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Full Length Research Paper

Effects of improved maize (*Zea mays* L.) varieties on household food security in the North West Region of Cameroon

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This study was carried out from April to September 2013 in the North West Region of Cameroon on the effect of adoption of improved maize varieties (IMVs) on household food security. One hundred and forty farmers were administered semi-structured questionnaires and data was analysed using SPSS. The t-test was used to analyze the 4 pillars of food security as concerns produced maize in adopter and non-adopter households. Socio-economic analysis showed that majority of the sample size were female (50.70%) aged below 50 with an average of 9 members per household. Majority of the respondents were Christians 82.60% had formal education with access to extension services (72.70%). Most farmers depended on household generated income which came mostly from farm activities. Most of the farm sizes were below 2 ha indicating low scale production and low capacity to obtain loans. In the study area, maize was allocated over 60.00% of the farm lands. Three IMVs were identified; Coca white, Kasai and ATP with the latter being the most widely cultivated. The analysis showed that there was a significant difference at the level of yields and quantity sold. This study shows that adopting improved maize varieties increased crop yields, food security and farmers income.

Key words: Improved maize varieties, rate of adoption, food security, North West

INTRODUCTION

A significant proportion of the population in sub-Saharan Africa, including Cameroon is food insecure and malnourished. Increasing food insecurity is therefore one of the main concerns in many developing countries, especially those in this region (FAO, 1996). Shala and Stacey (2001) found out that many countries experience food insecurity with food supplies being inadequate to maintain their citizens' per capita consumption. They also found that sub-Sahara Africa was the most vulnerable region with the average amount of food available per person per day in the region being 1,300 calories compared to the world wide average of 2,700 calories. In 2012, the food security crisis in the Sahel, driven by chronic poverty, malnutrition, high food prices, drought and low agricultural production, affected 18.7 million people across the region (FAO, 2013). This pushed many of the poorest households, already vulnerable from recurring shocks and crises, to sell their assets or reduce the number of meals per day so as to survive. Helen (2002) as cited by Idris *et al* (2008) asserted that food is useful for maintaining political stability and ensuring peace among people, while food insecurity can result in poor health and reduced performance of children. No doubt, this region has witnessed several political crises in the past decade such as that of Cameroon in February 2008 and the recent struggles in Mali and the Central African Repuclic.

Cameroon is a country with the backbone of its

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economy being agriculture. About 70% of its active population is involved in agriculture, which contributes to about 25% of the GDP (FAO, 2008). About 55% of the Cameroonian population lives in the rural environment with agriculture as main activity (Etoundi and Dia, 2008). Products from this activity serve for on-farm consumption and generating incomeCereals are a major source of food and contributed to close to 50% of the total dietary energy supplies (kcal) for this region for 2007-2009 (FAO, 2008). Indeed, cereals are the basis of human food in Cameroon, providing 36.2% calorie intake and 40% protein in-take (MINADER, 2006). Of the above caloric percentages, MINADER (2006) specified that 19.5% and 22% respectively come from maize produced in the entire country alone. Etoundi and Dia, (2008) confirms that maize does not only occupy an important place in the different functions of agricultural production in Cameroon but that it is also the most consumed cereal in the country, much more than sorghum, rice or wheat.

According to Etoundi (2007), maize is a very strategic crop in Cameroon, in terms of food security and sovereignty. Maize is the major source of income for more than three million smallholders in Cameroon and is the reserve currency of smallholders. In family farms, maize occupies a central place and determines the layout of associated crops. Etoundi (2007) further explains that at the socioeconomic level, the maize market amounts to about CFAF 25 billion per year and is a source of employment for an increasingly high number of citizens. Maize is the first ingredient in the manufacture of cattle feed and is indispensable in aviculture accounting for 65% of the input for manufacturing poultry feed. It also contributes CFAF 5.6 billion to GDP and is regularly consumed by 12 million Cameroonians (MINADER, 2006).

With a population growth rate of 2.8% per year (MINEPAT, 2009), the level of maize production in Cameroon, added to post harvest losses, is therefore ineffective to tackle the food crisis faced by the nation, despite the efforts put in by research and extension to provide improved maize varieties to the farmers. According to Ebouele (2009) despite the increases in production these past few years, maize production is still unable to satisfy the ever growing national needs. As a result, maize production has received substantial research and extension attention and intensification of effort on adoption of improved varieties for improved productivity so as to tackle food insecurity and push the nation towards attaining the objectives of the Vision 2035.

Although maize is cultivated in all the areas of Cameroon, the West and the North-West regions are the principal zones of production maize; followed by the Adamawa and North regions (AGRISTAT, 2010). The objectives of the study are to obtain the socio-economic characteristics of maize farmers in the North West Region and verify the level of adoption of IMVs.

