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Adoption of NERICA Varieties and Their Associated Technologies by Smallholder Farmers in the Northern and Southern Regions of Sierra Leone

Kamanda, Philip Jimia[1*] ., Momoh, Edwin. J. J[2] ., Yila, K. Mark[3] and Motaung, Masa. Veronica[4]

[1]Department of Agricultural Extension and Rural Sociology, School of Agriculture and Food Sciences, Njala University, Njala Campus, Private Mail Bag, Freetown 47235, Sierra Leone
[2]Ernest Bai Koroma University of Science and Technology, Sierra Leone
[3]Sierra Leone Agricultural Research Institute, Njala Agricultural Research Centre, Sierra Leone
[4]Department of Agricultural Extension and Rural Development, Faculty of Agribusiness, Education and Extension, Botswana University of Agriculture and Natural Resources, Botswana.
**Correspondence author Email: pjkamanda@njala.edu.sl*

Abstract

New Rice for Africa (NERICA) varieties and their associated technologies study was conducted in Sierra Leone. A purposive sampling followed by a multi-stage random sampling technique were employed to select 150 NERICA farmers from the two chiefdoms as the NERICA farmer sample frames were unknown. Quantitative data were collected with a structured questionnaire. With the aid of the Statistical Package for Social Science (IBM SPSS) version 25.0 software, socio-demographic characteristics were analyzed using descriptive statistics and logistic regression to determine the socioeconomic characteristics of farmers that influenced the adoption of NERICA varieties. The socio-demographic findings reveal that the bulk of the farmers (62.0%) were in their middle age, 90.0% were married, and 84.7% had no formal education. Nearly half of the farmers interviewed (49.0%) did not adopt any of the recommended production technologies, whilst 56.0% did not adopt any of the recommended post-harvest technologies. The R-square of 0.26 ($P<0.0001$) indicates that smallholder demographic and socioeconomic factors of farmers significantly influenced their ability to adopt the recommended NERICA varieties. The study, therefore suggests adult functional literacy programmes for the huge number of illiterate NERICA farmers and encourages them to adopt at least one of the recommended production and post-harvest technologies.

Keywords: Kaiyamba Chiefdom, Magbema Chiefdom, NERICA Associated Technologies

1. Introduction

Rice is consumed as the main staple food for most households in Sierra Leone even though rice is grown at subsistent levels. At the country level, 84.2 % of the total value of rice consumed is imported rice (World Bank, 2014). This, therefore, has given rise to huge rice importation at a very high cost. For example, in 2016, rice consumption was 1,101,000mt while rice importation at the same time was 370,000mt. The same could be said for 2017, where annual rice consumption was 1,206,000mt and rice imported was 350,000mt. In 2018, rice consumption was 1,156,000mt and rice importation was 400,000mt (Graham, 2020). It is as a result of this development that the New Rice for Africa (NERICA) was introduced in Sierra Leone by the West Africa Rice Development Association to complement this effort. The New Rice for Africa (NERICA) had spread rapidly in the Sub-Saharan Africa (SSA)

regions since the initial seeds of this high yielding rice varieties were first introduced in 1996 (Somado, Guei, & Keya, 2008). To increase the availability of rice in the country, the production of NERICA varieties was introduced as a solution to curb the inadequacy of rice in the country. NERICA varieties according to Somado et al., (2008) were first developed at the West Africa Rice Development Association (WARDA) Center in the early 1990s by a team of rice breeders led by Dr. Monty Patrick Jones at the main M'bé research center of WARDA in Bouaké, Côte d'Ivoire that developed the stable and fertile progeny from crosses between Asian rice, *O. Sativa* L. and African rice, *O. glaberrima* Steud. The agronomic characteristics of NERICA varieties widely vary but they are generally high yielding and early maturing (a trait much appreciated by farmers), do not lodge and shatter, are appreciated by farmers for their grain quality, and are relatively resistant to harsh environmental factors in Africa including both biotic and abiotic stresses (Diagne, Midingoyi, & Wopereis, 2010).

In addition, NERICA rice varieties have displayed resistance to local stress conditions such as drought, pests, and diseases). How far these varieties are released remains the main object of this investigation. Furthermore, field trials in Sierra Leone which started in 1997, have identified NERICA 1, NERICA 5, WAB 450-IB-P32, and WAB 450-I-B-P 33-11 as suitable which are currently used throughout the country (NRDS, 2009). However, adoption of rice varieties by farmers in Sierra Leone is not only influenced by the attributes of the variety itself but also by the farming circumstances of the farmer including lack of resources, farm inputs, and farming patterns. Farmers particularly in the North and South of the country can grow two varieties of different desirable attributes such as yield and resistance to diseases on a piece of land at the same time.

