EFFECTS OF POSTHARVEST CROP RESIDUES BURNING ON FARMER-HERDERS RELATION AND SOIL NUTRIENTS IN HONG LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA

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BEING A DISSERTATION SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY, FACULTY OF EARTH AND ENVIRONMENTAL SCIENCES, BAYERO UNIVERSITY KANO, IN PARTIAL FULFILMENT OF THE REQUEREMENT FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) DEGREE IN NATURAL RESOURCE MANAGEMENT AND CLIMATE CHANGE

DEPARTMENT OF GEOGRAPHY, FACULTY OF EARTH AND ENVIROMENTAL SCIENCES, BAYERO UNIVERSITY, KANO

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DECLARATION

I hereby declare that this work titled Effects of postharvest crop residue burning on farmers-herders relation and soil nutrients in Hong is the product of my research efforts undertaken under the supervision of Prof. NuratuMuhammed, and has not been presented anywhere for the award of a degree or certificate. All sources have been duly acknowledged.

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CERTIFICATION

This is to certify that the dissertation titled "Effects of postharvest crop residue burning on farmers-herders relation and soil nutrients in Hong" was conducted by Bala Abdu Bello under the supervision of Prof. NuratuMuhammed.

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APPROVAL PAGE

This dissertation by Bala Abdu Bello titled "Effects of postharvest crop residue burning on farmer-herders relations and soil nutrients" has been examined and approved for the award of Master of Science in Natural Resource Management and Climate Change.

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DEDICATION

I dedicate this dissertation to my parents, for their infinite support to the successful completion of this research work.

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ABSTRACT

The study assessed the effects of post-harvest crop residue burning on farmers-herders relations, soil nutrients, and the level of farmers' awareness in Hong Local Government, Adamawa state. Immediate Postharvest crop residue burning has been on the increase among rural farmers and this affects farmer-herders relations, soil quality and environment in general with consequential problems on agricultural production and sustainability. The study was based on primary data, and the data was sourced using structured questionnaire, Focus Group Discussion (FGD), Key Informant Interview (KII) and laboratory test. The data was analyzedusing descriptive statistics of frequency table and percentages using SPSS and excel. Three hundred and eighty four farmers were sampled for the study using Krejcie and Morgan sample determination. The findings of the study revealed that Rice and Maize are the major crop farmed in Hong with about 70%,violence and conflict were found to be the major factors for high increase in crop residue burning (CRB) in Hong as attested by 50% respondents which affects the farmers-herders relations. The relationship between farmers and herders was found to be deteriorated with the of burning crop residues and other factors like blockage of cattle route, drugs abuse, injustice by security and traditional rulers, climate change, population explosion, among others. The study also shows that farmers have fair knowledge on the effect of crop residue burning, but burning still have high percentage with 62% of respondents burned residue on farms, due to lack of law that ban crop residue burning in Hong. It can be concluded that crop residue burning triggers most of the conflicts between farmers and herders in the area, burning also increases soil fertility and reduces grass seedlings in farms, these aid greatly in the perpetuation of the tradition. The study recommends that there should be more enlightenment campaign, awareness and capacity building to strengthen farmers-herders relationship. Also traditional dialogue mechanism, conflict mediation, reconciliation and peace building should be strengthening to improve the relationship. Government should support the group with soft loan and encourage diversified uses of crop residue to reduces the rate of burning for improve livelihood. Law should also establish to ban crop residue burning.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Post harvest crop residue burning become common activities among farmers in Nigeria as a cheap and quick means of clearing farm, weeds, pest, and disease control and means of soil fertility enhancement. Agricultural crop residue burning is the practice of using fire to reduce or dispose of crops and vegetative debris from an agricultural activity, some common practices include field burning of large areas of crop residues after harvest to reduce excess plant material against next cropping in order to maintain crop yields (Cassou, 2018).

Crop residue is what is left of a crop after its value edible, fiber or energy in bio-fuel crops has been harvested, in maize the residue known as Stover consists of leaves, stems and husk; in sugar cane the residue is made up of the leaves, wheat stubble, rice straw and in potatoes most of what grows above ground is considered residue (Meera, 2018). However, it would be a mistake to dismiss crop residue as waste, crop residues can be used for several purposes apart from others economic important of crop residue which include organic soil amendment, fodder for livestock, domestic fuel, green manure and building materials etc. Residue also served as one of most important factors for healthy and productive soil but when burned all those benefits are lost plus others damage may be done (Indian Agricultural Research Institute IARI, 2012).

