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Analysis of Farmers' Perception, Preference and Adoption Likelihood for Provitamin-A Cassava Roots in Sierra Leone

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ABSTRACT

The main achievement of any scientific research is to ensure its technology produced is adopted by the intended clientele. The study aimed was to access Farmers' Perception, Preferences and Likelihood Adoption for Provitamin-A Cassava storage roots in Sierra Leone. The study sampled three districts (Bombali, Kailahun and Moyamba) to examined socio-economic characteristics, analyze farmer's perceptions, varietal preferences, determine the maximum likelihood of adoption and rank the most outstanding drivers and barriers of adoption. A multistage sampling technique was employed. Data were collected using pre-tested structured questionnaires for 150 household interviews and semi-structured questionnaires for focus group discussions (FGDs). Data collected were analysed for descriptive and inferential statistics. The results showed that Youths (male) predominated cassava production across the surveyed districts. 43% of the respondents didn't have access to any formal education while 62% of the respondents did not belong to any organization. Farmers however desired provitamin-A cassava that are high yielding, early maturing, appreciable marketable root size that are Poundable. Interviewees had no prior knowledge about provitamin-A cassava, but were willing to adopt it once it's made available. 90% of the respondents were willing to cultivate provitamin-A cassava varieties once it made available due to its nutritional value. The adoption likelihood analysis from two scenarios confirmed that total maximum likelihood adoption rate was 75.4% for scenario one followed by 78.1%forv scenario two. To increase maximum adoption rates for provitamin-A cassava varieties once release, flexible recommendations that combines both farmer's categories and production goals of technologies should be considered given the barriers identified from this pre-ante study in the cassava breeding program.

Keywords

Provitamin-A cassava, Farmer's perception, Preference and adoption likelihood.

Introduction

Cassava is the third-largest source of food carbohydrates in the tropics, after rice and maize and major staple food in the developing world, providing a basic diet for over half a billion people [1]. Africa currently produces more than 50% of global cassava production with 118 million tons and West African production has practically tripled from 26.01 million tons in 1990 to 76.1 million tons in 2011 [2]. Indeed, cassava is fast becoming an elite food

crop in sub-Saharan Africa. Nearly 90% of cassava produced in West African, is consumed by human and the remained 10% is semi-processed for on-farm animal feed [3]. The crop supports limited soil fertility and has the potential to produce high yields under poor conditions [4]. The flesh can be chalk-white or yellowish. Cassava roots are very rich in starch and contain small amounts of calcium (16 mg/100g), phosphorus (27 mg/100g), and vitamin C (20.6 mg/100g) Nevertheless, in Africa, cassava is a marginalized crop in food policy debates because it is burdened with the stigma of being an inferior, low-protein food that is uncompetitive with the glamour crops such as imported rice and wheat [5]. In Sierra Leone, all the released varieties of cassava been cultivated comprise of white or cream/light yellow storage roots and high dry matter content but are deficient in vitamin A. The development of bio-fortified or Provitamin-A cassava by IITA and its research partners is a strategy to address vitamin A deficiency in some of our communities whose consumptions heavily relies on cassava. Adoption of these varieties by farmers in Sierra Leone will amerorate vitamin A deficiency. Bio-fortified yellow storage root cassava has β-carotene, a dietary precursor of vitamin A, which is known to be responsible for the yellow to orange colour of flesh storage roots [6,7]. Vitamin A is important for immune competence and good vision, as well as, cellular differentiation, growth, and reproduction. In human nutritional studies, vitamin A activity is expressed as retinol equivalent, and 6 µg of *all-trans*-β-carotene has the biological (vitamin A) activity of 1 µg retinol [8]. The dietary allowance (RDA) of vitamin A for adults (men and women) and children (4 to 9 years) are 0.75 and 0.3 to 0.4 mg/day retinol activity equivalents (REjm A)/day, [7,8]. These recommended dietary requirements are not adequately supplied in diets, especially in children, pregnant women and the under privileged in most developing countries including Sierra Leone. In a cassava bio-fortification breeding programme for vitamin A, the following factors must be considered: farmers' and consumers' acceptability of the new product and bioavailability of the vitamin and nutrients. In Sierra Leone, adoption rates for new or improved technologies have been rather low; this is because during the early stages of the breeding process, farmers and consumers are not involved. However, it has been recommended that to increase the acceptability and adoption rate for bio-fortified pro-vitamin A cassava cultivar, farmers should be included in formulating research objectives and in the selection of varieties through participatory methods. The introduction of any new varieties with different food component to end-user requires baseline information about farmer's perceptions, hence the need for Adoption Likelihood Analysis (ALA) and Preference studies conducted as supported by Stroup et al., [9] will help researchers to minimize the risk of low adoption by the intended users and thereby foster maximum likelihood of recommended technologies to be adopted when released. The objectives of this study were to examine socio-economic characteristics of the farmers, analysis of farmer's perception and varietal preference, determine the maximum likelihood of adoption and ranked the most outstanding drivers and barriers of adoption of cassava root producers in Sierra Leone.

