Scientific Research Publishing

American Journal of Plant Sciences, 2023, 14, 741-762
https://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

Ethnobotanical Knowledge of Local Cassava Varieties and Characteristics Desired by Farmers in Sierra Leone

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How to cite this paper: Sesay, J.V., Lebbie, A., Wadsworth, R. and Chakanda, R.T.M. (2023) Ethnobotanical Knowledge of Local Cassava Varieties and Characteristics Desired by Farmers in Sierra Leone. *American Journal of Plant Sciences*, **14**, 741-762.
https://doi.org/10.4236/ajps.2023.147050

Received: May 26, 2023
Accepted: July 18, 2023
Published: July 21, 2023

Abstract

It has been observed that farmers adopt only a small number of the "improved" cultivars. A nationwide germplasm collection exercise in February 2018 provided the opportunity to collect indigenous technical knowledge (ITK) of the diversity of cassava varieties in terms of: their morphology, growth characteristics, uses (of tubers and leaves) and desirable characteristics. The objective is to see to what extent the objectives of the plant breeders are consistent with what farmers' value. We performed 405 structured and semi-structured interviews with informants who were selected based on "purposive household sampling". We found a considerable turn-over in cassava varieties, just over a third (45) have been in cultivation for at least 40 years, however, since the end of the civil war an additional 25 varieties are cultivated, while others varieties seem to have disappeared. One major issue with estimating turnover of varieties is whether the same variety might have several local names, and conversely the same name may be applied to different cultivars. Farmers overwhelmingly use ITK to select and preserve cassava germplasm for future use. Farmers have a clear preference for: sweet taste, high yield, early maturity and easy cooking and preferentially adopt cultivars that have those qualities. Cassava is primarily a human food eaten boiled or fried, some are processed into fufu and gari, and uses as livestock feed and medicine are reported but at low levels. The information produced during this study could help plant breeders choose selection criteria that will ensure their efforts are adopted and sustainable, the importance of preserving the genetic resources of local cultivars is also highlighted.

Keywords

Ethnobotanical-Knowledge, Local Cassava Varieties, Morphological

Characteristics, Farmers' Criteria

1. Introduction

Cassava is the most important crop in Sierra Leone and other Africa Countries within sub-Sahara that serves both as a staple and cash crop with a production rate of 30 million tons in 2018 [1]. In countries like Cambodia's cassava production increased from 150,000 tons to over 12 millons ton between 2000 and 2020 [2]. They set ambitious plans for production and processing with the aim of developing exports [3]. With this expansion, cassava has become core to the cropping systems of many small producers and even a pillar of rural livelihood around the globe [4] [5]. It's been produced in most African countries with DRC and Nigeria being the largest producers respectively with an average fresh root consumed per individual up to 334 kg of fresh storage roots, 150 kg of flour and 2 kg of leaves per year [6]. Moreover, cassava is the main source of revenue for 70% of households and the main source of nutrients for 70% - 80% of some Africa Countries. [7] Cassava is one of the most important crops for marginal lands, because of its drought tolerance and flexibility in planting and harvesting time, and well suited for incorporation in various cropping systems [8] [9] [10] [11] [12].

In Sierra Leone, the area under cassava cultivation is about 99,484 ha yielding a total of 479,458 ha with an average yield of 4.8 metric tonnes per hectare [13]. It is the second staple food after rice, and is grown by nearly every farming family as a source of income, processed into fufu and gari through value addition. The protein-rich leaves are widely and frequently consumed, and cassava provides on average 30% of daily calorie intake [1] [14] [15].

Smallholders tend to grow several varieties each year, each with locally preferred characteristics such as taste, early maturity, pest and disease resistance, and/or processing characteristics [16] [17]. It is known that farmers select and name cassava varieties based on morphology (e.g. tree), food (e.g. cooksoon), social and economic interest (e.g. IDA), village or community (e.g. Warima) or who they got it from (e.g. Ya Kanu) ([18] [19]. These findings agree with [20], who indicated that the naming criteria of rice varieties in the Himalayas were based on morphological traits, environmental adaptability, agronomic traits, place of origin and local recipes.

It has been observed that the various tribal groups in Sierra Leone give different names to the same cassava varieties according to their ethnicity, and this situation makes it difficult to ascertain the actual numbers and identities of cassava varieties under cultivation across the country. To date, there is no estimate of the diversity of cassava cultivars in circulation in the country either prior to the civil war, or post-civil war. The aim of this study was to collect cassava germplasm across the various agro-ecological zones with the aim of assessing the diversity of

the various local cassava accessions using ethnobotanical knowledge, morphological characterization and genetic diversity in order to assist the breeding efforts in Sierra Leone. In this paper, focus is placed on the first two components and the genetic diversity studies are addressed elsewhere.

2. Materials and Methods

2.1. Description of Study Area

The collection and characterization of local cassava varieties was conducted in rural communities located in the northern (Koinadugu, Bombali and Kambia districts), eastern (Kono, Kailahun and Kenema districts) and southern (Pujehun, Bo and Bonthe districts) regions of Sierra Leone (Figure 1). These activities were carried out between 5th and 14th February 2018. The districts were selected using the standard methodology employed by SLARI (Sierra Leone Agricultural Research Institute) to form a stratified random sample based on agro-climatic zones.

2.2. Data Collection

Qualitative and quantitative approaches were utilized in conducting the research which involved the use of structured open-ended and semi-structured questionnaires. The questionnaires were administered to 405 farmers (in each of nine

