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Farmers' perception of drought effects on cowpea and varietal preferences in Northern Ghana

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ABSTRACT

Farmer involvement in the development of cowpea varieties for cultivation is an integral component for crop improvement in Northern Ghana where the bulk of cowpea is produced. The objective of this study was to assess farmers' perception about the effect of drought on cowpea production, identify production constraints and determine farmer preferred traits using Participatory Rural Appraisal. Five cowpea producing districts were selected across the three Northern regions. Fifty cowpea producers, consumers and traders were randomly selected for the study. Data was collected using questionnaires and focus group discussions. Data was analysed using SPSS version 22. Kendall's Coefficient of Concordance statistical procedure was used to identify and rank farmers's constraints and preferences, and to measure the degree of agreement among the respondents. Ninety three percent of the farmers reported that, the number of hot days has increased over the past ten years. Farmers across all the three regions linked the effect of drought to the stages of cowpea growth with podding stage seen as the worst affected. About 70% of the farmers preferred varieties with large grain size, smooth or rough textured seeds with white coats. About 84 % of farmers preferred varieties that were early and drought tolerant.

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Key words: Cowpea; Drought; Focus group discussion; Participatory rural appraisal.

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1. Introduction

Cowpea is one of the widely cultivated and consumed grain legumes globally, especially in arid and semi-arid areas [1]. Ghana is the fifth largest producer of cowpea in Africa and has the fastest growth rate in terms of production of cowpea in Africa [2]. Cowpea is also the second most important grain legume after groundnut in Ghana, and plays an important role in the economy and diet of urban and rural poor [3]. Drought is a major constraint in cowpea production and for cowpea varieties with improved tolerance to drought to be recognized by farmers, it is imperative to solicit their views and get them involved right from the start of the research and breeding process to the end, in order to facilitate their adoption process[4]. Aside drought, anoher major factor that affects production and consumption of cowpea in Ghana is varietal preference [5]. Production of cowpea with consumer preferred grain type according to Egbadzor *et al.* [6] can boost cultivation in Ghana. Low adoption of technologies by farmers developed by research institutions show the need for consumer-orientation in research and development. The key factors that constrain farm-ers' adoption of technologies are inappropriate-ness of those technologies, unavailability of re-quired inputs, and farmers' socio-economic con-ditions [7]. Therefore, technologies that do not meet farmers' preferences, objectives, and con-ditions are less likely to be adopted [8]. Farmers are more likely to assess a technology with cri-teria and objectives that are different from crite-ria used by scientists. Participatory research al-lows incorporation of farmers' indigenous tech-nical knowledge, identification of farmers' criteria and priorities, and definition of research agenda. Participatory rural appraisal (PRA) tools are used to capture farmers' perceptions, preferences and constraints.

The objective of this study was to assess farmers' perception about the effect of drought on cowpea production in northern Ghana, identify farmer's constraints in cowpea production and determine farmer preferred traits

2. Methodology

2.1 Sampling procedure

Five cowpea producing districts were selected across the three northern regions of Ghana. They include Tolon District and Savelugu-Nanton Municipal in the Northern region, the Binduri District and Bawku Municipal of the Upper East region and Wa West district of the Upper West region. Two major cowpea producing communities were randomly selected from a list of cowpea producing communities in these Districts, giving a total of 10 communities. The communities selected were; Woribogu and Chirifoyili in Tolon District, Langa and Yilikpani in Savelugu-Nanton Municipal, Kpelwega and Asikiri in Bawku Municipal, Kulok Tengeri and Gumyoko in the Binduri District, and Vieri and Verempere in Wa West District. A total of fifty (50) cowpea producers were randomly selected from the participants across the three regions and interviewed using a semi structured questionnaire.

2.2 Data collection techniques

Data for the study was obtained using two techniques. The first technique involved the use of a focus group discussion (FGD), with the help of a questionnaire. This was to help farmers indicate

their preferred characteristics in cowpea varieties. The second technique employed, was the use of structured questionnaires to determine farmer's production constraints and their perception on drought and climate change in relation to cowpea production. The two sets of questionnaires were pre- tested to validate relevance of the variables and responses. Concerns realized from the field were revised and re-incorporated into the final questionnaire and check list.