METHODOLOGY

Study Area

This study was carried out in the Mezam and Ngoketunjia Divisions of the North West Region. Mezam is located between latitudes 5° 20' and 6° 15'N and longitudes 09° 7' and 10° 21'East. It has an approximate land surface area of 1,841 km^2 and a population of about 446,000 inhabitants. The area has a tropical montane climate characterized by cold, cloudy and misty weather in areas with elevations above 1800 m and a hot and humid weather in areas with elevations below 1800 m. The rainy season runs from mid-March to mid-November. The rest of the year is a dry season. Average annual rainfall is 2288mm.Higher elevations receive higher rainfall. The average annual temperature is 19.7°C and temperature ranges between 15°C to 32°C.

Ngoketunjia Division is situated between latitudes 5˚40 and 6˚10 North, and between longitudes 10˚15 and 10˚50 East. With a population of 144,125 inhabitants in 2005 on a surface area of 1,117 km^2, Ngoketunjia Division was projected in 2010 to have a population of 164,298 inhabitants (MINEPAT, 2009), with an annual population growth rate of 4.2%. Its altitude varies between 1140 and 1650 m. Most soils in this zone are hydromorphic in nature especially in the southern part of the plain, at the level of drainage basin. Ngoketunjia Division falls within the humid Sudanese climate with two, almost equally distributed seasons; the dry and the rainy seasons. The average rainfall in the lower basin is 1860mm. Averagely in the swampy area, it varies from 1500mm in the north and centre, to 1800mm in the south. The dry season extends from November to March. The average inter-annual maximum temperature is 26 to 32˚C, and the minimum being 15 to 16˚C and the general average is 20˚C.

Sampling: A multistage sampling technique was used for this study with three stages. In each of the Divisions, Sub-divisions were selected through simple random sampling technique. Four of the sub-divisions in the Mezam Division were selected whereas all three subdivisions in the Ngoketunjia Division were included in the study (Table 1).

Stage two involved selection of two villages in each of the sub-divisions selected in stage one giving a total of fourteen villages, while the third and final stage involved the selection of ten maize farmers from each of the fourteen villages selected in stage two giving a total of 140 maize producers interviewed for the study.

For primary data, a semi-structured questionnaire was used for the collection of data. This questionnaire was elaborated around a list of precise points that were related to the theme or topic of the study.

The collected data was analyzed with the help of statistical packages such as Statistical Package for

Table 1. Sampling of farmers in Mezam and Ngoketunjia Divisions

Division	Sub-division	Village
Mezam	Bafut	Nsem
		Nforya
	Bali	Wosing
		Mantum
	Santa	Awing
		Santa
	Tubah	Bambili
		Bambui
Ngoketunjia	Babessi	Babessi
		Babungo
	Balikumbat	Balikumbat
		Bafanji
	Ndop Central	Bamunka
		Bamessing

Source: Field survey, 2013

Social Sciences (SPSS). The analyses process consisted of coding the questionnaires and variables so as to ease their insertion in the statistical package.

Descriptive statistics such as frequencies, means, percentages, etc, were used to bring out the socio-economic characteristics of the maize households and the extent of improved maize seed adoption. The Chi Square test was used to determine which of the variables of the study were factors influencing the adoption of improved maize seeds.

To evaluate food security, the following equation will be used to express household food security:

H= P + E + U + S

Where **H** is household food security,

P is physical availability of food for the household (maize availability for use by household), **E** is economic access to food and basic needs (estimated by the cash income for household use from produced of maize), **U** is utilization of food (estimated by quantity of household produced maize consumed), **S** is stability of food supply (estimated by the duration of household produced maize).

P, E, U and **S** represent the four pillars of food security.

RESULTS AND DISCUSSION

Socio-economic characteristic of the maize farmers

The socio-economic characteristics of the farmers, retained for this study included sex, age, number of household members, religion, level of education, access to extension services, access to credit, possession of off-farm income and total farm area.

It was observed that the males made up 49.3% of overall number of respondents while 50.7% were females. This slight dominance is in conformity with Conte and Fusillier (1993) who indicated the predominance of women in the maize production sector of Cameroon. In some areas, maize cultivation is gender biased. For instance, maize farmers in Bali Subdivision are mostly females (65.00%) while maize growers in Babessi are males (70.00%)

Age groups with the highest proportion included the 30-39, 40-49 and the 50-59 years age groups with 27.90, 27.10 and 26.40%, respectively. The majority of the respondents were below 50 years of age, who are the active population, and thus the sample population had the required strength to carry out farm production (Idrisa *et al*, 2012). Less than 30 years old group was the least represented age group with just 6 respondents. This can be attributed to the fact that many youths in the study areas are now getting more involved in non-agricultural activities such as motorcycle riding (“okada”) for the males and phone booth business for the females as well as formal education for both sexes. This therefore reduces the proportion of this age group involved in agricultural activities.

