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# Socio-economic Analysis and Adoption of Improved Maize (*Zea mays* L.) Varieties by Farmers in the North West Region of Cameroon

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*Authors' contributions*

*This work was carried out in collaboration between all authors. Authors INM, IC, EEN and GFC designed the study, wrote the protocol while author DNT wrote the first draft of the manuscript and managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

This study was carried out during April -September 2013 in the North West Region of Cameroon on the socio-economic analysis and adoption of improved maize varieties (IMVs).One hundred and forty farmers were administered semi-structured questionnaires and the data were analysed using SPSS. Socio-economic analysis showed that majority of the sample size were female (50.70%), aged below 50 with an average of nine members per household. Majority of the respondents were Christians (82.60%) and had formal education with access to extension services (72.70%). Most of the farmers depended on household generated income mainly from farm activities. Most of the farm sizes were below 2ha indicating low scale production and low capacity to obtain loans. In the study area, maize was allocated over 60.00% of the farm lands. The level of adoption was found to be 74.30%, with 25.70% of the farmers cultivating both IMVs and local ones. Three IMVs were

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identified - Coca white, Kasai and ATP with the latter being the most widely cultivated. Chi Square test was used to analyze the determining factor of adoption of IMVs. Gender, level of education, access to extension services, access to credit/loans and possession of off-farm income were found to be the determinants meanwhile the other factors were not. The t-test was used to analyze the four pillars of food security as concerns produced maize in adopter and non-adopter households. The analysis showed that there was a significant difference between the level of yields and quantity sold. This study concluded that adopting improved maize seeds is beneficial to the farmers.

## 1. INTRODUCTION

In order to ensure political stability, economic growth and eradicate poverty, one of the four pillars of Cameroon's Vision 2035 is to address food crisis and make Cameroon the breadbasket of the Central African Region [1]. This implies that there is a need for the country to intensify its agricultural productivity so as to provide sufficient food to the 19 million inhabitants [2] as well as the neighbouring countries of the CEMAC zone and even beyond.

Cereals are a major source of food and contributed close to 50% of the total dietary energy supplies (kcal) for this region during 2007-2009 [2]. Indeed, cereals are the basis of human food in Cameroon, providing 36.2% calorie intake and 40% protein intake [3]. Of the above caloric percentages, [3] specified that 19.5 and 22%, respectively come from maize produced in the entire country alone. [4] 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 [5], 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. [5] 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 [3]. Maize yields in Cameroon are estimated at 2.1 t/ha [6]

comparable to the African average (2.0 t/ha) but much lower than the world average (5 t/ha) and Africa (11t/ha) figures of the same year.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.

## 2. METHODOLOGY

### 2.1 Study Area

This study was carried out in the Mezam and Ngoketunjia Divisions of the North West Region. Mezam is located between latitudes 5º 20' and 6º 15'N and longitudes 09º 7' and 10º 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 1800m and a hot and humid weather in areas with elevations below 1800m. 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 19.7ºC and temperature ranges between 15ºC to 32ºC.

Ngoketunjia Division is situated between latitudes 5º40 and 6º10 North and between longitudes 10º15 and 10º50 East. With a population of 144,125 inhabitants in 2005 on a surface area of 1,117km$^2$, Ngoketunjia Division was projected in 2010 to have a population of 164,298 inhabitants [1], 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 32ºC and the minimum being 15 to 16ºC and the general average is 20ºC.

## 2.2 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 14 villages, while the third and final stage involved the selection of 10 maize farmers from each of the 14 villages selected in stage two giving a total of 140 maize producers interviewed for the study.

For primary data collection, a semi-structured questionnaire was used. This questionnaire was elaborated around a list of precise points that were related to the theme or topic of the study. Firstly, the questionnaire had a section on socio-economic characteristics of the farmers: Religion, sex, age group, family size and level of education. Secondly, the questionnaire assessed the level of adoption by asking questions on maize varieties cultivated and source of these varieties. Finally, farmers were asked information on the access to extension services, credits/loans, off-farm income and farm inputs.

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

**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*

## 3. RESULTS AND DISCUSSION

### 3.1 Socio-Economic Characteristics 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 49.30% of overall number of respondents while 50.7% were females. This slight dominance is in conformity with [7] 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. 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 [8]. Less than 30 years old group was the least represented age group with just six respondents. This can be attributed to the fact that many youth 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 (Table 2).

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 as both the religions had the same adoption rate.

The overall statistics showed that 17.14% of the 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 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 nine 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, 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.

The farm sizes of the respondents ranged from 0.5 to 60ha and the mean farm size was 3.3ha. More than half of the farmers had small farm (below 2ha) which showed that a majority of the households were carrying out small scale subsistent production [9]. According to [10], this also reduces the strength of the respondents to take loans since land is a major form of collateral in the lending process.