The benefit of retaining crop residue is far better than burning, Crop residue can provide a protective layer for soil erosion by wind or water, can increase the organic matter and water holding capacity of the soil, and can provide feed and forage for earth worms and others organisms (Clark, 2015). The burning of crop residues is a short-term solution for much larger and longer-term losses, while burning returns some nutrients to the soil and can even result in a burst of fertility in the short run, most of the organic material and nutrient content is lost under high temperatures. Even though, there may be some short-term benefits to burning crop residue, there is a slow and steady reduction in soil health that will eventually result in reduced productivity that cannot be overcome with increased additions of mineral fertilizers.

The effect of crop residue burning extended beyond environment, burning of crop residue affect fodder resource and feeds for animals availability which consequently affect the social-economic and livelihoods of rural farmers, as well as the relations between farmers and others residue resource users. It also decreases interdependency relationship, traditional relationship and mutual trust, which in many cases result to violence and conflict. The relationship between herdsmen and farmers is dynamic, transforming and always evolving from one form to another, always moved between cooperation, competition andconflicts (Moritz, 2010), herders were allowed to graze on farmlands that belong to crop farmers and farmers depend on animal dugs for improving soil fertility (Hussein, 1998). Blench (2010) also analyzed this relationship as an economic exchange of diary product for grains, access to local markets and the provision of manure on arable land while the cattle consume crop residues. However, this relationship turned sour as a result of the scarcity of environmental resources which often brings farmers and herdsmen into competition for the available resources and resultant conflicts which often lead to violence.

Crop residues are primarily used as livestock feed, soil mulching, bio-gas generation, bio-manure/compost, thatching for rural homes, bedding material for animals, mushroom cultivation, biomass energy production, fuel for domestic and industrial use, among others (National Policy for Management of Crop Residue NPMCR, 2014). However, a large portion of crop residue is burnt on-farm primarily to clean the field for sowing the next crop. The on-farm burning of crop residues is intensifying in recent years due to shortage of human labour, high cost of removing the crop residue from the field and mechanized harvesting of crops. The other additional factors behind intentional burning of crop residues are pest and pasture management and soil fertility enhancement (Pathak*et al.,* 2011).

Cereal crops such as maize, rice, sorghum with some commercial crops like sugarcane and oilseed crop (groundnut) generates a considerable amount of residue after harvest. The farming dregs generated are mainly the cereal straws, stubble, woody stems, stalks and leaves, and the likes. A large amount of husk and other biomass is also generated after farm yield process, the potential of cereal crop residues as animal feed is enormous, if all the different types of cereal crops are considered and if appropriate methods of improving their nutritional value are employed. Legume crop residues, such as groundnut haulms, cowpea vines, and cowpea husks have higher crude protein content and are generally used as supplements in addition to the grazing of ranges and cereal crop residues (Singh *et al*., 2003).

On-farm burning is also perceived to boost soil fertility, although burning actually has a differential impact on soil fertility, It increases the short term availability of some nutrients, such as phosphorous (P), potassium (K) and reduces soil acidity, but ultimately leads to a loss of other nutrients like nitrogen (N), sulfur (S) and organic matter, (Richard 2001).Kumar *et al*. (2015) reported that with the crop residue burning practices, pollution has a severe impact on the environment including reduced soil quality, nutrients and reduces water infiltration capacity, enhanced soil erosion, and increased air pollutant and greenhouse gases. Crop residue management is a growing public concern in many countries in Africa, including Nigeria (Abebaw, 2008).

The first goal of any crop residue management system is to maximize the economic benefit from the waste resource and maintain acceptable environmental standards.This research focus on factors causes change in residue management and examines the effects of crop residue burning on farmer-herders relation and soil nutrients.

