Assessment of quality management techniques: Toward improving competitiveness of Nigerian rice

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Abstract
Despite the superior organoleptic properties of locally produced rice in Nigeria, it is not competitive against imported rice in terms of social price and grain quality. This paper examines the awareness and adoption of improved on-farm and post-harvest rice quality management techniques with a view to finding means to improve the competitiveness of local rice. Data were collected using questionnaires that were administered to a sample of 150 farmers and 18 rice parboilers, who were selected from six rice-producing areas of Niger State through multistage random sampling. Data were analyzed with descriptive statistics and ordinary least square regression. Results show that adoption of grain quality management technologies had not made any appreciable headway and traditional methods were predominant as reflected by technology use indices of 0.46 and 0.37, respectively. Age, level of education, contact with extension, access to credit and level of commercialization were statistically significant factors ($P \leq 0.05$) influencing adoption at farm level, while post-harvest technology adoption was determined by level of education, access to credit and membership of cooperatives. Low capital, lack of financial incentive, low return, high cost of processing equipment, seasonal and low supply of paddy, poor pricing, lack of technical knowledge and inadequate training were the major constraints faced by respondents. It is recommended that all factors that significantly affect adoption of technologies be improved. Promotion of adoption of improved rice quality management technology among farmers and parboilers would require adequate funding of research, training and extension activities, as well as provision of credit facilities to the major actors in the production chain.

Introduction

Rice is one of the major food crops cultivated by farmers in all agro-ecological zones of Nigeria and it is widely consumed by a large proportion of the population. An average of 25 kg of rice is consumed annually per person (Hussein, 2004). There is increasing demand for rice in Nigeria: annual consumption growth rate is 10% (Akande, 2001) compared to the population growth rate of 3.5%. Demand is met both by locally produced and imported rice. Of the total demand of 5 million tonnes in 2006, imports account for 1.6 million tonnes — the country ranks first among the major rice-importing countries in Africa and second after Philippines in the world (Africa Rice Centre, 2008).

The recognition of the importance of rice in national food security and the need to reduce the amount of foreign exchange spent on rice importation has made increased rice production a major priority of the Nigerian government. Hence, self-sufficiency in rice production is a major priority of the Nigeria food policy program. A disturbing situation about the issue of self-sufficiency is the increasing rate of consumers' preference for imported rice (Erenstein *et al.*, 2004) despite the superior organoleptic properties of the locally produced rice (Basorun, 2008). Although domestic rice is not competitive with imported rice in terms of price, imported rice is preferred because of its perceived cleanness and good grain quality (Erenstein *et al.*, 2004). The local rice is usually made artificially price competitive through import tariffs in order to protect domestic producers, thus raising consumers' rice prices. Recognition of the ultimate burden borne by consumers through import tariffs has increased policy-makers' interests in making local rice genuinely more price competitive with imported rice through reduction of production costs. Consequently, various steps have been taken to improve the productivity of rice cropping in order to reduce the cost of production. However, the cost reduction of local rice will be insufficient to close the self-sufficiency gap if the issue of quality is not addressed. This is because the number of rice consumers who will substitute local rice for imported rice in response to lower domestic rice prices will be limited in view of the quality differential. This paper examines quality management techniques among major actors in the rice production chain, with a view to finding means of raising the quality of locally produced rice to international standards, as a step in improving the competitiveness of Nigerian rice.

The objectives were: (i) to estimate level of adoption of rice grain quality management techniques among farmers and parboilers; (ii) to identify major socioeconomic factors that influence adoption of those techniques; (iii) to identify important constraints facing farmers and parboilers; and (iv) to suggest appropriate policy measures to improve the competitiveness of Nigerian rice.

Methodology

This study used primary data collected from sample survey of 150 rice farmers and 18 parboilers selected randomly from six villages in Gbako and Lavun local government areas of Niger State. The choice of the study

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areas was based on their closeness to National Cereals Research Institute (NCRI) headquarters, Badeggi, where rice production and processing technologies are developed. Farmers in this area have been exposed to these technologies through various training activities organized by NCRI. Information pertaining to rice production and processing was obtained through personal interviews using questionnaires. Data collected were analyzed using descriptive statistics and ordinary least square (OLS) regression model. Respondents were assessed on the basis of their adoption of recommended rice grain quality management techniques as follows:

1. On-farm seed quality management techniques:
   - Grow suitable varieties from good-quality seeds
   - Avoid growing different varieties together
   - Avoid harvesting immature grains by harvesting at the right time
   - Drain fields prior to harvesting
   - Avoid heaping harvested panicles on the field for a long time to prevent fungal damage
   - Avoid cross-contamination of seed during threshing, winnowing and drying
   - Prevent paddy from touching the ground during heaping (piling), threshing, winnowing and drying by using a clean concrete pad, polypropylene sack or tarpaulin
   - Winnow the rice seeds after threshing and pack in a clean sack
   - Dry the seeds well and disinfect the sack before packing for storage.

