

# The Effects of Grazing Livestock on Cowpea (*Vigna unguiculata*) and Soybean (*Glycine max*) Production in Abuja, Nigeria

**Julius Ajah**

Department of Agricultural Economics/  
Extension, Faculty of Agriculture,  
University of Abuja, Nigeria  
Email: juliusajah2@yahoo.com

**Oswin, C. Chibinga**

Department of Animal Sciences  
School of Agriculture, University of  
Zambia, Lusaka  
Email: ochibinga@gmail.com

**Elias Kuntashula**

Department of Agricultural Economics/  
Extension, School of Agriculture,  
University of Zambia, Lusaka  
Email: ekuntashula@unza.zm

**Abstract** – The study assessed the effects of grazing livestock (cattle, goat, sheep, domestic fowls) reared under extensive system on cowpea and soybean production in Abuja, Nigeria. For effective coverage of the study area, a multi-stage sampling technique was adopted while semi-structured questionnaires were used for data collection. A total of 410 small-scale farmers were interviewed in four Area Councils (Kwali, Kuje, Gwagwalada, Abaji). Data were analysed using a three-way mixed analysis of variance (ANOVA). The result indicated that the effects of grazing livestock on cowpea and soybean production significantly ( $p < .01$ ) varied from one location (area council) to another with Kwali Area Council as the most affected while Abaji was the least. The mean responses indicated that the effects of grazing livestock on cowpea and soybean significantly ( $p < .01$ ) differed. Also, the extent of crop damage significantly ( $P < .01$ ) depended on the type of grazing animal. Mean separation result showed that the most affected crop was cowpea with cattle and goat/sheep causing the major damages while domestic fowls had the least effect. The affected cowpea and soybean farmers lost an average of ₦5,310 (\$27 US dollars) and ₦3,453 (\$17 US dollars) respectively to grazing livestock in 2014 and this amount is capable of eliciting crisis between livestock owners and the crop farmers. Majority (44.88%) of the farmers reported that the animals affected the crops mostly after germination and during harvesting (34.14%). Generally, the findings showed that grazing livestock affected cowpea and soybean production in the study area but the effects depended on location, livestock type and crop type. Hence, any approach to address the problem of grazing livestock on the crops should take cognizance of these variables.

**Keywords** – Cattle, Domestic Fowls, Extensive System, Goat/Sheep.

## I. INTRODUCTION

Nigeria is one of the countries where extensive system of livestock production is predominant over intensive and semi-intensive systems. Intensive system is a total confinement of the livestock while semi-intensive system allows for good control of feeding and management and the animals are more protected [1, 2]. Extensive system refers to the system where the animals are allowed to roam and look for food unrestricted [1]. In other words, the system involves allowing livestock to move freely with or without restriction although there are variations in management techniques like scavenging, cut-and-carry production systems; seasonal tethering, fattening and compound dairying [3]. For example, cattle, goat and sheep are, in most cases, reared by nomads who move

from place to place in search of pasture and favourable conditions while some livestock farmers allow sheep, goats and domestic fowls to move freely without any form of guidance or restriction. According to [3], over 85 percent of all species and ruminant livestock are managed under extensive system and they rely on natural grass and forage legumes for subsistence. The extensive system of livestock production results in the destruction of crops [4, 5, 6] during grazing even when they are guided by the pastoralists. Apart from the destruction of crops, other studies showed that grazing animals contaminate water sources [7, 8], cause soil erosion due to overgrazing [9, 4, 10] and emit greenhouse gases [11]. A report by [12] indicated that methane (a greenhouse gas) emissions from enteric digestion of pasture by grazing ruminants are large. Some of the negative impacts have resulted in conflicts between crop and livestock farmers with multiple socio-economic consequences in the society.

The effects of grazing livestock have provoked a lot of studies that tried to assess and expose its negative effects on the society. For instance, [13, 14] and [15] argued and concluded that fresh water scarcity is a threat to the peaceful co-existence between crop farmers and pastoralists in Nigeria. In another study by [7], the authors identified some of the causes and effects of farmers-herder conflicts with some empirical evidence. Apart from the causes, the authors reported that some of the effects of farmers-herder conflict on crop production include: reduction in output and income of farmers/nomads, displacement of farmers, erosion, and loss of produce in storage [7]. Although the study reported some causes and effects of farmers-herder conflicts on crop production, it did not specify the effects of grazing livestock on any crop to show the level of damage that must have led to the conflict. Almost all the studies were interested in the general causes of farmers-herder conflicts and its effects on the civil society and not the effects of grazing livestock on crop production. Again, the effect of domestic fowls reared under extensive system on crop production was hardly addressed and these are animals (livestock) that have the potential like cattle, goat and sheep to damage crops and cause conflicts between the livestock owners and the crop farmers. Since studies have established that grazing livestock destroy crops resulting in farmers-herder conflicts, there is need to specifically, investigate the impact of grazing livestock on crop production with reference to cowpea and soybean that are widely grown in Abuja, Nigeria.

The study is very important because cowpea (*Vigna unguiculata*) and soybean (*Glycine max*) are among the grain legumes that are widely produced especially in northern Nigeria. They are crops cultivated in small portions of land that are scattered all over the area and are among the arable crops produced by rural-based small-scale farmers who, according to [16], account for about 80 percent of total food requirement. The farms are not fenced thereby making the crops to be prone to destruction by grazing livestock. Unlike cereal crops, cowpea and soybean are important staple food crops that are rich in protein and essential minerals [17]. Cowpea for example, is cultivated primarily for the grain, but it is also used as vegetable, fodder and cover crop [18]. As cover crop, its ability to replenish soil nitrogen makes it an important crop in sustainable soil fertility management and productivity. Soybean, on the other hand, can be successfully grown in many states in Nigeria and its cultivation has expanded as a result of its nutritive, economic importance and diverse domestic usage including its uses in poultry feed production [19]. Like cowpea, it is very rich in protein and [19] stated that it has an average protein content of 40 percent and is more protein-rich than any of the common vegetable or animal food sources found in Nigeria. The destruction of these crops occurs when the animals feed on the leaves, stems, seeds, flowers or use their hooves to destroy or damage the crop at any stage of development and when this occurs, it affects total outputs and/or productivity of the crops hence the need for the study. The questions addressed in the study are: How do farmers perceive (rate) the effects of grazing livestock on cowpea and soybean production? Which of the two grain legumes is most affected by grazing livestock? Which livestock is rated to be the most destructive? Are there location differences in the impact of the animals on the two grain legumes? What is the cost estimate of damaged cowpea and soybean by grazing livestock? At what stage of development do the animals destroy the crops?

### 1.1. Objectives of the Study

The broad objective of the study is to assess the effects of grazing livestock on cowpea and soybean production in Abuja, Nigeria. Specific objectives are to:

- 1) Assess and compare the effects of grazing livestock on cowpea and soybean production,
- 2) Determine the most destructive livestock (cattle, goats/sheep, domestic fowls),
- 3) Determine if there are locational differences in the effects of grazing livestock on cowpea and soybean production,
- 4) Estimate the cost of damaged cowpea and soybean by grazing livestock, and
- 5) Determine the stage of crop destruction by grazing livestock

### 1.2. Hypotheses

*Ho:* The effects of grazing livestock on cowpea and soybean production do not significantly differ from each other (crop type) ( $\mu_{\text{Cowpea}} = \mu_{\text{Soybean}}$ ).

*Ho:* The effects of cattle, goats/sheep and domestic fowls on cowpea and soybean production do not differ

from each other (livestock type) ( $\mu_{\text{cattle}} = \mu_{\text{goat/sheep}} = \mu_{\text{domestic fowls}}$ ).