The FGDs were carried out with 20 to 25 farmers in a community, and participation was balanced in terms of gender. A minimum of seven women participated in the focus group discussion across the three regions. The focus group discussions were organized with the help of Ministry of Food and Agriculture (MoFA) extension agents working across the selected communities in the three regions. Five cowpea producers were then randomly selected from the list of participants. Structured questionnaires were administered to individual farmers. This helped to obtain in-depth information on the production of cowpea at the farmer level. Pair wise ranking technique was used to rank production constraints and trait preference among the cowpea farmers in the study location.

2.3 Data analysis

The study employed the use of both qualitative and quantitative data for analysis. Data collected were analysed using SPSS version 22 and results presented using descriptive statistics such as frequencies, percentages, means, and graphical analysis. Data on ranking of constraints and consumer preference for cowpea characteristics was analysed using Kendall Concordance analysis[9]. The Kendall's Coefficient of Concordance statistical procedure was used to identify and rank a given set of constraints and farmer preference, from the most to the least influential, as well as measure the degree of agreement or concordance among the respondents on the ranking of constraints and preferences. The identified preferences were ranked from the most preferred to the least preferred using numerals, (1, 2, 3, 4… N), called a Likert. The mean rank score for each preferred character or constraint was computed and the factor with the least score was ranked as the most preferred or the highest constraint, whilst the highest score was ranked as the least preferred. The total rank score computed was then used to calculate the coefficient of concordance (*W*), which measures the degree of agreement among the respondents in the rankings [10]. The coefficient of concordance was estimated using the relation:

$$W = \frac{12\left[\sum T^2 - \frac{(\sum T)^2}{n}\right]}{nm^2(n^2-1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)} \ [11]$$

Where T = Sum of rank of factors being ranked
m = number of respondents (farmers)
n = number of factors being ranked
W = coefficient of concordance.

The Coefficient of concordance (W) was tested for significance in terms of the F distribution.

The F-ratio is given by $F = \frac{(m-1)\times(1-W)}{(1-W)}$ …… (2) [11]

with numerator and denominator degrees of freedom being $(n-1)-\left(\frac{2}{m}\right)$ and $m-1\left[(n-1)-2/m\right]$ respectively. The null and alternative hypotheses were stated as; H_0: There was no agreement between the respondents on the ranking of the factors H_1: There is agreement between the respondents on the ranking of the factors.

3. Results

3.1 Cowpea production across study location

The focus group discussion revealed that the most common and dominant method of land preparation across the study location was the use of tractors (53.1%). Others however resorted to the use of animal traction (40.8%), whilst a smaller proportion (6.1%) used hand held tools in land preparation. From the focus group discussion, it was observed that the most common source of labour across the study locations was household labour and hired labour within the community. These two sources accounted for 50% each, of labour used in communities for crop production of which cowpea is not an exception. Constraint in accessing labour was high (62.5%) across the study locations according to the respondents. Majority of the farmers (78%) across the study location were of the view that the trend of cowpea production was increasing, whilst 10% of them held to the view that the trend in production was decreasing. However, 12% of the farmers were of the view that the trend of production was stable. Farmers who were of the view that the trend was decreasing attributed it to factors such as a decline in soil fertility, erratic rainfall pattern, high cost of input, and unavailability of improved seeds. Cowpea is generally grown by majority of the farmers (73.2%) across the study location as a mono crop, whilst some farmers (26.8%) also grow it as an intercrop with maize, millet and sorghum.

3.2 Farmers preference of grain quality traits

From the focus group discussion, 75% of farmers within the Northern region preferred cowpea with white seed coat, while a high proportion (57.9% and 60%) of farmers in the Upper East and Upper West Region respectively also had preference for cowpea with white seed coat. The least preferred cowpea variety across the study location as revealed by the focus group discussion, are the varieties with mottle coloured seed coat. In terms of grain size (Table 1). Varieties with large grain sizes were preferred by majority of farmers (70.0%) across the study location, compared to varieties with small grain sizes (12.0%). High expansion ratio, good market prices, attractiveness of the grains, high yields, and ease of sowing were some of the reasons farmers preferred varieties with large grain sizes. The least preference for small sized grains were attributed to the difficulty of cooking, low expansion ratio and low market prices. The combined analysis in Table 1 shows that 54% of the farmers across the study location preferred varieties with smooth texture than varieties with rough texture (46%). On regional basis, the focus group discussion revealed that a high proportion of farmers in the Upper East (68.4%) and Upper West Region (72.7%) rather prefer varieties with rough seed coat, whilst the highest preference (90.0%) for smooth seed coat varieties is in the Northern Region.

