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Effects of Animal Husbandry on Soil Physical Properties in Zango Kataf Local Government Area, Kaduna State, Nigeria.

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Abstract: *This study set out to examine the effects of animal husbandry on soil physical properties (bulk density and percentage soil porosity) in Zango Kataf Local Government Area of Kaduna state. The study was based on the assumptions that animal husbandry has no significant impacts on soil physical properties of the study area. The purposive random sampling was used in collecting data from the selected sites in the four chiefdoms. The bulk density cores were used in collecting soils samples. A one – way multifactor analysis of variance (ANOVA) approach was used to analyze data. Analysis of results was done using the descriptive and inferential statistics using the Social Sciences Statistical Package (SPSS) software. The results obtained reveals statistical differences at $p < .05$ between grazed (impacted) areas and un-grazed (control) areas for bulk density and percentage porosity. Areas with higher bulk density values recorded lower soil porosity values in areas where grazing is taking place. Areas where grazing was restricted (control) recorded lower soil bulk density and higher soil porosity. The implication was that run – off was significantly reduced and condition favours vegetation growth in such areas. Based on the findings, the study recommended that rearing of animals be restricted to build enclosures, ranches, and reserves or otherwise controlled to enable effective monitoring, diseases control, tracking and treatment, environmental conservation and elimination of clashes between farmers and animal breeders.*

Keywords: *Soil, Bulk Density, Soil Porosity, Grazed areas, Un-grazed areas, Density cores*

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I. Introduction

The amount of cultivable land in the world is finite and any land that has been degraded is almost irreversibly lost for production. The average per capita available land has been reduced from 0.50ha in 1950 to 0.25ha in 2013 (Verheye, 2014). In some East Asian Countries, it is 0.15ha or even below. The pressing demand for food and space from the fast growing world population has created a competition for land (Verheye, 2014). This pressure on land is one of the many causes of land degradation, herders/farmers clashes which have caused a lot of losses in terms of lives and properties.

Globally, animal rearing is the world's largest user of land, and accounts for almost 40 percent of the total value of agricultural production (Wik *et al*., 2008). In developed countries, this share is more than half, while in developing countries, it accounts for one third. A major challenge in animal husbandry is the potential conflict between devoting land to feed production instead of food production (Galloway *et al*., 2007). It is observed that livestock production accounted for about 33 percent of arable land and the demand for arable land for the production of animal feed will continue to increase thereby putting more constraints on land resources needed for other purposes. In a similar vein, FAO (1995), observed that land degradation has often been exacerbated where there has been an absence of any land use planning, or of its orderly execution, or the existence of financial or legal incentives that have led to the wrong land use decision, or one – sided central planning leading to over – utilization of the land resources.

Abdel – Magid *et al*. (1987), found out that severe trampling of land by animals especially cows increased soil bulk density by 3% and decreased infiltration by 57%. On the other hand, Savory (2013) observed that Hoof action of animals is a tool to break up detritus accumulation and incorporate it into the soil in grassland ecosystems of temperate environment. For a healthy grazing ecosystem, Briske *et al*. (2008) suggested that temperate grazing systems should be designed to improve grassland health, and function, thus increasing forage production for livestock, harvest efficiency, and animal production, while improving wildlife habitat and increasing nutrient cycling and retention. The pertinent questions this research used to conduct findings includes how animal rearing impact on the soil; is there any variation in the impact between grazed and un-grazed areas? Further to this, is there any variation between the selected sites? The aim of the study was to determine the effects of animal husbandry on soil physical properties specifically the bulk density and porosity.

Large portions of the Local Government Area are already degraded and almost unfit for cultivation as a result of continuous grazing. As rightly observed by Nhojo (2011) in Mvomero district of Tanzania, the major clashes recorded in that district was between farmers and pastoralists, competing on the same area for their livelihood especially in areas without Land Use Plan (LUP). The need for LUP in Tanzania resulted in LUP been carried – out to accommodate changes in land use and increase in human population and to control large stock population which increases demand for grazing land and creates serious land degradation and to protect the environment from extension of cultivation to marginal areas and also reduce conflicts in land use between agriculturists and livestock keepers. In a similar vein, this matter needs urgent attention in the study area, however this study seek to establish first of all, the impact of grazing on soil physical properties specifically bulk density and porosity.

