

## **Factors influencing the creation of synergies between research-based technologies and farmers' indigenous knowledge systems and practices in Sierra Leone**

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### **Abstract**

The purpose of this study was to identify factors that affected the synergy between scientific research and technology and farmers' indigenous knowledge systems and practices in Sierra Leone. The study clearly demonstrated the importance of understanding indigenous knowledge and identifying areas where policy makers, service providers and researchers may intervene in future agricultural extension, research and development activities, since farmers also make recommendations based on areas that need improvement. The results demonstrated that significant proportion of rice farmers (both male and female) across the ten districts (53.8%) cultivated traditional rice varieties as a result of limited access to improved rice varieties. The results further demonstrate that improved techniques need to be integrated with indigenous practices of farmers through their learning fields; back up with the availability, accessibility and affordability of agro inputs, as farmers admitted that they cannot increase rice production by growing it their own ways. The conclusion of this paper is that, despite many changes in agricultural practices, indigenous knowledge has been used by most small-scale farmers in agricultural production, mainly because it has been tested over several generations.

**Key words:** Synergy, technologies, indigenous practices, farmers, and Sierra Leone

### **1. Introduction**

Indigenous knowledge is local knowledge specific to a particular culture or society. It is the basis for decision-making at the local level in agriculture, health, food preparation, education, natural resource management and many other activities of rural communities [1]. "Indigenous or local knowledge" refers to knowledge that communities have long generated and disseminated to cope with their own agro-ecological and socio-economic environments [2]. This knowledge is generated and transformed through systematic processes of changing the environmental, socio-economic and technological situation by observing local conditions, experimenting with solutions and reformulating previously identified solutions [3].

Researchers around the world face the challenge of combining indigenous farmers' technical practices with research-based technical practices to increase yields. Many authors believe that problems and tensions have led to indigenous knowledge being less useful than expected [4]. These issues include concerns about tensions between western science and indigenous knowledge systems as well as issues arising from divisions and power relations.

In the past few years, academic discussions have identified indigenous knowledge as an important development resource, particularly for local community development and resource management. To effectively involve indigenous knowledge in development, we must move beyond the indigenous and scientific dichotomy and work for greater autonomy for "indigenous" peoples [5]. The world therefore needs to seek more effective and creative interaction between indigenous and scientific knowledge systems, and to seek better ways in which scientists, social scientists and people with local knowledge can cooperate to improve the management of agriculture and natural resources [6]. An essential component of any country's knowledge system is its indigenous knowledge, which forms the basis of its culture, customs and traditions

and includes the skills, experiences and insights of its people, which they apply daily to sustain or improve their livelihoods [7]. The purpose of the study was therefore to identify and assess the impact of rice-based farmers' indigenous knowledge systems and practices on rice production in Sierra Leone and their potential contribution to improving the livelihoods of small-scale farmers.

