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PUBLIC AND PRIVATE EXTENSION SERVICES DELIVERY TO CASSAVA FARMERS IN SANNIQUELLIE AND SACLEPEA MAHN DISTRICTS IN NIMBA COUNTY, LIBERIA

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ABSTRACT

Public and private extension providers have been assisting farmers in Liberia but there has been no study done on services they deliver to cassava farmers. This study therefore investigated the delivery system of public and private extension services on cassava farmers. The study used quantitative survey in which 318 randomly sampled cassava farmers in the Sanniquellie and Saclepea Mahn Districts were interviewed using an interview schedule. The study revealed that the farmers were mostly males, have large household sizes, married, have low level of education but have vast cassava farming experiences. Majority (88.6%) of the cassava famers under public and private extension services were in their active working ages. Major sources of agricultural information were neighboring farmers (88.4%), radio (86.8%) and other farmers outside their neighborhoods (71.4%). Nearly every farmer obtains his/her planting materials from their own saving (95.3%), relatives (94.0%) and other cassava producers (69.1%). Farmers receiving public and private extension regarded their involvement in extension services as very low, though public extension farmers were significantly more involved than the private. The level of adoption of improved cassava technologies by both public and private extension farmers was low. The perceived impact of extension services on farmers was regarded as low, but public extension was perceived to have a significantly higher impact on cassava farmers than private extension.

Keywords: Public extension, Private extension, Level of use, Comparative analysis, Service delivery, Liberia

INTRODUCTION

Cassava (*Manihot esculenta*) is the fifth most important crop after wheat, rice, maize, potato and, yams as the primary staple food for more than 800 million people in the poorest tropical countries (Lebot, 2009). It is an essential food security crop because the matured edible roots can be left in the ground for 36 months. Cassava is important not only as food crop but also as a major source of income for rural households. The crop therefore represents a household food bank that can be drawn on when adverse climatic conditions limit the availability of other foods (Lebot, 2009). It can grow and produce high yields in areas where maize and other crops will not grow or produce well. The variety of foods that are made from the roots and the nutritious leaves are reasons why cassava cultivation is expanding worldwide (Lebot, 2009). In Liberia, cassava is the second subsistence crop after rice and is grown by small-scale farmers for consumption and sale. Unlike rice, cassava can be planted all year round in Liberia and its annual production was estimated at 520,000 metric tonnes (LNIC, 2016). Cassava has become a staple food in many rural communities because of its ability to grow on poor soil conditions. It can also tolerate nutrient deficiency and therefore, can be grown on soils with low nutrient capacity. Cassava also responds well to irrigation or high rainfall and fertilizer application. Cassava is highly flexible in its management requirements, and has the potential of high-energy production per unit area of land (MOA, 2007).

Agricultural extension has a major role to play in ensuring high production of cassava by farmers in Liberia. Agricultural extension services worldwide have played critical role in making sure that farmers have access to improved technologies and that their concerns and needs are properly addressed. Nevertheless, the role of extension today goes beyond technology transfer. The role of extension also includes training of farmers on appropriate farming methods, assisting farmers to form groups so they can collectively deal with the market forces. Agricultural extension also educates farmers on issues such as food security, food safety, nutrition, family education, youth development and partnering a broad range of service providers and other agencies (Onyenkazi and Gana, 2009). The effectiveness of agricultural extension services can be judged from the successful implementation of extension services using various extension approaches in extension methods (Onyenkazi and Gana, 2009). The effectiveness of extension also can be viewed not only by contacts made with farmers, but the demonstrations conducted to teach skills and lectures delivered to teach and inform the farmers. Agricultural extension is seen as a service that assists farmers through educational procedures in improving farming methods and techniques, increasing production efficiency and income as well as improving the standard of living and lifting the social and educational standards of farmers. It is a means by which technical information is passed to the farmers for development of agriculture (Onyenkazi and Gana, 2009). In any effort to improve the living conditions of the rural populace and agricultural production, an effective agricultural extension system has a significant role to play in attaining self-sufficiency in food production. It is not merely to inform but to keep people thinking about development and educating them with a view to raising the aspiration of the people in the right direction (Hycient *et al.*, 2009). Many studies have revealed that the rural farmers have not been making use of the recommended farm practices to its fullest. This is attributed to the gap between information generation and the dissemination to the end users. The extension services are meant to fill this gap in communication (Hycient*et al.*, 2009). A variety of tools and methods to disseminate farm information and improved technologies to farmers are needed by extension agents. Extension workers should therefore be trained on where and how to use extension methods. The more the variety of channels and methods used in introducing new ideas, the greater the chances of accepting new innovations by farmers (Hycient*et al.*, 2009). Extension in Liberia finds itself in a transitional environment as the country moves from the period of post-war relief and rehabilitation to an environment of development

and growth. After a fourteen-year decimating civil war, the country of Liberia was left with the challenge of rebuilding its human and institutional capacity, particularly at the higher education level (Rimer *et al*., 2014). The extension system in Liberia includes extension activities and Programmes delivered by NGOs, the Ministry of Agriculture Extension and a variety of emerging private sector actors (Ministry of Agriculture, 2008). The study therefore sought to conduct a comparative analysis of the involvement of cassava farmers in public and private extension services, to determine their level of adoption of improved cassava technologies, evaluate factors influencing levels of adoption of improved cassava technologies, and assess the extent of impact of cassava farmer's participation in public and private extension programme.