II. Hypothesis

H_o Animal husbandry has no significant impact on the soil physical properties in Zango Kataf Local Government area of Kaduna State.

H_1 Animal husbandry has significant impact on the soil physical properties in Zango Kataf Local Government area of Kaduna State.

The research hypothesis was statistically tested at 0.05 confidence level.

The Study Area

Zango Kataf Local Government Area (LGA) of Kaduna State, Nigeria lies between latitudes 9º 25´N and 10º 20´N and between longitude 7º 45´E and 8º 40´E, with a total land area of about 5,625km^2. Zango – Kataf LGA is located within the tropical continental climate (Koppen's A_W) with two distinct seasons –wet and dry. The vegetation type found in the study area is Southern Guinea Savana type characterized by thick woodlands, tall grasses and herbs with riparian forest along streams and river banks (Udo, 1981). The study area is drained by several perennial streams and rivers such as River Zagom, River Wonderful and River Kaduna taking their sources from the western escarpment of the Jos Plateau.

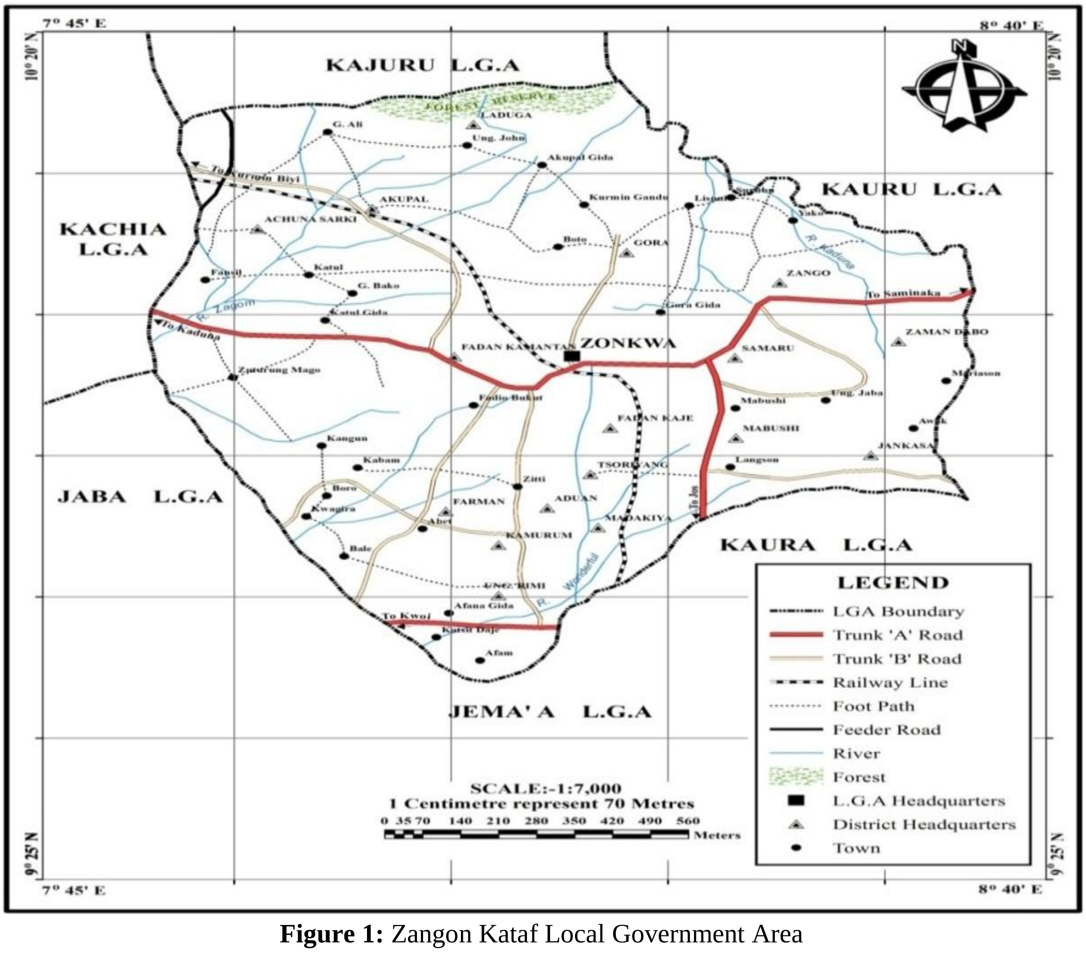

Figure 1: Zangon Kataf Local Government Area
Source: Department of Geography and GIS Laboratory, Kaduna Polytechnic.