## 2. Materials And Methods

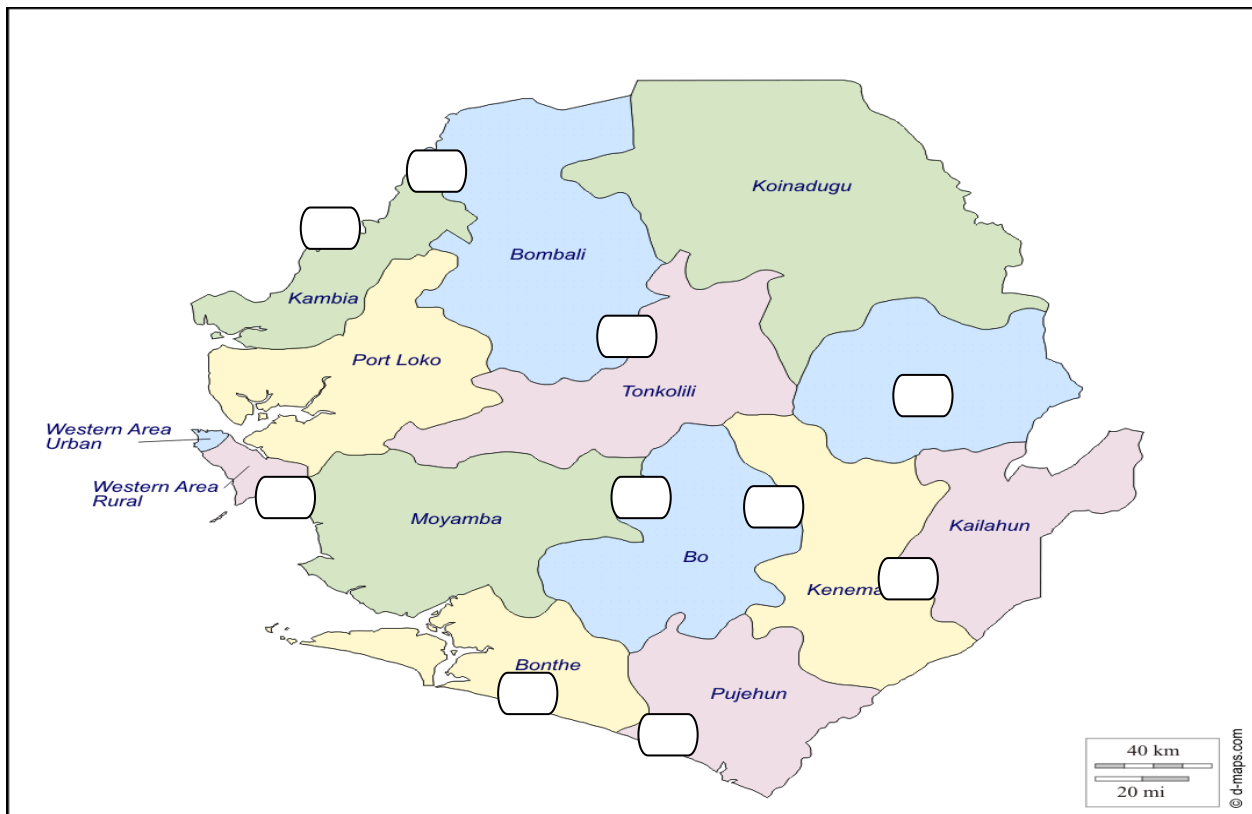
### 2.1. Study site and sample design

The study was conducted in Kambia, Tonkolili, Bombali, Moyamba, Bo, Bonthe, Pujehun, Kono, Kailahun, and Kenema Districts of Sierra Leone. Ten Districts were purposively selected, i.e. two Districts in each ecology (upland, inland valley swamps (IVS), boliland, mangrove swamp and riverine grassland) - Kailahun and Kono (upland), Kambia and Moyamba (mangrove), Bonthe and Pujehun (riverine grassland), Bo and Kenema (IVS), and Bombali and Tonkolili (boliland) (Table 1 and Figure 1). Two chiefdoms per district were selected using proportional sampling. A list of all chiefdoms within each district was prepared and calculated at 25% proportion using the RAND function in excel programme. Thirty two (32) chiefdoms were selected and three villages per chiefdom were also selected, giving a total of 96 villages. Six rice-based farming households were randomly selected in gender disaggregated group in each village for the study. A multi-stage random sampling was done for the selection of the villages and respondents/households. Two lists of (male and female farmers), not couples of all farming household heads were prepared at community level and these were then randomly selected through a balloting process, thus making a total sample of 576 respondents.

One key informant interview was held per Chiefdom using semi-structured questionnaires (thus a total of 32 key informants' interviews). The selection of respondents for the key informant interviews was based on position and role in the community as lead farmers, head of farmer-based organizations and religious/traditional leaders. This is because these categories are usually better informed about their communities. Four focused group (age and gender-disaggregated) discussions were held in each District (total of 32), to throw more light on emerging issues from household and key informant interviews and to validate the major themes that emerged within these communities.