NIMBA DEMOGRAPHICS

Survey was conducted in Nimba, located on the north-central of Liberia. It is one of the 15 counties constituting first-level of administrative division of Liberia. It has 17 districts with Sanniquellie as the capital. The 2008 census indicated that the county has a population of 462,026, making it the second most populous county in Liberia. The county occupies an area of 298 kilometers from Monrovia, capital of Liberia. The total geographic area (land and water) of Nimba is 2,300 square kilometers; from North to South, the county stretches 230 kilometers and East to West, 100 kilometers; out of the 11,551 square kilometers (4,460 sq mi) for the country making it the largest in the nation. Nimba shares common boundaries with Bong, Grand Gedeh, Rivercess, Sinoe, and Grand Bassa counties. Small scale farming is currently the main source of income of the people of Nimba. However, small agricultural projects are undertaken by some youth and women's associations, NGOs such as Liberia Community Initiative Programme (LCIP) and Agriculture Relief Services (ARS). The typical farming pattern is slash-and-burn and annual bush fallowing. The main food products are rice, cassava, plantain, banana, yam and sweet potatoes with some 75% of farm produce being consumed by the family (Nimba County Development Agenda, 2008). Sanniquellie Mahn District is one of the 17 districts of Nimba County, Liberia. It has the total population of 116, 947 and its capital lies at Sanniquellie. Saclepea Mahn District is also one of the 17 districts of Nimba County with a total population of 160 424 and Saclepea as its capital (Nimba County Development Agenda, 2008).

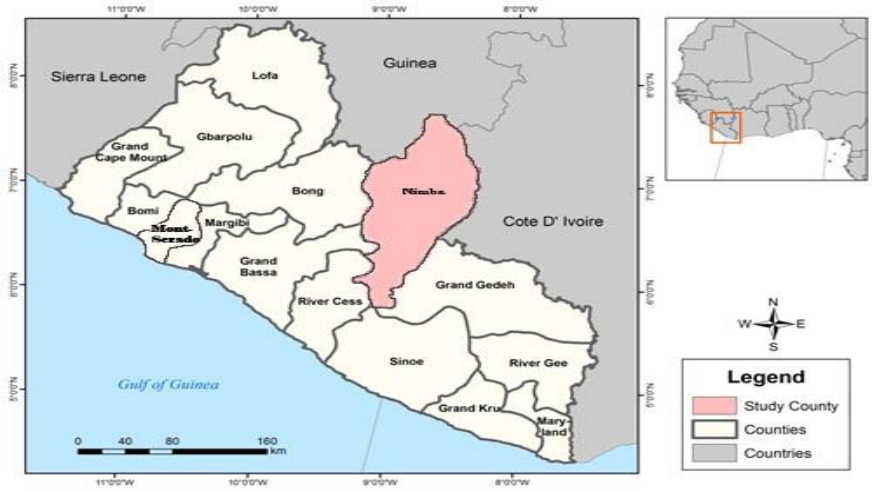

Figure 1: Map of Nimba showing the study area

MATERIALS AND METHODS

Study population

The population of the study was all extension contact cassava farmers in Sanniquellie and Saclepea Mahn districts in Nimba county of Liberia. The total number of cassava framers working with extension agents in Sanniquellie was estimated at 2000, while those from Saclepea were estimated to be 800 (Nimba County Development Agenda, 2008).

Sample size and sampling procedure

Following suggestions of Hejase and Hejase (2013), the sample size was based on 95% certainty, an equal proportion of private and public extension, and a 5% desired accuracy resulting in 384 persons. Then, for a small population of 2800, a correction factor is utilized resulting in a final sample size of 338. A list of all contact farmers was compiled by both private and public AEAs in the two study districts, Sanniquellie and Saclepea to serve as the sampling frame. A proportionate random sampling procedure was used to select 241 famers from Sanniquellie and 97 from Saclepea to get the 338 respondent farmers.

Data collection instrument

A structured interview schedule was used to collect data from the selected farmers who were receiving private and public extension services in the study area. The interview schedule was constructed according to the objectives of the study. The sections of the instrument that were used to solicit data from the farmers on the objectives of their level of involvement, impacts and factors influencing adoptions were measured on 5 Likert-type scales from not at all (1) to very high (5). Similarly, the objective of determining level of adoption was measured using the frequency of use ranging from not at all (1) to frequently use (5). The instrument was pretested on 30 farmers in Gbehlageh District of Nimba County, Liberia, since it had similar characteristics as the study area. The pretest was conducted to measure the reliability of the instrument. The Cronbach's alpha values of all the scales making up the interview schedule ranged from 0.70 to 0.77. Hence, the scales were considered reliable according to Burns and Burns (2008) who regarded reliability coefficient value of 0.70 and 0.80 as good and suitable for data collection.

Data collection procedure

The data were collected using two trained enumerators from each of the selected districts. They were trained on how to administer the instrument, meaning and interpretation of each item in the local language. Selected farmers were visited either in their homes or on their farmstead. Face-to-face interviews were conducted and the responses of the farmers were then transcribed on to the interview schedules. The data collection process started in March 2014 and lasted for 6 weeks. There was 94 percent response rate since 20 farmers selected out of the 338 were not available after several visits.