There are four major tribes that constitute almost 80% of the entire population of this Local Government; they include Atyap (Kataf), Bajju (Kaje), Ikulu and Kamanton. Other minor tribes include, Hausa, Fulani, Yoruba, Igbo, Tiv among others. According to National Population Census (2006) the Local Government had a population size of 318,991. However, the National Bureau of Statistics (2012) estimated the projected population size of 370,615 by the year 2011. Average population density of the Local Government is about76 persons per squares kilometer. The sex ratio of this population (NPC, 2006) stood at: 162,047 males to 156,944 females (approximately 50.8: 49.2). The structure of the population indicates that a higher proportion are children and youths who constitute about 65% of the entire population, a relative low middle and old age group. Thus, it is basically a fast growing population. The growth rate has been estimated to be 3.0% per annum (National Bureau of Statistics, 2012). About 70% of the total population is engaged in at least one form of subsistence, cultivation of crops and rearing of animals.

III. Review of Related Literatures

Researches on linkages between livestock production, the environment and sustainable development have been conducted by Herrero *et al.* (2012) and Pradère (2014). Their studies highlight the importance of improving livestock productivity and the interdependence of the economic, environmental and social components of sustainable development. Their findings reveal that there is a beneficial link via manure for fertilizing crops and crop residues for feeding animals which permits greater increases in production per unit area. Integration is possible when crops and animals are raised by households or by different groups operating close to each other (Ndlovu, 2012). A spatial integration of crops and livestock is achieved when animals are grazed by herders on fallow fields between plots cultivated by farmers. However both extensive and intensive forms of production Contribute to environmental degradation and destruction (Aganga, 2013; Fasae *et al*. 2014).

In Mvomero district of Tanzania, Nhojo (2011) the major clashes recorded in that district was between farmers and pastoralists, competing on the same area for their livelihood especially in areas without Land Use Plan (LUP). The need for LUP in Tanzania resulted in LUP been carried – out to accommodate changes in land use and increase in human population and to control large stock population which increases demand for grazing land and creates serious land degradation and to protect the environment from extension of cultivation to marginal areas and also reduce conflicts in land use between agriculturists and livestock keepers; this matter is still not currently addressed in the study area or in Nigeria as a country.

Other researchers rather focused on the adverse effects of animal rearing on the environment such as loss of biodiversity, depletion of vegetation and soil resources, ground water pollution, air pollution and other adverse effects for example, excessive in – take of animal foods on human health and Ozone Layer Depletion (GHG) from livestock emissions, for example, Halden and Schwab, (2010); Gerber, (2013); Iqubal, (2013) and USEPA (2013). Their researches established the fact that decomposition of animal faeces releases into the environment Methane and Nitrous oxide that are components of the greenhouse gases. Contamination of ground and surface water by animal wastes, zoonotics diseases, and depletion of vegetation resources, soil erosion and other forms of pollution is always associated with animal rearing. According to Gerber *et al.* (2010) Livestock affects the global climate, water resources, and biodiversity in major ways, for example, Livestock occupy over one-fourth of the terrestrial surface of the planet, on pasture and grazing lands, of which a significant part is degraded.

According to Herrero *et al.* (2012), Livestock production generates considerable pressure on land, water and biomass resources and is responsible for 18 percent of total greenhouse gas emission. Cattle grazing denude land of vegetation causing greater soil erosion and soil compactions due to their hooves resulting in reduced water infiltration (Jones, 2002). He further observed that the removal of vegetation also exposes the ground to greater solar radiation increasing the evaporation of moisture, leaving those plants not eaten by cattle's at increased risk of dying from lack of water. Grazing has damage 80% of Western streams and riparian areas in the U.S. (Belky *et al.*, 2002).