1.2 Statement of the Research Problem

Crop residue is increasingly being burned across the globe, especially following the cultivation of maize, rice, wheat and sugar cane. Although China, India and USA are the top burners of crop residue, Africa in relative terms is also the region where residue burning is growing the fastest (Meera, 2018). The effects of residue removal on soil properties and environmental quality need to be investigated more vigorously, as it is essential for these effects to be carefully weighed on a site-specific basis when making a determination about residues removal (Kludze*et al*., 2013).The problem of on-farm burning of crop residues is intensifying in recent years due to shortage of human labour, high cost of removing the crop residues by conventional methods and use of combines harvesting of crops. The residues of rice, wheat, cotton, maize, millet, sugarcane and sorghum are typically burnt on-farm across different states of the india (IARI, 2012).

Mamman, and Folorusho (2016) assessed the potential of open burning of agricultural crop residues in Biu. The findings revealed that, an inventory of agricultural practices are not properly carried out, that can provide valuable information on the magnitude of agricultural crop residues generated, quantity of residues disposed by burning as well as the estimated quantity of emissions from harmful pollutants released annually. The field survey and focused group discussion was adopted, it confirmed that farmers still engaged in poor management of agricultural crop residues such as open burning and dumping. It was found that lack of awareness on consequences on human health hazard and environmental pollution is one of the major challenges facing the study area. The study concluded that annual quantity of agricultural cropresidues generated for burning in these communities was estimated to be 381 tonnes.

A study by Ajibo*et al.* 2018 on dynamic of famers-herders relations in Nigerian, found out that there is an emphasis on promoting agriculture in Nigeria as alternative to oil, as a result more people are going into farming likewise livestocks, and this result to competition for available land between farmers and herdsmen. A dimensional problem arises as cattle do graze on the farms of farmers and farmers in retaliation attacks. The finding also shows that Nigeria has experienced a considerable increase in natural resource conflicts since the early 1990s, the competition between farmers and herdsmen, however, has often times turned into serious hostilities and social friction in many parts of Nigeria.

A study by Kwaghe*et al.* (2011) on economic analysis of agricultural waste management among farming households in Jere local government area of Borno State, Nigeria, showed that about 62.5% of respondents generate crop residues while recycling is the major waste management method while other farmers still practice dumping and burning of their farm waste.

An assessment of factors militating against efficient management of crop residue was carried out byAruya and Yusuf (2016) in the Ikara local government area of Kaduna state,the study shows that most of the farming households still engage in inefficient management practices such as open dumping and burning of their agricultural waste. The study further concluded that the management of crop residues appears inefficient given the multiple benefits they could otherwise provide. The findings explained that current management option is not perfect and the existing framework to ensure adequate management system and the collection facilities is not available, crop waste is still collected without separation at the source, treatment facilities are limited and the collected waste is mostly burnt before the next farming season or in most cases dumped haphazardly in open areas.

John (2011) studied agricultural and forestry wastes and their opportunities for use as an Energy Source in Nigeria. The study examined the uses of agricultural residues, their conversion routes and utilization systems. Various agricultural and forestry biomass convertible to energy products were identified. The benefits derived from the use of agricultural forest residues of Gasification, Bio-gasification, Liquefaction, Briquetting Process and Composting were highlighted. The research suggested that all the techniques of conversion discussed could form an agricultural complex utilizing briquettes as a renewable energy source; using anaerobic digestion (biogas) to produce energy and fertilizer. Others arecomposting for soil conditioner, pyrolysis to produce medium grade fuels and chemical preservatives and production of animal fodder through the process of pelletizing. The study concluded that, finding practical and economic uses for the agricultural and forestry residues will create an opportunity to build a bio economy which will deliver sustainable economic growth with job creation and social cohesion as key outcomes.

Ogbodo (2010) and Sidhu*et al.* (2008) find-out that incorporation of crop residues of both rice and wheat cropping system increased the soil organic and total nitrogen contents; Badarinath*et al.* (2006) studied agricultural crop residue burning in the Indo-Gangetic plains using satellite data and demonstrated that residue incorporation leads to a sustained and improved crop yield; Eagle *et al*. (2000) examined nitrogen dynamics and fertilizer use efficiency in rice following straw incorporation and winter flooding and found that field incorporation of residue is more advantageous and beneficial than field burning or removal.