Data analysis

The data collected were cleaned and coded into the Statistical Product and Service Solutions (IBM SPSS version 21). Descriptive statistics such as frequency, mean, standard deviations were generated to clean and correct errors in data entry. The appropriate statistics based on the objectives of the study were generated. Pearson chi-square, frequency, percentages, means and standard deviations were used to describe the socio-economic characteristic of cassava farmers targeted by public and private extension services as set in objective 1. For objective 2 which sought to compare the involvement of

cassava farmers in public and private extension services offered to cassava farmers, frequency counts, percentages, means, standard deviations and independent t-test were used to analyze the data. For Objective 3,4 and 6, which sought to determine the level of adoption of improved cassava technologies, factors constraining the provision of public and private extension services to farmers and factors influencing levels of adoption of improved cassava technologies, Pearson product moment correlation, point bi-serial, Spearman rho, bi-serial and stepwise multiple regression analysis were used to examine the relationship between variables. For Objective 5, independent sample t-test analysis was used to compare the extent of impact of cassava farmer's participation in public and private extension program.

Empirical Model Specification

To determine the factors associated with the levels of adoption of improved cassava varieties by farmers served by public and private extension services, ordinary least square (OLS) regression model was used.

$$Y = \beta_{0i} + \beta_{i1}X_{i1} + \beta_{i2}X_{i2} + \beta_{i3}X_{i3} + \beta_{i4}X_{i4} + \beta_{i5}X_{i5} + \beta_{i6}X_{i6} + \beta_{i7}X_{i7} + \varepsilon$$

Where:

Y = level of adoption (the dependent variable),

$X_{1=}$ Inadequate farm inputs,

X_2= Poor soil fertilizer,

X_3= Type of extension provider,

X_4= Shortage of farm labour,

X_5= Non- suitability of extension Programme,

X_6= Inadequacy of extension Programme,

X_7=Gender of farmer, and

ε = error terms

RESULTS AND DISCUSSION

Farmers' age plays a significant role in his/her adoption decisions (Alexander and Mellor, 2005). Out of the 318 farmers interviewed, 62.0 percent were below 50 years. Majority of the farmers from private extension public extension services were in this category (65.8% and 56.1% respectively). This implies that the majority of the cassava famers under public and private extension services within the two districts are in their active working ages. Nevertheless, those in the private extension service have more farmers in the working age groups than those in public extension. The private extension farmers are slightly younger than those in public extension. However, there was no statistical significant difference between the average ages of public and private extension receiver farmers (t-value = 1.094, p = 0.275). In view of the fact that majority of the farmers interviewed were in their working age, the prospects for increasing cassava production is high as posted by Ramat *et al.* (2013), that farmers within the active age are more receptive to innovation, more technically efficient, effective and could withstand the stress and strain involved in cassava production. Adofu *et al.* (2011) and Alexander *et al.* (2005) also indicated that older farmers may have a short life span and less likely to invest in new technologies.

Table 1: Age distributions of cassava farmers under public and private extension

Age Category	Type of extension organization				Total	
	Public		Private			
	Freq.	(%)	Freq.	(%)	Freq.	(%)
20-29	9	7.3	15	7.8	24	7.6
30-39	23	18.7	33	17.1	56	17.7
40-49	37	30.1	79	40.9	116	36.7
50-59	37	30.1	47	24.4	84	26.6
60-69	17	13.8	17	8.8	34	10.8
70-79	-	-	2	1.0	2	0.6
Total	123	100.0	193	100.0	318	100.0
Minimum	24		22		22	
Maximum	68		78		78	
Mean	47.03		45.782		46.285	
Standard Dev	10.68		9.955		10.229	
Mean diff.	1.291					
t-value	1.094					
Significance	0.275					

n = 318

The results from Table 2 reveal that majority of the respondents were males (58.2%) compared to females (41.8%). Within the public extension, 63.4 percent of the farmers were males while 36.6 percent of them were females. Similarly, about 55 percent of the farmers who received private extension services were males while the rest were females (45. 1%). This finding conforms to the report of Ayansina (2011) who declared that women have been found to be neglected in agricultural extension activities. Therefore, there is an urgent need to guard against that syndrome in order to make a balance within the context of agricultural development Programs.

Table 2: Sex distributions of cassava farmers under public and private extension

	Public		**Private**		**Total**	
	Freq.	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
Male	78	63.4	107	54.9	185	58.2
Female	45	36.6	88	45.1	133	41.8
Total	**123**	**100.0**	**195**	**100.0**	**318**	**100.0**
Chi-Square =2.262			Significant =0.133		n =318	

According to Alesina *et al.* (2010), the role of women in the family, in society and in the work force varies across nations and cultures. Women are often busy with household responsibilities such as caring for children and had no time to attend the training. Furthermore, women do not have access to technical training and are often not invited due to their low level of education. Regarding to this study, male farmers are mostly involved in cassava production. Female farmers are usually busy because of the numerous responsibilities which limit their involvements in production and adoption of new

technologies. Though it was observed that men were more than women in the production of cassava, there was no significant difference between males and females targeted by public and private extension services providers (Chi-square = 2.262, p > 0.05). This is in agreement with (Saito *et al.*,1994) that ratio of female-to-male of 0.64 indicates that men contribute more to total farm output at the margin than women.

Table 3 reveals that different levels of education existed among the respondents. Among the respondents, only 3 out of every 10 farmers have not had any formal education. This was representative of public and private extension receivers (29.3% and 33.5%, respectively). The results show high illiteracy level among public and private farmer extension receivers in the study areas. It is expected that the higher level of education will contribute significantly to decision making of a farmer. Research done by Pandey (1989) showed that the level of education of farmers plays a vital role and accelerates adoption of technologies by farmers. Obinne and Anyawu (1991) therefore suggested that education is capable of helping to develop managerial skills which lead to enhanced adoption index and adoption is positively related to education.