Materials and Methods

Study Area

The study was conducted in Sierra Leone located on the West Coast of Africa which lies between latitudes 6°55' and 10°00'N and longitudes 10°16' and 13°18'W, and covers a total area of 72 000 km^2 [10]. The study covered three regions with one district selected to make the sample and five chiefdoms selected from each of those selected districts to have a total sample of fifteen chiefdoms. These regions were (Kailahun district) Eastern, (Bombali District) Northern and (Moyamba District) Southern were selected based on the production, distribution and utilization patterns of cassava roots within the country for those selected regions (Figure 1).

Sampling Procedure

The mixed method research design as "qual quant" (qualitative and quantitative) approaches was exploited for this study. This approach is an integrated research paradigm that combines various schools of philosophy, such as positivism and realism within the research design. The qualitative methods exploited in the study include: focus group discussions and observations for the qualitative data, while survey and documentary review were applied to gather quantitative information.

Sample Size Determination

A multistage sampling (which involves purposive, simple random sampling and systematic techniques) was employed to select the cassava storage root producers within the three districts. This sampling method was adopted for determining sample sizes using the formula sampling size:

$$n = \frac{z^2pq}{d^2} = 1$$

Where n = the sample size, z =1.96, p = proportion of population (the proportion of cassava producers in the three regions of Sierra Leone selected), q = a weighting variable computed as 1-p and d = the margin of error.

Since the three regions in the country were known for agricultural production as a main source of livelihood activity, proportion of the population was estimated as 0.5 considering that the exact proportion of the population was unknown. To ease identification among the cassava storage root producers in the sampled population, 8% was used as the margin of error for cassava producers in the study. The sample size for cassava producer's household was computed using Anderson's formula below:

$$n = \frac{z^2pq}{d^2} = 1$$

$$n = \frac{1.96^2(0.5)(0.5)}{0.0800^2} = 150$$

A total of 150 cassava producers were sampled for all the three regions with each having 50 respondents. Community based information sharing, awareness creation and sensitization programs on the benefits of pro-vitamin A cassava in addressing malnutrition were undertaken across different districts before initiating the PRA study in the selected chiefdoms.