Table 1: Farmers' perception on grain quality traits in the northern, Upper East and West Regions

Character (**colour)**	Northern Region (%)	Upper East Region (%)	Upper West Region (%)	Combined (%)
Brown	15.0	26.3	30.0	22.4
Mottle	10.0	15.8	10.0	12.2
White	75.0	57.9	60.0	65.3
Grain size				
Large	60.0	75.0	80.0	70.0
Medium	25.0	15.0	10.0	18.0
Small	15.0	10.0	10.0	12.0
Texture				
Rough	10.0	68.4	72.7	46.0
Smooth	90.0	31.6	27.3	54.0

3.3 Constraints to cowpea production

Cowpea production constraints were classified into nine categories, this was to help identify major production constraints faced by farmers. These constraints were ranked to identify the most important constraint to the least important ones. From the focus group discussion conducted across the study locations, it was observed that high pest infestation was the most important constraint faced by farmers (Table 2). This was followed by high cost of seed, and labour. Whereas low soil fertility was ranked as the least important constraint. There was a higher level (78.23%) of agreement among the farmers across the study locations on the ranking of these constraints (Kendall's W = 0.7823, P = 0.000).

Table 2: Constraints of cowpea production faced by farmers across the study locations in Northern Ghana

Characteristics	Northern		Upper East		Upper West		Combined	
	Mean rank	Rank	Mean rank	Rank	Mean rank	Rank	Mean rank	Rank
High pests' infestation	4.63	4	1.66	1	3.65	2	3.27	1
High cost of seed	2.38	1	4.79	4	6.30	8	4.11	2
High labour cost	2.85	2	6.95	9	3.90	3	4.67	3
Seed unavailability	5.37	6	4.16	2	6.20	6	5.00	4
Land unavailability	4.18	3	5.39	5	6.75	9	5.01	5
Post-harvest loses	6.83	8	4.18	3	4.40	4	5.47	6
High weed infestation	6.68	7	5.58	7	3.40	1	5.56	7
Labour unavailability	4.70	5	6.82	8	6.22	7	5.77	8
Low soil fertility	7.05	9	5.47	6	5.70	5	6.15	9

There was a strong agreement (64.7%) among farmers in the Northern region that high cost of seeds was the most important constraint faced by cowpea farmers in the region (Kendall's *W* = 0.647, P = 0.000). Low soil fertility was ranked the least important constraint faced by cowpea farmers. High pest infestation was ranked as the most important constraint faced by cowpea farmers in the Upper East (Kendall's *W* = 0.374, P = 0.000), whilst the least important constraints ranked by cowpea farmers was high labour cost. For cowpea farmers in the upper west region, high weed infestation was ranked the most important constraint, whilst land unavailability was ranked the least important constraint (Kendall's *W* = 0.361, P =0.057). Despite these constraints faced by farmers across the study location, 76% of them still grow cowpea. An estimated 54.5% of farmers who have stopped cultivating cowpea have attributed it to factors such as low yields. Other factors also include lack of ready market (18.2%), whilst others also attribute it to factors aside low yields and lack of ready market. Credit for cowpea cultivation is absent or inadequate across the study locations. This is because farmers perceive the prcessing fee in accessing credit as a cumbersome one. Others also attribute it to high interest rates charged on loans, some also attribute it to the lack of information on these credit facilities, and the short repayment period for the loans.

3.4 Development of new varieties

From the focus group discussion, it was observed that in the development of new cowpea varieties, 83.7% of the farmers preferred varieties th- at were early maturing. However, 12.2% and 4.1% preferred medium and late maturing varieties respectively.

In terms of growth habit for new varieties to be developed (Table 3), 72.2% of the farmers in the upper east region preferred prostrate varieties, whilst 50% of the farmers in the northern region preferred varieties that were erect and 27.3% of

farmers in the upper west region preferred Semi-erect varieties. From the study, it was observed that across the study location, 51% generally preferred varieties that have prostrate growth habits.