Expansion of pasture occurs in Latin America at the expense of forests concentrated feed demand occupies about one-third of total arable land (Gerber *et al*., 2010). Pasture use and the production of feeds are associated with pollution, habitat destruction, and green house gas emissions (USEPA 2013; Iqubal, 2013). Many researches already conducted have shown that Livestock are also an important contributor to water pollution, particularly in areas of high animal densities. Total phosphorus excretions are estimated to be seven to nine times greater than that of humans (USEPA, 2013). Livestock excreta contain more nutrients than are found in the inorganic fertilizer used annually. Grazing intensities are often described in subjective terms, such as heavy, moderate or low intensity. Overgrazing, a function of both grazing and recovery time, results when livestock either overgraze the plants to a point of non-recovery or access the plants before they have had time to recover (Neely *et al*., 2010). Grazing intensity which removes vegetation beyond the point of recovery can impact on "soil quality" (which is defined as 'the ability of the soil to function' Larson and Pierce, 1991). In grasslands, soil quality is measured by the soil ability to provide structural support to vegetation, sustain biological diversity and productivity, store water and regulate water movement, and retain and cycle nutrients (Karlen *et al.* 1997; Redden, 2014). Because vegetation is frequently removed by grazing in grasslands soil is of particular interest because re – growth of vegetation depends primarily on soil nutrient content and plant subsoil structures.

A common measure of soil physical properties is bulk density (Blake1965; Redden, 2014), bulk density is the ratio of mass to bulk (volume) of soil. Soil with lower relative bulk density tends to have greater soil structure, greater plant – available water capacity, and higher infiltration rates. Heavy grazing may cause compaction, reducing water holding capacity and infiltration while increasing bulk density (Abdel – Magid *et al*. 1987; Redden, 2014; USDA, 2014) Table 3.3. The chemical indicators of soil quality include nutrients availability and organic carbon among others (Larson and Pierce, 1991).

Table 1: General relationship of soil bulk density to root growth based on soil texture.

Soil Texture	Ideal bulk densities for plant growth (grams/cm3)	Bulk densities that affect root growth (grams/cm3)	Bulk densities that restrict root growth (grams/cm3)
Sands, loamy sands	< 1.60	1.69	> 1.80
Sandy loams, loams	< 1.40	1.63	> 1.80
Sandy clay loams, clay loams	< 1.40	1.60	> 1.75
Silts, silt loams	< 1.40	1.60	> 1.75
Silt loams, silty clay loams	< 1.40	1.55	> 1.65
Sandy clays, silty clays, clay loams	< 1.10	1.49	> 1.58
Clays (> 45% clay)	< 1.10	1.39	> 1.47

Source: USDA (2014) Soil Bulk Density/ Guide for Educators.

IV. Materials and Methods.

Field measurements were carried out to examine the effects of animal rearing on soil physical properties (bulk density and % porosity) using Blake (1965) method. Soil samples were collected randomly at intervals of 10m apart from the following sites; Jankasa – Atyap Chiefdom N09º 43′ 22.3″, E008º 27′ 31.7″, Elevation 1035m; Kamantan – Kamantan Chiefdom N09º 48′ 20.8″, E008º 10′ 51.0″, Elevation 807m; Kamuru station – Ikulu Chiefdom N09º 52′ 34.0″, E008º 11′ 14.4″, Elevation 792m and Abet – Bajju Chiefdom N09º 40′ 35.6″, E008º 11′ 02″, Elevation 749m. The sites were chosen in each of the four chiefdoms where grazing intensities and animals rearing are more pronounced with well favoured rearing environments. A hand held GPS Instrument (GARMIN 101 – GECKO) was used to take the coordinates and elevation of each site.

Soil bulk density is the ratio of the oven-dried mass of soil to its volume either at time of sampling or at specified moisture content. It is used to measure soil compaction; the greater the density, the less pore spaces for water movement, root growth and penetration, and seedling germination (Blake, 1965). It is usually expressed in terms of grams per cubic centimeter (g/cm^3) or SI units of megagram per cubic meter (Mg/m^3).

