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**FARMERS' PREFERENCE FOR RICE TRAITS: INSIGHTS
FROM FARM SURVEYS IN BUSIA COUNTY, KENYA**

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Abstract

Purpose: A cross-sectional survey was designed to study farmers' preferences for rice varieties in Busia County, Kenya.

Methodology: The survey used a multi-stage sampling technique for site selection and a purposive strategy for rice growers/producers. Data was collected from key rice value chain stakeholders including farmers, extension service providers, local leaders and hoteliers using focus group discussions by use of guiding checklists and a structured questionnaire. A total of 26 key informants and 62 individual respondents in the categories mentioned were interviewed. Descriptive analysis was done along with cross-tabulations to establish associations.

Findings: Results indicated that rice was a significantly important farm enterprise among the respondents with a higher land allocation of 2.04 acres followed by maize with 1.14 acres. Seed sources were mainly traditional with fellow farmers being instrumental in seed sharing at cost (59.7% buying from other farmers) followed by free issues (19.4% getting free from other farmers). Research as a seed source lagged at 8.1%. Variety choice was said to be dictated by high yield, early maturity and one thousand seed weight by 80.6%, 77.4% and 40.3% respectively. These attributes were also ranked as first, second and third positions respectively. Rice production followed traditional patterns as 60% of producers/farmers depended on a farmer-to-farmer seed system over all the production periods. There also lacked structures and efforts to upscale rice production and therefore this paper recommends formulation and direction of concerted efforts towards on-farm participatory research and formation of social networks for rice production and marketing information

Contribution to theory, practice and policy: The results give impetus to conclude that farmers know which traits are of priority in variety selection. Going by farmers' perceptions simply means responding to consumer demand for quality in rice production. The study also demonstrated enormous potential for rice production as demonstrated by the will of the farmers to allocate 45% of their land parcels to rice production. It also brought out that the fact that certified rice seeds are rarely used and therefore, there is urgent need to establish seed systems and distribution pathways in order to improve on yields as well as quality of paddy hence more income to farmers and other rice value chain players. The concepts of field demonstrations and on-farm participatory research need to be up-scaling for enhanced transformation of rice production landscape in the region.

Key Words: *Attributes, Distribution, Preference, Rice, Certified Seed, Varieties, Farmers and Research*

INTRODUCTION

Rice production in Kenya dates back to 1907 when it was introduced by Europeans at the Coast (Kouko, 1997; Onyango, 2014). So far, three production systems (also referred to as value chains of the sub-sector) are known to exist namely; the integrated large farm chain, the highly concentrated chain of the National Irrigation Authority (NIA) schemes, and the traditional market value chain of the non-NIA irrigated production and rain-fed producers which includes the Busia County rice production model. Olembo, et al. (2010) observed that historically rice had been perceived as a cash crop for the rural population where it was grown, however, that perception is changing rapidly with many communities now appreciating the importance of rice as a food crop as well as an important source of livelihood income. This change in perception has greatly influenced the balance between production and consumption of rice in many African Countries including Kenya and more so some parts of Busia County that include Teso Sub-County. The change in focus towards rice as a food and cash crop also translates to a changing landscape in the target population diversity that rice has to satisfy which also means a need to direct efforts to explore the utility framework and factors that consumers wish to derive from rice consumption and/or value chain functions and which breeder need to address. The primary input for accelerated growth in rice production in order to meet the ever rising consumption is use of quality seed of the desirable variety attributes. Generally in the rice subsector, lack of quality seed that has undergone rigorous production system is lacking (Kimani, 2010 and Musila, 2015) and thus there is urgent need to scale up availability of certified seeds.