A majority of the households ranged between 6-10 members (55.72%), followed by the 1-5 range with 22.14% and the 10-15 range 15.71%. With household members being a source of labour, this shows that the households had a high labour force to carry out agricultural production. The two religions were Christianity and Islam. The main Christian denominations were catholic, Presbyterian, Baptist, Evangelical and plethora Pentecostal churches. Religion did not have an impact on IMVs adoption asboth religions had the same appetite for maize and maize-based products.

The overall statistics showed that 17.14% of the

Table 2. Sampling of farmers in Mezam and Ngoketunjia Divisions

Division	Sub-division	Village
Mezam	Bafut	Nsem
		Nforya
	Bali	Wosing
		Mantum
	Santa	Awing
		Santa
	Tubah	Bambili
		Bambui
Ngoketunjia	Babessi	Babessi
		Babungo
	Balikumbat	Balikumbat
		Bafanji
	Ndop Central	Bamunka
		Bamessing

Source: Field survey, 2013

respondents had no formal education; meanwhile 82.86% had formal education. The highest proportion were those with primary level education (55.00%) followed by secondary education (17.86%). With over four-fifth of the respondents having a formal education, this shows that the farmers have the ability to understand agricultural production systems and techniques, and so they have the capacity to undertake in agricultural production activities with fewer constraints.

Data showed that 27.86% of the respondents received no visits from extension agents yearly; against 72.14% who received extension visits. Some of the respondents (32.86%) received more than 9 extension visits a year; followed by 4-6 extension visits range (20%), the 1-3 extension visits range (11.42%) and finally the 7-9 extension visits range (7.86%).

About 55.00 % of the respondents had no access to credit while some of the respondents took credit once (25.72%), twice (15.00%) or more than once a year (4.29%). This showed that a majority of the farmers depended on household generated income to invest as capital in agricultural production. There was a great variation of access to loans from one sub division to the other. In Balikumbat sub-division a majority did not have access to loans while in Santa Subdivision, 80.00% took loans once a year. It was observed that 65.71% of the respondents did not have off-farm income while 34.29% had. This indicated that most of the households depended mostly on agriculturally generated income (on-farm income) to invest in their agricultural activities.

Three different types of IMVs used by the adopters. These varieties include; ATP (yellowish and sweet), Kasai (white small grains) and Coca White (white large grains). Some of the adopters used only one type of IMV while others made a combination of two improved varieties. The farm sizes of the respondents ranged from ranged from 0.5 ha to 60 ha, and the mean farm size was 3.3ha. More than half of the farmers had small farm (below 2 ha) which showed that a majority of the households were carrying out small scale subsistent production (Toussi *et al*., 2008). According to Bonabana-Wabbi (2002), this also reduces the strength of the respondents to take loans since land is a major form of collateral in the lending process.

Effect of adoption

Household yields from Maize production

As seen on table 2, it was observed that the estimated average yield of maize per hectare in the study area was 2.14 tonnes per hectare. The average yield per hectare in Mezam division was estimated at 1.35 tonnes as compared to a greater average yield of 3.29 tonnes per hectare for Ngoketunjia sub-division. The higher yields in Ngoketunjia can be attributed to the fact that the farmers in Ngoketunjia invest more in the production of maize, through the allocation of land and purchase of inputs, which is necessary to improve farm yields.

Babessi sub-division recorded the highest yield (5.44 tonnes per hectare) followed by Ndop sub-division Central (2.54 tonnes per hectare) and Bafut sub-division (1.92 tonnes per hectare). The least yield was recorded in Santa sub-division (0.86 tonnes per hectare) followed by Tubah sub-division (0.89 tonnes per hectare).

Household consumption of maize

All the respondents confirmed the fact that their households were consumers of maize products. Maize was consumed in the study area in the form of the following; Corn flour commonly known as “Fufu corn”, “corn chaff”, boiled, roasted, etc.