Table 3: Educational level of cassava farmers under public and private extension

Educational level	**Public**		**Private**		**Total**	
	Freq.	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
No formal education	53	43.1	92	47.4	145	45.7
Adult literacy class	34	27.6	37	19.1	71	22.4
Primary School Completed	32	26.0	54	27.8	86	27.1
Secondary Completed	4	3.3	11	5.7	15	4.7
Degree	-	-	-	-	-	-
Total	**123**	**100.0**	**195**	**100.0**	**318**	**100.0**

Chi-Square =3.799 Significant diff.=0.284

n = 318**.** Numbers in the parenthesis are percentages

A report by Moyib *et al.* (2013) stated that higher level of education determines the quality of farmers' skills, their allocative abilities and efficiency, and how well informed they are of the innovations and technologies around them. It also supports the result of Onubuogu and Onyeneke (2012) which indicated that individuals with higher educational attainment are usually faster in adoption of improved farming technologies. The low level of education among the public and private extension farmers may serve as a limitation for smooth and faster adoption of cassava technologies introduced to them by the various organizations. More effects and strategies are therefore needed by the change agents to be able to have impact on the adoption of the cassava technologies dissemination to them. Education is believed to improve the readiness of the farmers to accept new ideas and innovations, and get updated extension information which in turn enhance farmers' knowledge and skills to produce more and increase productivity and volume for sale (Onyeneke, 2012). There was no statistical significant association between levels of education and type of extension services (χ^2=3.799, p>0.05) received. Marital status determines an individual's resolve to indicate a corresponding source of labour input (Kuponiyi *et al.*, 2003). The results on marital status of the farmers revealed that about three-quarters of the respondents were married. More than 80 percent of the farmers who benefitted from public extension services were married while about 70 percent of those farmers who received private extension services were also married. The few that were not married were single, divorced,

widowed or separated. The percentage distribution of the respondents among the various martial statuses between public and private extension cassava farmers were statistically and significantly different (x^2 =12.79, p<0.05).

Table 4: Marital Status Cassava Farmers under public and private extension

	Public		**Private**		**Total**	
	Freq.	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**
Single	8	6.5	18	9.3	26	8.2
Married	102	82.9	135	69.6	237	74.8
Divorced	2	1.6	9	4.6	11	3.5
Widowed	2	1.6	20	10.3	22	6.9
Separated	9	7.3	12	6.2	21	6.6
Total	**123**	**100.0**	**195**	**100.0**	**318**	**100.0**
Chi-Square =12.791		**Significant diff.=0.012**			**p<0.05**	

n =318. Numbers in the parenthesis are percentages

This finding is similar to the revelations from earlier studies (Adefarasin, 2000; Kuponiyi, 2003) which found that larger percentages of the farmers from public extension services were married. Ayansina (2011) declared that small scale farmers could only be successful if they were married especially when they had to rely on family labour.

Table 5 shows the household size of cassava farmers who received public and private extension services. The result shows that 17.6 percent of the farmers had below 7 household sizes. About two-thirds of them had 7 to 9 members in their households while the rest of them (19.3%) had 10 or more members in their houses. While 1 out of every 5 private extension service receivers had household sizes of 1 to 3, just about 14 percent of their counterpart public extension service receivers had the same household sizes. On the other hand, while about 8 out of every 10 public extension farmers had from 7 to 9 members in their households, 53.6 percent of the private extension farmers had the same range of household size. About a quarter of the public extension farmers had more than 9 members in their households and 16.4 percent of the private extension farmers had household size of more than 9 members. While the minimum household size for both public and private extension farmers was 2 each, their maximum household sizes were 19 and 29 respectively. Notwithstanding, the average household size (mean = 7.07) for public extension farmers was higher than that of the private extension farmers (mean = 6.72). Nevertheless, the differences between these two groups of farmers was not statistically significant (t-value = 0.769, p > 0.05). The result had demonstrated that farmers from public and private extension services have slightly higher household sizes compared to that of the Nimba county's average household size of 5.9 and that of the country's average of 5.1 (Assaf, 2011). As argued by Dhungana *et al.* (2004), households with more family members tend to have more labour than households with fewer family members which in turn will increase production. The larger household size might benefit from being able to use more labour resources at the right time.

Table 5: Household size of cassava farmers under public and private extension

Household size	Public		Private		Total	
	Freq.	(%)	Freq.	(%)	Freq.	(%)
1-3	17	13.8	39	20.0	56	17.6
4-6	46	37.4	80	41.0	126	39.6
7-9	30	42.4	44	22.6	74	23.3
10-12	21	17.1	18	9.2	39	12.3
13-15	7	5.7	4	2.1	11	3.3
16-18	1	0.8	5	2.6	6	1.9
19-21	1	0.8	2	1.0	3	0.9
Above 21	-	-	3	1.5	3	0.9
Total	123	100.0	195	100.0	318	100.0
Minimum	2		2			
Maximum	19		29			
Mean	7.0732		6.7179			
Standard Dev.	3.47867		4.31462			
T-Value	.769					
p-value	.428					

Individual experiences in any enterprise play very vital role in harnessing innovations for increasing impact, most especially, among farmers. Experiences in cassava farming among the various groups of farmers could improve the competencies of farmers leading to increased productivity and income. The results presented in Table 10 reveal that, about a third of the farmers had less than 10 years of experience in cassava production. About 4 out of every 10 farmers had farming experience ranging 10 to 19 years. The rest (27.5 percent) had been in cassava production for at least 20 years. The proportion of public extension farmers who had experience above 19 years is almost about twice as the proportion of the private extension farmers who fall within the same category. The average experiences of public and private extension farmers were 16.5 and 13.3 years respectively. There was no statistically significant difference between the farming experiences of private and public extension farmers (t-value = 3.055, p = 0.82). This result suggests that most of the cassava farmers from both public and private extension services have long experience in farming. The experience of farmers will also have implication for adoption of new information and technologies. This implies that more experienced farmer's stand a chance to increase production since farming experience can lead to increase in efficiency of knowledge.

