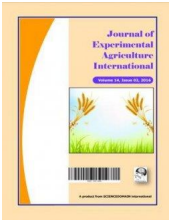

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Identification of Farmer's Constraints to Maize Production in the Humid Forest Zone of Cameroon

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Authors' contributions

This work was carried out in collaboration between all authors. Authors ELMN, LNT, VG and EN designed the study. Authors MY and LNT reviewed the experimental design and enabled the practical realization of this work. Author LNT performed physical and chemical soil analysis. Authors EN, HAM, AK and CVD designed the questionnaire and performed the statistical analysis. Authors EN, LNT, MY and ELMN wrote the protocol and the first draft of the manuscript. Authors NW and LNT managed the analyses of the study. Authors JN and HAM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Ten farmers were randomly selected in the humid forest zone of Cameroon to form the main focus group of 50 people. A total of 178 farmers were individually interviewed. A Participatory Rural Appraisal (PRA) was conducted in fives villages in the Bimodal Humid forest zone (BHFZ) of Cameroon in 2013. The objectives of the study were to elucidate farmer's perceptions on maize cultivars and to identify farmer's constraints on their maize production system. Quantitative data

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analyses were performed using least square means of the Statistical Package for Social Scientists (SPSS) version 17. Results showed that poor soil fertility was among the major six problems listed by farmers in the BHFZ. Maize was the main cereal produced as food and cash crop in the study area. The main land management practice was slash and burn with a fallow system. The major constraints facing farmers were inadequacy of improved varieties, post-harvest handling challenges, weeds infestation, poor soil fertility and high cost of fertilizers. Therefore, it became necessary to explore for more sustainable and affordable ways of increasing yield of the crop through identification of high-yielding and stable maize tolerant to these farmer's constraints. The practice of appropriate agricultural system associated with the utilization of improved and adapted varieties could significantly increase their maize yield.

Keywords: Participatory rural appraisal; farmer's constraints; focus group; soil fertility; maize tolerant.

1. INTRODUCTION

Maize productivity in sub-Saharan Africa as in Cameroon is low due to the variable production environment, stress and limited access to essential inputs. Maize (*Zea mays L.)* production in Cameroon is mainly in the hands of small scale farmers. Farmers grow the crop in highly variable and stress-prone environments [1]. The level of adoption of improved maize varieties was estimated in some villages in the humid forest zone of Cameroon and found to be low compared to the use of local varieties in those areas [2]. For effective breeding program, farmers' preferences for varieties should be clearly identified through researcher-farmer interaction and collaboration [3]. Breeders should involve farmers in their breeding programs to learn more about the most important selection criteria of male and female farmers for the cultivars preferred in their environments [4]. This encourages the use of locally adapted cultivars resulting in less dependence on introductions. Such a strategy has resulted in selection and development of new wheat, barley, common bean, quinoa, potato and maize cultivars in various part of the world [4]. This is a clear indication that breeders must be well acquainted with the farmer preferences such as the requirements for specific agronomic criteria, storage, processing and marketing traits if adoption rate is expected to be high [4]. The Bimodal Humid Forest Zone (BHFZ) of Cameroon has in the recent past seen the integration of maize into the cropping system. This has largely been due to the high demand for maize especially the fresh green cob in the administrative capital, (Yaounde), and the high return on the per unit area compared to the traditional root crops. However most of the soils in this zone are acidic, decreasing the yields [5]. The Acid Tolerant Population (ATP) introduced to the area decreases in yield when grown in the acid soils [6]. With the farmers' inability to correct acidity of the soils by applying agricultural lime, it has become imperative to develop acid tolerant hybrids which are also high-yielding. These hybrid varieties should have stable yield in most of the soils of the BHFZ. To develop a successful and adopted maize improved variety, it is very important for the researcher to consider farmers' preferences in terms of their ideal maize variety and also their specific needs vis-à-vis the cropping of the crop. It is with this reason that a participatory rural appraisal (PRA) in the South Region of Cameroon was carried out with the objectives of: (i) Elucidate farmer perceptions on maize cultivars (ii) Identify farmers' constraints on maize production.