Efforts by breeders have seen many rice cultivars released through the support of Kenya Agricultural and Livestock Research Organization (KALRO), International Rice Research Institute (IRRI), AfricaRice Centre, Alliance for a Green Revolution in Africa, (AGRA), International Centre for Tropical Agriculture (CIAT), Japan International Cooperation Agency (JICA), Korea-Africa Food and Agriculture cooperation Initiative (KAFACI), Nagoya University, East Africa Agricultural Productivity Project (EAAPP), the Lake Basin Development Authority (LBDA) and the African Development Bank (ADB) to farmers for both upland and irrigated conditions. These cultivars included the irrigated aromatic rice NIBAM 10 and 11, and other traditional irrigated rice cultivars grown by farmers that include Sindano, NIBAM 110 and NIBAM 109. There has been recently released varieties that include MWIR2, MWUR4, TXD306 (SARO5), IR05N221 (Komboka), CSR36, 08FAN10 and hybrid rice but the uptake by the farming community remain low due to lack of awareness due to very low demonstrations of these good varieties, lack of certified seeds, low extension service provision to support farmers on good agricultural management practices among other support needed. This is despite the enormous potential for rice production that exist in the county and the country at large therefore, there is urgent need to change the rice production landscape through stimulating producers to respond to the different value chain actors' preferences for specific attributes in rice or generally the market demand for rice (Atera, *et al.*, 2018). Preference exploration and documentation is a first basic step that complements to breeders' efforts in the improvement and alignment of crop varieties to the market thereby also improving their farm level adoption through accelerated seed production coupled with mass demonstrations that cause high productivity (Acheampong, *et al.*, 2013). This survey was conducted to explore the farmers' preferences in/for rice varieties as a reflection of the market preference set and/or the consumer, the production landscape of rice in

the study area, the pull factors for production as well as the underlying circumstances influencing productivity and the possible options that can be employed to unlock the production potential thereof.

Theoretical Framework of the Study

This study recognized the levels that farmers assume in society that include production, participation in the trade segment and also largely in the consumption segment. This concept follows the framework proposed by Acheampong, et, al (2018) that asserted that the preference for goods are a function of the traits or characteristics possessed by the goods rather than the goods themselves. Hence, the overall utility of a good can be decomposed into separate utilities for its constituent attributes. Acheampong (2018), further quotes Ouma, et al (2007) that for the consumer farmer, the utility function translates into attributes of the goods where the attributes can generate utility or disutility to individuals. We examined the choice framework for the rice varieties with reference to the random utility theory, an individual “n” derives utility “U” from choosing an alternative or a variety equal to; $U_{njt} = U(X_{njt})$ (i) from a finite set of ‘j’ alternative varieties in a choice set ‘t’ if and only if the alternative generates at least as much as any other alternative, with X_{njt} denoting a vector of the attributes of ‘j’. Hence, the utility associated with each set of ‘j’ alternatives as evaluated by each individual ‘n’ in a choice situation t is expressed in a discrete choice function as; $U_{njt} = \beta_n \chi_{njt} + e_{njt}$ (ii) where, χ_{njt} is a vector of observed variables that include the rice variety traits and the socioeconomic characteristics of the farmer who takes the levels of a producer. β_n in this case is a coefficient, mostly unobservable in the society.

For the farmer who assumes the level of a consumer who must access a rice variety without direct involvement in the primary production process but can buy to satisfy his utility function, the basic argument is based on having a variety that stimulates the consumer to be willing to pay for the preferred traits within a variety other than the variety itself. Roessler et al (2008) proposed a willingness to pay model in the form; $WTP = -1 * [\beta_x] / [\beta_{price}]$, (iii); where β_x is the estimate for the attribute x from the model, and β_{price} is the estimated price coefficient.

The above theories provided a framework within which this perceptions study was designed but with the recognition that farmers are both producers and consumers. The same farmers can also actively participate in the trade segment or node where they can satisfy consumers through delivering the place and time utility. At some point in time, farmers may solely be consumers due to total lack of the rice varieties they prefer due to one reason or another.

MATERIALS AND METHODS

The Study Area

The study was conducted in Teso South sub-county which is one of the seven administrative sub-counties of Busia County. Teso-South is the largest sub-county measuring 299.6 km². Data was collected from the main rice growing area which lies between 0⁰, 28’ and 0⁰, 34’ north of the Equator and 34⁰, 12’ and 34⁰, 35’ East of the Greenwich meantime. The main economic activity of the sub-county is agriculture which predominantly focuses on maize, cassava, millets, sweet potatoes and rice; all grown at small scale. Other crops include soya bean and cotton. Livestock enterprises include the local zebu cattle, dairy cattle, pigs, indigenous chicken and the local sheep and goat breeds.