*Ho:* There is no locational difference in the effects of grazing livestock on cowpea and soybean production ( $\mu_{\text{Kwali}} = \mu_{\text{Kuje}} = \mu_{\text{Gwagwalada}} = \mu_{\text{Abaji}}$ )

## II. METHODOLOGY

The study location was Abuja in the north central zone, Nigeria. It is located between latitudes  $8^{\circ} 25'$  and  $9^{\circ} 25'$  North of the Equator and longitudes  $6^{\circ} 45'$  and  $7^{\circ} 45'$  East of Greenwich. Abuja is bordered on all sides by four States namely: Niger, Nasarawa, Kogi and Kaduna [20]. The choice of Abuja is very important because it lies in the transitional zone between the savannah in the North and forest vegetation in the South that favours the production of cowpea and soybean [20]. The population of the study includes all small-scale farmers. For effective coverage of the study area, a multi-stage sampling technique was adopted while questionnaires were used for data collection. In the first stage, four (4) Area Councils (Abaji, Gwagwalada, Kuje, Kwali) were purposively selected out of six (6) because they were farming communities. In the second stage, five (5) communities were randomly selected from each of the 4 Area Councils giving a total of 20 communities. From each of the 20 communities (third stage) 24 farmers were randomly selected and interviewed giving a total of 480 respondents. That is, 120 questionnaires per each area council but only 115, 95, 90 and 110 were properly filled (and used) in Kwali, Kuje, Gwagwalada and Abaji Area Councils respectively. In the questionnaires, the farmers were asked to rate the effects of grazing livestock on cowpea and soybean production using “very highly destructive (4)”, “highly destructive (3)”, “moderately destructive (2)”, “least destructive (1)” and “not destructive at all (0)”. The responses from the farmers on the above rating scale were used to run the analysis in line with the method adopted by [21, 22], [23], [24] and [25].

The analysis was done using a three-way mixed analysis of variance (ANOVA) model and it is expressed mathematically as:

$$Y_{ijkl} = \mu + L_i + C_j + A_k + LC_{ij} + LA_{ik} + CA_{jk} + LCA_{ijk} + e_{ijkl} \dots (1)$$

Where:

$Y_{ijkl}$  = Individual farmer's response on the effects of grazing livestock on cowpea and soybean production.

$\mu$  = population mean

$L_i$  = effects of grazing livestock on cowpea and soybean due to differences in location (Kwali, Kuje, Gwagwalada, Abaji)

$C_j$  = Crop type - effects due to differences in crop type (cowpea and soybean)

$A_k$  = Livestock type - effects due to differences in grazing animal (Cattles, goats/sheep, domestic fowls)

$LC_{ij}$  = interaction effects of location and crop type

$LA_{ik}$  = interaction effects of location and livestock type

$CA_{jk}$  = interaction effects of crop type and livestock type

$LCA_{ijk}$  = interaction effect of location, crop type and livestock type

$e_{ijkl}$  = error term

In ANOVA model 1, the three factors considered to influence the effects of grazing livestock on cowpea and soybean production are the location of the farmer in the study area, livestock type and crop type. Crop type has two levels (cowpea and soybean) while the livestock type has three levels (cattle, goat/sheep, domestic fowls). There are four locations (Kwali, Kuje, Gwagwalada, Abaji). This gives a 2x3x4 mixed analysis of variance (ANOVA). Crop and livestock types were repeated measures (within factors) while location is a between factor. By interpretation, the model states that the effects of grazing livestock on cowpea and soybean production ( $Y_{ijkl}$ ), depend on the location of the farmer in Abuja ( $L_i$ ) crop type ( $C_j$ ), type of animal reared ( $A_k$ ), the joint effects of location and crop type ( $LC_{ij}$ ), joint effects of location and livestock type ( $LA_{ik}$ ), joint effects of livestock type and crop type ( $CA_{jk}$ ) and the joint effects of location, livestock type and crop type ( $LCA_{ijk}$ ). The population mean ( $\mu$ ) is the grand mean of the scores obtained and it does not

contribute to any variation in the observed differences [26] while  $e_{ijkl}$  is the error term. SPSS 21.0 was used to run the analysis and it was tested at 5 percent probability level. Mean separation was also done using Bonferroni model [25].

### III. RESULTS AND DISCUSSION

Table 1 shows the results of the three-way mixed analysis of variance (ANOVA) performed to assess farmers' reactions to the effects of grazing livestock on cowpea and soybean production. The application of the ANOVA model helps us to look at the data in different ways as reflected in the model. The column having "sources of variation" (Table 1) contains the factors and their interactions that form the bases for the study while the mean separations are shown in charts.

Table 1: ANOVA results of the effects of grazing livestock on cowpea and soybean production

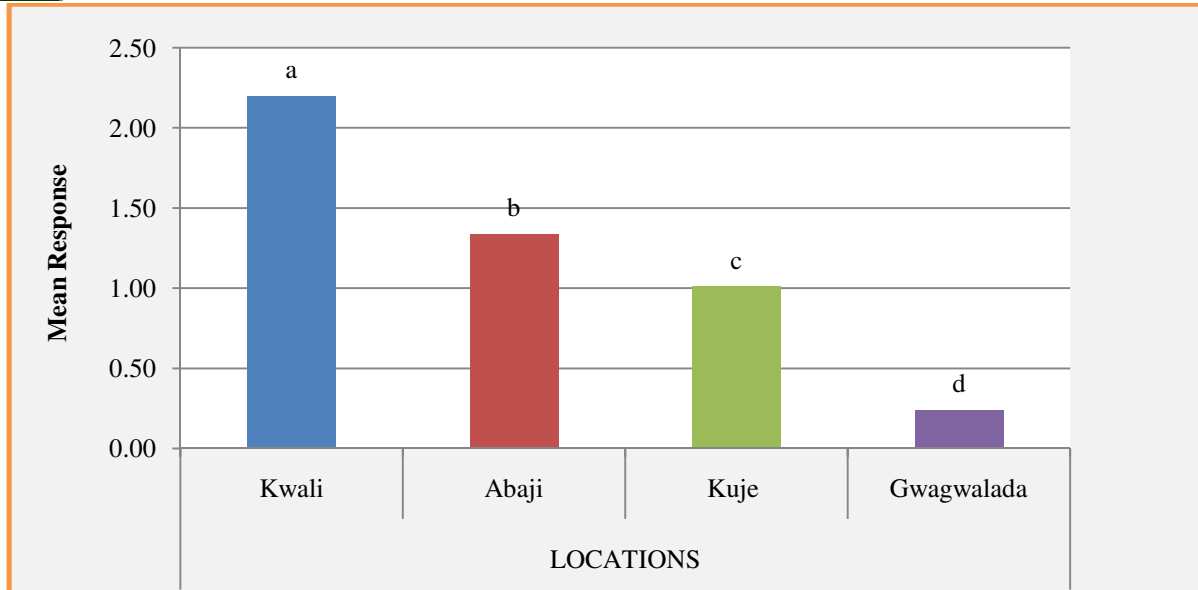
Sources of variation	Df	SS	MS	F-cal	P-value
Livestock type	2	178.28	89.14	228.56	0.00
Location*livestock type	6	40.73	6.79	17.41	0.00
Error (livestock type)	812	320.33	0.39		
Crop type	1	107.06	107.06	297.38	0.00
Location*crop type	3	109.35	36.45	101.25	0.00
Error (crop type)	406	145.02	0.36		
Crop type*livestock type	2	6.532	3.27	13.08	0.00
location*crop type*livestock type	6	10.957	1.83	7.32	0.00
Error (Crop type*livestock type)	812	200.816	0.25		
Location	3	201.587	67.20	560.00	0.00
Error (location)	406	49.267	0.12		

