assam (2171kg/ha) and national average. Since an increase in area of rice crop in Karbi Anglong is subjected to limited scope with different pre-conditions, hence increase in productivity through varietal

improvement may be one of the best way to increase rice production in the district which is again subjected to adoption of those rice varieties by the farmer.

The tribal farmers of Assam generally prefer indigenous rice varieties because of their taste, cooking quality etc, and preferred HYVs because of yield, market demand etc while non-tribal farmers prefer indigenous varieties because of their traditional delicacies, taste etc, and showed preference to HYVs because of cooking quality, market demand etc. (Goswami *et al.,* 2022).The adoption of improved rice varieties is important both for increasing agricultural productivity and minimizing the downside effect of food insecurity (Jin et al., 2020). The adoption of variety or technology depends on the attributes of the variety or technology and suitability of these attributes as perceived by the farmers or end users. The adoption of a variety depends on farmers' perception upon the new variety (Sall *et al.* 2000). An attribute of a variety which is suitable for one farmer may be not suitable for another farmer. The suitability and non-suitability of the attributes depends on situation, preference, resources, constraints at individual level (Bellon, 2001). Farmers may judge a new crop variety in terms of several attributes, such as duration, grain quality and input requirements besides grain yield (Traxler and Byerlee, 1993). Concern on situation specific preferred attributes of the farmers in accepting a crop variety could lead to successful crop improvement programme. For successful adoption of varieties, it is important that farmers' preferences and needs are incorporated in the breeding research to make sure that rice varieties developed are suitable to local conditions and at the same time respond to market requirements. Inclusion of farmers' preference criteria in technology design would enhance proper adoption of new technologies (Pingali *et al.*,2001). The specific attributes of crop varieties as perceived by farmer are the determining factors in adoption and use intensity (Adesina and Zinnah 1993). Hence, participation between Scientist and farmers is most essential for user accountable technology development.

The present study was undertaken to enlist the rice varieties grown in Karbi Anglong district of Assam, identify the most preferred varieties and the quality parameter as perceived by the rice growers at individual level, based on which rice growers prefer a rice variety. The results of the study are expected to guide rice scientists, agricultural extension agents and other stakeholders in refining their research and development procedures.

METHODOLOGY

The study was conducted, under mandatory activities of Krishi Vigyan Kendra, Karbi Anglong in 2018-2019, among the rice growers of Karbi Anglong district of Assam. The district has three sub-divisions- Diphu, Bokajan and Hamren. A total of nine locations, three from each subdivision of the district were selected purposively where rice is extensively grown. From each location 10 rice growers were selected randomly. So, a total of 90 rice growers were selected which is the total sample size for the study. The rice varieties grown by the respondent farmers are classified in to three classes - rice varieties grown for lunch & dinner, rice varieties grown for breakfast and rice varieties grown to prepare value added products. The present study confined only to the rice varieties which are grown for lunch and

dinner. The present study also has tried to reveal the preference criteria in respect of a rice variety as perceived by the rice growers and the relative ranking of preference criteria based on their importance perceived by the farmers in selection or adoption of a variety.

Before starting the study, non-respondent rice growers were asked to name the rice varieties which they grow and also state the important traits/parameter of a rice variety which they usually take into account in judging the variety whether to continue the cultivation of the variety or not. These informations were collected conducting three PRAs (1 per subdivision) and also taking personal interview of 30 rice growers (10 growers per subdivision). The non respondent farmers were also asked to assign score 1-5 against each criterion according to its importance as they perceived and based on these scores, weighted scores for each selected criteria were calculated out to represent their significance as per the following formula-

$$W=\frac{M}{H \times J}$$

Where ,

W= weighted score of the parameter

H = highest possible total score obtainable by the parameter

J = number of parameter

M = total of preference scores assigned to the parameter

The preferences of the farmers were measured using rice preference index (RPI). To calculate RPI, the respondents were asked to score from 1-5 for various quality parameters for each of the rice varieties. These scores of individual farmers were added together to arrive at the total score for a particular parameter of a variety. To obtain weighted score for the particular parameter, the total score of the parameter is again multiplied by its weight which was derived from the relative ranking of the criteria according to its importance done by the non respondent rice grower. All the weighted scores of each individual parameter are summed up to get grand weighted score for a particular variety and is divided by the number of respondent to get preference ranking index score. The varieties are then ranked according to this preference index score.

$$RPI = \frac{P1W1+P2W2.....+PnWn}{N}$$

where,

RPI= Rice preference index,

*P*1, P2…..Pn = total of preference scores of the variety in respect of each individual parameter

1, 2….n = Quality parameters, n =12

W1, W2….Wn= weight of the each individual parameter, n=12,

N= number of respondent

The preferred rice varieties were also compared in the aspects of cultivated area and number of farmers cultivating a preferred variety in the previous year by recording required data on the aspects.