Table 6: Cassava farming experience in public and private extension services

Cassava farming experience (years)	Public (n=123)		Private (n=195)		Total (n=318)	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
<5	4	3.3	21	10.8	25	7.9
5-9	23	18.7	64	32.8	87	27.4
10-14	29	23.6	47	24.1	76	23.9
15-19	25	20.3	24	12.3	49	15.4
20-24	18	14.6	15	7.7	33	10.4
25-29	12	9.8	11	5.6	23	7.2
30-34	9	7.3	5	2.6	14	4.4
35-39	0	0.0	4	2.1	4	1.3
40-44	3	2.4	2	1.0	5	1.6
Above 44	0	0.0	2	1.0	2	1.3
Total123		100.0	195	100.0	318	100.0
Minimum	2		2			
Maximum	42		66			
Mean	16.528		13.2718			
Standarddeviation	8.82278		9.51954			
T - Value	3.055					
p-value	.823					

According to Onyeneke and Iruo (2011) and Onubuogu and Onyeneke (2012), more experienced cassava farmers tend to know more about the problems associated with cassava production and they stand a better chance of overcoming these problems to improve on their yield than those that had little or no experience in the sector. Ewaonicha (2005) also posited that farmers with more experience would be more efficient, have better knowledge of farming conditions and situation. Other studies (Onyebinama, 2004; Esiobu *et al.*, 2014) also showed that previous experience in farm management enables farmers to set realistic time and cost targets as well as allocate, combine and utilize resources efficiently, and identify production risks.

Apart from the public and private extension, the cassava farmers received information from other sources such as neighbors, other farmers from other communities, radio and research institutions. This finding is presented in Table 7 It shows that most of the farmers receive information from neighboring fellow farmers (88.4%), radio (86.8%) and other farmers outside neighborhood (71.4%). Only a few (8.8%) receive information from research institutions like the Central Agricultural Research Institute of Liberia. While more of the private extension farmers received information from fellow farmers than the public extension farmers, more public extension farmers tend to receive agricultural information through the radio than the private extension farmers. Blench *et al.* (2003) who conducted a study in Northern Ghana on the use of radio in agricultural extension to disseminate information concluded that radio is a very important source for effective dissemination of extension information.

Table 7: Major Sources of Agricultural Information to Cassava Farmers

Sources of Information	Public		Private		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Neighborhood	103	83.7	178	91.3	281	88.4
Other Farmers Outside	82	66.7	145	74.4	227	71.4
Extension Agent	81	65.9	169	86.7	250	78.6
Radio	107	87.0	169	86.7	276	86.8
Research Institute	10	8.1	18	9.2	28	8.8

The low number of public and private extension farmers who receive agricultural information from research institutes implies that the research institutes and Universities in Liberia need to do more in extending expertise and services to farmers through research training and community outreach. Links between agricultural research institutes, farmers and technology transfer agencies are essential for successful technology development and delivery. Direct links with farmers, developed through on-farm research; ensure relevance and rapid feedback (Blench *et al.*, 2003).Agricultural extension depends to a large extent on information exchange between and among farmers on one hand, and a broad range of other actors (Adesoji and Aratunde, 2012).

Source of healthy planting materials is very important when growing cassava (Adelekan, 2013) and source of planting materials have become an important consideration in recent years. This study investigated into the main sources that cassava farmers obtain their planting materials. The findings presented in Table 8 revealed that most farmers obtained their planting materials from their own saving and relatives (more than 90%). Majority of them also obtained their cassava planting materials from other cassava producers (69.1%) and other projects or organizations (61.8%). Less than a quarter of the farmers obtained planting materials from the AEAs and only 4.1 percent obtained planting materials from research institutions. Thus, most farmers tend to rely on own sources, relatives or other farmers than other source due to the cost implications and accessibility of the planting materials from other sources. This observation is very similar between both public and private extension farmers in the study areas.

Cassava farmers' level of involvement in extension services

Table 8 shows the level of involvement of farmers in provision of extension services by public and private extension services. The study shows that the level of involvement of farmers in public and private services was very low in training on agro-technology, adult literacy program, financing cassava production, and farming system improvement technology (mean ranging from 1.11 to 1.44). However, the t-test shows a statistically significant (0.00) difference at 0.05 alpha level between public and private in training on agro-technology, financing cassava production, and farming system improvement technology. This indicates that the Ministry of Agriculture and extension agents should provide training in these areas that Farmers involvement are very low especially those targeted by public services. Furthermore, innovation sourcing to and from other farmers, marketing of cassava and dissemination of general information was regarded to be low. There were significant differences between the involvement of public and private extension farmers in all the extension activities except adult literacy Program low (mean ranging from 2.32 to 2.51) by farmers who benefited from public and private extension service.