2. MATERIALS AND METHODS

2.1 Study Site

The study was conducted in the Bimodal Humid Forest Zone (BHFZ) of Cameroon which covered three regions out of 10 in the country. Five villages (Asso'osseng, Biyeyem, Djop, Ndengue and Nkoemvone) were involved in the study. The annual rainfall in BHFZ is 1800 mm with bimodal distribution [7]. The soils are Oxisols and typically Kandiudox highly weathered and dominated by kaolinitic clay with high Aluminium (Al) toxicity [8]. The study site mainly has forest vegetation with mixed cropping as the main farming system. The crops grown include cocoa, maize, groundnut, cassava and yam. The villages were selected based on their acidic nature of the soils where maize is a major cereal crop cultivated.

2.2 Sampling Procedure and Data Collection

A multidisciplinary research team comprising of a Plant Breeder, (the principal investigator), a

social scientist, a facilitator, an agricultural extension officer, three students at the Masters level from the University of Yaounde and SupAgro Institute of Montpellier, France.

The selection of the households within each of the five villages was done through random sampling of farmers who were planting maize either as a sole crop or as a mixed crop in the studied area, their willingness and availability to cooperate with the research team. The selected villages were closed to the station of Institute of Agricultural Research for Development (IRAD) at Ebolowa. Focus group discussion was used where, 10 farmers were randomly selected from each of the five villages to form the main focus group of 50 people. These farmers were subdivided into five groups. For socio-cultural reasons and free discussion among the farmers, male and female groups were formed separately. Contact was established with the group via telephone and/or government zonal extension agent.

The focus group discussion was done using the format below as guidelines in developing a questionnaire:

- Introduction and purpose of the meeting
- Presentation of research team
- Presentation of the representative of farmers in the village
- Questions on farming system(s)
- Questions on crop production with more emphases on maize cropping
- Questions on the difficulties encountered in farming
- Questions on marketing, labor and expectations including other comments.

A recorder was discretely used during the group discussion to facilitate information gathering. In addition, illustrated charts were used to help elicit farmers' preferences, difficulties and their geographical location. [9] also adopted the same way in their work. The questions were translated into local language to help farmer understanding and for clarification of information. This was either done by a research team member or a participant from the farmers' group.

Although a leader guided the discussion, other scientists could intervene at any moment in case some relevant information may have been skipped. The zonal extension agent was the key informant and when necessary, added information when farmers were not able to provide. Care was taken to avoid people monopolizing the discussion because of their wealth status or their leadership role.

The group discussions involved listing of production constraints, varieties grown and identifying the preferred traits of maize cultivars. In the focus group discussions, individuals and group members were at times asked to write their contributions and present to the farmer group. Additional relevant data were also collected from secondary sources such as published and also from the Agriculture ministry in relation to agriculture production in the study areas. Farmers were randomly selected to list the five most pertinent problems of farming which were characterized. The weight of each problem was estimated by attributing the coefficient 1 to 5 to the best five pertinent problems with the coefficient 5 attributed to the main difficulty encountered.

A structured questionnaire was prepared based on the information gathered from the focus group discussions. A questionnaire was drafted to gather individual household information in each village. Individual interviews were used to assess thoughts, opinions, and feelings of individual farmers. A total of 178 farmers were individually interviewed.

2.3 Data Analysis

The qualitative data were analyzed using descriptive statistics to characterize the sample households in terms of different socio-economic and biophysical features. While the quantitative data analyses were performed using least square means of the Statistical Package for Social Scientists (SPSS) version 17. Descriptive statistics, Stata software for modelization and mean comparisons were used for data collected in each village followed by comparisons among villages. Ranking, scoring and pair wise scoring were used in each of the focus groups.