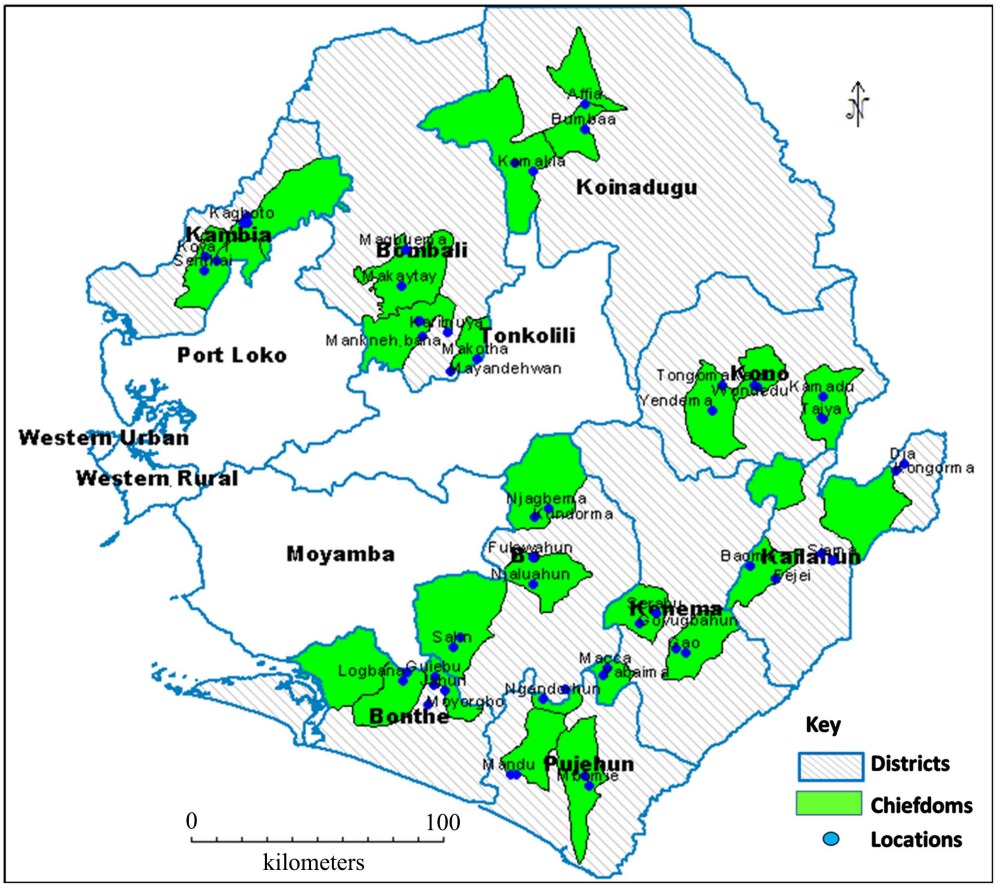

Figure 1. Map of Sierra Leone showing cassava germplasm collection area.

Districts, 3 Chiefdoms were selected, and in each Chiefdom one community, a total of 27 communities). We randomly selected 15 cassava farmers in each community, among male and female respondents with ages ranging between 18 to 86 years. Questionnaires obtained local knowledge of the varieties, uses and characteristics utilized in the categorization of the crop. The individual interviews were conducted using android devices programmed with the Census and Survey Processing System (CSPro 6.3) Macro international and serpo. SA 2000 software package. Focus group discussions (FGD) were conducted in each of the 27 communities, and each FGD comprised between 8 and 13 participants selected from the farmer groups participating in cassava cultivation. In communities, the turn-out of participants where high, male and female FGDs were held separately. This in-community approach allowed in depth observations and triangulation of some of the information provided by respondents during individual interviews and at the same time cross-checking the responses. After permission was obtained from the community and germplasm holders, a transect walk was conducted with key informants who volunteered to participate in the collection of the cassava germplasm.

One hundred and fifty-seven samples (cuttings) were collected from the farmers and characterised in terms of morphology, farmers' preferences and special attributes, and IITA cassava descriptors [21]. The data collected included accession code, local name of variety, sample status, name of farmer, ethnic group, village, collection institution, names of individuals forming the collection team, collection date, taste, maturity period, target use, period that variety had been with the farmer and preferred characteristics of the variety. The location of collection in terms of latitude, longitude and altitude were captured using a handheld GPS device.

The samples were planted in February 2018 at the Department of Biological Sciences trial site on the main campus of Njala University. The land was manually prepared using simple farm tools in an area of 24.5 m × 56 m, with a planting space of 1 m between plots and 0.75 m within plants. Cassava cuttings comprising of 20 - 30 cm length or 4 - 6 nodes were horizontally planted on ploughed soil at a depth of 10 cm. Weeding was done manually when necessary and irrigation was done on a daily basis up to three months. Harvesting was carried out 9 and 12 months after planting, with the goal of obtaining the best harvesting time with respect to variety and yield.

Morphological characterisation of the above and below ground parts was conducted using a modified cassava descriptor from IITA WMG (Fukuda 2010). The characteristics scored were: shoot colour, shoot pubescence, leaf lamina colour, leaf lobe shape, petiole colour, tender shoot colour, mature stem colour, branching habit, root outer skin colour, root inner skin colour, root pulp colour and taste.

2.3. Data Analysis

Qualitative data from FGDs was analysed using non-statistical methods such as

content analysis, pair wise and matrix ranking techniques which involved extracting the information and clustering it into themes and sub-themes and ranking according to priorities, weights or proportions of responses in a certain category [19]. Quantitative data from the household interviews was exported to various statistical packages: Statistical Analysis Systems (SAS 9.3), Microsoft Excel 2010 and Statistical Package for the Social Sciences (IBM SPSS Statistics 2) for analysis using different analytical tools in statistics.

Descriptive statistics (mean, frequency and percentages) were used to analyse quantitative data related to the respondent's profile, cassava production, access to agricultural inputs and services. KENDALL test was used to determine the degree of agreement among farmers in the ranking of cassava traits they preferred when selecting varieties for cultivation.

3. Results and Discussion

3.1. Diversity of Cassava Varieties in Sierra Leone

Farmers reported a total of 110 local names for cassava varieties they had grown both before the war (pre-1991) and were currently growing. Samples could not be obtained for all these names, and 43 of them were mentioned only once by a single farmer (out of 405 farmers who were interviewed). Local cassava varieties are divided into three broad groups:

- Common before the war but now rare or absent;
- Common before and after the war;
- Common now but rare or absent before the war.

Analysis is restricted to those varieties that were reported by five or more farmers (Table 1). A descriptive analysis showed that before and after the war, 19 different varieties of cassava were grown in the eastern, 14 in northern and 12 in southern regions of Sierra Leone. The results indicate that the reduction of cassava varieties used after the war in the Eastern Region with Nika-Nyene (−87.5%) and Banaquee (−85.7%) showed the greatest declines. In the Northern and Southern Region, kabei declined significantly (62.5% and 93.3%) followed by Rubber (88.9%).

There was an increase in the cultivation of some varieties after the war; in the Northern Region, Topoica (133%), Ya-Kanu (133%), Laguineanka (125%) and Rocass (100.0), all rapidly increased. In the Southern Region, Tangayawa (100%) and Majawai (100%) increased while in the Eastern Region, only Hamawai (100.0%) showed much increase.

3.2. Reasons for Abandoning Cassava Varieties

Table 1 indicated that most cassava farmers in all regions were changing the varieties they grew. The main reasons given for rejecting a variety were:

- BT: Bitter Taste;
- IBV: Introduction of Better Varieties;
- LMP: Long Maturity Period;

Table 1. Cassava varieties reported as being cultivated before the civil war (BW that is before 1991) and after the war (AW that is in 2018) by region.