Bulk density cores of dimension 3.66cm radius, 7.62cm height were used to collect the soil samples; this is done at an interval of 10m apart. For each site, soil samples were taken from Un-Grazed sites (Control) where animal grazing was restricted, and from Grazed sites (Impacted) where animal grazing takes place. The apparatus used includes; Core sampler, Harmer, Wood plank, Sharp rigid spatula, Trowel, Balance sensitivity 0.01 gm, Oven capable of 105ºC, Plastic bags, Weighing tins to hold soil samples, Metal disk to cover ends of core and Tape - (masking).

Procedure for Soil Sample Collection: A smooth “undisturbed” horizontal soil surface at a depth of 5cm was prepared, using the hand sledge and block of wood, the core was driven into the soil with the beveled edge down. The soil around the core was carefully removed by digging around it, then the trowel was carefully pushed underneath it, then it was lifted out to prevent any loss of soil. The excess soil from the bulk density core was removed using the sharp rigid spatula. Using the spatula, the soil sample was pushed out into a plastic sealable bag then it was labeled (the procedure was used to collect soil samples from grazed and un-grazed sites). The soil sample inside the plastic bag was mixed thoroughly by kneading it with fingers. The soil sample in its bag was weigh and result entered on the soil data worksheet as W2. The empty plastic bag was also weighed to account for the weight of the bag then enter result into the soil data worksheet as W3. The samples were transported to the laboratory with minimum disturbance. The soil from the plastic bags were placed in weighing tins and weighed. The weight of the wet soil plus tin plus plastic bag were recorded as Wl. The weight of the tins was recorded as W2 and the weight of the plastic bag as W3. These weights (W2 and W3) may be measured before sampling or after drying. The samples were then dried in an oven at 105ºC for 30mins. Then they were removed and cooled for 7hrs. The oven dried samples were weighed as W4.

The formula used to calculate the **bulk density** (Db) was as follows:

$$Db = \frac{W4-W2-W3}{\text{Vol. of bulk density core}} \quad (1)$$

Where:

Db = bulk density

W1 = weight of wet soil plus tin plus plastic bag

W2 = weight of tin

W3 = weight of plastic bag

W4 = oven dry weight of soil plus tin

Soil porosity (%) was computed as follows:

$$SP(\%) = 1 - \frac{Db}{2.65} \times \frac{100}{1} \quad (2)$$

Where:

SP (%) = Percentage soil porosity

Db = Bulk Density

2.65 = Constant (specific gravity)

The data obtained from soil samples collected were subjected to descriptive and inferential statistics. In order to establish significance result for data, a multifactor one – way analysis of variance (ANOVA) was used. ANOVA is a popular statistical technique used to indicate whether a factor (or an independent) variable has a significant effect on a response (dependent) variable. In this study, the response variables were the bulk density, soil porosity, percentage vegetation surface and leave cover, while site (location) and status of the area (grazed or un-grazed) were the independent variables.

V. Results

Effects of Animal Husbandry on Soil Bulk Density

The results obtained from field measurements of bulk density and percentage porosity of grazed (impacted) areas and un-grazed (control) areas were presented in Table 2.

Table 2: Analysis of Average Soil Bulk Density in Zango Kataf L.G.A.

Location	Bulk density Grazed (g/cm^3)				Bulk density Un-Grazed (g/cm^3)			
	$\bar{X}$	Std. Dev.	Var.	Std Error	$\bar{X}$	Std Dev.	Var.	Std Error
Jankasa - Atyap	1.642	.0057	.000	.001809	1.475	.0062	.000	.001961
Kamanton	1.620	.0023	.000	.000731	1.554	.0057	.000	.001814
Kamuru - Ikulu	1.640	.0039	.000	.001258	1.474	.0063	.000	.001996
Abet - Bajju	1.708	.0050	.000	.001590	1.689	.0068	.000	.002154
Overall Average	1.653				1.548			

Source: Field Survey, 2016

Table 2 showed the average bulk density and soil porosity for grazed (impacted) areas and un-grazed (control) areas in the four selected sites in the study area. Based on the USDA (2014) classification of soil bulk density with soil types (Table 1), the results in Table 2 revealed that the overall average soil bulk density for grazed areas (> $1.60g/cm^3$) were high. The implication is that plants growth, and water infiltration in these areas was affected by grazing. In Abet – Bajju, the average bulk density of un-grazed areas X = $1.689g/cm^3$ – which is higher than the other three sites) could be as a result of the lateritic hard pans soils which characterized the soils of that environment.