Source: Field data analysis, 2014

#### *The main effects of location on cowpea and soybean production*

The main effect of location is shown in Table 1 and it shows farmers' rating of the effects of grazing livestock in each area council. Here, emphasis is not placed on any animal or crop but on how the farmers generally perceived the effects of the animals on the two crops. The question is: Are there locational differences in the effects of grazing livestock on the two crops? The answer to this question led to the tests of hypothesis which states that there is no significant locational difference in the effects of grazing livestock on cowpea and soybean production. The result,  $F(3, 406) = 560.00, p = .00$ , revealed that there were significant ( $p < .01$ ) locational differences in the effects of grazing livestock on cowpea and soybean production hence the rejection of the null hypothesis. Mean separation (Fig. 1) showed that the most affected area council was Kwali. The effect of grazing livestock in Kwali was

significantly higher than that in Abaji while that in Abaji was significantly higher than that in Kuje. Similarly, the effect in Gwagwalada area council was significantly lower than what was obtained in other area councils. The locational differences in the impact of grazing livestock on cowpea and soybean may be attributed to the differences in livestock stocking densities or differences in the cropping intensities in those area councils. It could, as well, be due to the availability and use of grazing routes because [5] affirmed that there were 4125 grazing routes in Nigeria including Abuja where the study was conducted. This result brings to light the need for a bottom-up approach in addressing the problem because each location should be able to provide suggestions for everlasting solution. Any top-down approach may be fruitless because there must be socio-cultural factors that interplay with other variables to cause the locational difference in impact.



Note: Means (bars) with the same alphabet did not significantly differ from each other

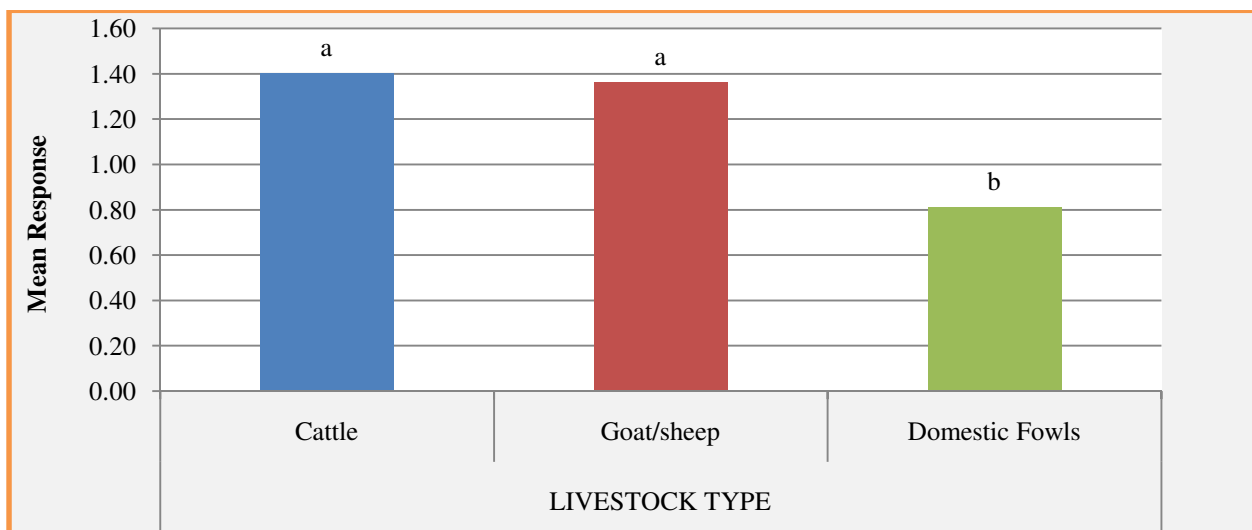
Fig. 1. Farmers' rating of the effects of grazing livestock on cowpea and soybean in different locations

Source: Field data analysis, 2014

### The main effects of livestock type on cowpea and soybean production

Farmers' rating showing the most destructive livestock (the main effects of livestock type) is shown in Table 1 and is denoted by *livestock type*. In this case, emphasis is placed on the entire study area and not on each area council hence the question is: How did the farmers see the effects of each livestock when they graze on cowpea and soybean crops? In other words, if any of these animals grazes on cowpea or soybean farm, which one is the most destructive? It tests the hypothesis which states that the effects of each livestock on cowpea and soybean production do not significantly differ from each other ( $\mu_{\text{cattle}} = \mu_{\text{goat/sheep}} = \mu_{\text{domestic fowls}}$ ). The result,  $F(2, 812) = 228.56, p = .00$ , indicated that the level of destruction that

occurs when any of these animals grazes on cowpea or soybean farm significantly ( $p < .01$ ) depended on the livestock type hence the rejection of null hypothesis. This agrees with the findings of [21] which revealed that the effects of livestock on crop depend on the type of grazing animal. Based on this, mean separation was done (Fig. 2) and it showed that the destructive effects of cattle and goat/sheep on cowpea and soybean during grazing did not significantly ( $p < .05$ ) differ from each other but was significantly higher than that of domestic fowls. Although, the mean responses for the effects of cattle and goat/sheep on cowpea and soybean were not the same, the non-significant difference between the two implies that when any of these animals grazes on cowpea or soybean crop, the cause almost the same harm to the crops.



Note: Means (bars) with the same alphabet did not significantly differ from each other

Fig.2. Farmers' rating showing the most destructive livestock in the entire study area

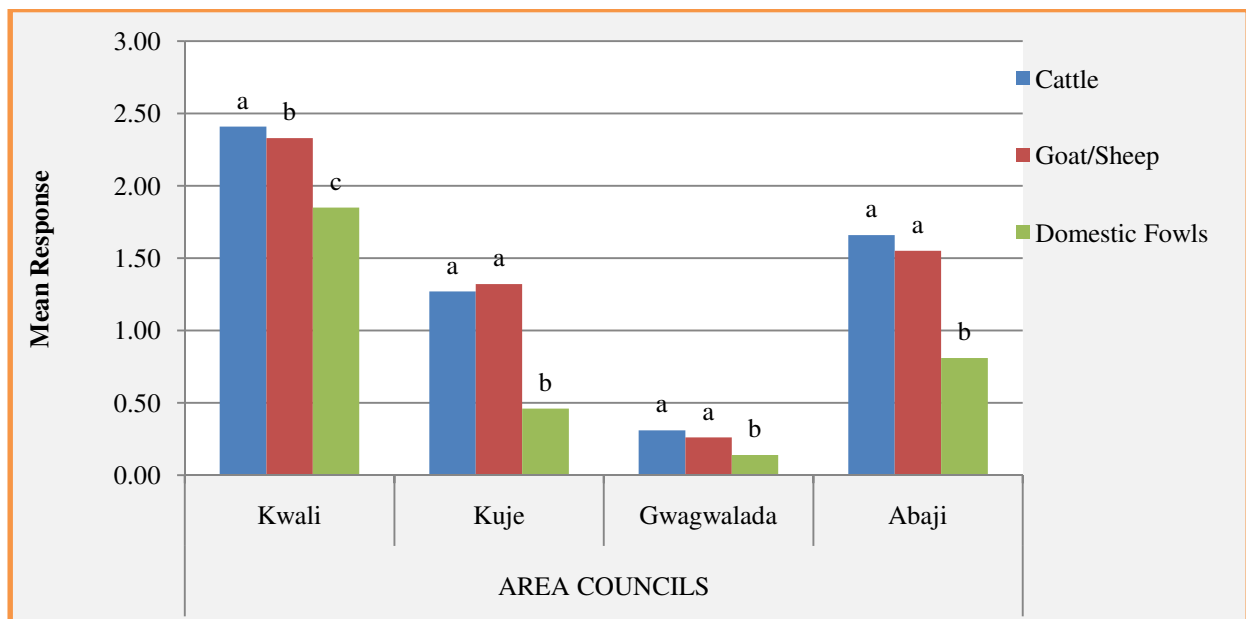
Source: Field data analysis, 2014

By implication, the mean responses suggest that cattle and goat/sheep were the most destructive while domestic fowls were the least. This affirms the report by [7], [6] and [4] which showed that the effect of grazing livestock on crops was a major source of farmers-herder conflicts in many locations in Nigeria.