Variety	Eastern region			Northern region			Sothern region		
	BW	AW	%	BW	AW	%	BW	AW	%
3 months	4	32	700	2	4	100.0	0	0	0.0
6 months	2	36	1700	0	0	0.0	0	0	0.0
Banaquee	14	2	−85.7	0	0	0.0	0	0	0.0
Barkei	2	6	200	0	0	0.0	0	0	0.0
Cocoa	86	30	−65.1	116	70	−39.7	134	28	−79.1
Gbekor	6	14	133.3	0	0	0.0	0	0	0.0
Gbongota	4	6	50	0	0	0.0	0	0	0.0
Gendemeh	2	8	300	12	13	8.3	0	0	0.0
Guineaca	0	0	0.0	4	8	100.0	0	0	0.0
Hamawai	0	0	0.0	0	0	0.0	2	4	100.0
IDA	0	0	0.0	10	22	120.0	0	0	0.0
Kabei	52	8	−84.6	20	8	−60.0	30	2	−93.3
Kandabendu			0.0	0	0	0.0	12	4	−66.7
Kandagboi	58	34	−41.4	0	0	0.0	156	52	−66.7
Kandamayugbe	6	2	−66.7	0	0	0.0	10	2	−80.0
Katala	0	0	0.0	0	0	0.0	2	3	50.0
Manjawai	0	0	0.0	0	0	0.0	2	4	100.0
Ndiamonyamawo	2	8	300.0	0	0	0.0	46	32	−30.4
Nikanyene	16	2	−87.5	0	0	0.0	0	0	0.0
Obasai	14	6	−57.1	0	0	0.0	0	0	0.0
Pajero	2	10	400.0	0	0	0.0	4	2	−50.0
Rubber	2	4	100.0	0	0	0.0	18	2	−88.9
Tangagbe	18	16	−11.1	0	0	0.0	0	0	0.0
Tangayawa	26	22	−15.4	0	0	0.0	2	4	100.0
Yamba fulalane	10	6	−40	0	0	0.0	0	0	0.0
Laguineaka	0	0	0.0	8	18	125.0	6	4	−33.3
Milikit	0	0	0.0	22	20	−9.1	10	4	−60.0
Munafa	0	0	0.0	38	40	5.3	0	0	0.0
Rocass	0	0	0.0	4	8	100.0	0	0	0.0
Samuyana	0	0	0.0	16	6	−62.5	0	0	0.0
Tapoica	0	0	0.0	6	14	133.3	0	0	0.0
Warima	0	0	0.0	122	158	29.5	0	0	0.0
Ya kanu	0	0	0.0	12	28	133.3	2	6	200.0
Siamie	0	0	0.0	0	0	0.0	6	4	−33.3
Tissay	0	0	0.0	0	0	0.0	10	4	−60.0

Cassava varieties cultivated before the war (pre-1991) and after the war (post-2001).

- LVW: Lost Variety during War;
- LRY: Low Root Yield;
- PCQ: Poor Cooking Quality;
- PYPM: Poor Yield of Planting Materials;
- SPD: Susceptible to Pest and Diseases.

Table 2 summarises the reasons for adopting or rejecting particular varieties given by farmers in the three regions.

Table 2. Reasons for not cultivating some varieties after the war.

Variety	Reasons (%)							
	BT	IBV	LMP	LVW	LRY	PCQ	PYPM	SPD
Eastern region								
Nikanyene	0.0	3.6	0.6	3.0	0.0	0.0	0.0	0.0
Banaquee	0.0	1.8	2.4	0.6	0.0	0.0	0.0	0.0
Kabei	0.6	10.7	2.4	13.6	0.6	0.0	1.2	0.0
Kandamayugbe	0.0	1.2	0.0	1.2	0.0	0.0	0.0	0.0
Cocoa	0.6	5.3	5.3	11.2	4.7	0.0	2.4	1.2
Obasai	0.0	0.0	0.6	1.8	0.6	0.6	0.6	0.0
Kandagboi	0.0	6.5	3.0	8.3	0.6	0.0	0.6	0.0
Yambafulalane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tangayawa	0.0	0.6	0.0	1.2	0.0	0.0	1.2	0.0
Tangagbe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total: 10	**1.2**	**29.6**	**14.2**	**40.8**	**6.5**	**0.6**	**5.9**	**1.2**
Northern region								
Samuyana	0.0	0.0	1.2	1.2	2.4	0.0	0.0	0.0
Kandamayugbe	0.0	7.3	1.2	2.4	0.0	0.0	0.0	0.0
Cocoa	0.0	18.3	12.2	19.5	14.6	0.0	1.2	0.0
Milikit	1.2	8.5	0.0	4.9	1.2	1.2	0.0	0.0
Total: 4	**1.2**	**34.1**	**14.6**	**28.0**	**18.3**	**1.2**	**1.2**	**0.0**
Southern region								
Kabei	0.0	2.5	0.4	1.4	0.0	0.0	0.0	0.0
Rubber	0.0	1.1	0.4	2.5	0.0	0.0	1.8	0.0
Kandamayugbe	0.0	1.1	0.0	0.7	0.4	0.0	0.4	0.4
Cocoa	0.4	6.8	4.3	10.4	2.2	0.7	8.3	0.7
Kandabendu	0.0	0.4	0.4	0.4	0.0	0.0	0.4	0.0
Kandagboi	0.7	9.0	2.5	11.5	2.9	0.7	7.9	0.7
Tissay	0.4	1.1	0.4	0.7	0.7	0.4	0.0	0.0
Pajero	0.0	0.0	0.4	0.7	0.4	0.0	0.0	0.0
Siamie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ndiamonyamawo	0.0	2.5	0.0	4.0	1.4	0.0	2.5	0.4
Total: 10	**1.4**	**24.5**	**8.6**	**32.4**	**7.9**	**1.8**	**21.2**	**2.2**

3.3. Reasons for Growing Other Cassava Varieties after the War

After the civil war, farmers continued to grow some cassava varieties that were grown before the war (Table 3), and reasons given across the Eastern, Northern and Southern Regions of Sierra Leone were due to the following traits observed by local farmers:

Table 3. Reasons for cultivating varieties after the war.