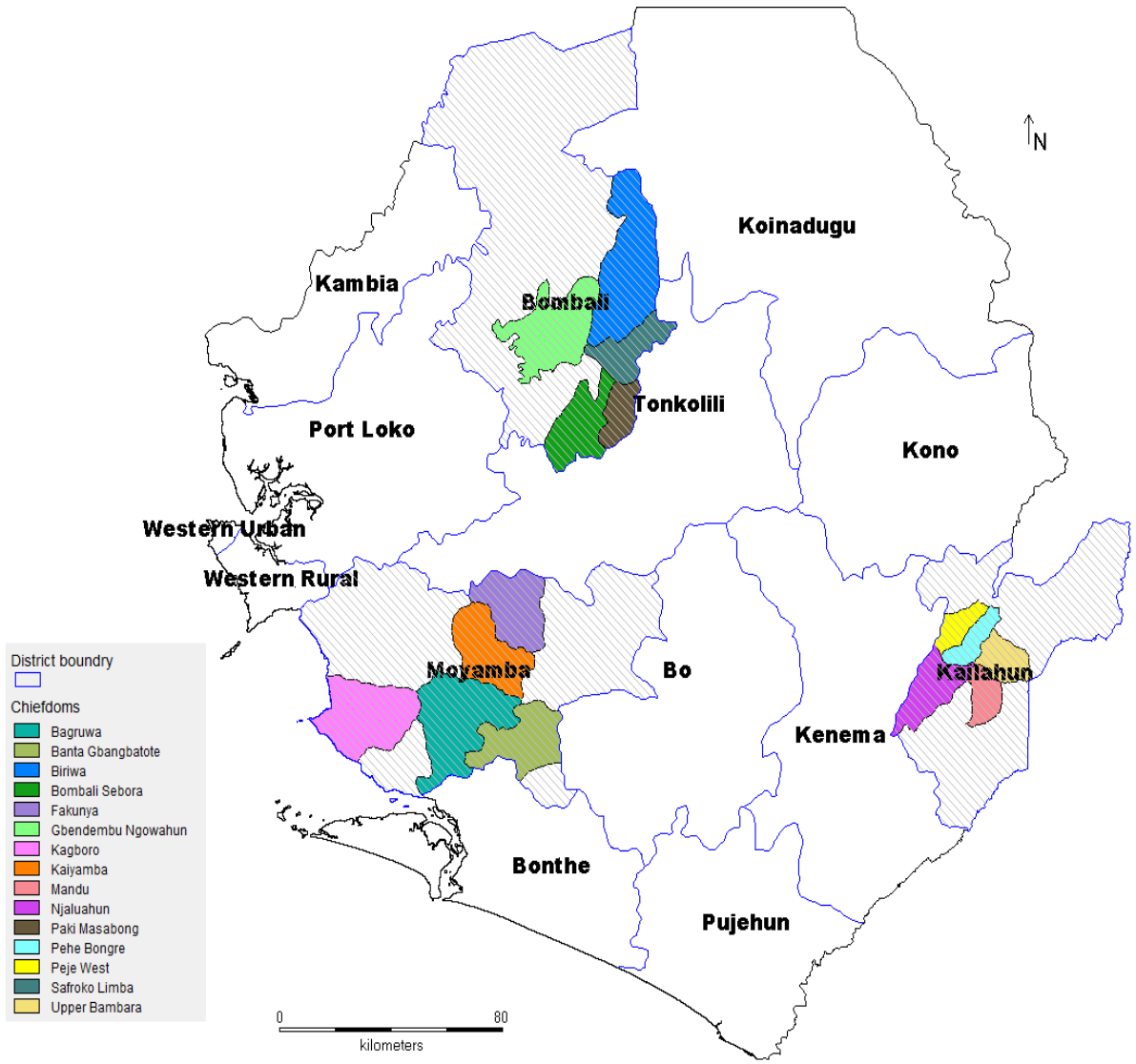

Figure 1: Map of Sierra Leone showing surveyed locations.

Data Collection

Primary and secondary data were collected. The primary data set on pro-vitamin A cassava was sourced from producers of cassava storage roots using pre-tested structured questionnaires for household interviews and semi-structured questionnaires for the focus group discussions. The household quantitative data set was collected through an electronic data capturing device using CSPro software 6.3, while, the qualitative was exploited using charts and notepads. A total of 150 questionnaires were administered to the sampled cassava storage root producers. The qualitative data sets were collected through focus group discussions and field observations with four groups: The discussions were separated into different categories which includes youths, adult male, adult female and all of them pulled together capturing. Secondary data were sourced from relevant journals, textbooks, internet, other related research projects while extensive reviews of relevant literature on cassava value chain report in Sierra Leone was exploited.

Data Analysis

Data collected were analyzed using the SAS 9.3, IBM SPSS Statistics 21 and Microsoft Office Excel 2010. Descriptive statistics (such as means, frequency distribution tables, charts and percentages) were used to describe the socio-economic characteristics, SWOT variables for the various actors in the study area were ranked with the use of Kendall's coefficient of concordance and inferential statistics (Adoption likelihood model).

Empirical Model

Based on the characteristics of targeted cassava producers, it was possible to calculate and predict their maximum adoption rate before any action is undertaken to test or diffuse improve Technologies. This priority estimation needs a good understanding of producers' population and the production goals for which technologies are meant to be. Likelihood to adopt the Provitamin-A or Yellow flesh genotypes were analyzed using a two functions adoption

Table 1: Socio-economic characteristics of respondents.