*Interaction effects of location and livestock type on cowpea and soybean production*

The result of interaction of location and livestock type (*location\*livestock type*) (Table 1) shows how the farmers rated the effects of each livestock on cowpea and soybean in each area council sampled. The result is similar to the one obtained in Fig. 2 but in this case, emphasis is placed on the most destructive grazing animal in each area council and not in the entire study area. Hence, the question is: Do the destructive effects of each grazing livestock on cowpea and soybean production differ in each of the locations sampled? On the other hand, it tests the hypothesis which states that there is no significant interaction effect of location and livestock type on cowpea and soybean production. ( $\mu_{Kwali-cattle} = \mu_{Kwali-Goat/sheep} = \mu_{Kwali-Domestic fowls} \dots \mu_{Abaji-cattle} = \mu_{Abaji-Goat/sheep} = \mu_{Abaji-Domestic$

$fowls$ ). The result,  $F(6, 812) = 17.41, p = .00$ , indicated that there was significant interaction effect of location and livestock type hence the rejection of the null hypothesis. Mean separation (Fig 3) showed that there were variations in the mean responses of the farmers in each area council but in Kuje, Gwagwalada, Abaji, the effects of cattle and goat/sheep on the production of the two crops did not significantly ( $p < .05$ ) differ from each other. But, on the contrary, the effects of cattle and goat/sheep significantly differed in Kwali Area Council. In all locations, domestic fowls had the least effect on the production of the two crops. In Gwagwalada and Kuje Area Councils, the magnitude of the mean responses was very low implying that the animals were not major threats to the production of these crops but in reality, issues that generate conflict between crop and livestock farmers in rural communities are, sometimes, very trivial. So, no matter the magnitude of the effects of grazing livestock on the two crops, it has to be tackled in view of the fact that crop production are, according to [27], important sources of livelihoods of millions of relatively poor people in less developed countries in the tropics including Nigeria.



Note: Means (bars) with the same alphabet did not significantly differ from each other  
 Fig.3. Farmers’ rating showing the most destructive livestock in each location  
 Source: Field data analysis, 2014

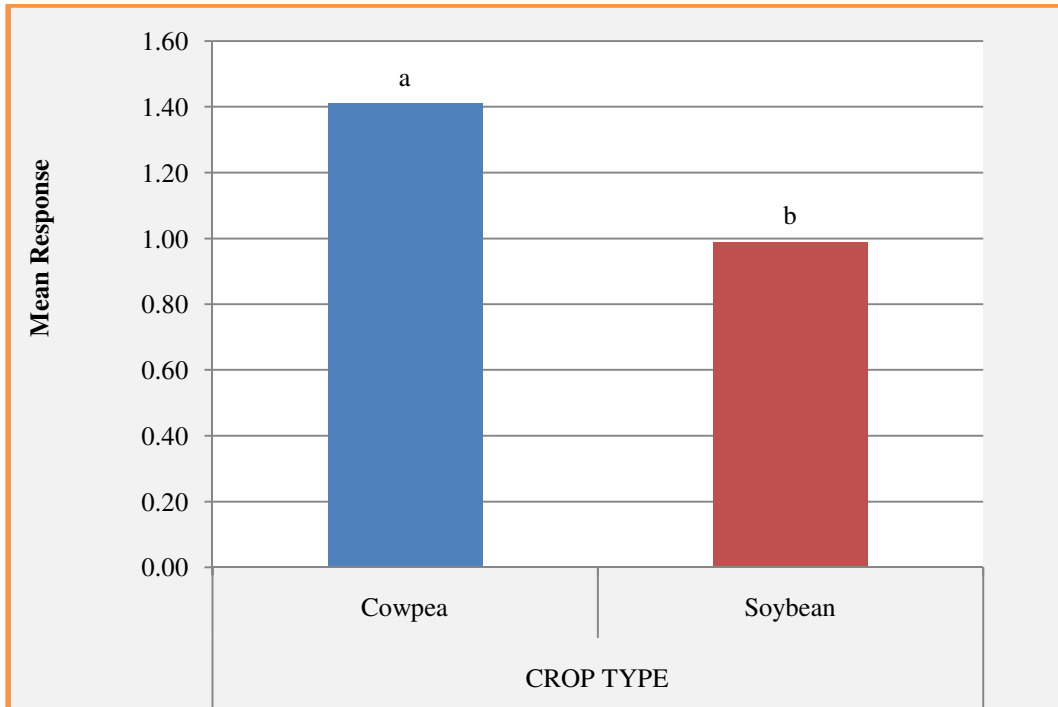
*The main effects of crop type on cowpea and soybean production*

One of the factors tested in the analysis is crop type and the result is shown in Table 1. It was included in the analysis to determine which of the crops was more vulnerable to destruction by grazing livestock. Here, emphasis is not on each livestock or area council as in Fig. 3 but on the most affected crop in the entire study area. It tests the hypothesis which states that the effects of grazing livestock do not depend on the crop type ( $\mu_{Cowpea} = \mu_{Soybean}$ ). The result,  $F(1, 406) = 297.38, p = .00$ , showed that there was significant ( $p < .01$ ) main effects of crop type thus the null hypothesis was rejected. This implies

that the impact of grazing livestock depends on crop type, That is, it depends on whether it is cowpea or soybean that the animals graze on. Mean separation (Fig. 4) revealed that cowpea is the most vulnerable to destruction by grazing livestock because the effect of grazing livestock on cowpea was significantly higher than that of soybean. In other words, whether it is cattle, goat/sheep or domestic fowls that graze on any of the two crops, the effect was always more on cowpea. Cowpea therefore, is the most affected crop while soybean is the least. The effects of these animals on the production of the crops should be addressed because [18] noted that cowpea contributes to food security, income generation and sustainable

environment for millions of farmers who cultivate it. Again, [28] reported that Nigeria is the highest producer of cowpea in the World and this is an impressive report that should be sustained. Although, the effect of domestic

fowls was the least, its effects can be further minimized if the farmers learn to plant crops some distance away from residential homes. If this is done, they can only contend with the menace of cattle, goat and sheep.