Variety	BRS	EM	GPQ	GCQ	HDM	HMVR	HRY	SMP	SRT
Eastern region									
Gbongota	0.0	0.0	0.0	0.7	0.0	0.7	2.2	0.0	1.4
Rubber	0.0	0.0	0.0	0.7	0.0	0.0	0.7	0.0	1.4
Gbekor	0.0	0.0	0.0	4.3	0.0	0.7	4.3	0.7	4.3
Barkei	0.0	0.0	0.7	0.0	0.0	0.0	2.2	1.4	1.4
Gendemeh	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.7	2.2
Ndiamonyamawo	0.0	0.0	0.0	2.9	0.0	0.0	0.7	0.0	3.6
Pajero	0.7	0.0	0.0	2.9	0.0	0.0	2.2	0.7	2.2
3 months	0.0	0.0	0.0	3.6	0.0	0.7	7.2	3.6	7.9
6 months	0.0	0.0	0.0	4.3	0.0	0.0	9.4	5.0	8.6
Total: 9	**0.7**	**0.0**	**0.7**	**19.4**	**0.0**	**2.2**	**31.7**	**12.2**	**33.1**
Northern region									
Munafa	0.2	0.0	0.0	1.7	0.0	1.7	3.1	2.3	5.2
Gendemeh	0.0	0.0	0.2	0.8	0.0	0.2	0.8	0.2	1.4
Warima	0.2	0.0	0.6	12.0	0.2	2.1	15.1	1.2	22.3
Agriculture	0.0	0.0	0.4	0.4	0.0	0.0	0.2	0.0	0.2
Guineaca	0.0	0.0	0.0	0.4	0.0	0.0	0.8	0.4	0.8
Rocass	0.0	0.0	0.0	0.6	0.0	0.2	0.2	0.0	0.6
IDA	0.0	0.0	0.2	0.6	0.0	0.0	2.7	0.8	1.4
Laguineaka	0.0	0.2	0.0	1.9	0.0	0.4	1.7	0.6	0.6
Tapoica	0.0	0.0	0.0	0.4	0.0	0.2	1.4	0.8	1.2
Ya kanu	0.0	0.0	0.0	0.8	0.0	0.6	2.3	0.0	4.1
Total: 10	**0.4**	**0.2**	**1.4**	**19.6**	**0.2**	**5.4**	**28.3**	**6.4**	**38.0**
Southern region									
Katala	0.0	0.0	5.3	0.0	0.0	0.0	5.3	0.0	0.0
Hamawai	0.0	0.0	0.0	2.6	0.0	0.0	2.6	0.0	5.3
Manjawai	2.6	0.0	2.6	0.0	2.6	0.0	2.6	0.0	0.0
Piseh	2.6	0.0	0.0	2.6	0.0	0.0	2.6	0.0	2.6
Yakanu	0.0	0.0	0.0	7.9	0.0	0.0	5.3	0.0	7.9
Bongoman	0.0	0.0	2.6	10.5	0.0	0.0	7.9	0.0	15.8
Total: 6	**5.3**	**0.0**	**10.5**	**23.7**	**2.6**	**0.0**	**26.3**	**0.0**	**31.6**

- Sweet root taste (SRT) (33.1%);
- Higher root yield (HRY) (31.7%);
- Good cooking quality (GCQ) (19.4%).

The two most preferred local "standard" varieties in the East are; "6 months" and "3 months", in the North "Warima" is preferred and in the South "Bongoman".

3.4. Cultivation of New Cassava Varieties in Post-War Sierra Leone

A total of 24 different new cassava varieties were cultivated in eastern, southern and northern regions of Sierra Leone (Table 4). Among those "new" varieties cultivated by cassava farmers, the "Slicass" are easily identifiable by name as being improved varieties, but of the 12 Slicass varieties released, only Slicass 4 is widely reported (southern, 92.6%, eastern, 63.0% and northern, 58.5%). The higher uptake in the south may be due to the promotion of gari and fufu processing centres in the south, and Slicass 4 was developed for processing into gari and fufu. Varieties like Butter, Slicass 1 and Cooksoon were only cultivated in the eastern and southern regions of Sierra Leone, and Cooksoon ranked the highest percentage of cultivation, as it is intended to address hunger in the rainy season, due to its ability to cook and mature faster than the other local varieties of cassava. According to the respondents, the cultivation of Butter variety was greatest in the south (32.6%) than the east (11.9%).

The new cassava varieties that were only cultivated in the north after the war were Nylon, Rubber and Slicass 12, while Care, Slicass 5, Slicass 7, and 3 months cassava varieties were only cultivated in the south. The results in Table 4 revealed that 16 new cassava varieties were cultivated in the east, 5 in the north 5 and 10 in the south. It was observed that 90% - 95% of the cassava varieties cultivated after the war were improved varieties provided by the Ministry of Agriculture, Forestry and Food Security (MAFFS), Sierra Leone Agricultural Research Institute (SLARI), and Non-Governmental Organisations (NGO) supporting livelihood recovery after the civil war.

3.5. Reasons for Newly Cultivated Cassava Varieties

In Table 4, respondents showed that the reasons for adopting a new variety were the same as for continuing to cultivate an established variety, namely; sweet root taste (35.6%), high root yield (28.2%), and good cooking quality (17.8%). Among the newly cultivated varieties, Cooksoon and Shortman are preferred varieties. In the northern region, Slicass 4 is prominent due to its good processing quality and high root yield, while Slicass 6 was preferred because of its high root yield, and Slicass 12 for its sweet root taste. In the southern region, high root yield (38.4%), good processing quality (26.8%) and sweet root taste (19.1%) were indicated as top reasons for cultivating new varieties and Slicass 4 was the most popular.

Table 4. Cultivation of new cassava varieties in post-war Sierra Leone.

Variety	BRS	EM	GPQ	GCQ	HDM	HMVR	HRY	SMP	SRT
Eastern region									
Chinese	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
Kandabendu	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Laguineaka	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0
SLICASS 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
Warima	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.6
SLICASS 6	0.0	0.0	0.6	0.0	0.0	0.6	1.1	0.0	0.0
White cassava	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.6	1.1
SLICASS 4	0.0	0.0	2.3	0.0	0.0	0.0	2.3	0.0	0.0
Yakanu	0.0	0.0	0.0	0.6	0.0	0.0	0.6	0.6	1.7
Bomba	0.6	0.0	2.3	0.0	0.0	0.0	2.9	0.0	0.0
Musakoro	0.0	0.0	0.6	0.6	0.0	0.0	1.7	1.1	1.7
Eighty	0.0	0.0	0.6	0.0	0.0	0.0	3.4	0.0	2.9
Butter	0.0	0.0	0.0	2.3	0.0	0.0	2.3	0.0	4.6
Shortman	0.0	0.0	0.0	4.0	0.0	0.0	5.2	2.3	10.3
Cooksoon	0.0	0.6	0.0	9.8	0.0	1.1	5.2	3.4	10.9
Total: 16	**0.6**	**0.6**	**6.3**	**17.8**	**0.0**	**1.7**	**28.2**	**9.2**	**35.6**
Northern region									
Nylon	0.0	0.0	1.8	1.8	0.0	0.0	1.8	0.0	1.8
Rubber	0.0	0.0	1.8	0.0	1.8	0.0	3.6	0.0	3.6
SLICASS 12	0.0	0.0	0.0	1.8	0.0	0.0	3.6	0.0	5.4
SLICASS 6	1.8	0.0	0.0	3.6	0.0	0.0	7.1	1.8	3.6
SLICASS 4	0.0	0.0	26.8	1.8	0.0	0.0	21.4	3.6	0.0
Total: 6	**1.8**	**0.0**	**30.4**	**8.9**	**1.8**	**0.0**	**37.5**	**5.4**	**14.3**
Southern region									
CARE	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
SLICASS 1	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0
SLICASS 5	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
3 months	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.8
Munafa	0.3	0.0	0.6	0.3	0.0	0.0	1.9	0.6	0.3
SLICASS 6	0.3	0.0	1.7	0.0	0.0	0.0	3.6	0.3	1.4
Butter	0.0	0.0	0.0	4.1	0.0	0.0	2.2	0.3	5.5
Cooksoon	0.0	0.0	0.0	5.8	0.0	0.0	1.9	0.0	7.2
SLICASS 4	0.3	0.0	24.6	0.6	0.0	0.6	26.0	0.6	2.2
SLICASS 7	0.0	0.0	0.0	1.1	0.0	0.0	1.4	0.0	1.4
Total: 10	**1.1**	**0.3**	**26.8**	**11.9**	**0.0**	**0.8**	**38.4**	**1.7**	**19.1**

3.6. Local Utilization of Cassava Parts

Cassava is put to a myriad of uses by locals and during the survey, it was observed that most farmers grow cassava to meet diverse needs including livestock feed, medicinal and other commercial purposes.