All of the 140 respondents acknowledged the fact that they were aware of the improved maize varieties and 104 of them adopted improved maize varieties. The data represented above shows that 60 respondents (42.9%) used only the improved maize varieties, 36 of them (25.7%) used only the local maize seed varieties while 44 of them (31.4%) used both the improved and local maize varieties.

## 3.2 Rate of Adoption of Improved Maize Seeds

Three different types of IMVs were 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. Results also showed that 44 adopters (42.30%) used only ATP, 25 (24.10%) used only Kasai, and 4 (3.80%) used only Coca White. Results further showed that 28 (26.90%) of the adopters jointly used Kasai and ATP, meanwhile 3 (2.90%) jointly used ATP and Coca White. More adopters used ATP because they loved its colour and taste, as well as the ready market for its sale due to its high demand in households in the region and beyond. Some farmers in the study area are not growing IMVs because the seeds are not readily available, sceptical in changing their old habits, lack of technical knowhow to cultivate the new varieties and lack of finance to invest (purchase of fertilizers, seeds and pesticides) in the production of the new varieties.

### 3.2.1 Variations in level of adoption

It was observed that there was a level of adoption of 73.75% for Mezam Division as compared to 75.00% for Ngoketunjia Division. Maize is consumed much more in Ngoketunjia and so adoption of the IMVs is required to meet up with the high household demands whereas farmers in Mezam cultivate

**Table 2. Socio-economic characteristics of respondents**

| | | Bafut | | Bali | | Santa | | Tubah | | Mezam average | | Babessi | | Balikumat | | Ndop central | | Ngoketunjia Average | | Average of the two divisions | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % |
| SEX | Male | 8 | 40 | 7 | 35 | 9 | 45 | 10 | 50 | 34 | 42.5 | 14 | 70 | 13 | 65 | 8 | 40 | 35 | 58.33 | 69 | 49.3 |
| | Female | 12 | 60 | 13 | 65 | 11 | 55 | 10 | 50 | 46 | 57.5 | 6 | 30 | 7 | 35 | 12 | 60 | 25 | 41.67 | 71 | 50.7 |
| AGE Group | <30 | 0 | 0 | 1 | 5 | 0 | 0 | 2 | 10 | 3 | 3.75 | 0 | 0 | 2 | 10 | 1 | 5 | 3 | 5 | 6 | 4.3 |
| (years) | 30-39 | 1 | 5 | 5 | 25 | 3 | 15 | 5 | 25 | 14 | 17.5 | 6 | 30 | 10 | 50 | 9 | 45 | 25 | 41.67 | 39 | 27.9 |
| | 40-49 | 5 | 25 | 7 | 35 | 6 | 30 | 5 | 25 | 23 | 28.75 | 8 | 40 | 2 | 10 | 5 | 25 | 15 | 25 | 38 | 27.1 |
| | 50-59 | 8 | 40 | 4 | 20 | 9 | 45 | 4 | 20 | 25 | 31.25 | 4 | 20 | 4 | 20 | 4 | 20 | 12 | 20 | 37 | 26.4 |
| | >60 | 6 | 30 | 3 | 14 | 2 | 10 | 4 | 20 | 15 | 18.75 | 2 | 10 | 2 | 10 | 1 | 5 | 5 | 8.33 | 20 | 14.3 |
| Religion | Christianity | 20 | 100 | 20 | 100 | 20 | 100 | 20 | 100 | 80 | 100 | 9 | 45 | 18 | 90 | 15 | 75 | 42 | 70 | 122 | 87.14 |
| | Islam | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 55 | 2 | 10 | 5 | 25 | 18 | 30 | 18 | 12.86 |
| Level of | No Formal | 2 | 10 | 6 | 30 | 2 | 10 | 5 | 15 | 15 | 18.75 | 1 | 5 | 7 | 35 | 1 | 5 | 9 | 15 | 24 | 17.14 |
| Education | Primary | 12 | 60 | 9 | 45 | 14 | 70 | 10 | 50 | 45 | 56.25 | 9 | 45 | 11 | 55 | 12 | 60 | 32 | 53.33 | 77 | 55 |
| | Secondary | 5 | 25 | 3 | 15 | 2 | 10 | 2 | 10 | 12 | 15 | 7 | 35 | 2 | 10 | 4 | 20 | 13 | 21.67 | 25 | 17.86 |
| | High School | 1 | 5 | 1 | 5 | 1 | 5 | 1 | 4 | 4 | 5 | 2 | 10 | 0 | 0 | 3 | 15 | 5 | 8.33 | 9 | 6.43 |
| | University | 0 | 0 | 1 | 5 | 1 | 5 | 2 | 10 | 4 | 5 | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 1.67 | 5 | 3.57 |

maize more for commercial purposes. Also, it can be attributed to the presence of the Regional Seed farm in Ndop, run by the Regional Delegation of Agriculture and Rural Development for the North West, which is the largest farm for cultivation and distribution of the improved maize seeds for the North West Region. [4] stated that belonging to a high maize consumption area increases the probability of adopting improved maize seeds which is the case in Ngoketunjia.