Earlier studies relating to the factors influencing the adoption of technologies by farmers seem to have concentrated on the characteristics of the technology as key determinants of the farmers' decision to adopt a farm technology (Liu, Bruins, & Heberling, 2018). A number of factors may have major influences on the extent of adoption of technologies such as characteristics of farm practice; the adopters; the change agent (extension worker, professional, etc.); and the socio-economic, biological, and physical environment in which the technology is adopted (Farid, Tanny, & Sarma, 2016). A key aspect of technology adoption is the access to extension services as an institution. Farmers are usually informed about the existence as well as the effective use and benefit of new technology through extension agents. The extension agent acts as a link between the innovators (researchers) of the technology and users (farmers) of that technology. This might help to minimize transaction costs incurred when passing the information about the new technology to a large heterogeneous population of farmers (Mwangi & Kariuki, 2015). In ideal situations, extension agents usually target specific or affluent farmers who are recognized as peers (farmers with whom a particular farmer interacts) exerting a direct or indirect influence on the whole population of farmers in their respective areas (Mwangi, & Kariuki, 2015).

The research problem, therefore, is whether farmers have the ability to effectively engage in NERICA production and post-harvest technologies even if NERICA varieties are at their disposal. Until now, we do not know whether farmers are accepting these new varieties or not, and if appropriate measures are not taken to facilitate their adoption, there is a possibility that farmers might fall back to the same problem of little or no adoption of these improved varieties. With regards to post-harvest operations, farmers would produce these new rice varieties and sell them at low farm gate prices because they lack value addition and poor storage facilities.

The main study objective was to assess the adoption of NERICA varieties and their associated technologies in the study areas. The study specifically sought to:

i. investigate the socio-demographic characteristics of NERICA varieties
ii. assess the adoption of NERICA varieties by smallholder farmers,
iii. Number of NERICA associated technologies adopted by farmers, and
iv. socio-demographic characteristics of farmers that influence the adoption of NERICA varieties.

2. Materials and Methods

2.1 The Variables of the Study

Dependent Variables

The dependent variables for this study involves only the selected NERICA varieties. They include: NERICA 1, NERICA 2, NERICA3, NERICA4, NERICA6, NERICA 16, NERICA19, NERICA20, and NERICA29.

Independent Variables

On the other hand, the independent variables include the demographic attributes of the farmers such as Gender, age, marital status, educational status, size of household; and the socioeconomic attributes which include; type of land ownership, major source of income, access to fertilizer, farm machines, credit facilities, belongingness to FBOs, and contact with the agricultural extension agents.

Table 1. Describing the independent variables in the logistic regression analysis

Variable	Definition
Gender of farmer	1 = Male rice farmer and 2 = Female rice farmer
Age (years)	Age of farmer at last birthday
Marital status	1 = Farmer is married and 0 = Not married;
Educational status	1 = Farmer has formal education and 0 = no formal education.
Size of household	1 = Size of household ≥7 and 0 = size of household <7
Land ownership type	1 = Farmer owns the land and 0 = Others (leased, bought, inherited, etc.)
Major source of income	F1 = from farming and 0 = Otherwise
Access to fertilizer	1 = Farmer has access to fertilizer and 0 = Otherwise
Access to processing machines	1 = Farmer has access to processing machines and 0 = No access to processing machines
Access to credit facilities	1 = Farmer has access to credit facilities and 0 = No access to credit facilities
Farmer Based Organisation (FBO) membership	1= Farmer is a member of FBO and 0 = Not a member of any FBO
Extension agent's contact	1 = Farmer has contact with extension agent and 0 = has no contact with extension agent

This study employed a non-experimental quantitative research design with survey methods. The situation, circumstances, or experience of the participating smallholder NERICA farmers are not manipulated in non-experimental research design surveys. It also lacks the researcher's manipulation of the independent variables. This implies that the investigator looked at what occurs naturally or has already occurred, as well as the interdependencies between the variables (Cherry, 2020). With the aforementioned critique in mind, matters of generalization including external validity were addressed by a panel of specialists in the department review the sample questionnaire to see if it fits the study framework. Pre-testing was done in a separate region to ensure the reliability of the instrument by determining the consistency of farmers' responses.