3.7. Utilization of Roots for Food

The results revealed that cassava roots were predominantly utilized for food (boiled and fried) and processed to give other products (gari, fufu, chips and tho) (Figure 2). The main cassava-based foods in household survey in the eastern region are boiled roots (100%), gari (99.3%), fufu (97.8%), fried roots (90.3%), tho (88.8%) and chips (76.1%). Though slightly different, the cassava root products in the south and north were similar.

3.8. Utilization of Roots as Livestock Feed

A small proportion of farmers indicated using cassava roots, foliage, peels and residues from cassava processed products as feed for Livestock (Figure 3). Chips product had the highest in the north (87.5%) followed by the east (76.1%), and the south the least (6.4%). Some farmers in the south processed cassava as tho (89.6%), next the east (88.8%) and north (88.2%), but there were no significant differences among the three regions. In southern region (92.6%), some of the farmers roasted the roots for consumption, with a good number of farmers in the east (90.3%) and north (79.4%) reporting similar activities. The findings showed that cassava roots used as feed for livestock was more prevalent in the northern region (14.0%) than the other regions (Figure 3). In the northern region, 100% of the respondents reported that cassava roots were fed to goats followed by sheep (97.0%), poultry and cattle (31.6%), and pig (15.8%). It was also

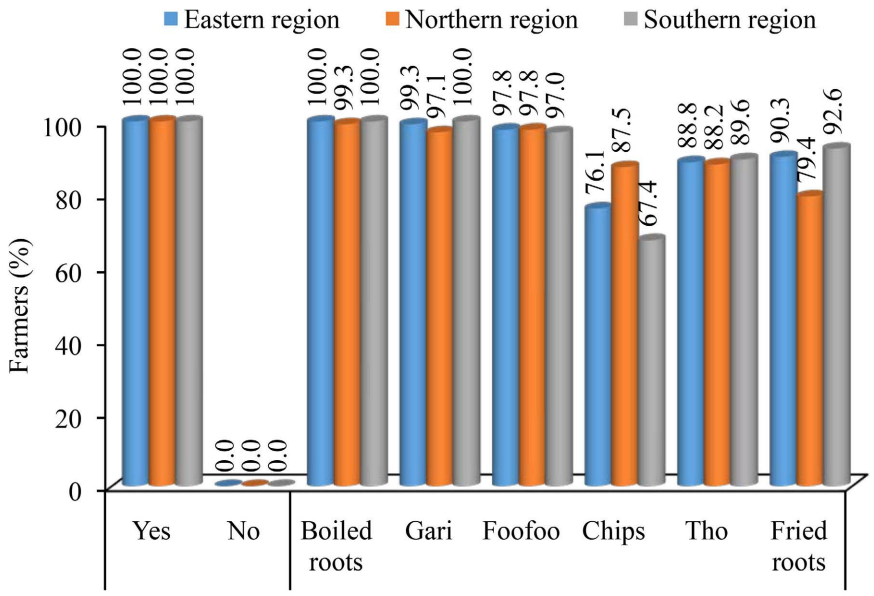

Figure 2. Use of Cassava root as Food.

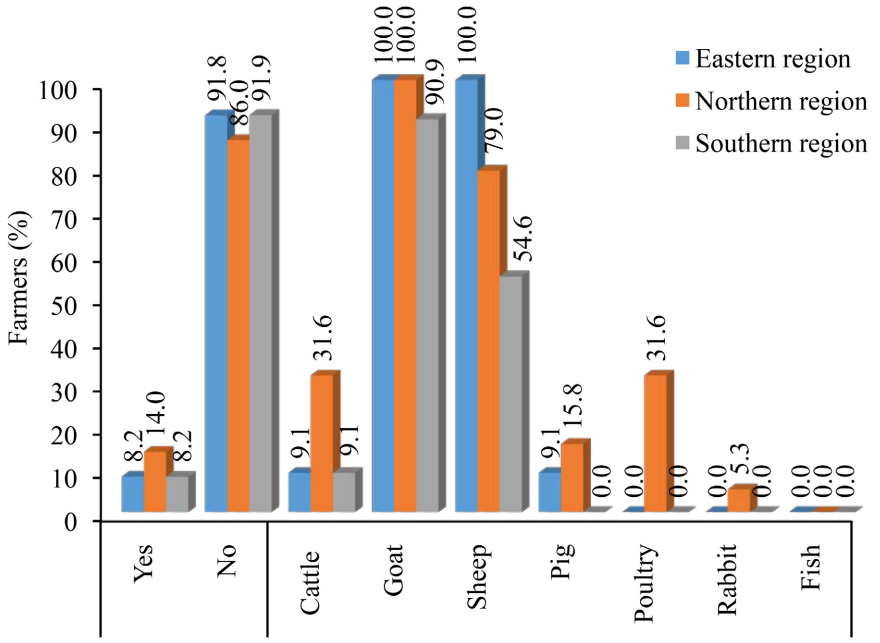

Figure 3. Use cassava roots as feed for selected livestock by farmers.

observed that only in the north did respondents (5.3%) indicate feeding with cassava roots. Additionally, 100% of the respondents in the eastern region revealed that cassava roots were used to feed goats and sheep, followed by cattle and pigs (9.1%), respectively. Furthermore, 90.9% of the respondents in the southern region revealed that cassava roots were fed to goats followed by sheep (54.6%) and cattle (9.1%).

3.9. Medicinal Use of Cassava Roots

A small percentage of the respondents (4.4%) in the northern region indicated cassava roots for medicinal purposes, with the roots being utilized treating dysentery (83.3%), and for eye disease (16.7%). In the eastern region, 28.6% of the respondents admitted using cassava roots to treat dysentery, with a higher percentage of use for treating eye disease (71.4%) (**Figure 4**). Furthermore, 100% of the respondents in the southern region reported that cassava roots were used to heal eye disease. This result agrees with http://www.sacredearth.com/ethnobotany/plantprofiles/cass ava.php, and Lebbie (23) who reported that the plant is a traditional remedy for abscesses, boils, conjunctivitis, diarrhoea, dysentery, flu, hernia, inflammation, marasmus, prostatitis, snakebite, sores, spasm, and swellings of testicles.