3. RESULTS AND DISCUSSION

3.1 Focus Group Discussion

Farmers were randomly selected the five most pertinent problems listed by the selected farmers. Farmers ranked change in weather as the most important constraint followed by post-harvest decay and weeds infestation (Table 1).

Pests and diseases were reported to be the least important (rank 10). All the constraints were grouped into biotic and abiotic problems (Fig. 1). The expression of abiotic constraints was higher at Asso'ooseng, Nkoemvone, Ndjop and Ndengue.

3.2 Individual Interviews

3.2.1 Farmer characteristics

The sample of farmers from Ebolowa was composed of 53% women and 47% of men. At individual village level, there were more women than men in Asso'osseng and Djop (Fig. 2).

Farmers were also classified according to their age per village and their level of education (Table 2). Many (43.8%) farmers were between 31–45 years old while 34.4% of farmers were between 46-65 years old. At Biyeyem, there were no farmers less than 30 years and over 65 years old. The highest level of study achieved by farmers was secondary school and 56.9% of them had reached that level (Table 3).

None of the female farmers reached the tertiary school. The level of education as well as the age of the farmers was significantly observed in the size sample of the population (Table 4).

None of the female farmers reached the tertiary school. The level of education as well as the age of the farmers was significantly observed in the size sample of the population (Table 4).

3.2.2 Farmers' activities

The main activity practiced by farmers in all the five villages was agriculture (Fig. 3).

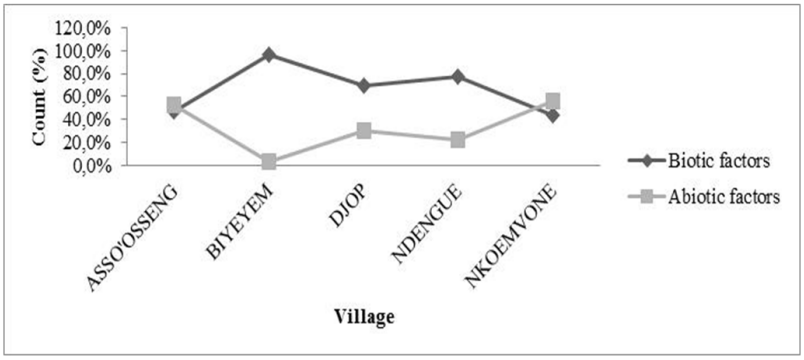

Fig. 1. Major constraints to maize production

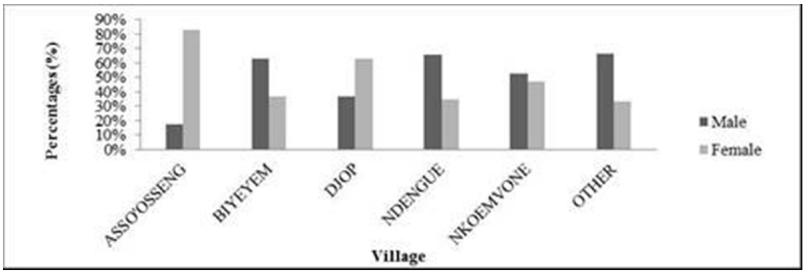

Fig. 2. Farmers' distribution according to gender

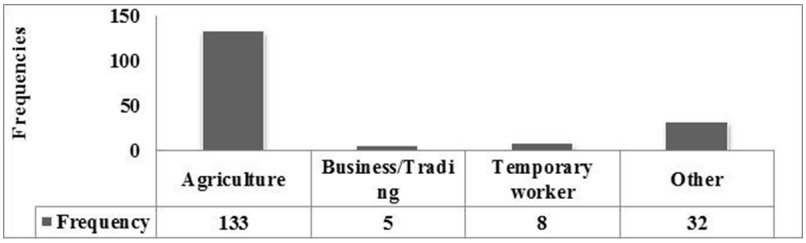

Fig. 3. Sample distribution of farmers according to their main activity

Table 1. Production constraints by farmers and their classification in order of priorities