Table 8: Cassava farmer's level of involvement in extension services

Technology	Public extension (n=123)		Private extension (n=195)		t-value	p-value
	mean	Std. Dev.	mean	Std. Dev.		
Supervision of advisory services for farmers	3.46	0.64	2.62	0.91	9.60	0.00
Innovation sourcing from farmers and extension providers	2.39	0.67	2.05	0.52	4.02	0.00
Innovation sourcing to farmers and extension providers	2.51	0.76	2.19	0.77	3.57	0.00
Marketing of cassava	2.32	0.97	2.71	0.02	3.45	0.00
Dissemination of general information	2.32	0.67	1.98	0.58	4.60	0.00
Training on agro-technology	1.18	0.48	1.41	0.74	3.39	0.00
Farming system Improvement technology	1.44	0.59	1.75	0.75	3.89	0.00
Financing cassava production	1.31	0.59	1.50	0.72	2.62	0.00
Adult literacy program	1.11	0.43	1.16	0.74	0.77	0.44
Composite involvement	2.00	0.27	1.93	0.33	2.15	0.03
Average mean values						

Means were calculated from scale of <1.5=Not at all (NAL), 1.5-2.4=very low (VL), 2.5-3.4= low (L), 3.5-4.4= high (H) and>4.5 =very high (VH) $p<0.05$

The t-test shows statistically significant difference among farmers who benefited from public and private extension services at 0.05 alpha levels. Nevertheless, public extension farmers' involvement in supervision of advisory services was rated as high (mean = 3.46) while the private extension farmers perceived their involvement as low (mean= 2.62). The t-test shows a statistically significant (0.00) difference between farmers targeted by public and private extension providers at 0.05 alpha levels. This implies that supervision of advisory services for public farmers is relatively better compared to private.

Level of use of improved cassava technologies

Table 9 shows the level of adoption of improved cassava technologies disseminated by public and private extension services to cassava farmers. One of the often reported (Ennin*et al.,* 2009; Howeler and Tan, 2001) benefits of ridging is its effectiveness in erosion control and high yields of crops. Odemerho and Awunudiogba (1993) compared ridging, mounding and flat ground seed bed preparations under monoculture of cassava for reduced soil erosion. They reported that ridging across the slope was the most effective in reducing soil loss, and planting on flat ground was the least effective. The slope of the land appears to

affect the effectiveness of ridges to control soil erosion and increase cassava yield. However, farmers from public and private extension perceived soil fertility or conservation technology, improved seed/cutting supply and pest control not to be frequently used. While timely harvesting was regarded by private extension as moderately used (mean=2.79), farmers using the public extension service regarded it as not frequently used. Fertilizer use significantly leads to increases in cassava output and the quantity of fertilizer used impact cassava production (Okezie and Okoye, 2006; Oladeebo and Oyetunde, 2013;Onubuogu et al.,2014). The inability of these farmers to use fertilizer may have a negative impact on their yield hence; farmers may not be able to derive optimum benefit from the cassava production. There was significant difference between the public and private farmers' level of adoption of new technologies in the area of clearing of land, soil preparation, soil fertility, special planting of cassava, weeding, hand picking and timely harvesting. However, there was no statistically significant difference of laying of ridges/mound/ flat bed, improve seed/ cuttings supply, pest control, crop rotation and fertilizer application. Public and private extension farmers virtually did not adopt fertilizer application by cassava farmers, farmer's level of adoption of soil fertilizer or conservation, improve seed/ cuttings supply and pest controls were very low. Again, where was low adoption of soil preparation, laying of ridges/ mound/ flat bed, weed control and crop rotation innovations. The composite levels of adoption of the technologies were low among both public and private extension farmers (mean= 2.43 and 2.52 respectively). And there is no statistically significant difference in the level of adoption between public and private extension farmers (t-value=2.58, $p<0.05$). However, the overall level of adoption by the private extension farmers was statistically and significantly higher than that of public extension farmers (mean= 2.52 and 2.43 respectively). The study therefore agrees with Swanson (2002) who noted that private sector firms and nongovernmental organizations (NGOs) have become important alternatives to public extension in providing technical inputs, information and training, and organizational support services to farmers and rural households. Indeed, private sector extension providers have become important contributors to agricultural technology transfer. In many cases, these private organizations have access to superior technologies as a result of their extensive involvement of in research and development for improving livelihoods of rural poor including cassava farmers. Farmers therefore stand to benefit more from such private outlets.

Table 9: Level of Adoption of Improved Cassava Technologies Disseminated by Public and Private Extension Services to cassava Farmers

Technology	Type of extension provider					
	Public		Private		t-value	Sig.
	Mean	St. Dev	Mean	St. Dev		
Clearing of land	3.33	0.57	3.52	0.81	2.57	0.011
Special planting of cassava	3.68	0.64	3.47	0.85	2.51	0.01
Laying of ridges/mount/flat bed	2.98	0.64	3.01	0.45	0.26	0.79
Weed control	2.86	0.55	2.66	0.84	2.64	0.01
Hand picking	2.86		2.09		7.79	0.00
Soil preparation	2.81	0.59	3.11	0.87	3.71	0.00
Crop rotation	2.67	0.49	2.78	0.56	1.31	0.10
Pest control	2.14	0.83	2.01	0.96	1.27	0.19
Improve seed/ cuttings supply	2.10	0.73	2.08	0.89	0.225	0.82
Timely harvesting	2.33	0.77	2.79	0.98	4.73	0.00
Soil fertility or conservation technology	1.51	0.67	2.39	0.11	9.10	0.00
Fertilizer application	1.27	0.64	1.40	0.79	1.30	0.10
Composite adoption	2.43	0.23	2.52	0.40	2.58	0.11
Aggregate mean						

Means were calculated from scale of <1.5=Not at all (NAL), 1.5-2.4=Not frequently use (NFU), 2.5-3.4= moderately use (MU), 3.5-4.4= frequently use (FU) and>4.5 =Most frequently use (MFU).