2.2 The Study Area

Magbema chiefdom in Kambia district and Kaiyamba chiefdom in Moyamba district were the study areas. Magbema chiefdom is bordered to the North by the Republic of Guinea, to the South by Port Loko district, and to the East by Bombali district. The chiefdom's population is 92,165 people (SSL, 2015) including smallholder NERICA farmers. The chiefdom is strategically located on the Freetown-Conakry highway which provides a vital commercial route. The Temne ethnic group comprises about 40% of the population, followed by the Susu (30%), and other ethnic groups including the Limba, Fula, Mandingo, and others in the chiefdom. Muslims are the predominant residents in the chiefdom. The study area for the Southern region was Kaiyamba chiefdom, Moyamba district. Moyamba town is the administrative headquarter town of the chiefdom. Moyamba town is located in Kaiyamba chiefdom, and Kaiyamba chiefdom is itself located in Moyamba district. Moyamba District is bordered on the West by the Atlantic Ocean, on the North by Port Loko and Tonkolili districts, on the East by Bo district, and on the South by Bonthe district. The population of the chiefdom is 25,749 people (SSL, 2015). The Mendes, Sherbros, and Limbas are the most dominant tribal groupings in the district.

2.3 Study Population

Smallholder NERICA farmers were the population of the study. They formed part of the total population of Magbema chiefdom in Kambia district with 92,165 residents, and Kaiyamba chiefdom in Moyamba district, which also had 25,749 residents (SSL, 2015).

2.4 Sample size and data collection

One hundred and fifty farmers were chosen at random from an unknown population of smallholder NERICA farmers in both chiefdoms. Ninety (90) farmers from Magbema chiefdom in Kambia district and sixty (60) from Kaiyamba chiefdom in Moyamba district participated in the survey. Due to the varying population sizes of residents in the two study areas, the proportion of respondents selected from both study areas (90 and 60) was also uneven. In addition, the researcher had limited resources to work with during the data collection process. As a result, manageable sizes of smallholder NERICA farmers in both chiefdoms were purposively determined and randomly selected from randomly selected chiefdoms in both districts.

2.5 Data Analysis

Descriptive statistics

The socio-demographic characteristics of the NERICA farmers were analysed using descriptive statistics.

Regression analysis

Logistic regression was used to determine the socioeconomic variables of NERICA farmers that influenced the adoption of NERICA varieties. The statistical analyses were performed using SAS 9.4 LOGISTIC function. In the model statement of PROC LOGISTIC, the LACKFIT and R SQUARE options request the Hosmer and Lemeshow goodness-of-fit tests and respectively provided the generalized R Square.

3. Results and Discussion

3.1 Socio-demographic characteristics of NERICA varieties

The socio-demographic characteristic findings of the smallholder NERICA farmers in Table 2 show that the majority (75.3 %) were males. Moreover, half of the farmers (62.0%) in the study areas were in the economically active age bracket of 36-55 years. Yet, a reasonable proportion of farmers (38.0%) were either young (16-35 years) or old (56 years and above). The findings further reveal that the majority of the farmers (90%) were married. The fact that most of the farmers were married shows that marriage remains to be a significant institution in the study areas. The provision of family labor on the farm is considered a major benefit of marriage. Married farmers, for example, are more likely to be under pressure to produce more, not only for family consumption but also for sale (Garner & de la O Campos, 2014). The majority of the farmers (44.0%) had Islamic literacy, while 40.7% were illiterate. As a result, 84.7% of respondents were unable to read or write in English, and only 15.3% were proficient in the English language. In this regard, the adoption of complicated technologies necessitates a high level of education for farmers, hence education can be a primary determinant in the adoption process of technology. Spencer and Fornah (2014) discovered that the educational level of smallholder NERICA farmers in Sierra Leone was quite low in a comparable study on the rice value chain in West Africa. Finally, the average household size of NERICA respondents ranged from 7 to 11 people.

According to the socio-economic characteristics of NERICA farmers, 92.7% identified crop farming as their primary occupation. For 4.0% of the respondents, employment was a major occupation, while for 2.7%, trade/commerce was their primary activity. The majority of the respondents (64.8%) added that rice was their main crop, while 19.8% revealed tuber crops as their main crop. The findings also found that 45.0% and 35.4% of the farmers planted NERICA on upland and Inland Valley Swamps (IVS) respectively, 16.0% cultivated NERICA on Boliland ecology, and 3.4% cultivated NERICA on mangrove ecology. Regarding the land ownership arrangements, 61.3% of respondents farmed on family land, while 21.0% owned their own land. Finally, 82.7% of respondents reported that farming was their primary source of income. Only 8.7% engaged in commerce, and 6.0%t relied on family members as their primary source of income.