Table 3: Varietal Preference for growth habit in new varieties to be developed

Variety	Northern Region (%)	Upper East (%)	Upper West (%)	Combined (%)
Erect	50	27.8	18.2	34.7
Prostrate	30	72.2	54.5	51.0
Semi erect	20	0	27.3	14.3

The focus group discussion also revealed that 32.8% of the farmers across the study locatiopreferred high yielding to be considered in developing new varieties(Table 4). The least preferred character by the farmers is the ability to thrive in poor soils. An estimated 34.5% of the farmers in the northern region and 34.8% in the upper west region preferred high yielding varieties, whilst 58.3% of famers in the upper west region preferred drought tolerant varieties, and 34.8% of the farmers in the upper east region preferred Pest and insect resistant varieties.

Table 4: Traits preferred by farmers in new varieties

Characteristics	Northern Region (%)	Upper East Region (%)	Upper West Region (%)	Combined (%)
Ability to thrive in poor soils	17.2	0	0	7.8
Drought resistant	13.8	4.3	58.3	18.8
Early maturing	6.9	26.1	16.7	15.6
High yielding	34.5	34.8	25.0	32.8
Pest and insect resistant	27.6	34.8	0	25

3.5 Farmers perception about climate change

Approximately 59.2% had knowledge on climate change, whilst 40.8% had less knowledge about climate change. Farmers who had knowledge on climate change. described it as a change in rainfall pattern and an increase in temperature. They attributed the causes of climate change to factors such as the cutting down of trees, increase in population and bush burning, whilst others attributed it to natural causes which they claim they had no control over.

About 94% of the farmers reported that, the number of hot days has increased over the past ten years, whilst only 2% were of the view that it has decreased over the past ten years. However, about 4% of the farmers interviewed acro- ss the study location said that the number of hot days has remained the same over the last 10s.

Change in cowpea variety was a strategy majority of the farmers used as an adjustment to address the shift in number of hot days for the production. This adjustment strategy was used by majority of farmers in the upper east region. Only 2% chose to practice mulching on their cowpea fields, as a means of conserving moisture on their fields. Others also resorted to plan- ting trees to provide shade for their crops, whilst others did nothing. Majority (93.9%) of the farmers across the study locations were of the view that the number of rainy days has reduced over the past ten years, whilst the rest (6.1%) were of the view that the number of rainy days has remained unchanged over the past ten years.

3.6 Farmers perception of drought effects on the growth stages of cowpea

Majority (35%) of the farmers in the Northern Region indicated that the podding stage of the cowpea crop is affected by inadequate rainfall, whilst 5% of the farmers indicated that seedling stage is the most sensitive stage.(fig 1)