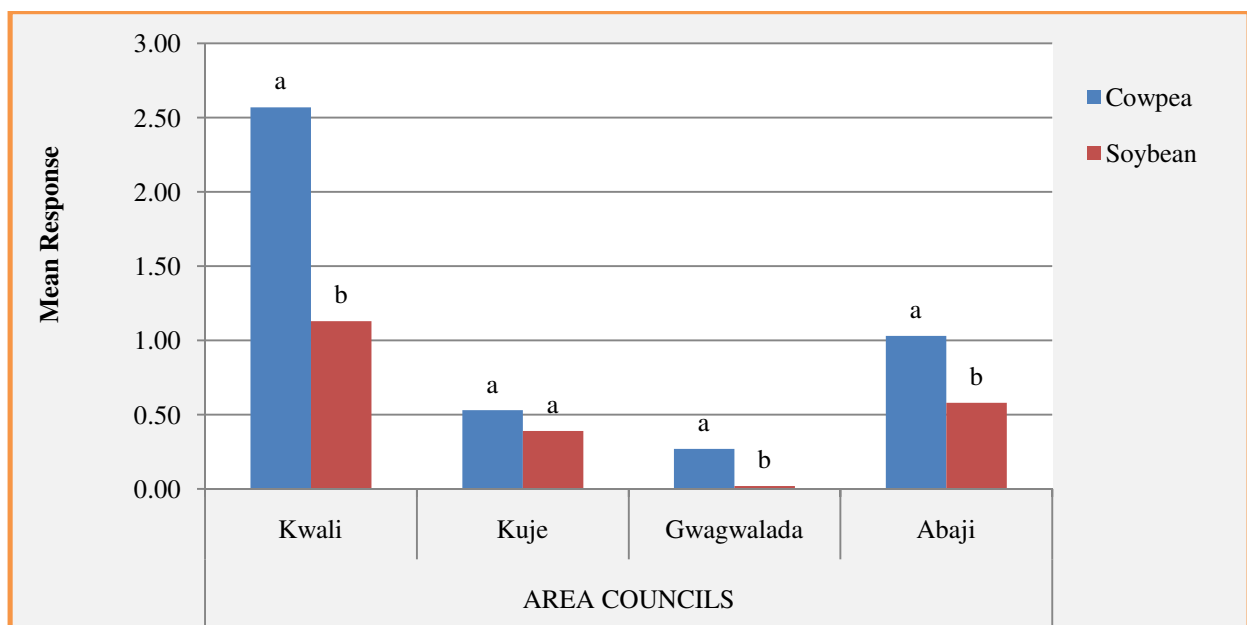


Note: Means (bars) with the same alphabet did not significantly differ from each other  
Fig 4: Farmers' rating showing the most affected crop in the entire study area.  
Source: Field data analysis, 2014

### Interaction effects of location and crop type on cowpea and soybean production

The result of the interaction effects of location and crop type (location\*crop type) on cowpea and soybean production is shown in Table 1. The interaction shows

how the farmers rated the impact of grazing livestock on cowpea and soybean in each of the locations sampled. In other words, it answers the question of whether the effects of grazing livestock on cowpea and soybean production differed in each of the locations sampled.



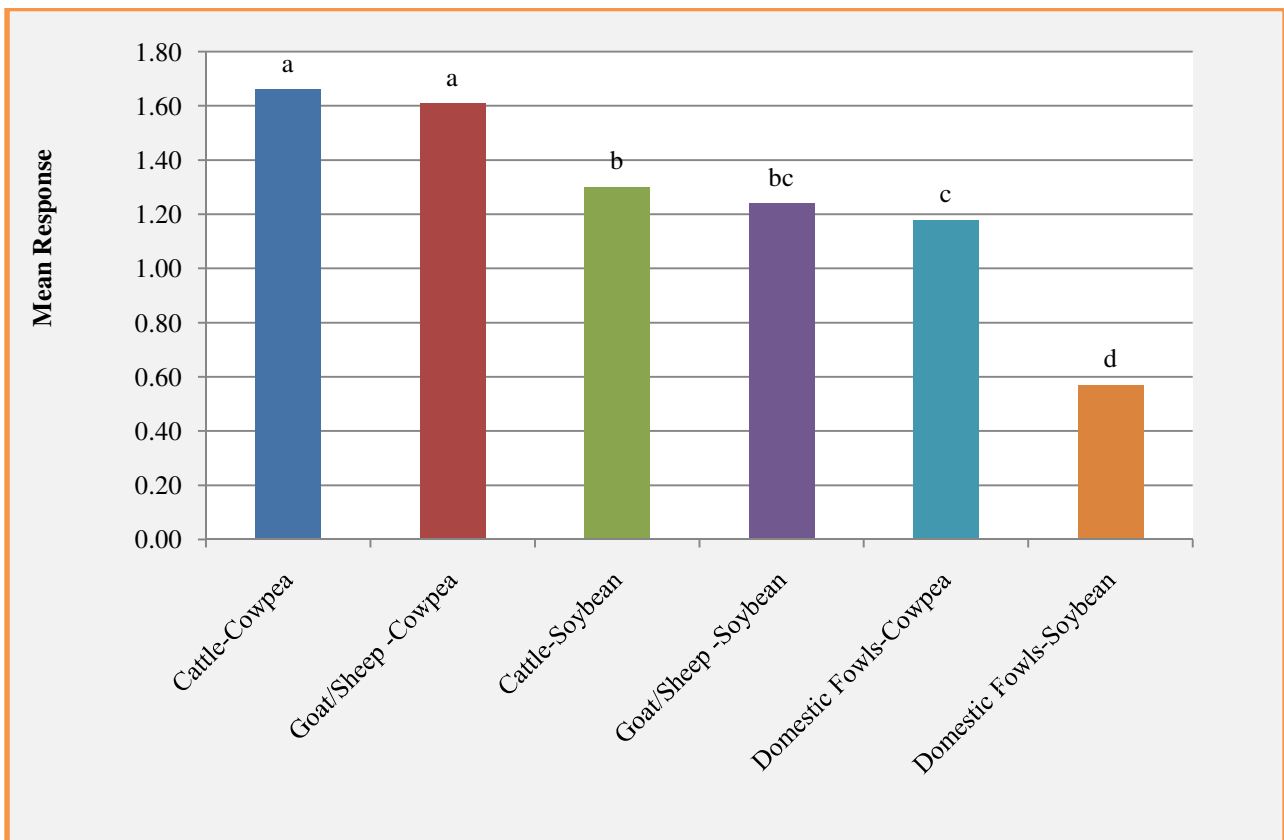
Note: Means (bars) with the same alphabet did not significantly differ from each other  
Fig.5. Farmers' rating showing the most affected crop in each location.  
Source: Field data analysis, 2014

The result,  $F(3, 406) = 101.25, p = .00$ , showed that there was significant interaction effects of location and crop type hence the null hypothesis was rejected. To determine the nature of the variations in each area council, mean separation was done and the result (Fig. 5) showed that in all the area councils, the most affected was cowpea although the level and magnitude of effects differed from one area council to the other. For example, in Kwali Area Council, the effect of grazing livestock on cowpea was very high and significantly higher than the effect on soybean. A similar result was also observed in Abaji Area Council but the magnitude of the impact was small. The farmers' rated the effects of grazing livestock on cowpea and soybean in Kuje and Gwagwalada very low and it has some implications. First, it could be that these two area councils do not produce cowpea in large quantity or they have and, as well, adhere to the use of grazing routes resulting in minimal impact. Second, it could also mean that they have rules and regulations guiding crop and livestock production in their areas.

*Interaction effects of crop type and livestock type on cowpea and soybean production*

The result of the interaction of livestock type and crop type (crop type\*livestock type) is shown in Table 1. Here, emphasis is not placed on any area council but on how the farmers rated the effects of each livestock on each crop in entire study area. It tests the hypothesis which states that the effects of each livestock on each crop do not

significantly differ from each other ( $\mu_{\text{Cattle-Cowpea}} = \mu_{\text{Cattle-Soybean}} = \mu_{\text{Goat/sheep-Cowpea}} = \mu_{\text{Goat/sheep-Soybean}} = \mu_{\text{domestic-fowls-Cowpea}} = \mu_{\text{domestic-fowls-Soybean}}$ ). The result,  $F(2, 812) = 13.08, p = .00$ , showed that there was significant interaction effects of livestock and crop type hence the rejection of the null hypothesis. Mean separation (Fig. 6) showed that the effect of cattle and goat/sheep on cowpea was not significantly different from each other but it was significantly higher than the effects of cattle, goat/sheep and domestic fowls on soybean. The rating showed that the effect of cattle and goat/sheep on soybean was not significantly different from that of domestic fowls on cowpea implying that domestic fowls, like cattle and goat/sheep, were also major limiting factors to cowpea production in the study areas. But on the other hand, the effect of domestic fowls on soybean was the least and was significantly less than the effects of the other animals on cowpea and soybean as well. This suggests that domestic fowls reared under free range system did not constitute a major threat to the production of soybean in the area but the effect of cattle and goat/sheep was major limiting factors to the production of the two crops. If this is taken as a test of preference or palatable test it implies that cattle, goat/sheep and domestic fowls prefer cowpea to soybean during grazing and this agrees with the findings of [29] which indicated that livestock selectively forage on grasses.