Survey Design and Sampling

The survey followed a cross-sectional design of descriptive nature where all respondents (across age and gender) were interviewed at once and within the same time (a lapse of only four days).

A multistage sampling procedure was used where sites were selected systematically based on intensity of rice growing activities; hence settling largely on one administrative division of South Teso sub-county namely Chakol and two administrative locations namely Amagoro and Asing'e. Thereafter, a purposive selection of farmers (only those that grow rice) was done and a list established through the assistance of local opinion leaders and the agricultural extension service provider (AESP). A systematic random selection/identification of respondents was then used to identify individual respondents for a one-to-one verbal engagement based on the nth occurrence of farmers on a designated transect and direction.

Data Collection Techniques

The survey used three approaches namely; (i) key informant interviews (KIIs) which engaged agricultural extension service providers (AESP), LBDA staff, and local leaders (ii) group discussions which brought together village elders (4 in number) and two groups of farmers (one in Amagoro and the other in Asing'e) locations. The two focus groups brought together a total of fifteen (15) farmers (seven (7) from Amagoro and eight (8) representing Asing'e farmers. These farmers doubled to be producers as well as consumers. Four (4) hotel operators were also interviewed separately in Busia town using a guiding checklist similar to the one used for the agriculture extension service providers and the farmers but with emphasis questions segmented specifically on preferences for rice consumption traits. The third approach relied on a one-to-one administration of a semi-structured questionnaire on farmers who also doubled to be both producers and consumers of rice.

Data Management and Analysis

Data was keyed-in through the Statistical Package for Social Scientists (SPSS) cleaned for outliers and analyzed through descriptive statistics (mainly frequencies and percentages). Further analysis which basically involved attributions was done through cross-tabulations and subsection of the tabulations to chi-square tests for goodness of fit.

RESULTS AND DISCUSSION

The results documented herein are original to the survey procedures and findings and are interpreted in line with the subject of this paper as perceived by the key informants (on a unanimous approval of their collective responses) and the individual questionnaire responses analyzed on a cross-sectional basis.

Respondents' Descriptors

Tables 1. The demographic characteristics of the respondents engaged in the survey.

Category of KI	Total Number (N)	Number by gender (n)		
		Male	Female	
Farmer representatives (2 groups)	15	11	4	
Village/Opinion leaders	4	4	0	
AESPs	2	1		1
LBDA staff	1	1		N/A
Hoteliers	4	3		1

Source of data: Survey October/November 2019

Table 2: Socio-Demographic statistics of the respondents

Sample size (N)	62
<i>Gender composition (percent)</i>	
Male	88.7
Female	11.3
<i>Age brackets (percent)</i>	
<25 years	6.8
26 – 35 years	33.9
36 – 45 years	27.1
46 – 55 years	22.0
>55 years	10.1
<i>Education (percent per level)</i>	
None	6.6
Primary	67.2
Secondary	23.0
College	3.3
<i>Occupation (percent)</i>	
Full-time farmer	91.9
Other (off-farm)	4.8
Farming and Off-farm	3.2
<i>Group Membership</i>	
Membership/affiliation to group/s	28.2

Source: Survey data, October/November 2019

The majority of key informants (KI) were from farmers representatives, village opinion leaders and hoteliers who were 23 out of 26, (88.46%) thus giving more relevant and reliable information on rice various aspects. The respondents' structure particularly based on occupation provides a sense of reliability of the information on rice production as qualified and quantified

by the data that 92% were full time farmers and therefore had first-hand information on the farming system and crop production patterns within the study area.