2. Post-harvest seed quality management techniques:
   - Use clean water to wash paddy
   - Remove floating immature grains, residual dirt and stones
   - Soak paddy overnight in boiled water
   - Ensure that all grains are covered with hot water during soaking
   - Drain the water and steam the paddy (do not boil)
   - Cover with cloth while steaming and steam until 25% of grains have split open
   - Spread on a clean surface to dry and turn frequently
   - Avoid very hot sun during drying
   - Avoid contamination with dirt or stone.

A farmer or parboiler scored 1 for each of these management techniques that he/she adopts, and zero otherwise. A technology adoption index for individual farmers/parboilers was developed as the proportion of improved methods he/she adopted out of the total package recommended (Chandra and Singh, 1992; Dipeolu, 2000; Igbokwe, 2001; Tiamiyu *et al.*, 2009). For instance, if a farmer adopted 6 out of the 10 recommended practices, his/her technology adoption index would be 0.6. Adoption indices of individual farmers/parboilers were regressed against some socioeconomic characteristics using OLS technique. The OLS regression equations are expressed as follows:

$$Y = b_o + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_nX_n + ei$$

Where Y = technology adoption index, X_1 = age of farmer/parboiler in years, X_2 = education in number of years spent in schools, X_3 = years of rice farming/perboiling experience, X_4 = income from the previous year's rice farming/parboiling activities, X_5 = household size, X_6 = number of contacts with extension agent per cropping season, X_7 = membership of association (1 for member, 0 otherwise), X_8 = amount of credit used (in naira), X_9 = extent of commercialization (fraction of total output offer for sale).

The choice of these variables (X_n) was based on the findings of previous studies on technology adoption (Feder *et al.*, 1985; Baidu-Forson, 1990; Nkonya *et al.*, 1997; Manyong *et al.*, 1999; Tiamiyu *et al.*, 2001), which identified these variables as significant factors affecting agricultural technology adoption in developing countries.

Age of farmer is expected to influence technology adoption in any direction depending on the farmer's position in the life cycle, education level and experience. Age contributes positively if the level of the farmer's education and experience in farming is high, and negatively if the level of education and experience of farmers is low. Farming experience could take on either negative or positive sign depending on the length of time. It is expected to demonstrate increasing returns up to a stage and later diminishing return as more elderly farmers have been reported to be more risk averse, hence are less likely to experiment with new technologies. Income is expected to influence technology adoption positively. The expectation is that farmers will have capital to plow back into the production process in order to increase profit. Family size often determines how much family labor will be put into the farm. It is expected to influence technology adoption positively. Extension contact is expected to be positively related to technology adoption, because any newly developed technology is introduced to farmers through extension agents. A farmer whose contact with extension agents is frequent is expected to be more familiar and more knowledgeable about the use of improved agricultural innovations. Membership of an association is expected to assist farmers to get easy access to credit and other production inputs. It can also

enhance access to information about technologies. The sign of the parameter of this variable is expected to be positive. Credit use is expected to be positively related to technology adoption because it gives the farmer more chances of securing necessary inputs for crop production and also provides farmers with an additional source of investment in new ideas. Commercialization (defined as the proportion of total rice output offered for sale to earn cash income) is expected to empower farmers through assess to cash that can be plowed back into production via purchase of production inputs. It is expected to contribute positively to technology adoption.

Results and discussion

Assessment of rice quality management techniques at farm level

The technology adoption index of respondents ranged from 0.2 to 0.7, with mean of 0.46 (Table 1). An average technology adoption index of 0.46 indicates that less than half of the technology package was adopted by farmers, 52.7% had indices less than 0.5, indicating that only 47% of them used up to half of the package. This implies that adoption of improved grain quality management technologies had not made appreciable headway — traditional methods still predominted. The low adoption level will affect the quality of paddy produced, and no matter how well controlled the processing stages are, good-quality milled rice will not come out of poor-quality paddy. The low adoption level of rice management techniques contributes to poor quality of local rice.

Table 1. Summary of descriptive statistics of technology adoption index of farmers

Technology index	Frequency	Percentage	Cumulative
0.2	6	4.0	4.0
0.3	35	23.3	27.3
0.4	38	25.4	52.7
0.5	16	10.6	63.3
0.6	44	29.4	92.7
0.7	11	7.3	100

Source: Survey data 2008.

Table 2 present some socioeconomic variables regressed against technology adoption indices of farmers and the result of OLS regression analysis is presented in Table 3. All the variables in the model except farm income had the expected signs and six were significant ($P \leq 0.05$) in explaining adoption of improved rice quality management technologies. The significant variables were: level of education, extension visits, credit use, commercialization rate and membership of association. This suggests that improvement in these significant factors would lead to higher levels of technology adoption by rice farmers.

Table 2. Summary of descriptive statistics of socioeconomic variables of farmers

Variable	Minimum	Maximum	Mean	SD	Mode
Age	33	65	47.7	8.18	50
Education	0	16	4.25	5.18	0
Farming experience	12	28	22.34	3.17	20
Farm income	220	450	319.4	42.95	300
Household size	5	15	10.14	2.13	10
Extension contact	0	8	3.54	2.89	0
Association membership	0	1	0.37	0.48	0
Credit use	0	1	0.326	0.47	0
Commercialization	0.4	0.9	0.745	0.123	0.7

SD, Standard Deviation.
Source: Survey data 2008.