Note: Means (bars) with the same alphabet did not significantly differ from each other

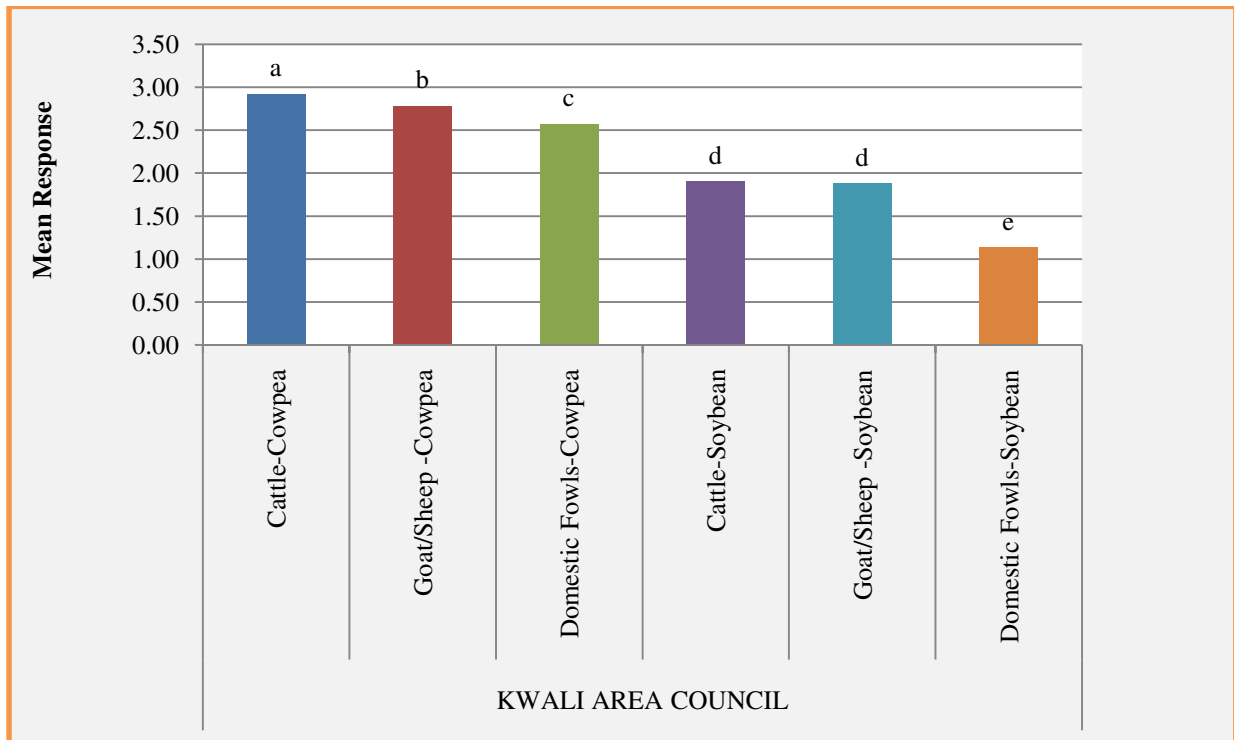
Fig.6. Farmers' rating showing the effects of each livestock on each crop in the whole area.

Source: Field data analysis, 2014

*Interaction effects of location, crop and livestock types on cowpea and soybean production*

The interaction effect of location, crop and livestock types on cowpea and soybean production (location\*crop type\*livestock type) is shown in Table 1. This interaction provides information on how the farmers rated the effects of cattle, goat/sheep and domestic fowls on cowpea and soybean production in each area council. The result is very important because it disaggregates the data into locations (area councils) and gives the picture of how the farmers in each area council perceived the effects of grazing livestock on cowpea and soybean production. It tests the hypothesis which states that the effects of each livestock on cowpea and soybean production does not significantly differ in each location. The result,  $F(6, 812) = 7.32, p = .00$ , shows that there was significant ( $p < .01$ ) interaction of location, crop type and livestock type on cowpea and soybean production hence the rejection of the null hypothesis. Mean separation for this interaction was done per area council and are reflected in Fig.7, 8, 9 and 10. In Kwali Area Council, the mean separation (Fig. 7) indicated that the effect of cattle on cowpea production was the highest and it is significantly ( $p < .05$ ) higher than that of goat/sheep while the effect of goat/sheep was significantly higher than that of domestic fowls. For soybean, the effect of cattle and goat/sheep was not significantly ( $p > .05$ ) different from each other but significantly ( $p < .05$ ) higher than that of domestic fowls. This shows that cowpea was the most affected crop in Kwali Area Council with cattle as the most destructive grazing animal. In Kuje Area Council, the mean separation result (Fig. 8) was different from what was obtained in

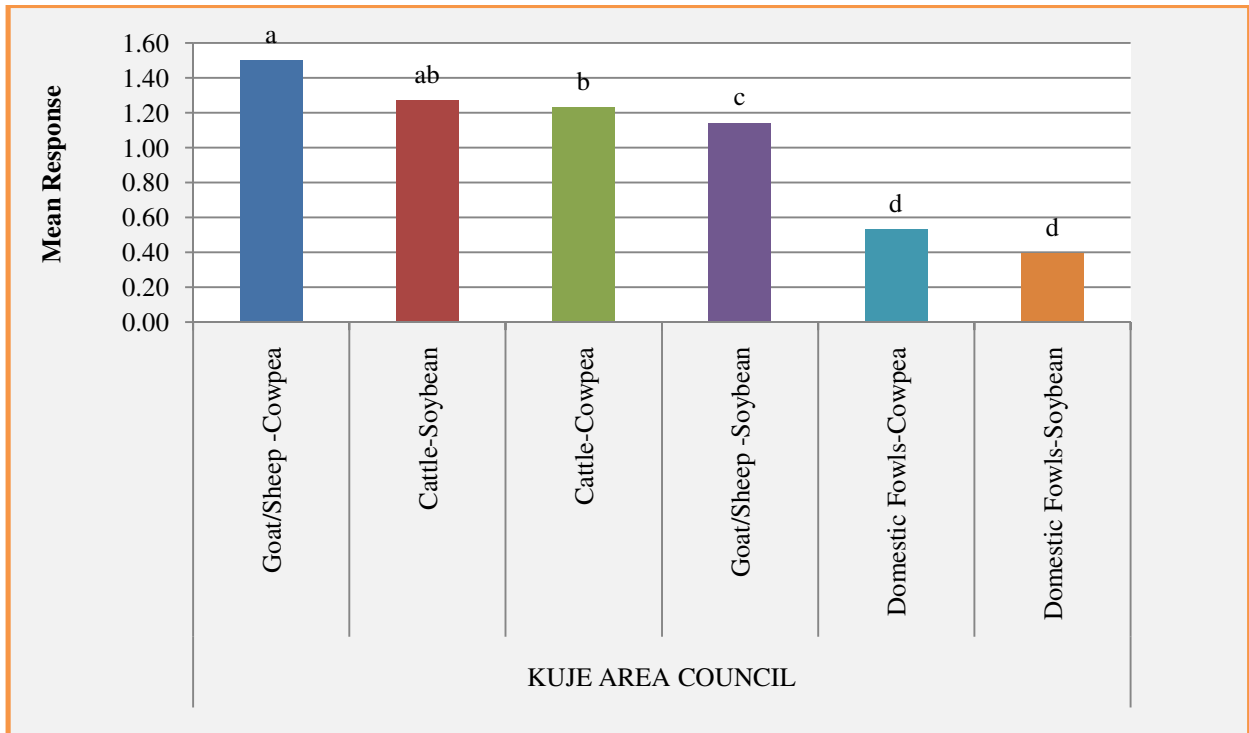
Kwali Area Council. Here, goat/sheep was rated as the most destructive animal but its effect on cowpea was not significantly ( $p > .05$ ) different from the effects of cattle on soybean. The farmers rated the effects of cattle on cowpea and soybean the same. The mean response indicated that domestic fowls had the least effects on the production of cowpea and soybean in Kuje. Again, the result in Gwagwalada Area Council (Fig. 9) is similar to that obtained in Kwali Area Council (Fig. 7) but the magnitude of the mean responses is very low. Although, there were significant differences in the mean responses, the magnitude suggests that grazing livestock did not constitute a major threat to the production of cowpea and soybean in that location. This needs further verification to find out if they are not more into livestock production or that they have rules that regulate the activities of crop and livestock farmers. Also, it should be investigated to see if they have and are adhering to the use of grazing routes resulting in minimal destruction by grazing livestock. In Abaji Area Council, the result (Fig.10) indicated that cattle were the most destructive livestock and its effect on cowpea was significantly ( $p < .05$ ) greater than that of goat/sheep and domestic fowls on cowpea and soybean. In all the locations, the effect of domestic fowls on soybean production was the least. Generally, it can be seen that there were variations in the effects of grazing livestock on cowpea and soybean production in all the area councils as shown in Fig.1 but the mean separation of the interaction of location, crop type and livestock type (Figs 7, 8, 9, 10) has actually revealed the nature of the variations in each location hence the importance of the three-way mixed analysis of variance in the study.