The adoption of IMVs by males was 81.20%, while that of females was 67.60%. The reason for the greater rate of adoption for males as compared to females can be attributed to the fact that in the African society today, women still remain inferior to men, who take advantage of it to overpower the women. According to [11], this difference arises from gender linked differences in access to key inputs. Their study showed that male farmers have better access to land, labour and even extension contacts than women. This increases their probability to adopt new innovation than women.

The >30 years age group had the highest rate of adoption of IMVs followed by the 40-49 years age group. The least rate of adoption was at the 30-39 years group with 66.7%. Below 30 years, the farmer is young and adventurous. This makes him a risk taker, increasing his probability of adopting new innovations. Between 30-39 years of age, the farmer's probability to adopt drops due to the fact that it is at this stage that the farmers have several responsibilities such as starting and taking care of a family, owning his own assets and investments, etc. This reduces his investment in agricultural production thereby decreasing the rate of adoption at this age. At age 40-49 years, the farmer has a stable family and is quite acquainted with his or her responsibilities as well as experiences in the maize production field. This increases his probability to adopt new innovation.

A decrease is observed in the rate of adoption as the farmer's age from the 50s and above. This is due to the fact that they are less open to new innovation. [10] stated that because of investing several years in a particular practice, older

Respondents with access to extension services had 85.00% adoption level while less than half (47.5%) of those with no extension access adopted. Good extension programmes are a key aspect in innovation dissemination and adoption [10]. Extension contact's influence can counter

farmers may not want to jeopardize it by trying out an innovation. [12] stated that the farmer's advanced age and a possibility of not living long enough to enjoy an innovation may reduce their rate of adoption. [10] stressed the fact that older farmers are no longer income-orientated and so will not be expected to adopt income-generating innovation.

It can be observed that households with more members have a higher level of adoption. Households with more than 15 members have 100% adoption of IMVs, and this decreases with reduction in number of household members down to 71% for households with 1- 5 members. This increase in r adoption with increase in household size can be attributed to the fact that with more mouths to feed, the household will require higher yielding varieties so as to feed the household as well as cater for the growing needs of the household members.

About 74.60% of the Christians and 72.20% of the Muslims adopted the IMVs. The rate of adoption of the Muslim community was higher than expected. This can be attributed to the fact that a lot of efforts have been put in to empower the Muslim communities in the region which has led to the rapid integration of the Muslim community in the society. Another factor may be the fact that most of the Muslims in the region are now settling down and getting more involved in agricultural production and are moving away from nomadism.

The level of adoption increased with increase in the level of education. At the highest levels of education (high-school and university), the level of adoption is at 100 % and decreases to 84.00% for secondary education, 72.70% for primary education and 54.20% for those with no formal education. [13] indicated that technology complexity has a negative effect on adoption. According to [10], education is thought to reduce the complexity perceived in an innovation, thereby increasing its adoption. Adoption of an innovation in agriculture therefore requires a greater understanding of the production system as well as the innovation itself.

balance the negative effect of lack of years of formal education in the overall decision to adopt an innovation [14].

Level of adoption was estimated to be 85.70% for respondents with access to credit/loans and 64.90% for respondents with no access to

credit/loans. Credit and loans boost the capacity of a farmer to invest in agricultural production by increasing his capital. Farmers with access to credit/loans can easily purchase innovations than those without. [15] stated that most farmers fear trying improved technologies due to lack of the necessary financial resources. According to [8], this can be due to the fact that most agricultural innovations require complementary inputs such as fertilizers, pesticides, herbicides etc. Access to credit and loans therefore helps to break this barrier. That is why the frequency of adoption of respondents with access to credit/loans is higher than that of those with no access.

Off-farm income entails regular sources of income other than agricultural production, such as civil service, businesses, craft, etc. Farmers with an off-farm income had adoption of 87.50%, which is higher than that of those with no off-farm income (67.40%).The higher adoption of IMVs by farmers with off-farm income can be attributed to the fact that off-farm income, like credit and loans, also increase the farmer's capital to be invested in agricultural production and so increasing his chances to invest in innovation. [16] reports that employment in off-farm activities is essential for diversification of farm households' production; it enables households to modernize their production by giving them an opportunity to apply the necessary inputs.