**Table 1: Distribution of samples**

Districts	No. of Chiefdoms	No. of villages per chiefdom	No. of Key Informant Interviewed	No. of FDGs done in age and gender segregated groups	No. of Household Interviewed
Kailahun	4	12	4	4	72
Kenema	4	12	4	4	72
Kono	3	9	3	3	54
Bo	4	12	4	4	72
Bonthe	3	9	3	3	54
Moyamba	3	9	3	3	54
Pujehun	3	9	3	3	54
Kambia	2	6	2	2	36
Bombali	3	9	3	3	54
Tonkolili	3	9	3	3	54
Total	32	96	32	32	576



**Figure 1. Map of Sierra Leone showing study districts**

## 2.2. Data Analysis

The data was analyzed with the use of SPSS and ARiS statistical packages. Chi Square analysis was done to show the significant relationship between some of the qualitative variables. Box-plot analysis showing the relationship between two qualitative variables and one quantitative variable were done to present data on the general age distribution.

## 3. Results and Discussions

### 3.1 Sample characteristics

Table 2 showed the educational levels of the respondents. The educational level of the male population is higher than that of the females. Most of the respondents are illiterate, but there are more illiterate female (76.0%) than male (46.5%) respondents; 3.7% of female farmers had tertiary education.

**Table 2: Educational level of respondents across surveyed Districts (%)**

District	Educational level by District (%)											
	None		Literate/Koranic		Primary		Junior high school		Senior high school		Tertiary	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Kailahun	38.9	72.2	22.2	5.6	16.7	16.7	16.7	5.6	2.8	0.0	2.8	0.0
Kenema	36.1	69.4	22.2	0.0	25.0	30.6	5.6	0.0	8.3	0.0	2.8	0.0
Kono	51.9	85.2	14.8	0.0	3.7	3.7	14.8	11.1	7.4	0.0	7.4	0.0
Bombali	51.9	88.9	7.4	3.7	14.8	3.7	11.1	3.7	14.8	0.0	0.0	0.0
Kambia	44.4	88.9	0.0	5.6	27.8	5.6	11.1	0.0	16.7	0.0	0.0	0.0
Tonkolili	74.1	77.8	7.4	11.1	3.7	7.4	11.1	3.7	0.0	0.0	3.7	0.0
Bo	50.0	61.1	11.1	2.8	22.2	22.2	8.3	11.1	2.8	2.8	5.6	0.0
Bonthe	59.3	81.5	22.2	7.4	7.4	7.4	7.4	3.7	3.7	0.0	0.0	0.0
Moyamba	29.6	74.1	14.8	7.4	14.8	11.1	22.2	0.0	14.8	3.7	3.7	3.7
Pujehun	33.3	74.1	37.0	3.7	11.1	18.5	11.1	3.7	3.7	0.0	3.7	0.0
Average	46.5	76.0	16.7	4.5	14.9	13.9	11.8	4.5	6.9	0.7	3.1	0.3

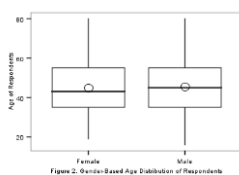


Figure 2 presented the gender-based age distribution of respondents - female respondents are younger than their male counterparts. For the females, the lower quartile is between 35 to 44 years; the median age is 45 years, while the upper quartile is 55 years. For the male respondents, the lower quartile is between 45 to 47 years; the median age is 48 years and the upper quartile is also 55 years.

The types of varieties cultivated by sampled respondents were categorized into four groups: traditional, RARC improved, NERICA, and other improved rice varieties. It could be seen from the results presented in Tables 3 and 4 that the majority of the farmers' cultivate traditional varieties, followed by other improved rice varieties.

Table 3 illustrated that most of the farmers' cultivated traditional varieties, followed by other improved, RARC-improved and NERICA varieties in decreasing order, while Table 4 shows the rice varieties cultivated by male and female farmers according to District. Most farmers (57.3% of males and 50.3% of females), cultivate traditional varieties, followed by other improved varieties, RARC-improved varieties, and NERICA varieties. The percentage of male respondents growing traditional varieties was highest in Kono District 93.0% followed by Kambia District 83.3% and Pujehun District 77.8%. For females, the corresponding percentages were 88.9% in Kambia District, 85.2% in Kono District and 66.7% in Bombali District.