Socio-economic characteristics	Districts							
	Bombali		Kailahun		Moyamba		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Age group								
Youths below 36 years	21	42	27	54	25	50	73	49
Adults 36-60 years	25	50	19	38	23	46	67	45
Aged above 60 years	4	8	4	8	2	4	10	7
Total	**50**	**100**	**50**	**100**	**50**	**100**	**150**	**100**
Gender								
Female	7	14	1	2	18	36	26	17
Male	43	86	49	98	32	64	124	83
Total	**50**	**100**	**50**	**100**	**50**	**100**	**150**	**100**
Educational level								
None	22	44	19	38	24	48	65	43
Koranic	4	8	2	4	2	4	8	5
Primary	15	30	7	14	9	18	31	21
Junior secondary school	6	12	14	28	9	18	29	19
Senior secondary school	2	4	6	12	5	10	13	9
Tertiary	1	2	2	4	1	2	4	3
Total	**50**	**100**	**50**	**100**	**50**	**100**	**150**	**100**
Marital status								
Married	44	88	44	88	38	76	126	84
Single	3	6	5	10	7	14	15	10
Widow/widower	2	4	0	0	3	6	5	3
Divorced	1	2	0	0	0	0	1	1
Separated	0	0	1	2	2	4	3	2
Total	**50**	**100**	**50**	**100**	**50**	**100**	**150**	**100**
Membership in an organization								
Yes	5	10	24	48	28	56	57	38
No	45	90	26	52	22	44	93	62
Total	**50**	**100**	**50**	**100**	**50**	**100**	**150**	**100**
If yes, key benefits derived from organization								
Labour exchange	3	60	13	54	16	57	32	56
Loan facilities	2	40	2	8	6	21	10	18
Input	0	0	4	17	1	4	5	9
Marketing	0	0	2	8	4	14	6	11
Information sharing	0	0	3	13	1	4	4	7
Total	**5**	**100**	**24**	**100**	**28**	**100**	**57**	**100**

Source: Survey data, 2016

model. The adoption model assumed that technology adoption is a function of the relationship between farmer's category and production goals as summarized in the equation described below.

$$MAR = \frac{\{cf(i,n) * gf(i,n)\}}{100}$$

Where:
MAR = Maximum adoption rate (%)
$gf(i,n)$ =Frequency of farmer categories (%)
$gf(i,n)$ =Frequency of Production goals (%)

Two categories of farmers were identified and three production goals based on their reasons for cultivating cassava were identified in the surveyed areas.

Results and Discussion

Socio-Economic Characteristics of Respondents Across the Surveyed Districts

Youths (< 36 yrs.) played predominant roles in cassava production in Kailahun and Moyamba districts with 54% and 50% respectively, as opposed to Bombali district were 50% of the respondents fall within the age category of 36 – 60 years (adult). It came out clearly that majority 93% of the respondents falls within the active age labour force. This implies that the youth were actively involved in cassava cultivation in Moyamba and Kailahun. Age is said to be a primary latent characteristic in adoption decisions. This agrees with Okoye [11], who reported that young people adopt innovations faster than old people. Nwaru [12] reported that the ability of a farmer to break risk is innovative and starts from 30 years, but decreases with age.

Eighty-six percent, 98% and 64% of the respondents in Bombali, Kailahun and Moyamba districts were male, indicating the predominance of males in cassava farming. The very high percentage of men compared to women in cassava farming in the surveyed districts could possibly be due to lack of mechanization facilities, Labour intensiveness and task demands which may prevent women from actively involving in cassava cultivation and production (SLARI Cassava Value Chain Report unpublished). This was however contrary to findings reported by Adebayor and Salahu [13], Oyegbami et al., [14] and Thompson [15] who reported the higher percentage of female (women) in cassava cultivation and production in Nigeria and Ghana. Respondents with no formal education were the highest 43% followed by primary 21%, junior secondary 19%, senior secondary 9%, koranic 5% and tertiary 3% across the surveyed districts. Education has been reported to be very important as it helps to refine a person's perceptions of issues for him/her to make reasonable decisions based on available information. Low level of formal education of about two-third of the farmers in all three districts contributed to the slowdown of the adoption of released technologies (improved varieties). Ajibefun and Aderinola [16] observed that education facilitates adoption of new varieties; hence the low level of education among farmers in all the three districts sampled could negatively influence the selection and adoption of introduce improved provitamin-A or yellow flesh cassava varieties and gari.