Table 3. Maize consumption data per locality

	Average rate of consumption of maize by household (days per week)	Average quantity of consumption of maize by household (kg per week)	Standard Deviation
Bafut	3	9.55	7.163
Bali	4	10	3.084
Santa	3	11.2	11.619
Tubah	3	7.3	3.951
Mezam Divisional Mean	3	9.4	7.348
Babessi	6	27.9	33.355
Balikumbat	5	14.8	6.237
Ndop Central	5	19.6	12.271
Ngoketunjia Divisional Mean	5	20.8	21.919
Overall Mean	4	14.3	15.907

Table 4. Maize commercialization data per locality

	No. of Farmers selling maize	Percentage of farmers selling maize (%)	Average quantity maize sold Yearly per household (kg)	Standard Deviation
Bafut	19	95	673.6	738.014
Bali	16	80	884.5	2196.912
Santa	12	60	209	380.643
Tubah	15	75	296.6	379.922
Mezam Divisional Mean	**62**	**77.5**	**516.5**	**1199.097**
Babessi	18	90	2474	4355.673
Balikumbat	12	60	596	1321.688
Ndop Central	18	90	972.6	1423.345
Ngoketunjia Divisional Mean	**42**	**70**	**1347.8**	**2827.257**
Overall Mean	**104**	**74.29**	**872.7**	**2092.976**

It can be observed from table 3 that the average rate of consumption of these maize products per household for the respondents was estimated at 4 days a week with an average quantity of 14.3kg a week. This confirms the fact that maize is a major staple food in this study area. Ngoketunjia division had a greater consumption rate of 5 days a week with an average quantity of 20.8kg per week, as compared to Mezam division with a rate of 3 days a week and an average quantity of 9.4kg per week. In the sub-divisions, the highest rate of consumption was recorded in Babessi sub-division (6 days a week) and the lowest in Bafut, Santa and Tubah sub-divisions (3 days a week). Babessi sub-division also had the highest average quantity of maize consumed per week (27.9kg), followed

Table 5. Duration of household produced maize per locality

	Average duration of produced maize (months)	Standard Deviation
Bafut	10.1	2.789
Bali	9.8	3.054
Santa	11.6	1.392
Tubah	11.9	0.671
Mezam Divisional Mean	**10.8**	**2.345**
Babessi	11.9	0.671
Balikumbat	10.9	2.498
Ndop Central	12	0.000
Ngoketunjia Divisional Mean	**11.6**	**1.555**
Overall Mean	**11.2**	**2.070**

by Ndop Central sub-division with 19.6kg. The least was observed in Tubah sub-division with 7.3kg per week, followed by Bali sub-division with 10 kg per week.

Sales of maize

Table 4 shows that the proportion of respondents who commercialized maize was 74.29% with the average quantity sold by household per year being 872.7kg. Mezam division had a proportion of respondents who commercialize maize (77.5%) with an average quantity sold by household per year being 516.5kg; meanwhile Ngoketunjia division had a lower proportion of respondents who commercialize maize (70%) with a higher average quantity sold by household per year of 1347.8kg. High household consumption of maize in Ngoketunjia accounts for the low proportion of farmers commercializing produced maize.

Bafut sub-division had the highest proportion of respondents who commercialized maize (95%), meanwhile the least was observed in Santa and Balikumbat sub-divisions (60%). Babessi sub-division had the highest average quantity of maize sold per household yearly with 2474kg, followed by Ndop Central sub-division with 972.6kg and Bali sub-division with 884.5kg. The least was observed in Santa sub-division with 209kg followed by Tubah sub-division with 296.6kg.

Duration of household maize

The duration of maize produced by the household is very essential for the stability of the household's food security. As seen on table 5, the average duration of the maize produced for the respondents was 11.2 months. Ngoketunjia division had a longer duration (11.6 months) than Mezam division (10.8 months). Ndop Central sub-division had the longest duration of maize produced of 12 months followed by Babessi and Tubah sub-divisions with 11.9 months each. The least duration was observed in Bali (9.8 months) followed by Bafut (10.1 months). This longer duration of produced maize in Ngoketunjia shows that maize is of a higher importance there than in Mezam. This can also be backed by the fact that respondents in Ngoketunjia invest more in Maize production as well as consume and commercialize more maize than those in Mezam.

Effects of adoption of improved maize seeds on household food security

This section of the study is involved with the testing of the following hypothesis: "Adopters of improved maize varieties are closer to food security than non-adopters".
In this study, Household food security (**H**) is represented as:

$$H = P + E + U + S$$

P, E, U and S represent the four pillars of food security, where;

P (Physical Availability) is represented by the yield of

Table 6. Statistics on Food Security Pillars of Adoptive and Non-Adoptive Households

		Mean
P- Yield of maize produced (tonnes/ha)	Adopters	1.36
	Non-Adopters	0.99
E- Quantity of produced maize sold (kg)	Adopters	1088.90
	Non-Adopters	248.22
U- Quantity of produced maize consumed per year (kg)	Adopters	745.5
	Non-Adopters	556.1
S- Duration of produced maize (months)	Adopters	11.2
	Non-Adopters	10.9