**Table 3: Rice varieties cultivated by respondents**

Variety cultivated	Frequency	Cumulative frequency	Percent	Valid percent	Cumulative percent
Traditional	310	310	53.8	53.8	53.8
RARC Improved	44	354	7.6	7.6	61.5
NERICA	27	381	4.7	4.7	66.2
Other Improved	195	576	33.9	33.6	100

*RARC = Rokupr Agricultural Research Center; NERICA=New Rice for Africa*

From table 4, about 54% of the total farmers interviewed across the ten (10) Districts depend on traditional rice varieties to carry out their farming. Some of the reasons for using traditional rice varieties over improved ones are: inaccessibility and high cost of the improved rice varieties. However, about 34% of farmers interviewed used other improved rice varieties. The use of RARC-improved varieties was highest in Moyamba and Bonthe District compared to the other Districts (Table 4). The least rice varieties used by farmers across the ten (10) Districts is NERICA.

**Table 4: Rice variety type cultivated by farmers in surveyed Districts (%)**

District	Traditional		RARC-improved varieties		NERICA varieties		Other improved varieties	
	Male	Female	Male	Female	Male	Female	Male	Female
	%	%	%	%	%	%	%	%
Kailahun	47.2	44.4	0	8.3	11.1	0	41.7	47.2
Kenema	38.9	33.3	0	2.8	22.2	0	38.9	63.9
Kono	93.0	85.2	0	0	3.7	0	3.7	14.8
Bombali	70.4	66.7	3.7	0	11.1	25.9	14.8	7.4
Kambia	83.3	88.9	11.1	0	0	0	5.6	11.1
Tonkolili	48.1	51.9	3.7	11.1	0	0	48.1	37.0
Bo	6.7	50	0	16.7	0	0	33.3	33.3
Bonthe	25.9	29.6	22.2	18.5	0	14.8	51.9	37.0
Moyamba	37.0	33.3	37.0	3.7	0	0	25.9	63.0
Pujehun	77.8	40.7	0	18.5	0	0	22.2	40.7
Average	57.3%	50.3%	6.9%	8.3%	5.6%	3.8%	30.3%	37.5%

*RARC = Rokupr Agricultural Research Center; NERICA = New Rice for Africa*

Table 5 shows that the Chi squared value of 33.8 and 13 degrees of freedom indicate that areas of farm management where farmers' indigenous practices are more prevalent is significantly gender sensitive ( $P = 0.00127$ ). Pest management is the operation where indigenous knowledge is highly utilized by both gender; (males 95%, and females 100%). With regards land preparation, male farmers use indigenous knowledge the most, compared to females, (63%, and 33%) respectively. The reverse is the case when it concerns weed management where women are more mostly the ones who make use of their indigenous knowledge and practices to address this challenge. From these results, one can vividly see the gender role differentiation in farm management.

**Table 5:** Chi Squared analysis of areas of farm management where farmers indigenous practices are more prevalent by gender

Areas_of_farm_management_where_farmers_indigenous_practices_are_more_prevalent	Gender %	
	Male	Female
Pest management	95	100
Mixed cropping	26	28
Mono cropping	8	3
Seed selection	0	3
Nursing of seeds	3	5
Transplanting	5	6
Rogueing	1	1
Land preparation	63	33
Weed management	40	77
Timely planting	15	13
Ploughing/sowing	7	6
Fertility management	1	0
Postharvest management	4	0
Site selection	20	13

### 3.2. Farmers' suggestions for a better uptake /adoption of improved technologies

The uptake of improved technologies is key to improving farmers' rice yields. Farmers suggested the following interventions for improving their uptake of technologies (Table 6&7) - provision of micro-credit, assistance with inputs, researchers should first acknowledge farmers' practices, organizing farmer field days, sensitization of farmers on new technologies, training through farmers' learning fields, supply and training of farmers on technological packages that have been validated on farmers' fields and proven to be better than farmers practices, frequent visitation from researchers and extension agents, and making technology adoption less expensive for farmers. An average of 65% of both male and female farmers interviewed suggested training through farmers learning field to be a better way to facilitate better adoption of improved technologies. Farmers learning fields will create a platform where farmers will fully participate in the technology development and promotion activities. This will help farmers to better understand the technology in terms of it efficiency and cost involved to generate the technology.