3.10. Utilization of Leaves as Food

Cassava leaves are largely consumed in the three study areas as a potherb, with the southern region utilizing the highest percentage of cassava leaves (100%), followed by the other two regions that were almost similar (99.3%) to the southern region (**Figure 5**). Furthermore, the highest frequency of consuming cassava

leaves per month was recorded from the northern region (4.4%) followed by the eastern (2.3%) and southern (0.7%) regions. The percentage increase in the consumption of cassava leaves per month in the north over that of the eastern region was about 91.30% and for the southern region was 528.6%. The analysis of variance similarly showed that the southern region had the highest percentage (99.3%) of respondents consuming cassava leaves at least once a week followed by the eastern region (97.0), while northern region recorded the lowest (94.8%). Additionally, the highest consumption of cassava leaves per day was recorded in the northern region (0.8%) compared with the eastern (0.7%) and southern (0.0%) regions. It had been previously reported that leaves of cassava are used as a vegetable where they provide significant proportion of protein and other nutrients [7] [11].

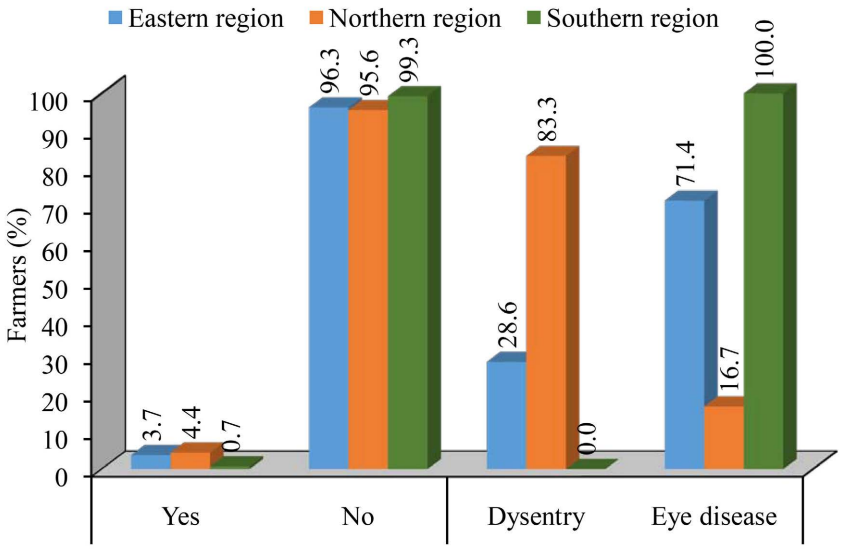

Figure 4. Use cassava roots as medicine by farmers to cure diseases.

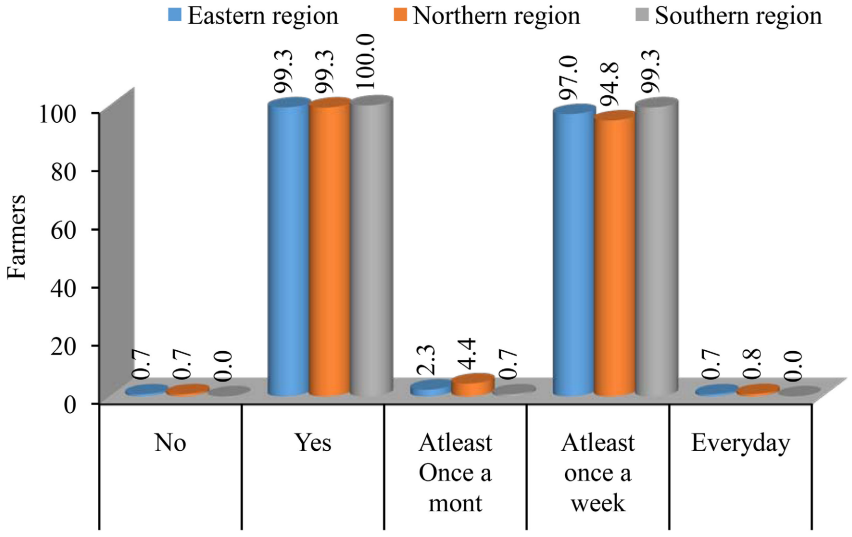

Figure 5. Use of cassava leaves as food.

3.11. Utilization of Leaves as Livestock Feed

The percentage of respondents feeding livestock with cassava leaves ranges from 5.9% to 25.7% in the study areas (Figure 6). The analysis of variance revealed that the southern and eastern regions of Sierra Leone fed their cattle with cassava leaves (100%), with a percentage increase of 8.61% over northern region (91.4). Also, 100% of the respondents in the eastern region indicated that they fed their goats with cassava leaves followed by the northern region (91.4%), while the southern region recorded the lowest (87.5%) feeding of goats with cassava leaves. Additionally, 94.1% of the respondents from the east reported feeding their sheep with cassava leaves while 82.9% from the north and 50% from the south reported similar activity. In the case of pigs (11.4%), poultry (5.7%) and rabbits (2.9%), only respondents from the north reported feeding these animals and domesticated flocks with cassava leaves.

3.12. Utilization of Leaves as Medicine

In Figure 7, respondents reported the use of cassava leaves for medicinal purposes, which ranged from 3.0% to 11.8%. The northern region (11.8%) recorded the highest use of cassava leaves for medicinal purposes, followed by the east (10.4%), with a lower usage from the southern region (5.0%). However, cassava leaves used to heal stomach ache and snakebite was greater in the southern region (50.0%) than the northern and eastern regions. Respondents from the northern region also confirmed the use of cassava leaves for healing eye disease (31.3%), fever (12.6%), broken bones, cough and skin diseases (6.2%). A similar trend was observed in the eastern region, as cassava leaves were reportedly used to heal dizziness (14.5), diarrhoea and boil (7.1%). The result of this study is similar to [22]), who reported that extracts from the leaves of the cassava plant

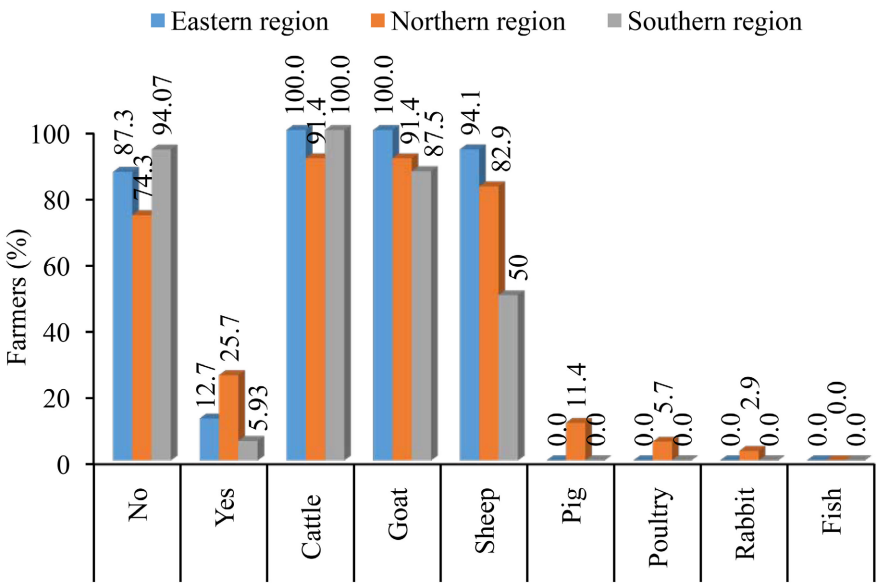

Figure 6. Use of cassava leaves as feed for livestock.