Eighty-eight percent of respondents in both Bombali and Kailahun and 76% in Moyamba which makes up the farming population across the three surveyed districts were legally married implying that the land on which cassava is being cultivated and produced is owned by family, rented by family or secured as a family property. From the FGDs, the average land holdings in the surveyed districts ranges from 0.5 to 6 hectares. This implies that only a small portion of land has been allocated for cassava production and that subsistence agriculture predominates. This however does not serve as motivation in trying new technologies or innovations as it agrees with findings from Ochola [17], who reported that adoption of new technologies may be affected by the land sizes used by farmers for agricultural purposes. Majority of the respondents did not belong to any form of organization. However, 56% of the interviewees in Moyamba district belongs to different organizations such as Agricultural Business Centers and Farmers Based Organizations. Although 60%, 54% and 57% of respondents in Bombali, Kailahun and Moyamba districts confirmed labour exchange as the major benefit derived from belonging to organizations, an additional 40% of respondents in Bombali further revealed that they have been benefiting from loan facilities within their affiliated organizations. This shows that access to loan and labour are the most important resources for cassava cultivation and production in the surveyed areas.

Respondents' Average Income in the Study Areas

It came out clearly that most of the respondents are low income earners and they are earning less than Leones (SLL) 500,000 which is approximately to US 68.00 dollars annually. It implies that this would negatively affects the level of adoption of Provitamin-A Cassava and its products after release.

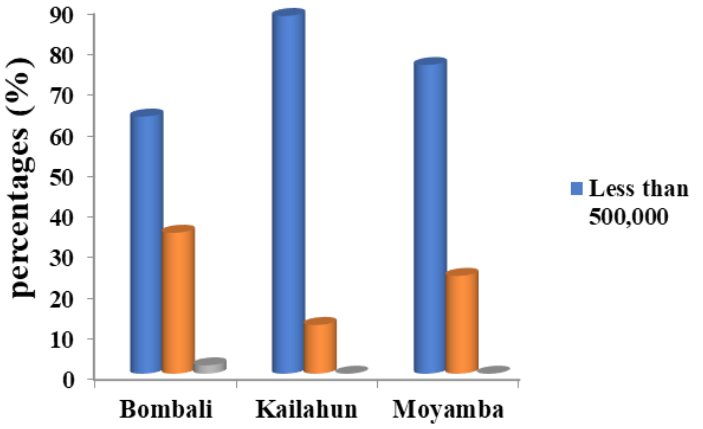

Figure 2: Respondent's average monthly income in the study area.

Varietal Preference for Provitamin-A Cassava Across Districts

Results in Table 2, indicates the importance attached to the different factors that determine the adoption of provitamin-A cassava cultivars by respondents in the three districts. Cultivar selections made by farmers across the surveyed areas in Bombali, Kailahun and Moyamba were based on traits preferences as they were ranked in order of their importance. The first four traits of utmost interest to the farmers in Bombali district were; high yielding, early maturing, edible (mealiness) and root size, while in Kailahun the order of importance for the traits were high yielding, early maturing, root size and petiole colour. In the case of Moyamba, the four most important traits were high yield, early maturing, root size and mealiness. Overall, high yielding, early maturing root size and edible (mealiness) were the key traits for preferred by farmers across the surveyed districts.

Figures in brackets denote traits of preference ranked in order of importance for variety adoption by producers in each district; 1 = highest importance, 9 = lowest importance.

Farmer's Perception for Pro-Vitamin a Cassava across the Survey Districts

Eighty-nine percent of the respondents haven't heard about provitamin-A or yellow flesh cassava. Twenty-four percent, 6% and 4% of interviewees in Bombali, Kailahun and Moyamba have heard about yellow flesh or pro-vitamin A cassava.