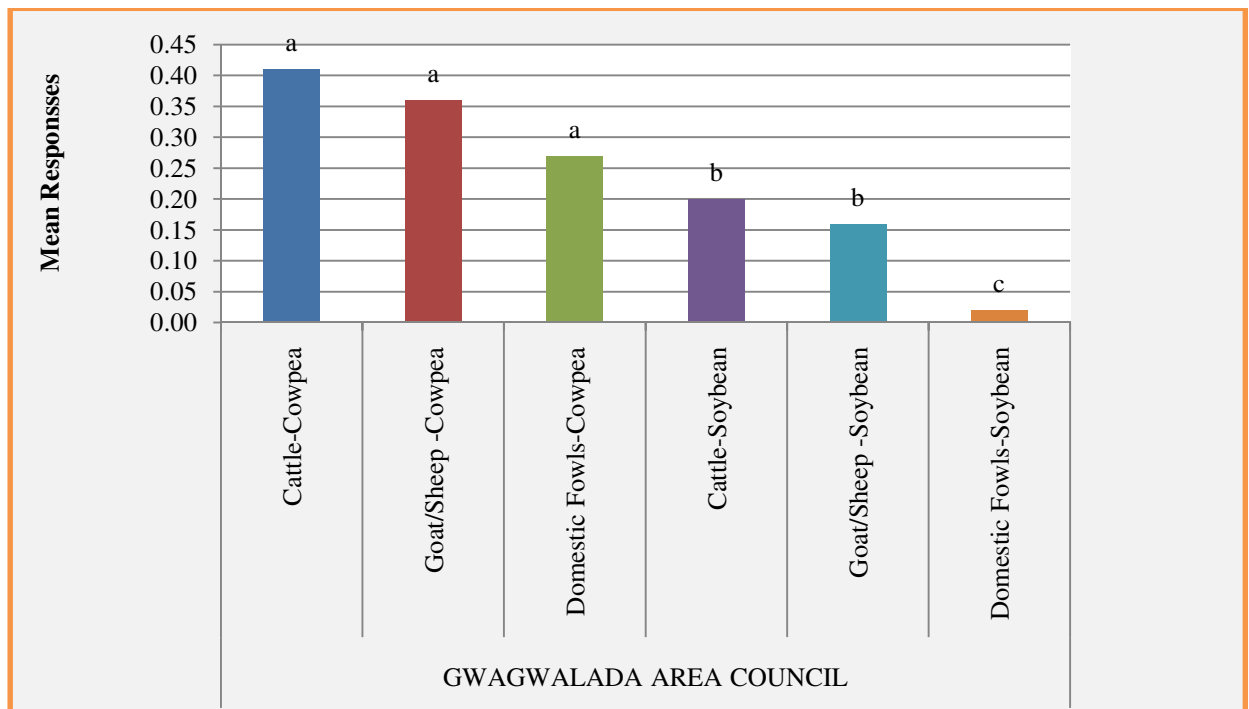
Note: Means (bars) with the same alphabet did not significantly differ from each other  
Fig.7. Farmers' rating showing the effects of livestock on cowpea and soybean in Kwali  
Source: Field data analysis, 2014

Analyzing the data separately in each area council is important because [30] stated that data and research at grass-root level provide local administrators and policy-makers information needed for decisions-making. The

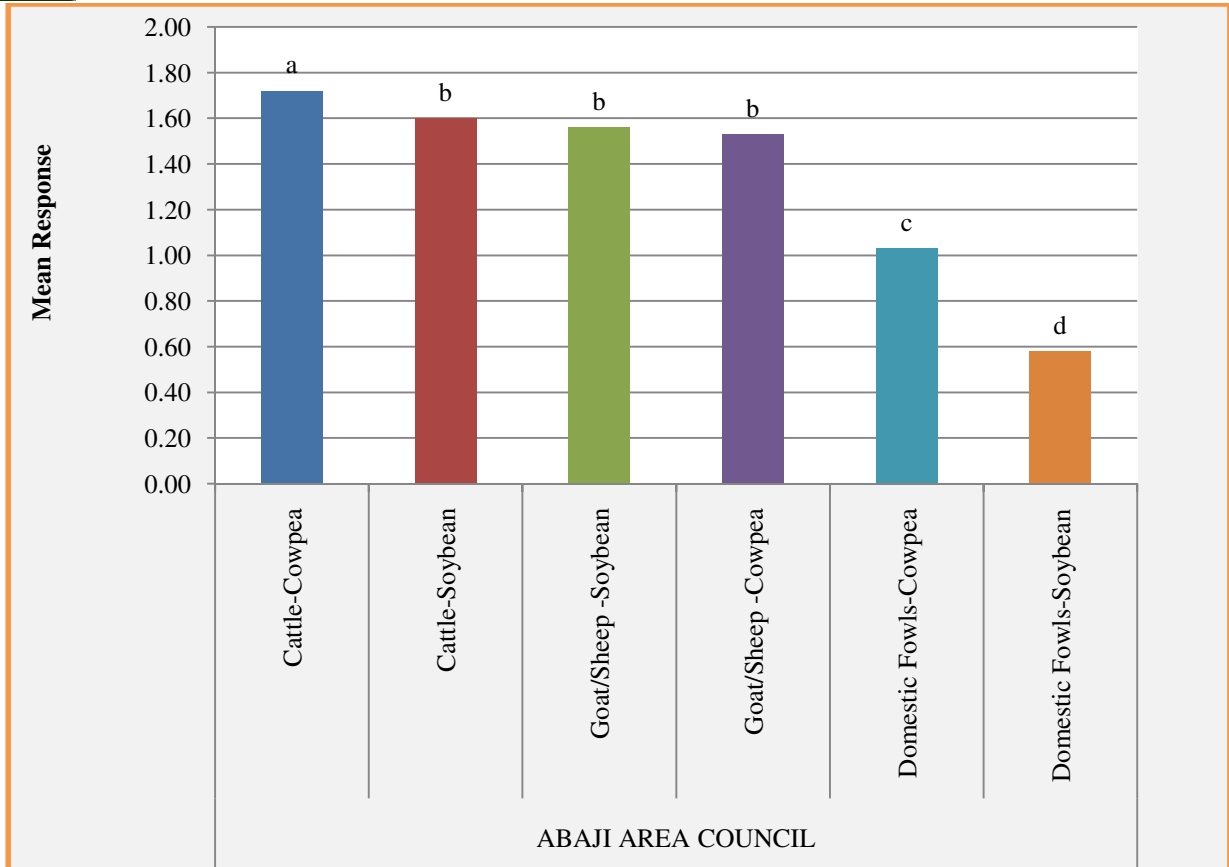
observed differences in the effects of grazing livestock on cowpea and soybean in different locations should form the bases for appropriate intervention measures.