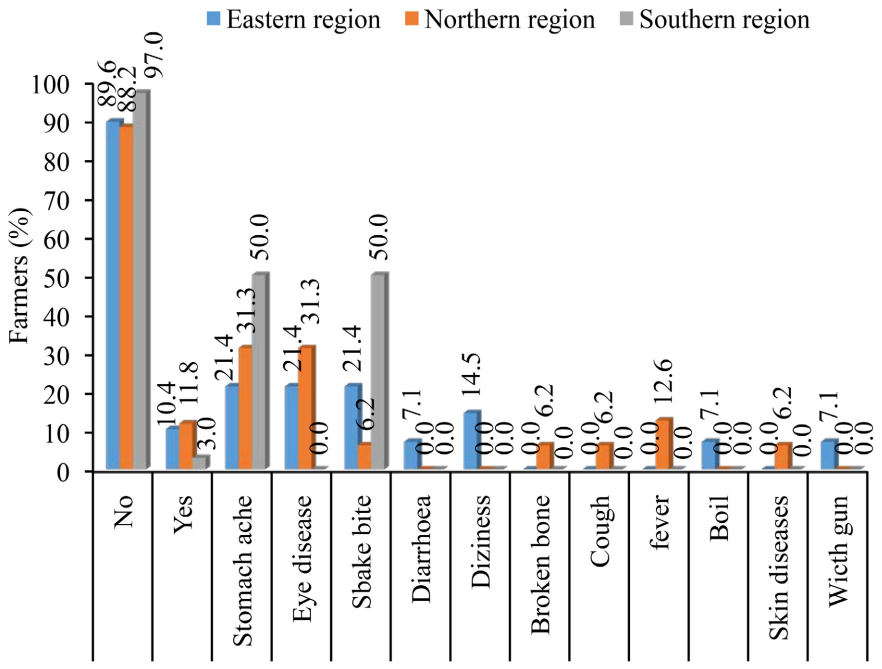

Figure 7. Use of cassava leaves as medicine.

were found to exhibit broad spectrum antibacterial activity but no specific antibacterial agents were isolated nor identified. [23] has also reported the use of cassava leaves in the management of snakebite envenomation by herbalists in the southern region of Sierra Leone.

3.13. Utilization of Cassava Stem

Higher percentages of respondents (96.3% - 99.5%) reported the use of cassava stems (**Figure 8**). In the three study areas, 100% of the respondents used cassava stems for planting materials, and 9.1% of the respondents in the southern region reported the use of cassava stems for firewood. This result agrees with the findings of [16] [24], who reported that dry cassava stems are used for fuelwood and has emerged as an important biofuel resource. We speculate that this could happen in areas where there is an abundance of the material and possibly a shortage of alternative sources of firewood.

4. Discussion

The studied districts are institution to a remarkable amount of biodiversity that is linked d with indigenous diversity; however, these districts are under studied [25]. The significant cultural diversity of this region results from a convergence of various cultures and populations that have different uses for the available plants. Therefore, records of the cultural diversity from ethnobotanical studies are important tools for the development of realistic and functional models for the use and management of natural resources, which can assist public policy planning and decision-making [25].

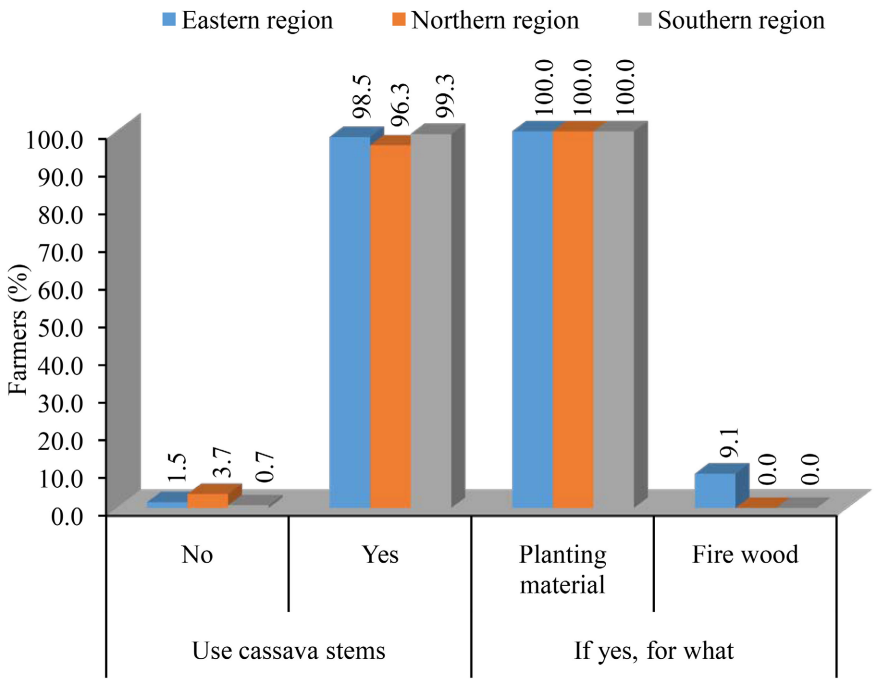

Figure 8. Use of cassava stems.

Cassava production is predominantly done by small holder farmers in our study area. All the communities visted are known farmers are known for cassava farming. In Accordant with its prevalent presence, cassava was a income and food security crop and a focus of daily activity.

With the nutritional and cultural significance of cassava, growers were highly practiced and knowledgeable about its management, attentive to the characteristics of cultivars and selective about those gown in their fields. These patterns echo those in other regions of Amazonia, and support the longstanding hypothesis that humans are the impulsion behind cassava's diversification throughout the country [16] [25].

4.1. Similarities of Reasons across Region

The similarities among the three regions in terms of reasons for abandonment are; introduction of better varieties, long duration varieties, lost of varieties during the war, low root yield and poor planting materials. These report is inconsistent with results shown by [26] and that provisions of inputs, knowledge and technical skills provided by policy makers helped in the not abandonment of varieties.

4.2. Differences in Reasons between Regions

The south, East and Northern region had major differences in reasoning for not cultivating some varieties. The reasonings are as follows: susceptible to pest and different with a score of (1) (0) and (3) in the east, North and south respectively. For Some varieties rejected by farmers in the east are not due to poor cooking

quality while as the north and south mentioned then though in low percentage

4.3. Reason That Stands out the Most across Regions

Introduction of better varieties and loss of varieties during the war stand out as major reasons why some varieties where abandoned across the three regions. These observations provide more insight into what is motivating and did not agree with the IITA [21] report that just said farmers' main reason for abandoned a variety was the non-availability of the planting material.