Less than 59% of the respondents refers to SLICASS 11 (cream colour) as provitamin-A or yellow flesh biofortified cassava, while 47% of the interviewees have planted yellow flesh (cream colour) variety. Respondents in Bombali were the farmers whom were and are still cultivating yellow flesh or provitamin-A cassava varieties. The presence of an NGO called Village Hope distributing planting materials and processing cassava in Bombali district coupled alongside with the robust activities of SLARI's extension office has contributed greatly in influencing the availability and accessibility of SLICASS 11 (cream colour) cassava. Interviewees further revealed that they source their planting materials from NGOs 87% and Ministry of Agriculture Forestry and Food Security (MAFFS).

Table 2: Varietal preferences of producers for pro-vitamin A cassava across the surveyed districts.

Cassava traits	Districts							
	Bombali (N = 50)		Kailahun (N = 50)		Moyamba (N = 50)		Total (N = 150)	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
High Yield	92	1	98	1	58	1	83	1
Early maturing	72	2	94	2	48	2	71	2
Root size	52	4	46	3	42	3	47	3
Mealiness	70	3	4	7	38	4	37	4
Skin colour	4	6	34	5	24	6	21	5
Petiole colour	2	7	44	4	12	8	19	6
Plant size	2	7	4	7	28	5	11	7
Branching pattern	6	5	0	9	24	6	10	8
Root colour	0	9	8	6	16	8	8	9

Source: Survey data, 2016

Table 3: Farmer's perception of pro-vitamin A cassava across the surveyed districts.

Farmer's perception on yellow flesh cassava	Districts							
	Bombali		Kailahun		Moyamba		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Heard or aware about yellow flesh cassava								
Yes	12	24	3	6	2	4	17	11
No	38	76	47	94	48	96	133	89
Total	**50**	**100**	**50**	**100**	**50**	**100**	**150**	**100**
Name of yellow flesh cassava variety								
SLICASS 11	8	66	1	33	1	50	10	59
Yellow flesh	2	17	2	67	1	50	5	29
Don't know	2	17	0	0	0	0	2	12
Total	**12**	**100**	**3**	**100**	**2**	**100**	**17**	**100**
Have you planted yellow flesh cassava								
Yes	8	67	0	0	0	0	8	47
No	4	33	3	100	2	100	9	53
Total	**12**	**100**	**3**	**100**	**2**	**100**	**17**	**100**
Source of planting materials of yellow flesh cassava variety								
MAFFS	1	13	0	0	0	0	1	13
NGOs	7	88	0	0	0	0	7	87
Total	**8**	**100**	**0**	**0**	**0**	**0**	**8**	**100**
Means of sourcing the yellow flesh cassava variety								
Purchasing	1	13	0	0	0	0	1	13
Gift	7	88	0	0	0	0	7	87
Total	**8**	**100**	**0**	**0**	**0**	**0**	**8**	**100**
Did you plant yellow flesh cassava last season								
Yes	7	88	0	0	0	0	7	87
No	1	13	0	0	0	0	1	13
Total	**8**	**100**	**0**	**0**	**0**	**0**	**8**	**100**
Proportion land area planted with yellow flesh per acre								
0 - 25%	4	57	0	0	0	0	4	57
26 - 50%	2	29	0	0	0	0	2	29
Above 75%	1	14	0	0	0	0	1	14
Total	**7**	**100**	**0**	**0**	**0**	**0**	**7**	**100**
Willingness to grow yellow cassava variety								
Yes	42	98	48	96	48	96	138	97
No	1	2	2	4	2	4	5	3
Total	**43**	**100**	**50**	**100**	**50**	**100**	**143**	**100**

Source: *Survey data, 2016*

Ninety-eight percent, 96% and 96% of interviewees in Bombali, Kailahun and Moyamba districts were willing to adopt pro-vitamin-A or yellow flesh cassava varieties once available.

Overall, 97% of all the respondents across the three districts indicated willingness to adopt provitamin- A or yellow flesh cassava once it's made availa 54321§iuy43poiuytrewq.ble due to its perceived their nutritional quality.