Elaboration of the preference criteria

1) Yield: The main product, seed
2) Suitability to land: Land of Sali rice fields of the district which are comparatively up land and withhold less water.
3) Duration: Framer don't want neither short nor too long duration rice, the preferred duration is 145-160 days.
4) Taste: Taste of cooked rice
5) Planting time flexibility: No restriction or limitation of transplanting in any days between June 25 to 10 August
6) After cook quality: Quality of cooked rice after 2 hours and onward
7) Disease and pest resistance: Capacity of a rice variety to resist disease and pest attack.
8) Fertilizer requirement: Variety with high fertilizer need is less preferred by farmers,, less fertilizer need is highly preferred by the farmers.
9) Market demand: It implies available buyers to buy the produce at comparatively good price.
10) Hunger chasing: Capacity of the cooked rice to stop hungriness for longer time after eating it.
11) Draught resistance: Capacity of a rice variety to withstand draught period and in less or no standing water.
12) Cold resistance: Capacity of a rice variety to withstand considerable temperature drop during winter.

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RESULT AND DISCUSSION

From the results of PRA and personal interview of non respondent rice growers it was found that 18 rice varieties (Table 3) are normally grown by the farmers of Karbi Anglong district for lunch and dinner making. There are 12 criteria which were identified by the non respondent rice growers based on which farmers select a particular rice variety. The preference parameter and their calculated weight based on importance are presented in the Table 4.

Table 3: Rice varieties grown for lunch & Dinner by the farmers of Karbi Anglong & Preference criteria

Varieties grown for lunch & Dinner
Bordhan,Ranjit,Agarsali,Gaya,Masuri,Mekera,Bahadur,Basuri,Katika,Sakualahi,Richem,Jaibangla,Gajalilahi,Tengrasali,Ahomsali,Batiaijong,Locallahi,Aijong

Table-4: Preference parameter

Preference parameter	Calculated weight
Yield (Y)	0.077
Suitability to land (SL)	0.074
Duration (D)	0.067
Taste (T)	0.065
Planting time flexibility (PTF)	0.062
Quality after cooking (QAC)	0.060
Disease and pest resistance (DPR)	0.054
Fertilizer requirement (FR)	0.048
Market demand (MD)	0.048
Hunger chasing(HCH)	0.047
Draught resistance (DR)	0.046
Cold resistance (CR)	0.042

The six most important preference parameters are yield, suitability to land situation, duration, taste, planting time flexibility, after cooking quality as expressed by the non respondent rice growers. The total of the scores in respect of preference parameter obtained by the rice varieties are presented in the Table 5 and total weighted scores, total grand weighted score, Rice Preference Index for each of the rice variety and their preference rank are presented in the table 6. It is found that among 18 rice varieties *Gaya, Ranjit, Agarsali, Bordhan, and Basuri* are the five most preferred rice varieties respectively.

Table-5: The total of the scores in respect of preference criteria obtained by the rice varieties