P < 0.05

Considering the low level of adoption of the new technologies, the farmers were asked to indicate the extent to which some identified factors affected them in adopting the technologies. Table 10 reveals that the public extension farmers agreed that poor soil fertilizer, high cost of farm input, shortage of farm labour and non-availability of market for produce highly constrained their ability to adopt the various technologies. On the other hand, the private extension farmers identified poor soil fertilizer, inadequate size of farm land, high cost of farm input, lack of transport facilities, absence of processing facilities, shortage of farm labor and non-availability of market for produce highly affected their ability to adopt the new technologies. Other factors that the public extension farmers indicated to be affecting their level of adoption were inadequate size of farm land, Inadequate farm inputs, inadequate finance and credit facilities, non-suitability of extension Program, lack of transport facilities and absence of processing facilities. The farmer indicated that though these factures affect them, they are to a lower extent similarly; private extension farmers also regard inadequate finance and credit facilities, non-suitability of extension

Program and inadequacy extension Program to be affecting them but a low extent. There was significant difference between public and private extension farmers the extent to which the factures are constraining their level of adoption except in high cost of farm input, non-suitability of extension Program and inadequacy extension Program. In general, though both the public and private extension farmers saw the constraining factors affecting their level of adoption as high (mean=3.45 and 3.66), there was statistically significant difference between them. Thus, private extension farmers perceive the factors to be affecting their adoption more than their public extension counterparts.

Table 10: Factors constraining the provision of cassava farmers under public and private extension

Factors	Type of extension provider					
	Public	St. Dev	Private	St. Dev	t-value	p. value
Non-availability of market for produce	4.38	0.66	4.16	0.87	2.43	0.02
Poor soil fertilizer	3.85	0.65	4.01	0.71	1.92	0.07
High cost of farm input	3.77	0.59	3.88	0.63	1.54	0.13
Shortage of farm labor	3.71	0.62	3.90	0.72	2.46	0.02
Lack of transport facilities	3.39	0.72	3.84	1.01	4.57	0.00
Inadequate size of farm land	3.32	0.56	3.48	0.88	1.83	0.07
Absence of processing facilities	3.19	0.78	3.67	1.18	4.34	0.00
Inadequate finance and credit facilities	3.19	1.09	3.68	1.22	3.72	0.00
Inadequacy of extension program	3.14	0.84	3.24	0.91	0.99	0.33
Non- suitability of extension program	3.07	0.66	3.18	0.87	1.34	0.18
Inadequate farm inputs	2.92	0.59	3.24	0.59	2.33	0.02
Composite limitation to adoption	3.45	3.31	3.66	0.59	4.11	0.00

Means were calculated from scale of <1.5=Not at all (NAL), 1.5-2.4=Not frequently use (NFU), 2.5-3.4= Moderately use (MU), 3.5-4.4= Frequently use (FU) and>4.4 =Most frequently use (MFU)

P< 0.05

Nweke and Akorhe (2002) indicate that if farmers are expected to have high level of adoption of cassava technologies in the study area, these factors must consider seeing how they can be reduced. For instance, soil improvement programs must be added to any training on cassava technology transfer in addition to provision of inputs and capital at affordable levels. According to Nweke and Akorhe (2002), adoption of technological innovation in agriculture has attracted considerable attention among developing economies because the majority of the population of less developed or developing countries derive their livelihood from agriculture and agricultural products, and because new technology apparently offers opportunity to increase production and income substantially. Ngigi (1999) views finance as an issue crucial to entering processing and buying of farm inputs like herbicides, insecticides, and fertilizer in farming of which cassava is inclusive. Effective management of cassava farmers toward higher productivity is a function of the availability and level of finance or credit facilities at the cassava farmers' disposal. One of the main aims of agricultural extension is to transform the level of production and income of farmers in such a way that it will improve their living standards. The study therefore sought to find out whether the extension services received by the farmers from both public and private extension organizations had any impact on selected areas of livelihoods of these farmers. Further, the study tried to find out whether there are differences in the impact between public and private extension receivers. This finding is presented in Table 11. The results indicate that, farmers from both public and private extension services through the impacts of the extension services on selected aspects of their production and living standards were generally low (mean = ranging from 2.80 to 3.42) except public extension farmers who perceived their impact on increased production to be high (mean = 3.59) as a result of the public extension interventions services. Nevertheless, there were statistically significant differences between the public and private extension service farmers in the area of increased production (t-value=2.729, p=0.007), increased yield (t-value=2.652, p=0.008), farm management skills (t-value=4.41, p=0.000) and general standard of living (t-value=3.059, p=0.002), except that of increase in income (t-value=0.401, p=0.688).

Table 11: Perceived Impact of Public and Private Extension Services to Cassava Farmers

Impact	**Type of extension organization**					
	Public (n=123)	**St. Dev.**	**Private (n=195)**	**St. Dev.**	**t-value**	**p- value**
Increase in production	3.59	0.67	3.35	0.84	2.729	**0**.007
Increase in yield	3.42	0.65	3.19	0.82	2.652	0.008
Increase in income	2.84	0.64	2.81	0.78	0.401	0.0688
farm skills management	3.42	0.72	3.02	0.85	4.262	0.000
standard of living	3.38	0.79	3.09	0.90	2.973	0.002
Composite impact	3.33	0.50	3.09	0.67	3.59	0.000

Means were calculated from scale of <1.5= Not at all (NAL), 1.5-2.4= Very low (L), 2.5-3.4 = Low (L), .5-4.4= high (H), > 4.4 = Very high (VH)

P<0.05

The perceptions of public extension farmers among all the indicators were higher than those of private extension farmers. This indicates that public extension workers tend to impact more in their clients than their private counterparts. This is because even though farmers received limited services from extension providers (for instance planting materials in Table 11), they make use of these limited services information to improve their level of production, income and living standards. In order to raise farmers' income and production in the study area, government of Liberia and the county authorities must aggressively promote public and private agricultural extension services through collaboration and partnerships. According to Birkhaeuser and Evenson (1991), extension services have contributed to some extent to raising the amount of information and thus the production levels of farmers. This however did not concur with a study done by Haq*et al.* (2003) who found that the extension contacts with farmers had positive impact on the income of farmers. This is in agreement with a study done by Obisesan and Omonona (2013) that says adoption of improved agricultural technologies is a tool needed to improve agricultural productivity which serves as the key to global food security. Farmers try to make use of the insufficient extension Programs by adopting more to be able to have adequate knowledge on cassava production.