**Table 6: Farmers' suggestion for a better adoption of improved technologies (%)**

District	If researchers technologies are tested on farmers' field and prove better than farmers' practices		Assistance with inputs		Frequent visitation from researchers & extension agents		Training Through Farmers' Learning Fields	
	Male	Female	Male	Female	Male	Female	Male	Female
	%	%	%	%	%	%	%	%
Kailahun	19	14	0	0	19	8	50	69
Kenema	25	14	11	3	0	3	64	67
Kono	44	52	19	11	0	0	37	37
Bombali	15	0	15	22	7	4	63	74
Kambia	0	0	22	22	17	17	50	56
Tonkolili	4	0	11	7	4	15	78	74
Bo	3	6	0	3	3	3	94	89
Bonthe	4	0	15	11	4	33	78	52
Moyamba	4	7	4	4	4	7	78	78
Pujehun	0	7	7	0	4	22	81	33
Average	11.8	10	10.4	8.3	6.2	11.2	67.3	62.9

### 3.3 Views from Key informant interviews

**Table 7: Suggestions for better adoption of researchers'/improved technologies.**

Suggestions	Frequency	Percent	Valid percent	Cumulative percent
If technologies are tested on farmers field and prove better than farmers	5	15.6	15.6	15.6
Training through farmers' learning fields	12	37.5	37.5	53.1
Organizing farmers' field days	1	3.1	3.1	56.2
Frequent visits by researchers and extension	4	12.5	12.5	68.8
Assistance with inputs	9	28.1	28.1	96.9
Provision of micro credit	1	3.1	3.1	100.0
Total	32	100.0	100.0	

### 3.4.Focus Group Discussions across the Ten (10) Districts

#### 3.4.1. Suggestions for a better uptake of improved technologies

The focused group discussions suggested the provision of machines to reduce manual labour, timely planting with the availability of inputs on time, and training through farmers learning fields. Help with fertilizer and seeds of improved rice varieties. Because of these constrains, farm sizes are very small among majority of farmers in Sierra Leone. Also training and provision of working tools, or better farm machines will go a long way in fast tracking adoption of improved technologies. The need for the establishment of chiefdom based offices of the Ministry of Agriculture, Forestry and Food Security, which should target employing many youths, men and women, and also provision of herbicides to control weeds.

#### 4. Conclusions and Recommendations

The conclusions and recommendations of this study are based on the results and findings of this study from all categories of respondents: focus group discussions, household and key informant interviews. In the study, the researchers wanted to know the challenges farmers face in rice farming, whether their indigenous practices and techniques have a gender dimension, and in what direction. Data disaggregated by gender and age are therefore required. According to the research results, some indicators and/or techniques used by farmers are indeed gender sensitive.

The study revealed gender dimensions of indigenous knowledge about the practices of farmers in rice cultivation in different areas of Sierra Leone. In Kono District in the eastern region, with regards to suggestions for better uptake of improved technologies, female farmers ranked as utmost importance “if researchers/ improved technologies are tested on the field and proves better than theirs”, while males prefer “training by field demonstrations on farmers’ learning fields, then they will adopt the research technologies”.

Also analysis showed that there is a strong gender dimension between the gender of farmers and the areas of farm activity where indigenous knowledge is more prevalent, implying that any intervention in this regard should be gender sensitive, and will act as a guide for targeting any particular gender group. Furthermore, Illiteracy is high among farmers, especially female farmers. To minimize some of the constraints to rice production in the study area, farmers should be made functionally literate to be able to do simple book keeping, learning basic calculation of their expenses and income from rice farming, and in entrepreneurial skills.

It is recommended that research be conducted to identify appropriate science-based interventions to improve on the effectiveness of some of these indigenous practices. Therefore the need for a synergy between improved technologies and farmers’ indigenous practices, through farmers’ learning fields and improved availability, accessibility and affordability of agro inputs.

Finally, appropriate policies should be formulated by Government and their implementation monitored to ensure their effectiveness.

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