Note: Means (bars) with the same alphabet did not significantly differ from each other  
Fig.8. Farmers' rating of the impact of livestock on cowpea and soybean in Kuje  
Source: Field data analysis, 2014



Note: Means (bars) with the same alphabet did not significantly differ from each other  
Fig.9. Farmers' rating of the impact of livestock on cowpea and soybean in Gwagwalada  
Source: Field data analysis, 2014



Note: Means (bars) with the same alphabet did not significantly differ from each other  
 Fig.10. Farmers' rating of the impact of livestock on cowpea and soybean in Abaji  
 Source: Field data analysis, 2014

### Cost estimate of damaged cowpea and soybean crops by grazing livestock

During data collection, the farmers were asked to estimate the cost of damaged cowpea and soybean by

grazing livestock. Only affected farmers provided the data and the result is presented in Fig. 11. The result indicated that cowpea and soybean farmers lost an average of

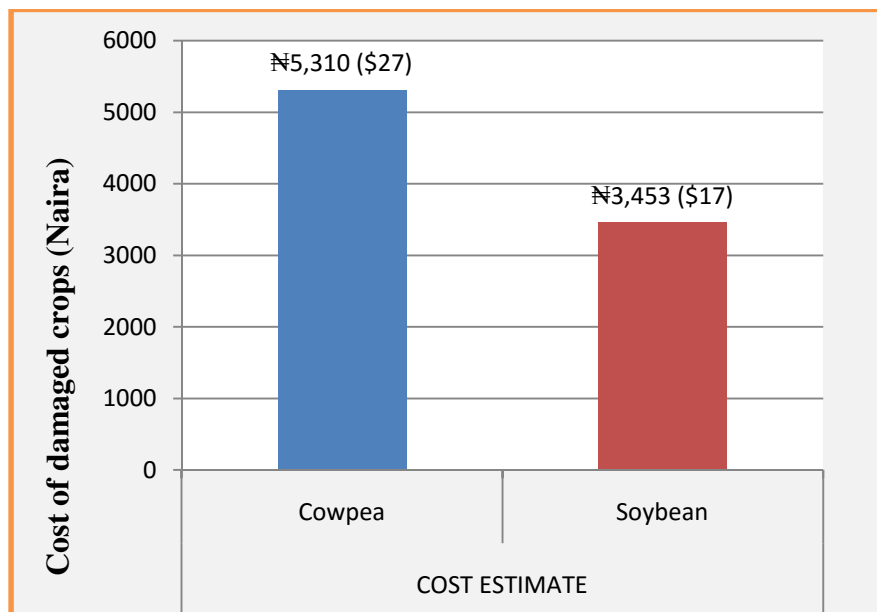


Fig.11. Cost estimate of damaged crops  
 1US Dollar = ₦199 [33]  
 Source: Field data analysis, 2014

₦5,310 (\$27US dollars) and ₦3,453 (\$17 US dollars) respectively in 2014 to grazing livestock with cowpea farmers losing more than the soybean farmers. This tallies with the result in Fig 4 which shows that the farmers rated the effects of grazing livestock on cowpea more than soybean. It also validates the importance of using rating scale in data analysis as reported by [31]. The damaged crops represent a substantial amount of the farmers' total farm income and it is very discouraging and a disincentive to investment in cowpea and soybean production. Unfortunately, it is not the only factor affecting the production of the two crops because [32] stated that legumes like cowpea are always under heavy biotic pressures, particularly from insects and other pests which often affect the plant throughout life cycle. All these factors are capable of eliciting aggressive response from the crop farmers even on mere sighting grazing livestock from a distance.

#### *Stage of crop destruction or damage by grazing livestock*

Table 2 shows the farmers' responses on the stage at which the crops were mostly damaged by grazing livestock. The result indicated that grazing livestock affect cowpea and soybean mostly after germination (44.88%), that is, during the period of vegetative growth and during harvesting (34.14%) stage. The effect of grazing livestock on stored cowpea and soybean was very low (0.98%) and this is line with the a priori expectation because it is only when the crops are carelessly stored that the animals will have the opportunity to destroy them. About 17 percent of the crop damages occurred during processing and this may be attributed to goat, sheep and especially domestic fowls because they are mostly reared around homes and (at times) managed as pet animals. Generally, it is worth noting that 79.02% of the damages caused by grazing livestock on the crops occur within the period of vegetative growth and maturity – harvesting stage. Although, there is no stage of destruction that is not painful, but imagine the mood of a farmer who has passed through germination stage only for the crop to be eaten by grazing animal. A critical look at the real life situation leaves no one with doubt that even the stage of destruction is capable of causing conflict between the crops and livestock farmers. This goes to confirm that crop damages according to [4] and [6] is one of the causes of farmers-herder conflicts in Nigeria.

Table 2: Stage of crop destruction by grazing livestock

Stage of destruction	Frequency	Percentage
During germination	(23) 12	2.93
After germination	(341) 184	44.88
Harvesting stage	(261) 140	34.14
During processing (e.g. during sun-drying)	(129) 70	17.07
During storage	(7) 4	0.98
<b>Total</b>	<b>(762) 410</b>	<b>100</b>

Note: Values in parentheses are multiple frequencies

Source: Field data analysis, 2013.

## IV. CONCLUSION

Agriculture is as old as mankind and for man to survive on earth, one of his major responsibilities is to identify factors that limit the production and productivity of agricultural products; otherwise hunger and starvation will be the order of the day. This is a fact and does not need scientific proof hence the need to assess the effects of grazing livestock on cowpea and soybean production in Abuja, Nigeria. The result indicted that the effects of grazing livestock on cowpea and soybean production varied from one area council to another implying that location specific strategies should be adopted in addressing the effects on the crops. The most affected crop was cowpea with cattle and goat/sheep causing the major damages while domestic fowls had the least effects. Generally, the effect of cattle and goat/sheep on cowpea and soybean was higher than that of domestic fowls thus domestic fowls can be reared in an environment where cowpea and soybean are grown. Affected cowpea and soybean farmers lost an average of ₦5,310 (\$27 dollars) and ₦3,453 (\$17 dollars) respectively to grazing livestock in 2014. This amount is big enough to cause conflict between the crop and the livestock farmers because it represents a substantial amount of their farm and annual income. The study generally concluded that grazing livestock affected cowpea and soybean production in the study area but the effects depended on location, livestock type and crop type. Hence, any approach to address the effects on the crop should take cognizance of these variables. Finally, the introduction and use of grazing routes in each location, using bottom-up approach is strongly recommended.

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