3.2 Adoption of NERICA varieties and associated technologies

The adoption of the different NERICA varieties by sampled farmers in the study areas was investigated and the results in percentages are shown in Table 3 below. The findings show that among all the NERICA growing farmers in both study areas, 53.3% cited NERICA L 19 as their popularly grown variety, followed by NERICA L 20 (14.7%). The results also show that besides NERICA L 19, adoption of the other NERICA varieties was generally low, as most farmers did not grow those other varieties. The results are not surprising as similar findings have emerged from Asante, Wiredu, Martey, Sarpong, & Mensah-Bonsu (2014) in Ghana which concluded that more than 58.0% of the farmers had adopted and used diverse NERICA varieties at diverse levels. However, these findings do not support those of Ojo, Dimelu, and Okeke (2018) who discovered that NERICA 1 was the highly adopted variety with a mean score of 3.12, followed by NERICA 8 (2.98), and NERICA 7 with a mean adoption score of 2.25 in Nigeria.

3.3 Number of NERICA associated technologies adopted by farmers.

An assessment of the number of NERICA associated technologies adopted by NERICA farmers was done and the results are presented in Table 4**.** The results show that 49.0% of the sampled farmers did not adopt any single recommended NERICA associated production technologies, whilst 29.0% adopted only 1 production technology, 17.0% adopted 2 production technologies, and 5.0% adopted 3 of the technologies. Under the recommended post-harvest technologies, more than half of the sampled farmers (56.0%) did not adopt any of the recommended technologies, whilst less than one-third (31.0%) adopted only 1, and 13.0% adopted 2 technologies.

The high percentage of nearly half of the sampled farmers incapable to adopt a single recommended production technology, and more than half who failed to adopt a single recommended post-harvest technology is a very serious threat to rice value addition in Sierra Leone. This implies that most NERICA farmers still rely on traditional practices in producing and processing NERICA which has a counter-productive cost-benefit analysis effect on the farmers.

Table 2. Socio-demographic characteristics of NERICA farmers (N=150)

Gender of farmer	Variable category	Frequency	Percentage
	Male	113	75.3
	Female	37	24.7
Age at last birthday	16-25	12	8.0
	26-35	27	18.0
	36-45	53	35.3
	46-55	40	26.7
	56-65	16	10.7
	66-75	2	1.3
Marital status of farmer	Married	135	90.0
	Single	6	4.0
	Widow/widower	6	4.0
	Divorced/separated	3	2.0
Level of educational	Illiteracy	61	40.7
	Islamic literacy	66	44.0
	Primary school	15	10.0
	Junior Secondary School	8	5.3
Household size	2-6	27	18.0
	7-11	69	46.0
	12-16	30	20.0
	17-21	21	14.0
	22-26	3	2.0
Occupation (main)	Crop production	139	92.7
	Animal production	1	.7
	Commerce	4	2.7
	Employment	6	4.9
Crop grown (major)	Rice	147	92.7
	Other cereal	6	2.6
	Tuber	27	19.8
	vegetable	19	8.8
	Legume	9	4.0
Ecology	Upland	81	45.5
	Inland valley swamp (IVS)	63	35.4
	Mangrove	6	3.4
	Boliland	28	15.7
Type of Land Ownership	Personal	32	21.3
	Family	92	61.3
	Rented	21	14.0
	Leased	5	3.3
Source of income (main)	Family	9	6.0
	Farming	124	82.7
	Commerce	13	8.7
	Employment	4	2.7

Table 3. Adoption of NERICA varieties

NERICA varieties farmers grow	Frequency	Percentage
NERICA 1	7	4.7
NERICA 2	3	2.0
NERICA 3	20	13.3
NERICA 4	7	4.7
NERICA 6	9	6.0
NERICA 16	1	0.7
NERICA 19	80	53.3
NERICA 20	22	14.7
NERICA 29	1	0.7

Table 2. Number of NERICA associated technologies adopted by NERICA farmers

Number of associated technologies adopted (recommended)	Frequency	Percentage
Production		
0	74	49
1	43	29
2	26	17
3	7	5
4	-	0
Post-harvest		
0	84	56
1	46	31
2	20	13
3	-	0

***Note**: NERICA variety itself was not computed as a recommended technology, hence the zero. The associated production and post-harvest technologies were otherwise considered the recommended technologies adopted by NERICA farmers.*

Table 3. Adoption of at least 1 NERICA associated technology by farmers

At least 1 recommended Production technology	Frequency	Percentage
Adopted	76	51
Not adopted	74	49
At least 1 recommended Post-harvest technology		
Adopted	66	44
Not adopted	84	56

Table 5 shows the percentages of NERICA farmers who adopted at least 1 recommended NERICA associated technology in both production and post-harvest technologies.