Table 7.1 t-test results on Food Security Pillars of Adoptive and Non-Adoptive Households

Statistics on Food Security Pillars of Adoptive and Non-Adoptive Households		
	t	**Probability**
P- Yield of maize produced (tonnes/ha)	2.992	0.003***
E- Quantity of produced maize sold (kg)	2.103	0.037**
U- Quantity of produced maize consumed per year (kg)	1.187	0.237
S- Duration of produced maize (months)	0.783	0.435

maize per hectare oh household.
E (Economic Access) is represented by the quantity of produced maize sold by the household.
U (Utilization) is represented by the quantity of produced maize consumed by the household.
S (Stability) represents the duration of the produced maize by the household.

Table 6 shows how improved maize variety adoption influences the four pillars of food security. From the table above, it can be seen that at all the four pillars of food security, adopters have a relative advantage over non-adopters, but this is not enough to conclude that adopters of improved maize seeds are further from food insecurity than non-adopters. To analyze the above stated hypothesis, we used the t-test analysis to compare the means and test the following sub-hypotheses, to see if there is a statistically significant difference at the level of the four pillars of food security in adopter and non-adopter households:

H1: Adopters of improved maize seeds have a significantly greater physical availability of maize for the household than non-adopters.
H2: Adopters of improved maize seeds have a significantly higher cash income for household use from the production of maize than non-adopters.
H3: Adopters of improved maize seeds have a significantly higher household consumption of produced maize than non-adopters.
H4: Adopters of improved maize seeds have a quantity of produced maize which significantly lasts longer than that of non-adopters.

The table 7 below shows the results of the t-test analysis. The results show that there was a significant difference between the yield of maize of adopters and non adopters at the 1% (***) level, and there was also a significant difference between the quantity of produced maize sold by adopters and non-adopters at the 5% (**) level. There was no significant difference between the quantity of produced maize consumed by the adopters and non-adopters as well as the duration of the produced maize.

For **H1** (physical availability), adopters of have a mean yield of produced maize (1.36 tonnes/ha) higher than that of non-adopters (0.99 tonnes/ha), and this difference is statistically significant at the 1% level. We therefore conclude that adopters of improved maize seeds have a significantly greater physical availability of maize for household consumption than non-adopters.

For **H2** (economic access), adopters of improved maize varieties commercialize a greater mean quantity of produced maize each year (1088.9kg) than non-adopters (248.22kg), and the difference is statistically significant at the 5% level. We therefore conclude that adopters of improved maize seeds have a significantly higher cash income for household use from the production of maize than non-adopters.

For **H3** (utilization), adopters of improved maize varieties consume a greater mean quantity of produced

maize each year (745.5kg) than non-adopters (556.1kg), but this difference is not statistically significant. We therefore conclude that adopters of improved maize seeds have a mean household consumption of maize which is not significantly higher than that of non-adopters.

For **H4** (stability), adopters of improved maize varieties consume a longer duration of produced maize each year (11.2 months) than non-adopters (10.9 months), but this difference is statistically insignificant. We therefore conclude that adopters of improved maize seeds have a quantity of produced maize which insignificantly lasts longer than that of non-adopters.

At the different pillars of food security, adopter households of IMVs had a greater yield of maize, a greater quantity of produce maize sold, a greater quantity of produced maize consumed as well as a longer duration of produced maize than non-adopter households per year. The t-test was used to analyze the significance of these differences. The analysis showed that there was a significant difference at the level of yields and quantity sold. This led to the acceptance of the hypothesis that adopters of IMVs were closer household food security than non-adopters. This study shows that adopting improved maize seeds is beneficial to the farmers.

CONCLUSION AND RECOMMENDATIONS

At the different pillars of food security, adopter households of IMVs had a greater yield of maize, a greater quantity of produce maize sold, a greater quantity of produced maize consumed as well as a longer duration of produced maize than non-adopter households per year. The t-test was used to analyze the significance of these differences. The analysis showed that there was a significant difference at the level of yields and quantity sold. This led to the acceptance of the hypothesis that adopters of IMVs were closer household food security than non-adopters.

To increase the rate of adoption of IMVs in Cameroon, farmers are advised to adopt IMVs due to high yields, seek advice from extension agents, keep farm records and ensure use of appropriate inputs so as to maximize productivity, which is a prerequisite for attaining household food security while GP-DERUDEP and other stakeholders such as PNAFM and the government should educate the public, booster extension services and provide agricultural credit and loans to farmers.

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