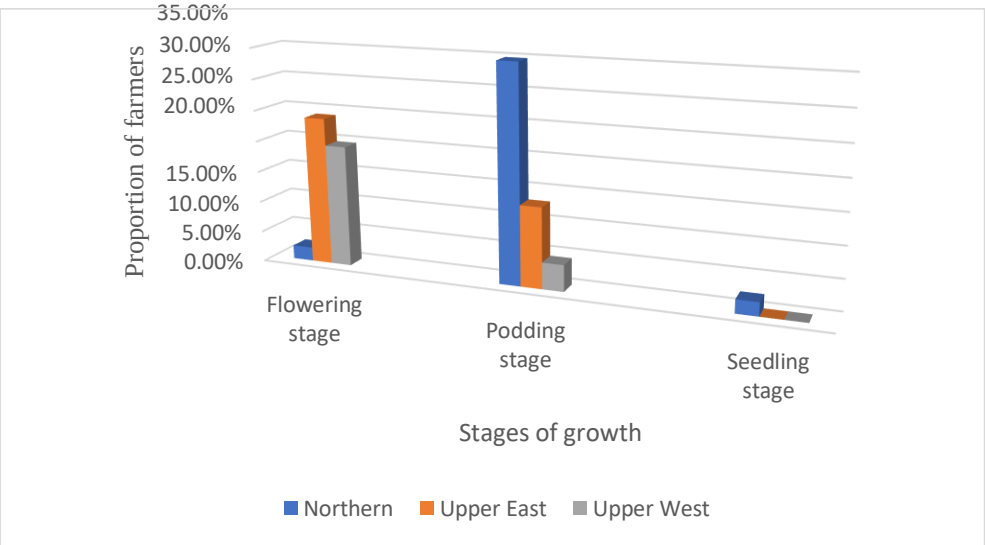

Fig. 1: Stages of the cowpea crop as affected by shortage in rainfall

4. Discussion and conclusion

4.1 Discussion

The study revealed an increasing trend of cowpea production across the study location. Farmers attributed the increase in production to the promotion of cowpea production as a result of projects such as International Institute for Tropical Agriculture (IITA) Cowpea Out scaling Project (COSP) and the Tropical Legume II (TL 2) projects. Few farmers were however of the view that there was a decline in the production level for cowpea across the study locations. They attributed this to factors such as a decline in soil fertility levels, erratic rainfall patterns, unavailability of improved seeds and high cost of inputs. Cowpea production is usually done on sole crop basis. Farmers often intercrop cowpea with cereals such as maize, sorghum, and millet in the study area. These practices, according to [12] is in conformity with cowpea cultivation in other parts of sub Saharan Africa (SSA), which explains the relevance of cowpea as a companion crop in cereal-legume cropping systems which are common practices adopted by farmers in sub Saharan Africa to avert risk, crop failure, and distribution of farm labour[12, 13].

Farmers often resorted to cropping cowpea once a year, except for farmers who lived along the banks of Black and White Volta Rivers and those around the few irrigation dams along the hydromorphic low land areas. Some farmers usually made use of the residual moisture from the spillage of the Bagre dam in Burkina Faso. This results corroborates earlier finding by SARI[14, 15] ([16, 17] that cowpea production is gaining prominence in the hydromorphic lowland areas where farmers would usually use residual moisture in establishing cowpea at the seedling stage and harvest with the first rains before the main cereal crop is planted.

Cowpea production is generally done for home consumption and sale across the study locations. This agrees with the result of a survey study on cowpea by Rachie [18] . Majority of the farmers produced for home consumption but resorted to selling in times of financial crisis and when they were challenged with issues such as lack of storage facilities.

The study also revealed a higher preference for large grain size of cowpea by both consumers and producers. This corroborated the findings of [19], in which they reported that consumers in West and Central Africa preferred large cowpea grain size. Large grain sized cowpea was preferred because of their high expansion ratio during cooking, high market value and ease of sowing compared to small grain sized cowpea. Preference for texture of cowpea was high for varie-

ties with smooth skin coat across the study locations. This findings corroborates with the findings of [20]. However, farmers and consumers in the upper east and west regions rather preferred cowpea with rough seed coat.

Farmers across the study location preferred varieties with large grain size, smooth or rough texture depending on the study location. Similar studies by [21, 22] on cowpea and grain and quality traits reported that, farmers preferred a cowpea variety that combines high yield with rough texture, white or brown colour. Farmers and consumers preference for early and medium maturing lines with large seed size observed in this current study agree with reports by [23] Singh *et al.* [24] and Asiwe [25], that farmers prefer early maturing varieties which could be cultivated twice in one growing season, hence giving them more income Preference for prostrate varieties was bas- ed on their claim that those varieties are ability to suppress weeds and their high yields compared to erect and semi erect varieties.

The study also revealed that a greater proportion of farmers preferred early maturing cowpea varieties when developing new cowpea varieties by research institutes and universities. This attribute is due to the long drought conditions experienced across the study locations and field insect and pest infestation, thus the need to breed cowpea varieties that combines tolerance to drought with insect pest resistance in order to increase yield and sustain productiion. These results also confirms previous studies on the importance of biotic factors to cowpea production by Emechebe and Shoyinka, [26], Jackai and Daoust, [27], Singh [28], Singh *et al.* [29] and Asiwe *et al.*, [30] . Another constraint to cowpea marketing is the inadequate capital to expand business, as such traders often rely on smaller quantities they obtain from farmers, which makes their trade unsustainable in time of scarcity. This finding agrees with results obtained by Faith *et al.* [31] in a study on the economic analysis of cowpea marketing in Magama Local Government area of Niger State, Nigeria.

4.2 Conclusion

The results of the PRA conducted across the three regions of northern Ghana revealed that farmers generally prefer varieties that are early maturing and drought tolerant. They were of the view that such varieties could be cultivated twicce within a year to increase production for consumption and sale. The preferred grain quality characteristics by farmers across the study locations were varieties with large seeds size, white seed coats, and smooth or rough texture seed coats depending on the location. These traits were preferred by both farmers, consumers, and processors due to their short cooking times, high expansion ratio, and good prcessing abilities.

Farmers also demonstrated a high understanding of climate variability and adopted measures such as a change in cowpea varieties, time of planting, use of cultural practices such as means of mitigating the effects of these climate variabilities.

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