From Table 5 above, 51.0% of the farmers adopted at least 1 recommended NERICA associated production technology (planting, transplanting, weeding, and fertilizer application) whilst 49.0% did not adopt any 1. At the same time, only 44.0% of the sampled respondents adopted at least 1 recommended post-harvest associated technology whereas 56.0% did not adopt any single technology (threshing, milling, storage, etc.). This situation is far worse than the production technologies because the high number of non-adopters of the recommended post-harvest associated technologies is an indication that farmers have limited capability to process and package their rice into various value added products.

3.4 Socio-demographic characteristics that influence the adoption of NERICA varieties

The smallholder NERICA farmers' socio-demographic characteristics that influenced the adoption of NERICA varieties were examined by using logistic regression. Table 6 shows the findings of the Logit model used to investigate the factors influencing the adoption of NERICA varieties. There is fit in overall model, as indicated by an R-square of 0.26, a likelihood ratio chi-square of 2452.2 (P 0.0001), and a Wald chi-square of 2452.2 (P 0.0001); the hypothesis that all regression coefficients jointly equal to zero were rejected, and the explanatory variables used in the model were able to explain the decision of the farmers to adopt NERICA varieties in Sierra Leone. The findings imply that NERICA variety adoption is influenced by both demographic and socioeconomic factors. The only demographic factor that nonetheless significantly influenced the probability of adopting one NERICA variety was the age of the farmer. For every 1% increase in age, we expect a 4.6% increase in the probability of adopting 1 NERICA variety holding other factors constant. This means that NERICA as technology is easily accepted by middle-aged farmers. Comparable findings were reported by Dibba, Diagne, Fialor, and Nimoh, (2012) when they revealed that the average age of selected farmers was 45, which indicates that rice production is mainly done by the middle-aged group of farmers in their 40s and 50s. The probabilities that Gender, marital and educational statuses, the household size would influence the adoption of at least 1 NERICA variety were however insignificant. For every 1.0% increase in education, we expect an 87.0% probability of adopting NERICA variety holding all other factors constant.

The socioeconomic factors that significantly influenced the probability of adopting one NERICA variety were; access to processing machines, access to credit, and contact with an extension agent. Holding all other factors constant, the probability that smallholder NERICA farmers with access to machines, access to credit, and contact with extension agents would adopt 1 NERICA variety are 177.5%, 219.7%, and 142.6% respectively. These findings,

therefore, imply that farmers' access to processing machines, credits, and extension services will enhance their ability to adopt the use of NERICA varieties on their farms.

Table 4. Analysis of maximum likelihood estimates (MLE) of the factors that influence the adoption of NERICA varieties using the logistic regression.

Parameter	Estimate	Standard Error	Wald X^2	Pr > X^2
Demographic				
Gender (Male)	-0.8133	0.8866	0.8416	0.3589
Age (Years)	0.0459	0.0252	3.3227	0.0683 **
Marital status (Married)	-1.1635	0.9364	1.5437	0.2141
Educational status (Formal)	0.8692	0.6540	1.7663	0.1838
Household size (> 7 persons)	-0.5306	0.4816	1.2137	0.2706
Socioeconomic				
Land Ownership (Inheritance)	-0.1671	0.5061	0.1090	0.7413
The major source of income (Farming)	0.1789	0.6149	0.0846	0.7711
Access to fertilizer (Yes)	-0.1994	0.7765	0.0659	0.7973
Access to processing machines (Yes)	1.7784	0.7832	5.1557	0.0232 **
Access to credits (Yes)	-2.9169	0.9752	8.9469	0.0028 ***
Membership in FBO (Yes)	0.8389	0.7595	1.2201	0.2693
Contact with extension agents (Yes)	1.4257	0.7555	3.5609	0.0592 *
Model characteristics	Number of observations = 150			
	r^2 = 0.2608			
	LR: X^2 (12) =28.2108; P > X^2 = 0.0052			
	Wald: X^2 (12) = 18.5473, P > chi square = 0.1001			