Problem	Weight	Ranking
Change in weather	22	1
Conservation problem (post-harvest problem)	17	2
Weeds control	13	3
Market problem	12	4
Maize shelling	10	5
Poor soils (set aside)	9	6
High cost and lack of fertilizers	9	7
Field road management problem (infrastructure problem)	5	8
Unawareness on improved and adapted seeds	5	9
Pests and diseases	3	10

Table 2. Farmers' distribution according to the age per village (%)

Characteristics	Villages					
	Asso'osseng	Biyeyem	Djop	Ndengue	Nkoemvone	Overall
Age of farmer						
‹ 30 years	17.2	0.0	40.7	13.8	17.6	18.8
31-45years	20.7	56.5	44.4	48.3	58.8	43.8
46-65years	55.2	43.5	14.8	34.5	17.6	34.4
›65 years	6.9	0.0	0.0	3.4	5.9	3.1
Level of studies						
Noformal education	10.3	4.0	0.0	10.3	0.0	5.4
primary	51.7	16.0	51.9	34.5	23.5	36.2
secondary	37.9	80.0	48.1	51.7	70.6	56.9
Tertiary (university)	0.0	0.0	0.0	3.4	5.9	1.5

Table 3. Farmers' characteristics according to the level of instruction per gender (%)

Characteristics	Gender		
	Male	Female	Overall
Age of farmer			
‹ 30 years	18.7	18.5	18.6
31-45years	50.5	43.2	47.1
46-65years	29.7	34.2	47.1
›65 years	1.1	3.7	2.3
Level of studies			
Noformal education	4.3	3.7	4.0
primary	22.8	42.7	32.2
secondary	63.0	53.7	58.6
Tertiary (university)	9.8	0.0	5.2

Also, the distribution of farmers based on their main activity per village (Table 5). At Asso'osseng and Nkoemvone, 2.4% and 17.9% of farmers were temporary workers in the Research Institute. Few of them manage small businesses (2.4% at Asso'osseng, 3.3% at Ndengue and 7.7% at Nkoemvone) while most of them farmed (Table 5).

3.2.3 Maize and other type of crops grown in different villages

There was a diversity of crops grown in the villages. Among them, maize, cassava, cocoyam, groundnut, cocoa and sweet potato were the most important (Fig. 4). Rice and sorghum were not widely grown in that part of the country.

Table 4. Chi square of some characters coming from the survey

Characteristics	Farmer sex				
	df	$x^2_{cal.}$	x^2 read	P-value	Significance
Age of farmer	3	7.82	7.82	0.05	*
Level of education	3	14.26	7.82	0.003	**

**: significant at 5%; **: significant at 1% Independence: The null hypothesis is that the response category is independent of the treatment group. The alternate hypothesis is that there is some sort of (ill defined) association*

Table 5. Sample distribution according to the main activity by village (%)

Villages	Main activity				
	Agriculture	Business/	Temporary	Other	Total
Asso'osseng village	70.7	2.4	2.4	24.4	100.0
Biyeyem	93.3	0.0	0.0	6.7	100.0
Djop	96.4	0.0	0.0	3.6	100.0
Ndengue	96.7	3.3	0.0	0.0	100.0
Nkoemvone	43.6	7.7	17.9	30.8	100.0
Other	30.0	0.0	0.0	70.0	100.0
All	**74.7**	**2.8**	**4.5**	**18.0**	**100.0**