A correlation matrix was conducted to test for the degree of associated of the independent variables (factors influencing the level of adoption) on the dependent variables (level of adoption). Only those coefficients associated with statistically significant variables at the 5 percent alpha level or better are entered into the regression model. These variables were inadequate farm inputs, poor soil fertilizer, type of extension service provider, shortage of farm labor, non-suitability of extension program, inadequacy of extension program and gender of farmer. The coefficient of determination of the linear regression (adjusted R-square= 0.28) indicates that 28 percent variation in the level of adoption of improved cassava technologies was explained by the 7 variables entered in the model.

The result reveals that those farmers who perceived farm inputs to be inadequate will not adopt a high level of the technologies introduced to them by the extension services providers. On the other hand, farmers whose lands were of poor soil fertility tend to adopt the technologies more than those who believed they do not have enough poor soil fertilizer. Thus, farmers who work with private extension agents will have higher levels of adoption than those working with public extension organizations. Thus, revelation indicates that though public extension farmers perceive impact of extension services on selected aspects of the cassava farming business and living standards to be higher than those in the private extension services, they tend to have less level of adoption than private extension farmers.

Table 12: Multiple regression of factors influencing farmer's level of adoption of improve cassava technologies

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Significance	Collinearity Statistics	
	B	Beta				Tolerance	VIF
(Constant)	3.32	0.224		14.83	0.000		
Inadequate farm inputs	-0.204	0.028	-0.158	-7.282	0.000	0.627	1.595
Poor soil fertility	0.180	0.048	0.066	3.754	0.000	0.746	1.340
Type of extension provider	-0.205	0.059	-0.187	-3.447	0.001	0.960	1.042
Shortage of farm labor	0.133	0.048	0.029	2.788	0.006	0.739	1.353
Non- suitability of extension Program	-0.187	0.049	-0.099	-3.838	0.000	0.543	1.842
Inadequacy of extension Program	0.118	0.044	0.153	2.678	0.008	0.537	1.863
Gender of farmer	-0.133	0.060	0.017	-2.218	0.027	0.921	1.085

To elaborate further, the model equation for the regression is presented to show the functional relationship between the dependent variable (level of adoption) and the independent variables which fit into the model.

$$Y = - 0.158X_1 + 0.066X_2 - 0.187X_3 + 0.029X_4 - 0.099X_5 + 0.153X_6 - 0.017X_7$$

Where:

Y = level of adoption, $X_{1=}$ Inadequate farm inputs, X_2= Poor soil fertilizer, X_3= Type of extension provider, X_4= Shortage of farm labor, X_5= Non- suitability of extension Program, X_6= Inadequacy of extension Program, and X_7=Gender of farmer

The variance inflation factor (VIF) indicates whether a predictor has a strong linear relationship with other predictors (Field, 2013). Although there are no hard and fast rules about what value of the VIF should cause concern, Myers (1990) suggest that a value of 10 is a good value at which to worry. Related to the VIF is the tolerance statistics, which is the reciprocal of the VIF. As such values below 0.1 indicates serious problems although Menard (1995) suggests that values below 0.2 are worthy of concern. Since the tolerance statistics for all the predictors are above 0.2 (ranging from 0.54 to 0.96) and the VIF for these predictors are below 10 (ranging from 1.04 to 1.86), these assumptions of multi-collinearity are not violated in this study. More so the average VIF of 1.45 is very close to 1, which confirms that collinearity is not a problem for this model. Hence, the regression model for the selected factors influencing level of adoption can be said to be a valid model. Thus, there is no cause for concern about strong correlation among the predictor variables in the regression model.

CONCLUSIONS

Based on the findings of the study, the following conclusions are drawn:

- Cassava production in the selected districts in Nimba County of Liberia was characterized by male dominance, large household sizes and married famers who have low level of education but vast cassava farming experiences.
- The main sources of agricultural information to cassava farmers receiving public and private extension services in the study area were neighbors, radio, extension agents and other farmers outside their neighborhood. Most of the cassava farmers used planting materials from their own farms, relatives, other cassava producers and projects or organizations.
- The level of involvement in public and private extension services by cassava farmers was very low, though farmers were more involved in public extension than private extension. The null hypothesis of no significant difference in farmers' level of involvement in extension services between public and private extension is therefore rejected and the alternative accepted.
- The level of adoption of improved cassava technologies by farmers in public extension was very low and those farmers in private extension were low. There was no significant difference in their level of adoption of improved cassava technologies between farmers under public and private extension services.
- Extension services were perceived to have had significantly higher impact on yield, income and living standards of farmers under public extension than those under private extension.
- The main factors influencing the level of adoption of improved cassava technologies were inadequate farm inputs, poor soil fertilizer, type of extension service provider, shortage of farm labor, non-suitability of extension Program, inadequacy of extension Program and sex of farmers.

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