4.4. Reasons for Cultivating Varieties after the War

The results from cassava farmers' preference reported diverse traits which assist them in the identification and selection of preferred varieties and for economic gains. Hence the ethnobotanical information collected from the field revealed that preferences for cultivation and selection of cassava varieties by farmers varied according to the intended use and modes of utilization in that particular region. These findings are in consistent with previous studies of IITA [21], which revealed that farmers wanted cassava varieties with good quality for processing into foods particularly gari and fufu, in addition to high yield, big roots, high market demand, and early maturity.

4.5. Utilization of Roots as Livestock Feed

A small proportion of farmers indicated using cassava roots, foliage, peels and residues from cassava processed products as feed for Livestock Chips product had the highest in the north followed by the east and the south the least. Some farmers in the south processed cassava as tho, next the east and north but there were no significant differences among the three regions. In southern region, some of the farmers roasted the roots for consumption, with a good number of farmers in the east and north reporting similar activities. The findings showed that cassava roots used as feed for livestock was more prevalent in the northern region than the other regions. In the northern region, 100% of the respondents reported that cassava roots were fed to goats followed by sheep, poultry and cattle, and pig. It was also observed that only in the north did respondents indicate feeding with cassava roots. Additionally, 100% of the respondents in the eastern region revealed that cassava roots were used to feed goats and sheep, followed by cattle and pigs, respectively. Furthermore, great increase of the respondents in the southern region revealed that cassava roots were fed to goats followed by sheep and cattle.

4.6. Medicinal Use of Cassava Roots

A small percentage of the respondents in the northern region indicated cassava roots for medicinal purposes, with the roots being utilized treating dysentery, and for eye disease in the eastern region, some respondents admitted using cassava roots to treat dysentery, with a higher percentage of use for treating eye

disease. Furthermore, all of the respondents in the southern region reported that cassava roots were used to heal eye disease. This result agrees with http://www.sacredearth.com/ethnobotany/plantprofiles/cass ava.php, and Lebbie [23] who reported that the plant is a traditional remedy for abscesses, boils, conjunctivitis, diarrhoea, dysentery, flu, hernia, inflammation, marasmus, prostatitis, snakebite, sores, spasm, and swellings of testicles.

4.7. Utilization of Leaves as Food

Cassava leaves are largely consumed in the three study areas as a potherb, with the southern region utilizing the highest percentage of cassava leaves, followed by the other two regions that were almost similar to the southern region. Furthermore, the highest frequency of consuming cassava leaves per month was recorded from the northern region followed by the eastern and southern regions. The percentage increase in the consumption of cassava leaves per month in the north over that of the eastern region and for the southern region. The analysis of variance similarly showed that the southern region had the highest percentage of respondents consuming cassava leaves at least once a week followed by the eastern region while northern region recorded the lowest. Additionally, the highest consumption of cassava leaves per day was recorded in the northern region compared with the eastern and southern regions. It had been previously reported that leaves of cassava are used as a vegetable where they provide significant proportion of protein and other nutrients [26] [27] [28].

4.8. Utilization of Leaves as Medicine

Respondents reported the use of cassava leaves for medicinal purposes. The northern region recorded the highest use of cassava leaves for medicinal purposes, followed by the east, with a lower usage from the southern region. However, cassava leaves used to heal stomach ache and snakebite was greater in the southern region than the northern and eastern regions. Respondents from the northern region also confirmed the use of cassava leaves for healing eye disease, fever, broken bones, cough and skin diseases. A similar trend was observed in the eastern region, as cassava leaves were reportedly used to heal dizziness, diarrhoea and boil. The result of this study is similar to Zakaria [22], who reported that extracts from the leaves of the cassava plant were found to exhibit broad spectrum antibacterial activity but no specific antibacterial agents were isolated nor identified. [29] has also reported the use of cassava leaves in the management of snakebite envenomation by herbalists in the southern region of Sierra Leone.

4.9. Utilization of Cassava Stem

Higher percentages of respondents reported the use of cassava stems. In the three study areas, all of the respondents used cassava stems for planting materials, and hug number of the respondents in the southern region reported the

use of cassava stems for firewood. This result agrees with the findings of [6] [24], who reported that dry cassava stems are used for fuelwood and has emerged as an important biofuel resource. We speculate that this could happen in areas where there is an abundance of the material and possibly a shortage of alternative sources of firewood.

5. Conclusions

A good number of cassava farmers across Sierra Leone are still using local varieties found in their communities, and at the same time are quick to adopt new varieties that meet their requirements as well as reject those that do not meet those requirements. These requirements are clearly defined, and consistently and rationally applied by farmers, but unfortunately, few of the improved cassava varieties promoted by local and national institutions meet these requirements. Out of the 12 "Slicass" cultivars released since 2005 by the Sierra Leone Agricultural Research Institute, only one is widely adopted and less than half were known to those interviewed across the country.

The names used by cassava farmers are based on the diverse attributes possessed by a variety, the origin of the variety, the person who introduced the variety to the community and the morphological variations inherent in that variety. During the survey, it was observed that most cassava farmers grew cassava varieties that are known to be high yielding, mature early, have good cooking qualities and taste sweet. This is because these farmers are using cassava as a food security item that is directly boiled or roasted and consumed as such. Some cassava is processed for gari and fufu as a livelihood option, especially in the south, and is more kin on adopting those varieties that meet processing requirements. The use of cassava for livestock feed and medicinal purposes was mentioned by fewer numbers of respondents.

Given the significance of cassava as a livelihood and food security crop, it is important that cassava breeders take into account local ethnobotanical knowledge of farmers before engaging in improvement programs. Whilst we have endeavored to explore the range of knowledge and requirements of cassava farmers, we consider further investigation is required to fully understand the influence of traditional practices and knowledge in the selection, maintenance and conservation of cassava varieties. Preferred varieties for local use and industrial purposes should be incorporated in the breeding scheme of the Sierra Leone Agricultural Research Institute prior to on-farm testing and evaluation to allow farmers the opportunity to test and evaluate those preferences perceived to be "good" for them.

Acknowledgements

We are grateful to Mr. Dan Quee and Keiwoma Mark Yilla for assistance with the development of the survey instrument. We are thankful to the farmers and local authorities in the various regions for granting permission to conduct the

study in their localities and on their farms. We would like to acknowledge the permission given by the Department of Biological Sciences, Njala University to establish the trial at their trial site.

Conflicts of Interest

Authors declare there is no conflict of interest among them.

Funding

Funds were provided by the Sierra Leone Agricultural Research Institute (SLARI) and additional funding by lead-supervisor (Prof. Aiah Lebbie) to conduct the field work.

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List of Abbreviations

FAO, Food and Agricultural Organization; FGD, Focus Group Discussions; IITA, International Institute of Tropical Agriculture; SAS, Statistical Analysis Systems; SLARI, Sierra Leone Agricultural Research Institute; NGO, Non-governmental Organization; CSPRO, Census and Survey Processing System; MAFFS/NARCC, Ministry of Agriculture Forestry and Food Security (MAFFS) and the National Agricultural Research Coordinating Center (NARC).