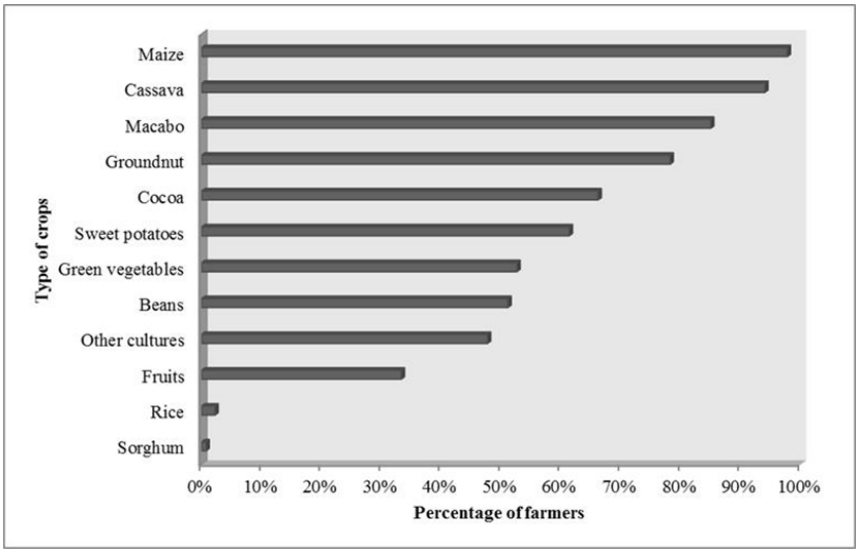

Fig. 4. Distribution of farmers based on their village and the type of crop grown

The most important cereal produced in all the villages was maize where averages of 97.7% farmers were producing it. Only 3.4% of farmers grew rice at Asso'osseng, 3.4% at Ndengue and 5.9% at Nkoemvone. Sorghum was grown at Ndengue by 3.4% of farmers (Table 6). Vegetables such as beans (51.1%), groundnut (78.2%) and green vegetables (52.6%) were also produced.

3.2.4 Agricultural and production system used by farmers

In all the villages, most farmers (72.5%) practiced intercropping system (Table 6).

22.9% grew maize only (monoculture) in their field during a given agricultural season (69% of men and 31% of women) while 4.6% of farmers practiced relay cropping system (100% of men) (Fig. 5). In all the villages, farmers produce under rain-fed agriculture (94.5% of farmers) while few of them (4.7%) used irrigation system (Table 6).

3.3 Discussion

3.3.1 General constraints

Poor soil fertility was among the six major problems listed by farmers in the BHFZ. According to [5], soil acidity is a major constraint in the humid forest area of Cameroon and this acidity is mainly due to Al toxicity ,while in western Ethiopia, two major constraints of the production of the maize are the unavailability of improved seed and lack of production inputs [10]. The soils in this region are of poor fertility due to a combination of Al toxicity and deficits caused by leaching or decreased availability of P, Ca, Mg and some other micronutrients, especially Mo, Zn and B [11]. As a consequence the productivity of the crop in general, particularly maize reduced significantly. Farmers mentioned that the change of weather was among the major problems facing maize farming. The weather patterns have become unpredictable. The raining seasons are no more following exactly the

Table 6. Agricultural system used and type of maize variety grown by farmers (%)

	Villages					
	Asso'osseng	**Biyeyem**	**djop**	**Ndengue**	**Nkoemvone**	**Total**
System used						
Monoculture (maize only)	18.5	28.6	37.0	20.7	5.9	22.9
Intercropping	81.5	53.6	59.3	79.3	94.1	72.5
Relay cropping	0.0	17.9	3.7	0.0	0.0	4.6
Provenance of water for crop						
Rain	92.3	96.2	92.3	100.0	88.2	94.5
Irrigation	0.0	0.0	0.0	0.0	0.0	0.0
Rain and irrigation	0.0	3.8	0.0	0.0	0.0	0.8