***, **, and * denotes significance at 1%, 5% and 10% respectively; LR: Likelihood ratio; X^2: chi square.

4. Conclusion and Recommendation

The research reveals that the majority of the farmers in the study areas are married even though more men than women took part in the study. The modal age of the farmers is between 36-45 years which implies that middle-age farmers are more involved in farming in these communities. Even though more than half of the farmers grow NERICA 19 variety, it is obvious that less than half of them have not adopted any production associated technology whereas more than half have not adopted any post-harvest associated technology. The findings further show that only age as a socio-demographic characteristic significantly influences the adoption of NERICA varieties. Access to processing machines, access to credit, and contact with extension agents as socio-economic characteristics of farmers are the only post-harvest technologies that significantly influence the adoption of NERICA varieties. It is therefore suggestive that the findings of this study will henceforth contribute to the existing body of knowledge in NERICA production and post-harvest technologies for farmers and other researchers. For the prevailing high number of illiterate NERICA farmers, the study submits adult functional educational programmes and encourages them to adopt at least one of the recommended production and post-harvest technologies.

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References:

1. Asante, B. O., Wiredu, A. N., Martey, E., Sarpong, D. B., & Mensah-Bonsu, A. (2014). NERICA adoption and impacts on technical efficiency of rice producing households in Ghana: implications for research and development. American Journal of Experimental Agriculture, 4(3), 244.

2. Cherry, K. (2020). Introduction to Psychology Research Methods. https://www.verywellmind.com/introduction-to-research-methods-2795793

3. Diagne, A., Midingoyi, S. G., & Wopereis, M. (2010). The NERICA Success Story : Development , Achievements and Lessons The NERICA Success Story : Development , Achievements and Lessons. 1–29.

4. Dibba, L., Diagne, A., Fialor, S. C., Nimoh, F., Gambia, T., & Africa, W. (2012). Diffusion and Adoption of new rice varieties for Africa (Nerica) in the Gambia. African Crop Science Journal, 20(1), 141–153.

5. Farid, K., Tanny, N., & Sarma, P. (2016). Factors affecting adoption of improved farm practices by the farmers of Northern Bangladesh. Journal of the Bangladesh Agricultural University, 13(2), 291–298. https://doi.org/10.3329/jbau.v13i2.28801

6. Garner, E., & de la O Campos, A. P. (2014). Identifying the "family farm." ESA Working Paper, 14, 1–30.

7. Graham, E. G. (2020). An Optimal Rice Policy for Sierra Leone: Balancing Consumer and Producer Welfare. SSRN Electronic Journal, August. https://doi.org/10.2139/ssrn.3693830

8. Liu, T., Bruins, R. J., & Heberling, M. T. (2018). Factors influencing farmers' adoption of best management practices: A review and synthesis. Sustainability 2018, 10(2), 432; https://doi.org/10.3390/su1002043210(2), 432.

9. Mwangi, M., & Kariuki, S. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. Journal of Economics and Sustainable DevelopmentIssn, 6(5), 2222–1700. Retrieved from www.iiste.org.

10. National Rice Development Strategy (NRDS) Sierra Leone, (2009). Prepared for the Coalition for African Rice Development (CARD). https://www.jica.go.jp/english/our_work/thematic_issues/agricultural/pdf/sierraleone_en.pdf

11. Ojo, O. F., Dimelu, M. U., & Okeke, M. N. (2018). Adoption of new rice for Africa (NERICA) technologies in Ekiti State, Nigeria. African Journal of Food, Agriculture, Nutrition and Development, 18(3), 13617–13633. https://doi.org/10.18697/AJFAND.83.16265

12. Somado, E. a., Guei, R. G., & Keya, S. O. (2008). NERICA : the New Rice for Africa – a Compendium. WARDA, Cotonou, Benin, 210.

13. Spencer, D., & Fornah, D. (2014). Value Chain Analysis in the Rice Sector in Sierra Leone. Academia. Accelerating the world's research. https://www.academia.edu/39069598/VALUE_CHAIN_ANALYSIS_IN_THE_Rice_SECTOR_in_sierra_leone_15_Mudge_Farm_Off_Sir_Samuel_Lewis_Road

14. Statistics Sierra Leone (2015). Population and Housing Census Summary of Final Results. 1–190. http://www.statistics.sl.

15. World Bank (2014). The World Bank Poverty Reduction & Economic Management Unit Africa Region. https://www.statistics.sl/images/StatisticsSL/Documents/rice_prices_in_sierra_leone.pdf