In order to test the hypothesis which states that animal husbandry has no significant impact on the soil physical properties (bulk density) in Zangon Kataf Local Government Area, a one – way analysis of variance (ANOVA) was conducted for sites and status (Table 3 and Table 4). The results (Table 3) showed that F = 22.505, p = 0.00 and (Table 4) F = 48.209, p = 0.00, indicating that there was significant difference ($p < .05$) in bulk density due to sites (location) and status (grazed and un-grazed), hence the null hypothesis was rejected. The implication is that the bulk density in at least one of the sites (Table 3) differs from the others but ANOVA does not provide a pairwise comparison an additional pos hoc analysis is required to determine where significant variations occurred. The result (Table 4) also implies that there was significant difference in bulk density between grazed and un-grazed areas.

Table 3: ANOVA for Bulk Density (sites)

	Sum of Squares	df	Mean Square	F-value	Significance
Between Groups	.270	3	.09	22.505	.000
Within Groups	.304	76	.004		
Total	.574	79			

Result is significant at p < .05 (.000)

Table 4: ANOVA for Bulk Density (status – Grazed and Un-grazed)

	Sum of Squares	df	Mean Square	F-value	Significance
Between Group	.219	1	.219	48.209	.000
Within Group	.355	78	.005		
Total	.574	79			

Result is significant at p < .05 (.000)

A pairwise Tukey HSD test for multiple comparisons for mean differences in bulk density between sites was carried out to determine where significant variation occurred as presented in Table 5. The result (Table 5) showed that the overall mean difference was significant at p < .05. Furthermore, the mean difference between Jankasa and Kamanton = .028850, p = .477 was not significant at p < .05. Similarly, the results showed no significant differences between Jankasa and Kamanton, between Jankasa and Ikulu, between Kamanton and Ikulu. The similarity in bulk density between these three sites might be attributed to their similarity in soil type and grazing intensities. The results however showed significant difference at p < .05 between Jankasa and Abet, between kamanton and Abet, between Ikulu and Abet (Table 5). The differences in bulk density between Jankasa - Abet, Kamanton – Abet and Ikulu – Abet was also observed to be caused by the lateritic soils found in Abet which are heavier and less porous; it was also attributed to the higher cattle sizes and trampling intensity in Abet compared to the other three sites (Jankasa, Kamanton and Ikulu).

Table 5: Tukey HSD Multiple Comparison for Soil Bulk Density

(I)Sites	(J) Sites	Mean Difference (I-J)	Std Error	Significance
1	2 -.028850	-.028850	.019994	.477
	3 .001300	.001300	.019994	1.000
	4 -.140400*	-.140400*	.019994	.000
2	1 .028850	.028850	.019994	.477
	3 .30150	.30150	.019994	.438
	4 -.111550*	-.111550*	.019994	.000
3	1 -.001300	-.001300	.019994	1.000
	2 -.030150	-.030150	.019994	.438
	4 -.141700*	-.141700*	.019994	.000
4	1 .140400*	.140400*	.019994	.000
	2 .111550*	.111550*	.019994	.000
	3 .141700*	.141700*	.019994	.000

*. The mean difference is significant at p < .05 level.
Note: 1 = Jankasa – Atyap, 2 = Kamanton, 3 = Kamuru – Ikulu and 4 = Abet - Bajju