A study carried out by United State Department of AgricultureUSDA (2010) reported that the major challenge for many countries is how to increase agricultural production without degrading the environment. This is a global issue; the study suggested that adoption of environment-friendly intervention and technology in massive food production is necessary, and one of such environment friendly intervention is effective management of crop waste. The study further found that many farmers view the practice of residue utilization for energy regeneration as an extra cost with small returns, and that the best way is to get rid of the residues is a least effort method like dumping, open burning and others (El-Haggar 2004). But the hazards to the environment by such practices can no longer be ignored. This is even more appropriate as a number of agricultural and biomass studies have concluded that it may be appropriate to remove and utilize at least a portion of these residues for energy production, providing a large volume of low cost materials (Fapetu 2000).

Though various studies in the literature have addressed this issue of burning of the crop stubbles, few attentions were paid specifically to theeffects of crop residue burning and the implications on farmers-herders relationsin Hong Local Government Area of Adamawa State. Furthermore there was limited research carried out on effects of postharvest crop residues burning on farmer-herders relations and soil nutrients in study area. Also Hong like any other northern Nigerian society is agrarian where several tonnes of agricultural crop residues are abused and misusedthis affect livelihood of people as well as soil health, especially given the fact that the area is dominated by both farmers and herders . For these reasons, this study intend to filled the gap in knowledge by examinethe effects of postharvest crop residues burning on farmers-herders relations and its effect on soil nutrients.

1.3 Research Questions

1. What are the factors causing change in crop residuemanagement?

2. How crop residue management affect farmers-herders relations?

3. What is the effect of crop residue burning on soil nutrients?

4. What is the level of farmer's awareness on the effect of crop residue burning in the study area?

1.4 Aim and Objective of the Study

The aim of the study is to assess the effects of crop residue burning on farmers-herders relations and soil nutrients in Hong Local Government Area with a view to suggest problem solving solutions in order for improve farmers-herders relations for sustainable agricultural practice, livelihood and environment. The specific objectives of the study are to:

i. Identify the factor that causes change in crop residue management in the study area.
ii. Examine the effect of crop residue management on farmer-herders relations.
iii. Evaluate the effect of crop residue burning on soil nutrients.
iv. Ascertain the level of farmer's awareness on the effects of crop residue burning in the study area.

1.5 Justification for the Study

Crop residue is increasingly being burned in Hong Local Government Area, as a result of high increase in production of cereals crops among farmers, high increase tension between farmers and herders among others. Crop residue is been used for various purposes which include feed/fodder for cattle, fuel for domestic and industrial use, construction, biomass energy production, soil amendment among others. But large quantity of these resource is been misused by farmers by burning as the easier means of farm clearance and soil fertility enhancement among others which consequently affects livelihood of farmers as well as the relationship between farmers and other residue resource users. The practice of burning residue decrease interdependent relationship between farmer and herders for the exchange of residue and manure, grain and dairy among others. The relationship between these two groups of resource users to be initially symbiotic that usually promotes interdependence and reciprocity (Moritz, 2010)

Conflict and violence is on the increase in the region, destructions of crop farmland as a result of competition over resources which lead to loss of life's and properties, displacement of people and destruction of trade between the groups. The destruction has direct impact on the peoples' livelihood as their economic activities are tied to these environmental resources (Bello, 2013). Others include on farm grazing, reprisal attack among others. Blench (2004) also reported that Farmer-pastoralist conflicts have been associated with the conflict of land resource use exacerbated by dwindling resources, environmental factors and exploitation of scarce resources leads to conflict and violence.

The symbiotic and cordial relation between the two groups is declining; air pollution is on increase with affect on human health and environment through increase greenhouse gases(GHG)emission among others, soil quality is been depleted. Burning of crop residues lead to release of soot particles and smoke causing human health problems; emission of (GHGs) cause global warming; loss of plant nutrients such as nitrogen (N), phosphorous (P), potassium (K) and sulphur (S) which lead to adverse impacts on soil properties and wastage of valuable carbon (C) and energy rich residues (Pandey*et al.,* 2006).These gases increase the atmospheric temperature which, affect to the worldwide environment (Satyendra 2015). Agricultural biomass continues to gain attention as a source of alternative energy, given its potential ability to offset fossil fuels and reduce CO2 emissions, while simultaneously providing an added source of income to farmers (Kludze*et al*., 2013).