Adoption likelihood analysis of the pro-vitamin A cassava across the surveyed areas,

Maximum likelihood (rate) of adoption of pro-vitamin A cassava genotypes

Table 4, confirms the maximum adoption rates for different scenarios that were based on farmers' category and production goals. The adoption likelihood analysis showed that, scenario one has a total maximum likelihood adoption rate of 75.4% while scenario two was 78.1%. The indicates that, there is an interaction between different production goals and farmer categories while blanket recommendations have low maximum adoption rates. In other to increase the maximum adoption rates flexible recommended that has several-dimensions of technologies must be taken into consideration. This is similar to findings reported by Tenge et al., [18].

Table 4: Maximum possible adoption rate of Yellow Flesh Cassava Varieties.

There are two categories of farmers with three production goals for cassava production					
Category A = 37.3%			**Category B = 62.7%**		
G1 = 14.3%	G2 = 48.2%	G3 = 37.5%	G1 =30.9%	G2 = 56.4%	G3 = 12.8%
C_AG_1 rate = (14.3 x 37.3) / 100 = 5.3%			C_BG_1 rate = (30.9 x 62.7) / 100 = 19.4%		
C_AG_2 rate = (48.2 x 37.3) / 100 = 18.0%			C_BG_2 rate = (56.4 x 62.7) / 100 = 35.4%		
C_AG_3 rate = (37.5 x 37.3) / 100 = 14.0%			C_BG_3 rate = (12.8 x 62.7) / 100 = 8.0%		
If the technology is applicable to production goals 2 and 3 then, MAR = **75.4%** (32.0 + 43.4) If the technology is applicable to production goals 1 and 2 then, MAR = **78.1%** (23.3 + 54.8)					

Source: Survey data 2016

Note:
C_A = Farmer category 1(% of farmers that grow cassava as MAIN crop "yes")
C_B = Farmer category 2 (% of farmers that grow cassava as not MAIN crop "no")
G_1 = Production goal 1 (% of farmers for Consumption/Food security)
G_2 = Production goal 2 (% of farmers for Market/Income)
G_3 = Production goal 3 (% of farmers for Processing)

Scenario 1: Using farmer's category (Cassava as MAIN crop of cultivation), provitamin-A or yellow flesh cassava which were applicable for two production goals (2 & 3) and would have a maximum adoption rate of 32.0% by category A farmers and 43.4% by category B farmers. This accumulates a total maximum adoption rate of 75.4%.

Scenario 2: Using farmer's category (Cassava as MAIN crop of cultivation), provitamin-A or yellow flesh cassava which were applicable for two production goals (2 & 3) and would have a maximum adoption rate of 23.3% by category A farmers and 54.8% by category B farmers. This accumulates to a total maximum adoption rate of 78.0%

SWOT Analysis for Cassava Producers: Drivers and Barriers for Potential Adoption for Provitamin-A Cassava

Enablers / Drivers for potential adoption of provitamin-A cassava

Result in Table 5, reveals that respondents' perception on strengths and opportunities across the surveyed districts. The key strengths by producers were access to land availability and household labour while the major opportunities were accessibility to improved planting materials and processing units/centers within their communities. The Kendall's coefficient of concordance indicates a high degree (0.57) of agreement among the producers in relation to their strengths and low degree (0.20) of agreement as in the case of their opportunities even though the P values for strengths and opportunities were highly significant. The major adoption drivers identified in this study could possibly enhance the quick adoption of provitamin-A cassava once it is release and made available.

Barriers for Potential Adoption of Provitamin-A Cassava

The result in Table 6, confirms respondents' perception on weaknesses and threats across the three surveyed districts. Limited access to finance and credit and high transportation cost of cassava storage roots were highlighted as key weaknesses while lack of eternal funding, transportation and high market competition as threats. The Kendall's coefficient of concordance indicates a low degree (0.27) of agreement among the producers in relation to their weaknesses and very low degree (0.01) of agreement with their threats. The P value for weaknesses were highly significant while threats weren't significant. The major barriers, weaknesses and threats listed here could possible impede the growth, expansion and adoption of provitamin-A or yellow flesh cassava production once it made available if immediate interventions to combat them are not taken into consideration. These findings agrees with that of Parkes, [19] who reported that high cost of transportation negatively affects cassava production and expansion in Ghana. Respondents showed a high level of willingness to adopt and promote the use of provitamin-A or yellow flesh cassava roots and products, due to its perceived nutritional benefits. This agrees with the results of Nkonya and Featherstone, who found that varieties with farmers' preferred traits were easily adopted. Farmers' personal experiences influenced decisions on what varieties they grew.