Farm Enterprise Details

Exploration of farm enterprises and their respective share or allocation of farm resources such as percent land share demonstrates to a large extent the value or otherwise revealed preference of that enterprise to the farm household (Acheampong, et al, 2013). From the results in table three (3) below, sugar-cane leads the list with a mean of 4.0 acres of enterprises followed by rice with 2.04 acres. Rice leads the list of annual crop enterprises and significantly leads maize, which is the staple food crop, with 1.14 acres. The high standard deviation of 1.78 acres confirms the high variability and range of the acreage under the crop (rice) which also represents resource inequality and capacity to effectively grow a substantial rice acreage by some farm households. The results also demonstrate that out of the total respondents, 50 out of the total 62 farmers who grew rice grew maize thereby translating to 80.1%. At least 89 to 95% of the respondents were keeping livestock of either local chicken, goat or cattle category.

Table 3: Different farm enterprise statistics

Variable	n	Mean	Std
Farm size (acres)	62	4.5	3.8
Area under rice (acres)	62	2.04	1.78
Area under maize (acres)	50	1.14	0.99
Area under cassava (acres)	26	0.70	0.49
Area under millet (acres)	15	1.03	0.99
Area under soya-bean (acres)	27	0.82	0.74
Area under vegetables (acres)	4	0.38	0.14
Area under sugar-cane (acres)	3	4.0	5.2
Area under other crops (acres)	16	0.86	0.6
Number of cattle	59	2	2.8
Number of goats	58	1	1.5
Number of chicken (local)	55	12	23.2

Source: Survey data, November 2019

Rice Varieties Grown

Table four (4) below provides a list of the rice varieties grown in Teso-South District (as represented by Amagoro and Asing'e locations) and the percentage of farmers growing each variety. The table simply represents the farmers' decision framework for the rice varieties that give the preferred incentives as well as guaranteeing less risks through the chain of activities through production to disposal of rice (Asrat et al., 2009). Further, Patricia et al. (2013) asserts that choices demonstrated by preference ranking are a representation of the utility functions of consumers interpreted by producers. This utility function is derived from the proposition that; an individual n derives utility U from choosing an alternative i from a finite set j of alternatives in a

choice set k , if and only if, the alternative generates at least as much utility as any other alternative where X_{ni} denotes a vector of attributes of i . The utility of the good, is composed of an observable or deterministic component (V_{ni}) which is simply the array of preferred traits and an unobservable or random error component (e_{ij}).

Table 4: Rice varieties grown by % of the respondents

Variety name	Proportion of farm h/holds (by %) growing (N=62)
Pakistan	48.4
Bedinego	22.6
Vietnam	21.0
Kaiso	11.3
Supa	9.7
China	6.5
Winter-Nile	6.5
Upland variety	4.8

Chi-square value=32.71 (computed) against a tabulated value of 14.067 and 18.475 with $df=7$ and at $p<0.05$ and 0.01 respectively (Source: Survey data, November 2019)

It is rational to therefore allude that Pakistan, Bedinego and Vietnam rice varieties as they are known (by common names) in the study site have preferred traits that conform to the rice value chain actors' (mainly consumers and traders) specifications and therefore interpreted by farmers or producers as the correct varieties to invest in.

Source of Seed for the Varieties Grown

Seed sources and quality planting seeds are strategic pillars for any value chain's upgrading including the rice value chain (IRRI, 2016). Empirical evidence demonstrated existence of five (5) sources of seed available to farmers. These are presented in table five (5) below with their implications thereof.

Table 5: Seed sources available to farm households in the study area

Seed Source	Proportion of (by %) farmers dependent (N=62)
Fellow farmers (bought)	59.7
Fellow farmers (free)	19.4
Fellow farmer (bought) and market	11.3
Research	8.1
Seed market	1.6

The choice of seed source was dictated by the ease or simplicity of access of the point of sale as well as perceptions on the seed quality with respect to production objectives which were mainly to satisfy market demand and consumer preferences. The above feedback from the rice farming community indicated that formal seed system was completely lacking and that farmers generally use own planting materials. It was evident that farmers do not even practice any kind of selection

in an attempt to clean and upgrade their planting materials which resulted in highly mixed up populations in term of plant height, maturity, colour and different paddy types (Kimani 2010). These varietal admixtures observed in farmers field and heterogeneity result in low yields per hectare and low head rice due to mixture of different grain types and sizes as well as maturity. The reason for low head rice is because different paddy sizes and differential maturity make calibration of the machine difficult and early maturing plants over dry resulting in fissures that under slight pressure result in breakage. Small actions like roughing off types in the crop field of a designated section area could result in more homogeneous plants and the paddy from such selection could result in establishment of better crop and desirable attributes and yield.