Assessment of management techniques among rice parboilers

The technology adoption indices of respondents ranged from 0.22 to 0.56, with a mean of 0.37 (Table 4). An average technology adoption index of 0.37 indicates that parboilers' technology adoption was very low. The low adoption level of improved parboiling practices further explains the generally poor quality of local rice. This is because good-quality milled rice will not come out of poor-quality parboiled rice, no matter how well controlled the milling stage is.

Technology adoption indices of parboilers were regressed against some socioeconomic variables (Table 5). The results of OLS regression analysis are presented in Table 6. All the variables in the model had the expected

Table 3. Regression estimates of the adoption indices and socioeconomic variables

	Coefficient	SE	*t*	*P*†
Intercept	–0.03466	0.046174	–0.75058	0.454163
Age	–0.00068	0.000345	–1.97693	0.050014
Education	0.005092	0.001099	4.632845	8.17E–06
Experience	0.000612	0.00107	0.571897	0.568309
Income	–1.1E–05	7.11E–05	–0.15939	0.873595
Household size	0.000506	0.001331	0.38048	0.704166
Extension	0.014021	0.001789	7.836026	1.06E–12
Association	0.01374	0.006562	2.09434	0.038032
Credit	0.022261	0.010714	2.077743	0.03956
Commerce	0.58817	0.043478	13.52786	3.42E–27

Source: Survey data 2008.
† Any value >0.05 is not significant at the 5% level.

Table 4. Summary of descriptive statistics of technology adoption index of parboilers

Technology index	Frequency	Percentage	Cumulative
0.22	7	38.9	38.9
0.33	4	22.2	61.1
0.44	4	22.2	83.3
0.56	3	16.7	100

Source: Survey data 2008.

Table 5. Summary of descriptive statistics of socioeconomic variables of parboilers

Variable	Minimum	Maximum	Mean	SD	Mode
Age	28	50	40	6.08	39
Education	0	11	3	4.38	0
Farming experience	20	37	28	4.6	26
Farm income	100	170	129	18.09	120
Household size	5	10	7	1.82	5
Extension contact	0	4	1	1.35	0
Association membership	0	1	0.28	0.46	0
Credit use	0	20	5	6.98	0
Commercialization	0.75	1	0.9	0.08	1

SD, Standard Deviation.
Source: Survey data 2008.

Table 6. Regression estimates of the technology indices and socioeconomic variables

Variable	Coefficient	SE	*t*	*P*†
Intercept	–0.22382	0.158506	–1.41206	0.195626
Age	–0.00442	0.005697	–0.77594	0.460105
Education	0.016095	0.003713	4.334542	0.002497
Experience	0.00155	0.005659	0.273868	0.791125
Income	0.001299	0.000834	1.557329	0.158007
Household size	0.009449	0.008594	1.099526	0.303522
Extension	0.00393	0.015523	0.253184	0.80651
Association	0.013757	0.004802	2.864766	0.020997
Credit	0.001463	0.000661	2.213114	0.0578
Commerce	0.42729	0.280506	1.52328	0.166191

Source: Survey data 2008.
† Any value >0.05 is not significant at the 5% level.

signs and three were significant ($P<0.05$) in explaining adoption of improved rice quality management technologies among parboilers. The significant variables were: level of education and membership of

association. Improvement in these significant factors would lead to higher levels of technology adoption by rice parboilers.

Major constraints of respondents

The major problems faced by respondents were: low capital, lack of financial incentive, low return, high cost of processing equipment, seasonal and low supply of paddy, poor pricing (offering price below production costs), lack of technical knowledge and inadequate training (Table 7).

Table 7. Major constraints of respondents

Constraint	Farmers		Parboilers	
	Frequency	Percentage†	Frequency	Percentage†
Low capital	120	80	15	83
Lack of financial incentives	98	65	12	67
Low return	85	57	12	67
High cost of equipment	79	53	12	67
Seasonal and low supply of paddy	–	–	10	56
Poor pricing	76	51	10	56
Lack of technical knowledge	75	50	10	56
Inadequate training	75	50	10	56
Fertilizer expensive and/or in short supply	70	47	–	–
Low soil fertility	65	43	–	–
Bird damage	65	43	–	–
No access to timely mechanization	65	43	–	–
Insufficient access to information	61	41	10	56

† Multiple responses per respondent.
Source: Survey data 2008.

Conclusion

Adoption of rice quality management techniques among sampled farmers and parboilers was low. The low adoption contributed to the poor grain quality of rice and its inability to compete with imported rice. Some constraints faced by farmers might account for the low adoption. These constraints need to be addressed by policy-makers. All factors that significantly affect adoption of rice quality management techniques should be improved. Promotion of adoption of quality management techniques among farmers and parboilers would require intensive training as well as provision of credit facilities to the major actors in the production chain. Adequate funding of research, training and extension activities is also necessary.

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