Respondents with farms above four hectares have the highest proportion of IMV adopters and the lowest proportion is obtained for farmers with 0-1.0ha of land. This is due to the fact that farmers with larger pieces of cultivated land are moving towards the commercial direction than low farm size farmers. This increases their probability of adopting IMVs so as to obtain higher yields and have fewer losses from pest and disease attacks. [10] stated that farm size is very important because it affects adoption costs, risk perceptions, human capital, credit constraints, labour requirements, tenure arrangements and more. [17] stated that larger farms are the most probable to adopt innovations requiring high fixed costs and [14] stated that small farms are the most probable to adopt innovations requiring high variable costs.

## 3.3 Factors Affecting the Level of Adoption of Improved Maize Seeds

Different socio-economic characteristics of the respondents on which adoption of IMVs dependent were analysed. Socio-economic characteristics of interest analyzed 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. The Chi Square test results are presented in Table 3.

**Table 3. Chi square test results for factors affecting the adoption of improved maize varieties**

| Socio-economic factor | Chi-square | Probability |
| --- | --- | --- |
| Sex | 3.365 | 0.067* |
| Age | 1.917 | 0.751 |
| Number of household members | 3.650 | 0.302 |
| Religion | 0.046 | 0.830 |
| Level of education | 11.265 | 0.024** |
| Access to extension services | 21.034 | 0.000*** |
| Access to credit/loan | 7.832 | 0.005*** |
| Possession of off-farm income | 6.677 | 0.010** |
| Total farm area | 5.400 | 0.249 |

The adoption of IMVs was dependent on five of the factors at the 10 (*), 5 (**) and 1% (***) levels of probability and was independent of four of the factors. Age, household size, religion and total farm area had no significant relationship with adoption. They were therefore not considered as factors affecting the adoption of IMVs in the North West Region of Cameroon. At the 10% probability level (ρ≤0.1), adoption was found to have a significant relationship with sex. At the 5% probability level (ρ≤0.05), adoption was found to be dependent on level of education and possession of off-farm income. At the 1% probability level (ρ≤0.01), adoption was found to depend on access to extension services, as well as access to credit and loans. These five factors (sex, level of education, access to extension, access to credit or loans and possession of off-farm income) are therefore considered as the main factors affecting the adoption of IMVs.

Every day, over 1 billion people go hungry. The cost of food is a constant concern for impoverished people in developing nations, as they spend 50-80% of their budget on food [18]. Poverty is the principal cause of hunger. In 2008, the World Bank estimated that nearly 1.4 billion people in developing nations live on less than $1.25 per day [19].

Food prices have been rising for a while. In some countries this has resulted in food riots and in the case of Haiti where food prices increased by 50-100%, the Prime Minister was forced out of office. Elsewhere people have been killed, and many more injured. While media reports have been concentrating on the immediate causes, the deeper issues and causes have not been discussed as much. As of March 2008, average world wheat prices were 130% above their level a year earlier, soy prices were 87% higher, rice had climbed 74% and maize was up by 31% [20].

Cameroon is erroneously considered to be food self – sufficient. The number of persons suffering from hunger in Cameroon increased from 4.3 million in 1990-92, to 5.1 million in 1995- 1997, and then dropped again to 4 million in 2003-2005. The double crises (economic and food crises) that countries worldwide are currently facing, has certainly worsened the food security situation in the country [21]. During the 2008 food crisis, the population found themselves on the streets and the President of the Republic had to make a speech on an extraordinary day to stop the crisis. It should be reminded that this is the only day that President Paul Biya created such a surprise in over three decades of his reign. It should also be noted that things have been going from bad to worse after this year with prices of cereals skyrocketing. Increasing maize production through IMV will go a long way to solve this problem.

## 4. CONCLUSION AND RECOMMENDATIONS

This study carried out in the North West Regions of Cameroon tried to characterize the socio-economic characteristics of maize farmers as well as the production of maize in the study area. Close to 27.80% of the respondents had no access to extension services, only 45.00% had access to credit/loans. 65.71% of the farmers had no off-farm income and a majority of the farm sizes ranged from 1.1ha to 2ha. As concerns the characteristics of maize production in the study area, the percentage of farm land used for maize production was 60.08%.

The level of adoption was found to be 74.30, with 25.70% of the farmers cultivating both IMVs and local seeds. Three IMVs were identified in the study area; Coca white, Kasai and ATP with the latter being the most widely used. Adoption increased with increase in level of education and 85.00% of those with access to extension

services adopted IMVS. Farmers with access to loans had an adoption rate of 85.70% meanwhile those with off-farm had an 87.5% adoption rate. The Chi Square ($\chi^2$) test was used to analyze the determining factor of adoption of IMVs. Gender, level of education, access to extension services, access to credit/loans and possession of off-farm income were found to be the determinants meanwhile the other factors were not.

To increase maize production 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.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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