Preferred Rice Variety Attributes

The role of variety attributes towards adoption by farm households has extensively been studied and evidence adduced. Timu, et al. (2014) used a probit model to justify the contribution of variety characteristics towards adoption decisions for improved sorghum varieties in Kenya. Ghimire et al. (2015) also documented some empirical results on the contribution of ‘the high yielding’ trait as significant characteristic that positively influenced rice varieties’ acceptance and adoption among farm households. The survey results on farmers’ choice framework for rice varieties is summarized in table six (6) below.

Table 6: Preferred variety attributes cited by farmers by % in Busia County

Preferred attribute	Proportion of respondents (by %) scoring for preference (N=62)
High yielding	80.6
Early maturity	77.4
1,000 seed weight	40.3
High grain recovery at milling	14.5
Cooks well (none sticky grain)	12.8
Rice taste	8.1
High tillering ability	8.1
Aroma	4.8
Ease of threshing	4.8
Others (drought tolerance, weed competition)	3.1

Chi-square value= 27.53 (computed) against a tabulated value of 16.919 and 21.666 with df = 9 and at $p < 0.05$ and 0.01 respectively (Source: Survey data, November 2019)

The results concur with those by Musila et al. (2018) particularly for high yield and early maturity which ranked first and third respectively. One thousand seed weight which farmers commonly referred to as seed density was scored third in this study which was clear demonstration that most rice was destined for the market, as rice is sold by weight, than for household consumption. This was confirmed by the ranking of high grain as the fourth (4th) attribute while cooking well (grains remain separable after cooking) was fifth in priority, this was also in agreement with study by Kimani (2010) and Kimani *et al.* (2011). Cooking well which is determined by time and swelling measured by ratio of grain to water or eating quality which is determined by visual look and feel in the mouth was categorized as an attribute more to the consumer. However, unlike in the coastal Kenya study done by Musila et al. (2018), which

listed aroma and good weed competition as among the significant priority attributes, the Busia study listed these as of least importance to the farmers' choice framework for rice varieties to grow.

Ranking of Variety Attributes

Attributes' ranking is one major tool that employs a multi-criteria approach to collectively narrow down onto a variety that conforms to the requirements and/or specifications of the producer and/or end-user who is mostly the consumer. In the case of this study on farmers' preference, ranking was done as per the procedure used by Fazil, et al (2008) for a food safety decision making problem. The multi-criteria approach seeks to realize a balance between diversity of issues that ultimately satisfy social and economic aspects in rice production. These aspects in the case of rice production include early maturity, high yields, good cooking attributes as well as the one thousand seed weight of the varieties among others.

Table 7: Ranking of variety attributes by respondents

Preferred attribute	% respondents ranking attributes (N=62)					
	(n)	1 st	2 nd	3 rd	4 th	5 th
Early maturity	48	30.1	37.1	4.5	1.6	1.6
High yielding	48	50	22.6	3.2	1.6	0
Cooking quality	27	6	12	14.5	4.8	4.8
High seed density	25	3.2	11.3	16.1	4.8	4.8
High grain recovery	9	6.5	1.6	3.2	3.2	0
High tillering ability	5	0	3.2	1.6	3.2	0
Appealing aroma	3	0	0	1.6	0	3.2
Good taste	3	1.6	0	0	0	3.2
Ease of threshing	2	0	1.6	0	1.6	0

Source: Survey data, November 2019

Early maturity and high yields were ranked reasonably high in the first and second positions than all the other attributes and this had also been observed in a similar study by Kimani et al (2011) in Central Kenya. Other attributes that received good recognition (through the ranking procedure) included cooking qualities, one thousand seed weight (density) and grain recovery which were ranking reasonable in the second and third positions. Asante et al. (2013) and Kimani (2010) also documented evidence of grain quality (including uniform white color) and cooking qualities as traits that positively influenced preference of rice varieties. The issue of cooking quality was mentioned significantly by key informants who included hoteliers and extension service providers.