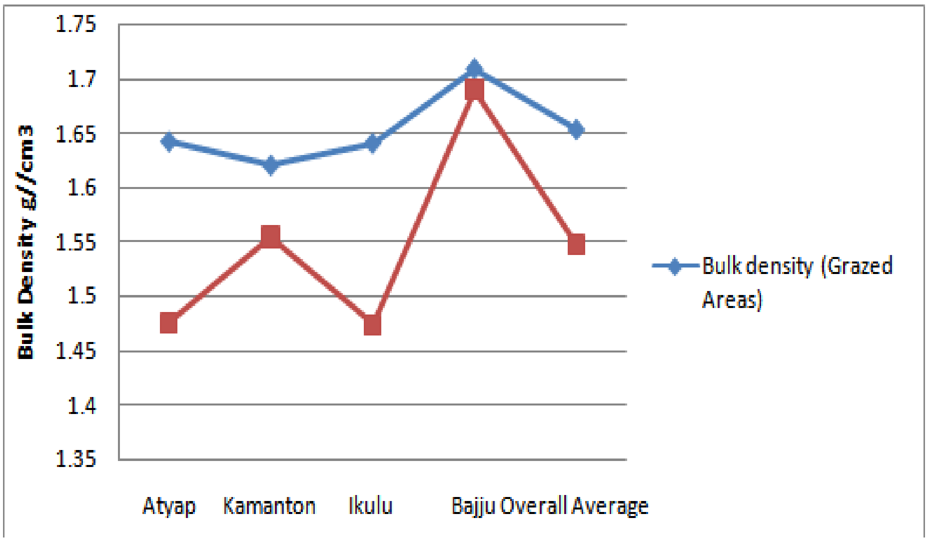

Figure 1: Average Bulk Density (g/cm^3) for the Four Sites.

Effects of Animal Husbandry on Soil Porosity

Table 6 showed that the overall average percentage soil porosity had lower value X = 37.48% in grazed areas compared to un-grazed areas X = 41.63%. The implication of these results is that higher percentage of soil porosity in un-grazed areas implies higher infiltration rates, reduced runoff and better plant growth.

Table 6: Analysis of Average Percentage Soil Porosity in Zango Kataf L.G.A.

Table 6: Analysis of Average Percentage Soil Porosity in Zango Kataf L.G.A.

Location	Soil Porosity Grazed (%)				Soil Porosity Un-Grazed (%)			
	X	Std. Dev.	Var.	Std Error	X	Std Dev.	Var.	Std Error
Jankasa - Atyap	38.02	.2251	.051	.0712	44.39	.2283	.052	.0722
Kamanton	38.96	.3098	.096	.0980	41.34	.2271	.052	.0718
Kamuru – Ikulu	38.07	.1767	.031	.0559	44.41	.2234	.050	.0706
Abet - Bajju	35.64	6.7697	45.829	2.1408	36.36	.3307	.109	.1046
Overall Average	37.48				41.63			

Source: Field Survey, 2016

The hypothesis which states that animal husbandry has no significant impact on the soil physical properties (percentage soil porosity) in Zangon Kataf Local Government Area, was tested using a one – way analysis of variance (ANOVA) for sites and status (Tables 7 and 8). The results (Table 7) showed that F = 7.079, p = 0.00 and (Table 8) F = 21.676, p = 0.00, indicating that there was significant difference ($p < .05$) in soil porosity due to sites (location) and status (grazed and un-grazed), hence the null hypothesis was rejected. The implication is that the soil porosity in at least one of the sites (Table 7) differs from the others. The result (Table 8) also implies that there was significant difference in soil porosity between grazed and un-grazed areas.

Table 7: ANOVA for Percentage Soil Porosity (Sites)

	Sum of Squares	df	Mean Square	F-value	Significance
Between Groups	239.422	3	79.807	7.079	.000
Within Groups	856.807	76	11.274		
Total	1096.230	79			

Result is significant at $p < .05$ (.000)

Table 8: ANOVA for Percentage Soil Porosity (Status – Grazed and Un-grazed)

	Sum of Squares	df	Mean Square	F-value	Significance
Between Group	238.395	1	238.395	21.676	.000
Within Group	857.835	78	10.998		
Total	1096.230	79			

Result is significant at $p < .05$ (.000)

A pos hoc pairwise Tukey HSD analysis for multiple comparisons of mean differences in percentage soil porosity between sites was carried out to establish where significant variation occurred as presented in Table 9. The result showed that the mean difference was significant at $p < .05$. Furthermore, the overall mean difference between Jankasa and Kamanton = 1.0550, $p = .753$ was not significant at $p < .05$. Similarly, the results showed no significant differences between Jankasa and Kamanton, between Jankasa and Ikulu, between Kamanton and Ikulu. The similarity in bulk density was attributed to their similarity in soil type and grazing intensities. The results however showed significant difference at $p < .05$ between Jankasa and Abet, between kamanton and Abet, between Ikulu and Abet (Table 9). The differences in soil porosity in Abet compared to the other three sites was observed to be as a result of the lateritic hardpan soils found in Abet that are heavier and less porous; it could also be as a result of higher cattle density compared to the other three sites.