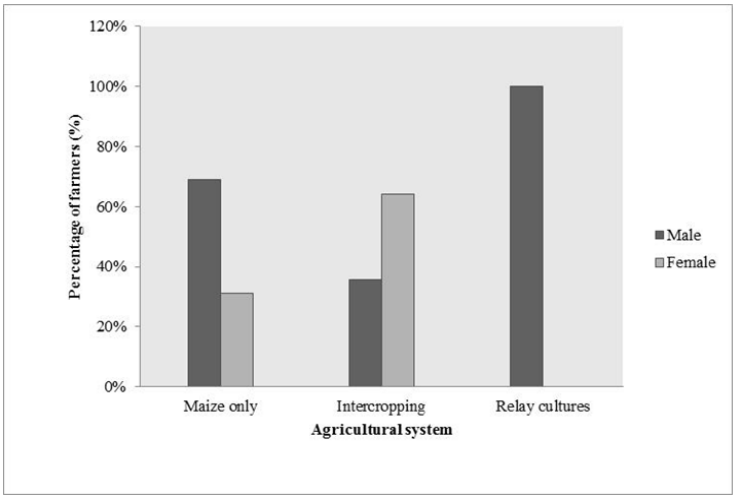

Fig. 5. Farmers' distribution according to the agricultural system by gender

calendar of cropping seasons. This is a general constraint globally and therefore, is not specific to the study environment.

3.3.2 Increasing population in farming

In the present research, 47% of farmers were between 31 to 45 years old while 32% of them were between 46 to 65 years old indicating that young people were involved in agricultural activities. This result could be explained by the fact that the 1990's economic crises in Cameroon made the Government to reduce by half the number of youth employed. Consequently, most of these youths became self- employed and farmers, especially in maize production, which is considered like one of their target areas because of the wide consumption of the crop. Additionally, about 55% of the Cameroonian population lives in the rural environment with agriculture as their main activity [12].

3.3.3 The redundancy appearance of women in agriculture

Results from the study indicated that 59% of farmers had reached the secondary school level while only 4% were found to be illiterate. The government policy in the country is to provide basic education to every citizen. This reflects the level of education observed among the farmers. It was revealed from this study that male farmers were more educated than female meaning that girls dropped from school very early and started farming activity especially when they gave birth. It has been noted that the female farmers started farming earlier than males and stopped during their old age (after 65 years) while most men stopped early (between 46 to 65 years old). This could be explained by the fact that young ladies stopped going to school earlier than the young men. The age and the level of study of farmers in the survey area depend on their gender. More women were involved in farming than men in this

study region of the country. This could be explained by a higher number of women than men in those areas. The result matched with those of [13] on the size of population which was approximately 16.5 million inhabitants, 51% was composed of women and only 49% of men. Among women, 65% of them lived in the rural areas.

3.3.4 The common food crops

The principal crops produced in most of the villages were: Maize, cassava, macabo, groundnut, cocoa, sweet potato, green leaves, beans, other crops (such as plantain, banana, yam, and pepper), fruits, rice and sorghum. This result is similar to that of [14] which stated that subsistence food crops grown in the Southern Region were comprised of taro, yams, cassava, rice, banana, plantain, maize, potatoes, roots and tubers, avocado, beans, okra, and were traded largely outside the cash economy. Farmers were forced to abandon cocoa or coffee plantations for other income – generating opportunities such as food crops [15]. Among the cereals produced, maize is the most important (98%) and has become one of their cash crops. According to [10], maize was ranked number one as both food and crash crop by 82%.

3.3.5 The agricultural system still precarious

The agricultural system used by smallholders was based on traditional slash-and-burn agriculture or shift cropping. In this system, farmers slashed the forest vegetation, burned the biomass and then cropped before abandoning the land to fallow. The length of the fallow varied from about three years in high population areas with relatively fertile soils to over ten years where population density was low and soil acidity was a major constraint [16,17]. This technique improved the nutrients elements of plants in the soil. The problems of low productivity and food security had been attributed to slash and burn cropping systems [18].

4. CONCLUSION

Farmers usually grow maize for subsistence and as a cash crop or source of income. Maize production is facing different constraints in the humid forest zone including the problem of low production per unit area, low soil fertility, high cost of fertilizers, post-harvest conservation of maize and weeds control are prevalent. Breeding maize variety with multiple traits will curb most of these constraints hence enhance adoption of maize in the humid forest zone of the country. The practice of appropriate agricultural system associated with the utilization of improved and adapted varieties could significantly increase their maize yield.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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