CONCLUSION AND RECOMMENDATIONS

The study facilitated knowledge sharing among the stakeholders who included the farmers, rice value chain stakeholder and the research team. In particular, key informants such as the AESP, the LBDA staff, and a section of the farming community represented by the participants of the FGDs provided evidence that there were minimum efforts to promote the rice sub-sector in study

area and Busia County in general despite its enormous potential in rice production. This was confirmed by documentation of the seed sources which were mainly at community level and driven by external market demand in the absence of quality seed certification efforts through research and regulatory agency.

From the study findings, three scenarios have been demonstrated; i) that as much as there is potential for rice production, production efforts are much on a traditional basis and therefore there is need for focused improvement in rice seed system, management practices, farmers and stakeholders trainings, and other farm enterprises production. The need for seed systems improvement as a first step to increasing production and productivity was very eminent and requires quick investment through participatory research approaches such as on-farm demonstrations and seed access points establishment (ii) the market pull was not well defined in terms of quality specifications which was probably the cause of the poor conformity of rice seed to milling factories, delayed farmers delivery payments, mushrooming of middle men with ready cash, out dated mills leading to poor milled rice and eventual collapse of the local millers. (iii) Farmers conducted their production business in isolation thereby which rendered them to having limited opportunity to learn from one another or even share production and market information. The study also noted that, most (over 90%) of the farmers had no information about alternative uses of rice culms or chuff which in other places like Mwea is a significant by-product and an input to other value chains such as livestock, and value addition like making of block boards, tables, briquettes, biochar, cement from rice husk ash. This is a problem of limited social networking which inhibits information sharing.

The potential for rice production from the historical narrative by the LBDA over ten years ago which continued to diminish because of lack of quality seeds, market imperfection and limited agricultural extension services was demonstrated. Aspects of increasing labor costs for rice production on an increasing trend were also learned along with their implications on profit regimes. Rice productivity has also been decreasing hence making it difficult to break even despite the increasing rice demand currently at 12% per annum which presents a gap between production and consumption of 180,000 mt to 950,000 mt per annum respectively. This gap remains elusive. One of the main options to curb this gap is to continue increasing productivity per unit area as well as bring more land especially rain fed lowland and uplands rice. A vertical and horizontal rice value chain growth model is recommended supported by other factors such as robust seed system, perfect market outlook where farmers are organized into societies with facilitative management structure that pass benefits to members in a timely and predictive manner. This is expected to exponentially spur rice production and marketing through triggering rice value chain segments into auto action due to derived benefits in line with agri-food systems in a changing climate scenario.

The authors further recommend a strengthened consortium of development partners that include, Kenya Agricultural and Livestock Research Organization (KALRO), International Rice Research Institute (IRRI), AfricaRice Centre (ARC), Japan International Cooperation Agency (JICA), Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI), Alliance for a Green Revolution in Africa (AGRA), Nagoya University, Shanghai Agro-biological Gene Centre (SAGC - China), National Irrigation Authority (NIA), Lake Basin Development Authority (LBDA), Seed merchants, Universities, Africa Agricultural Technology Foundation (AATF)

among others. These partners together with Kenya's policy documents directives such as National Rice Development Strategy (NRDS-2019-2030), Vision 2030, Medium-Term Plan III, the President's Big Four priority agenda for 2017-2022 and the Agricultural Sector Growth and Transformation Strategy (ASGTS) present a unique opportunity to contribute to the rice sector development towards self-sufficiency estimated to be 1,290,000 mt year⁻¹ by 2030.