Preference criteria*	Total score obtained by the varieties																	
	Gaya	Ranjit	Bordhan	Agarsali	Basuri	Masuri	Tengrasali	Aijong	Bahadur	Locallahi	Jaibangla	Bati Aijong	Mekera	Richem	Kotika	Ahomsali	Sakualahi	Gajallahi
Yield	370	365	300	296	350	265	285	281	360	270	270	268	263	260	256	251	248	246
SL	390	340	380	375	372	368	368	364	342	362	357	356	350	349	347	345	342	340
Duration	430	428	426	423	421	402	419	418	427	415	415	413	312	411	408	406	402	398
Taste	375	376	352	350	337	380	338	337	362	349	331	326	320	318	315	312	312	310
PLF	442	420	440	440	438	436	435	432	422	430	430	428	427	425	424	422	420	420
QAC	362	363	342	338	332	364	330	326	362	317	313	310	290	278	276	274	274	272
DPR	264	264	261	260	260	268	258	255	255	253	252	248	246	243	241	238	236	233
FR	355	350	352	351	330	328	330	326	348	317	313	310	302	300	298	297	288	286
MD	408	410	395	387	360	412	386	382	380	377	375	372	370	368	365	365	363	360
HC	320	364	360	356	345	345	348	348	356	344	340	337	331	330	330	327	325	325
DR	321	300	310	308	303	298	298	298	297	295	295	293	293	290	290	288	287	285
CR	371	370	360	358	340	334	348	347	347	345	345	343	343	340	340	338	337	335

* SL= Suitability to land , PLF= Planting time flexibility , QAC= Quality after cooking , DPR= Disease and pest resistance , FR= Fertilizer requirement , MD= Market demand , HC= Hunger chasing , DR= Draught resistance, CR= Cold resistance

Table-6: Total weighted scores, grand total of weighted score, Rice Preference Index for each of the rice variety

		Weighted scores																	
Preference criteria*	**Weight**	**Gaya**	**Ranjit**	**Bordhan**	**Agarsali**	**Basuri**	**Masuri**	**Tengrasali**	**Aijong**	**Bahadur**	**Local lahi**	**Jaibangla**	**Bati Aijong**	**Mekera**	**Richem**	**Kotika**	**Ahomsali**	**Sakua lahi**	**Gajalilahi**
Yield	0.077	28.49	28.105	23.1	22.792	26.95	20.405	21.945	21.637	27.72	20.79	20.79	20.636	20.251	20.02	19.712	19.327	19.096	18.942
SL	0.074	28.86	25.16	28.12	27.75	27.528	27.232	27.232	26.936	25.308	26.788	26.418	26.344	25.9	25.826	25.678	25.53	25.308	25.16
Duration	0.067	28.81	28.676	28.542	28.341	28.207	26.934	28.073	28.006	28.609	27.805	27.805	27.671	20.904	27.537	27.336	27.202	26.934	26.666
Taste	0.065	24.375	24.44	22.88	22.75	21.905	24.7	21.97	21.905	23.53	22.685	21.515	21.19	20.8	20.67	20.475	20.28	20.28	20.15
PLF	0.062	27.404	26.04	27.28	27.28	27.156	27.032	26.97	26.784	26.164	26.66	26.66	26.536	26.474	26.35	26.288	26.164	26.04	26.04
QAC	0.06	21.72	21.78	20.52	20.28	19.92	21.84	19.8	19.56	21.72	19.02	18.78	18.6	17.4	16.68	16.56	16.44	16.44	16.32
DPR	0.054	14.256	14.256	14.094	14.04	14.04	14.472	13.932	13.77	13.737	13.662	13.608	13.392	13.284	13.122	13.014	12.852	12.744	12.58
FR	0.048	17.04	16.8	16.896	16.848	15.84	15.744	15.84	15.648	16.704	15.216	15.024	14.88	14.496	14.4	14.304	14.256	13.824	13.72
MD	0.048	19.584	19.68	18.96	18.576	17.28	19.776	18.528	18.336	18.24	18.096	18	17.856	17.76	17.664	17.52	17.52	17.424	17.28
HC	0.047	15.04	17.108	16.92	16.732	16.215	16.215	16.356	16.356	16.732	16.168	15.98	15.839	15.557	15.51	15.51	15.369	15.275	15.27

DR	0.045	14.445	13.5	13.95	13.86	13.635	13.41	13.41	13.41	13.365	13.275	13.275	13.185	13.185	13.05	13.05	12.96	12.915	12.82
CR	0.042	15.582	15.54	15.12	15.036	14.28	14.028	14.616	14.574	14.574	14.49	14.49	14.406	14.406	14.28	14.28	14.196	14.154	14.07
Grand weight		255.606	251.085	246.382	244.285	242.956	241.788	238.672	236.922	246.436	234.655	232.345	230.535	220.417	225.109	223.727	222.096	220.434	219.08
Number of respondent		90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
RPI		2.8400067	2.789833	2.737578	2.714278	2.696951	2.686533	2.651911	2.632467	2.738178	2.607278	2.581611	2.5615	2.449078	2.501211	2.485856	2.467733	2.449 2667	2.433756
Rank		R1	R2	R4	R5	R6	R7	R8	R9	R3	R10	R11	R12	R17	R13	R14	R15	R16	R18