Conclusion

Participatory Rural Appraisal approach used in this study yielded meaningful results as cassava value chain actors willingly shared their experiences and knowledge. A reliable database on provitamin-A cassava has been developed. Farmers appreciate new technologies that have added advantages over their existing technologies. There is high prospect for this new technology (provitamin-A cassava) to be adopted in Sierra Leone as revealed in this study. Producers' preference for provitamin-A cassava root is linked to the crop's nutritional benefits as informed during the awareness and sensitization campaigns conducted before

Table 5: Kendall Strength and Opportunity ranking for cassava producers: Drivers for potential adoption.

Key Drivers	Bombali		Kailahun		Moyamba		Total	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Strengths								
Agricultural land	1.50	1	1.04	1	2.00	1	1.51	1
Labour	2.02	2	1.98	2	2.74	2	2.25	2
Improved planting material	2.88	3	3.04	3	4.02	3	3.31	3
Finance and credit	4.92	4	5.16	5	4.82	5	4.97	4
Member of FBO	5.50	5	5.58	6	4.82	5	5.30	6
Experience and knowledge	5.50	5	6.06	7	5.28	7	5.61	7
Have processing facilities	5.68	7	5.14	4	4.32	4	5.05	5
P value	<0.0001		<0.0001		<0.0001		<0.0001	
Kendall's W[a]	0.71		0.83		0.31		0.57	
Opportunities								
Availability of improved varieties	1.82	1	1.08	1	2.38	1	1.76	1
Support from government and NGOs	2.90	2	3.08	3	3.82	5	3.27	3
Training on improved agronomic practices	3.02	3	3.76	4	3.30	4	3.36	4
Availability of markets	3.62	4	4.08	5	2.76	3	3.49	5
Availability of processing Centre's	3.64	5	3.00	2	2.74	2	3.13	2
P value	<0.0001		<0.0001		<0.0001		<0.0001	
Kendall's W[a]	0.22		0.54		0.13		0.20	

Source: Survey data, 2016

Table 6: Kendall Weakness and Threat ranking for cassava producers: Barriers for potential adoption.

Weaknesses and Threats	Bombali		Kailahun		Moyamba		Total	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Weaknesses								
Limited access finance and credit facilities	2.04	1	1.22	1	2.45	1	1.90	1
High transportation cost of tubers	2.26	2	2.48	2	2.74	2	2.49	2
Limited access to market	3.08	3	3.14	3	3.09	3	3.1	3
Lack agricultural machines and equipment	3.50	4	3.82	4	3.40	5	3.57	4
Low agricultural productivity	4.12	5	4.34	5	3.32	4	3.93	5
P value	<0.0001		<0.0001		<0.064		<0.0001	
Kendall's W[a]	0.30		0.59		0.01		0.27	
Threats								
Lack of external funding	2.00	1	4.00	5	3.02	5	3.01	4
High transport fares	2.92	2	3.62	4	3.14	3	3.23	5
High market competition	2.86	3	2.84	3	3.18	4	2.96	3
High interest rates on loan	3.46	4	2.40	2	2.94	2	2.93	2
High cost of agricultural machinery	3.76	5	2.14	1	2.72	1	2.87	1
P value	<0.0001		<0.0001		<0.611		<0.353	
Kendall's W[a]	0.18		0.25		0.01		0.01	

Source: Survey data, 2016

the data collection across the surveyed districts. Therefore, to increase the maximum adoption rates for provitamin-A cassava varieties once release, flexible recommendations that combines farmer's categories and production goals of technologies are to be addressed and taken into consideration as identified during this pre-ante study. There is no available market outlet where yellow cassava or provitamin-A storage roots/products can be obtained across the three surveyed districts. Adoption of provitamin-A cassava varieties once release will contribute to the reduction of malnutrition in children under five years, pregnant and lactating mothers and enhance livelihood and food nutritional security for cassava producers in Sierra Leone.

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