Finally, a multi-stakeholder approach involving local leadership, the farmers cooperative, seed and agro-input merchants, mechanization stakeholders, credit providers, agri-business and social services departments as well as AESPs and researchers is therefore recommended to positively change the rice production landscape of Busia County in general.

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REFERENCES:

1. Acheampong, P. P., Owusu, V. and Nurah, G. (2018): How dose farmer preference matter in crop variety adoption? The case of improved cassava varieties' adoption in Ghana
2. Atera, E. A., Onyancha, F. N. and Majiwa, E. B. O. (2018): Production and marketing of rice in Kenya: Challenges and opportunities; In the Journal of Development and Agricultural economics; Vol. 10(3), pp. 64-70, March 2018
3. Asrat, S., Yesuf, M., Carlsson, F. and Wale, E. (2009): Farmers' Preferences for Crop Variety Traits Lessons for On-Farm Conservation and Technology Adoption. Environment for Development Discussion Paper Series July 2009, EfD DP 09-15
4. Acheampong, P. P., Owusu, V. and Nurah, G. K. (2013): Farmers Preferences for Cassava Variety Traits: Empirical Evidence from Ghana. Contributed Paper Prepared for Presentation at the Fourth International Conference of the African Association of Agricultural Economists (4th ICAAAE), 22-25 September 2013, Hammamet, Tunisia
5. IRRI (2016): Rice Agri-Food CRD, Rice: Full proposal 2017-2022; Proposal for a Rice Agri-Food System (RICE) CGIAR Research Program
6. Kimani J. M., Tongoona P., Derera J, and Nyende A.B. 2011. Upland Rice Varieties development Through Participatory Plant Breeding. ARPN Journal of Agricultural and Biological Science. 6 (9): 39-49. ISSN1990-6145
7. Kimani, J.M. 2010. Genetic studies of quantitative quality traits in rice under low and high soil nitrogen and phosphorous conditions, and a survey of farmer preferences for

- varieties. A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (PhD) in Plant Breeding. African Centre for Crop Improvement (ACCI), School of Agricultural Sciences and Agribusiness, Faculty of Science and Agriculture
8. Kouko, W. O. 1997. Rice. In: P. D. Smith, ed, Agricultural reviews on Kenyan agriculture. Centre for Arid Zone Studies, University of Wales, Bangor, Gwynedd, LL57 2UW:1-33.
 9. Timu, A. G., Mulwa, R. Okello, J. and Kamau, M. (2014): The role of varietal attributes on adoption of improved seed varieties: the case of sorghum in Kenya
 10. Ghimire, R., Huang W. and Shrestha, R. B. (2015): Factors Affecting Adoption of Improved Rice Varieties among Rural Farm Households in Central Nepal. In Science Direct; Rice Science, 2015, 22(1): 35–43
 11. Ruth N. Musilai, Julia Sibiya, John Derera, John M. Kimani, Pangirayi Tongoona and Kengo Danda (2018): Farmers' Perceptions of, and Preferred Traits in, Rice Varieties in the Coastal Region of Kenya and Their Implications for Breeding; In the Journal of International Cooperation for Agricultural Development; *J Intl Cooper Agric Dev* 2018; 16: 20–30
 12. Fazil, A. Rajic, A., Sanchez, J. and Mcewen, S. (2008): Choices, Choices: The Application of Multi-Criteria Decision Analysis to a Food Safety Decision-Making Problem. In the journal of Food protection; Vol. 71, No. 11, 2008, Pages 2323–2333
 13. Asante, M. D., Asante, B. O., Acheampong, G. K., Wiredu, A. N., Offei, S. K., Gracen, V., Adu-Dapaah, H. and Danquah. E. Y. (2013): Grain quality and determinants of farmers' preference for rice varietal traits in three districts of Ghana: Implications for research and policy. In the Journal of Development and Agricultural Economics; Vol. 5 (7), pp. 284-294, July, 2013
 14. Onyango AO (2014). Exploring Options for Improving Rice Production to Reduce Hunger and Poverty in Kenya. *World Environ.* 4(4):172-179