* SL= Suitability to land , PLF= Planting time flexibility , QAC= Quality after cooking , DPR= Disease and pest resistance , FR= Fertilizer requirement , MD= Market demand , HC= Hunger chasing , DR= Draught resistance, CR= Cold resistance

Data in respect of the cultivated area and number of farmers cultivating a particular rice variety in the previous year of the study are presented in the table 7.

Table-7: Cultivated area, number of farmers cultivating a particular rice variety in the previous year of the study

Rice varieties	Preference Rank	Area, Percentage, Nos. of Farmer of the ranked varieties in the previous year of the study		
		Area(ha)	Percentage	Nos. of farmer
Gaya	1	44.53	25.41	63
Ranjit	2	39.73	22.67	51
Bahadur	3	12	6.84	30
Bordhan	4	15.73	8.98	42
Agarsali	5	13.06	7.45	18
Basuri	6	6.8	3.88	16
Masuri	8	6.13	3.50	14
Tengra Sali	7	5.33	3.04	14
Aijong	9	5.06	2.89	13
Local lahi	10	4.93	2.81	12
Jaibangla	11	4.40	2.51	9
Bati Aijong	12	3.73	2.13	10
Richem	13	3.33	1.90	8
Kotika	14	2.0	1.14	5
Ahomsali	15	2.93	1.67	7
Sakua lahi	16	2.4	1.36	7
Mekera	17	1.73	0.98	6
Gajali lahi	18	1.33	0.76	6

The rice growers of Karbi Anglong district grow a number of rice varieties. The top five rice varieties preferred by the rice growers are *Gaya, Ranjit, Bahadur, Bordhan* and *Agarsali*. Production and consumption attributes of a variety constitute the preference criteria of the rice growers to prefer a variety. In this study, it is found that the production and consumption attributes of a variety those matters most respectively are yield, suitability to existing land situation, draught resistance, fertilizers non-responsiveness, planting time flexibility, taste, market value, durability of non-hungriness after eating, cold tolerance, duration, goodness of earlier cooked rice. Out of these attributes, some are common and some specific. The important attributes are yield, land situation, duration, taste, planting time flexibility. Land situation suitable for a variety and draught resistance are two criteria which the rice grower take utmost care in Karbi Anglong. Similar to the present findings, studies in India (Burman *et al*. 2018), Nepal (Ghimire *et al*. 2015), Philippines (Laborte *et al.* 2015), China (Liang *et al*.2017) and Sierra Leone (Jin *et*

al., 2020) also showed that farmers have strong preferences for potential yield, early maturity, pest-disease resistance, and seed longevity as the most important rice variety attributes (Jin *et al.,* 2020). Farmers' preferences for an improved rice variety are also influenced by the extent to which a particular variety is suitable to the farmers' environment (Asrat *et al*. 2010; Batz *et al.* 2003; Sall *et al.* 2000). The depth of standing water in the winter rice fields of the study area varies to a great extent. Thus, the respondent rice growers prefer varieties which perform well with low depth of standing water for the fields which are comparatively upland and prefer varieties which perform better in comparatively high depth of standing water for the fields those are comparatively lowland. On the other hand, the rice growers of the district prefer winter rice varieties which have drought tolerance traits and also flexible in planting time. This may be due to soil topography as Karbi Anglong is a hilly district and on the other hand receives less and erratic rainfall.

CONCLUSION

This study reveals that the farmers consider a number of preference criteria in selecting a variety. Productivity of a variety alone is not all in all for the growers. Adoption depends on attributes of a variety as desired by the farmers. On the other hand a single variety cannot hold all the desired attributes as desire varies depending on factors relating to various situations. Hence variety development programme should ensure participation of the end users to make the programme user accountable. Participatory varietal improvement and development programs will be an effective approach to address the grower's situation specific problems and develop a variety desired by the users. The results of the study can guide breeders to develop more resource efficient and farmer-oriented rice-breeding programs.

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