Table 9: Tukey HSD Multiple Comparison for Percentage Soil Porosity

(I)Sites	(J) Sites	Mean Difference (I-J)	Std Error	Significance
1	2	1.0550	1.0618	.753
	3	-.0350	1.0618	1.000
	4	4.2050*	1.0618	.001
2	1	-1.0550	1.0618	.753
	3	-1.0900	1.0618	.734
	4	3.1500*	1.0618	.021
3	1	.0350	1.0618	1.000
	2	1.0900	1.0618	.734
	4	4.2400*	1.0618	.001
4	1	-4.2050*	1.0618	.001
	2	-3.1500*	1.0618	.021
	3	-4.2400*	1.0618	.001

*. The mean difference is significant at $p < .05$ level.

Note: 1 = Jankasa – Atyap, 2 = Kamanton, 3 = Kamuru – Ikulu and 4 = Abet – Bajju

VI. Discussion

The higher bulk density values recorded in grazed (impacted) areas and low values recorded in un-grazed (control) areas concurred with the findings of Abdel-Magid *et al*. (1987); Mallo (2010) and Redden, (2014) whose findings showed that animals trampling increased soil bulk density and lower infiltration rates. On the other hand, the results of percentage soil porosity reveals higher values in areas un-grazed (control) compared to areas where grazing was taking place (impacted areas). The implication of these results is that grazing cause compaction of soil leading to higher bulk density and lower percentage soil porosity. In these areas (impacted) direct field observations showed that there was evidence of soil erosion due to exposure of soil surfaces. Percentage vegetation surface cover was also low in these areas implying that the top soil was exposed to agents of erosion such as wind and water. The finding also agreed with (Abdel-Magid *et al*. 1987; Redden, 2014). This result however contradicts findings of Savory (2013) who observed that hoof action of animals breakup detritus accumulation and incorporates them into soils in grassland ecosystems of temperate environment. While Savory (2013) findings might be true, the opposite action was observed (Conant and Paustin, 2002) in the tropical environment where the study area is located due to higher temperatures and soil moisture which favour higher decomposition of litter. This results further agreed with findings made by Black (1986), Vallentine (2001) and Redden (2014), that soil with lower relative bulk density tends to have greater soil structure, greater plant – available water capacity, and higher infiltration rates which encourage plant growth. The results of findings on soil bulk density and porosity in the study area revealed detrimental effects of animal rearing on the environment and cattle's grazing was observed to be most responsible for the bulk of this effect

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VII. Conclusions

This study set out to examine the effects of animal husbandry on soil physical properties (bulk density and percentage soil porosity) in Zango Kataf Local Government Area of Kaduna state. The study was based on the assumptions that animal husbandry has no significant impacts on soil physical properties of the study area. Literatures visited reveals that researches have been conducted in many aspects of animal husbandry such as its effects on nutrition, income generation and rural development, impacts on climate change and green house gases emissions, pollution, diseases and management to mention a few.

The purposive random sampling was used in collecting data from the selected sites in the four chiefdoms. The bulk density cores were used in collecting soils samples. A one – way multifactor analysis of variance (ANOVA) approach was used to analyze data. Analysis of results was done using the descriptive statistics such tables, percentages, graphs and inferential statistics using the Social Sciences Statistical Package (SPSS) software.

Results of field measurements on soils reveals statistical differences at $p < .05$ between grazed (impacted) areas and un-grazed (control) areas for bulk density and percentage porosity. Higher bulk density values with lower soil porosity were recorded in areas where grazing is taking place. Areas where grazing is restricted recorded lower soil bulk density and higher soil porosity. Results of the vegetation measurement also reveal statistical differences at $p < .05$ between grazed (impacted) areas and un-grazed (control) areas which reveals that the nature of animal rearing in the study area affects land resources development negatively in the study area. The consolation animal rearers have in the study area is the income realized annually from sales of animals and the use of animal dung in fertilizing their croplands. Based on the findings, the study recommends that rearing of animals be restricted to build enclosures, ranches, and reserves or otherwise controlled to enable effective monitoring, diseases control, tracking and treatment, environmental conservation and elimination of clashes between farmers and animal breeders.

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