The large quantities of crop residues produced in Nigeria can play a significant role in meeting its energy demand. Most of these residues are biomass, which contains enormous amounts of energy. However, it is unfortunate that these residues are neither utilized efficiently nor properly managed effectively in all developing countries, including Nigeria (Jekayinfa, 2005). The prevailing practice is usually to burn this waste or leave it to decompose. These necessitate the need to identify the factors responsible for this postharvest crop residue burning and to assess the implication on livelihood for sustainable environment and for maintenance of peace between pastoralist and farming communities.

1.6 Significance of the Study

Burning of postharvest crop residues is a phenomenon that impact negatively on environment and livelihood that needs to be mitigated. The findings of this research should expose and throw more light to farmers and larger societies of diversified economic options available for effective and efficient crop residue management, that can improve agricultural productions, expand economy and strengthen the relations between various crop residues resource users by reducing the conflicts between the groups. The findings would also add knowledge and awareness to farmers about the effects of burning crop residues by suggesting alternative ways for improving soil quality for effective, profitable and sustainable agriculture.

The findings of the study will recommends policy guide and reference document for Stakeholders, Government, Civil Societies and other private sector for developing crop residues management policy on preventing and monitoring of crop residue. The study will explore more area for further research on crop residue utilization and management for increase academic knowledge.

1.7 Scope and Limitation of the Study

The study covered all the seven (7) districts of Hong LGA, namely; Pella, Gaya, Uba, Dugwaba, Kulinyi, Hildi and Hong. For this study, farmers-herders relations and soil nutrients effects of postharvest crop residuesare examined with the specific focus on the effects on farmers-herders relations, and also the factors that causes change crop residue management. The study further evaluates the effects of residues burning on soil nutrients and the level of farmers' awareness concerning the consequences of residue burning on their livelihood. The studyhas one year completed period.

The study was limited to the effects on soil Nitrogen, Phosphorus, Potassium (N. P. K) for Maize and Rice farm plots at depth of 0-10cm. And it was for the period of one season. Further research may be conducted on the effects on soil structure and texture at a different depth

1.8 THE STUDY AREA

1.8.1 Brief History of the Study Area

Hong Local Government Area occupy a region that is generally hilly with highlands ranging from 426 to 1158m above mean sea level and people depends on highland features such as caves and water for existence (Gandapa, 2016). The highlands have diverse attributes such as presence of settlement sites, caves, perennial water points, observation post and niches that are used for defense and sustenance. The people attach predominant socio-economic and traditional activities to some observable locations on the highlands that enabled them to withstand undesirable circumstances (Gandapa, 2016). The present Hong was said to have originated or taken his historical roots from Hong Krama a place on top of the Hong Mountains and surrounded by mountains precisely 3.5km from Hong town center. The reason for inhabiting the mountain from the ancestral record is for defense purpose and from conflict and external aggression and invasion from the Fulani and other neighboring invasion tribes and clan (Adamawa state in map, 1998).

Apart from the security reason, for refuge on top of the mountains, yet certain limitation become eminent which one could attribute to the first law of survival. Among agrarian society, which must farm to keep life sustainable, such reason now necessitates coming down to farm at the foot of the mountains on the plains areas. This eventually led to relocation from their original settlement to tsohonGari. In any case as socialization and civilization increased with time and space, inter-marriages set in, and the fission of culture and diverse ethnicity set in as well, which eventually now became nucleation of diverse group coming together to live as one (Adebayo, 1999).

1.8.2 Location and Extent

Hong is located at latitude $09^{0}57'$ and $10^{0}32'$N and between longitudes $12^{0}38'$ and $13^{0}16'$E as shown on Figure 1, is situatedin the north central part of Adamawa state, It has 12 political wards that are subdivided into two State Constituencies, with each having six wards. Hong Constituency comprises Bangshika ward, Daksiri ward, Hong ward, Husherizum ward, Shangui ward and Thilbang ward. Uba/Gaya Constituency comprises Garaha ward, Gaya ward, Hildi ward, Kwarhi ward, Mayo-lope ward and Uba ward. Hong is bounded by Borno state to the

North and five (5) other local government areas of the state which include Mubi North, Mubi South and Maiha to the East, Gombi to the West and Song local government area to the South. Hong Local Government has a total land area of about 2,376.66km^2 (National Population Commission, 2006).

1.8.3 Climate

Hong has a tropical climate marked by the dry and raining season. The raining season commence the April and end October. The average rainfall for Hong town is 759mm (Gandapa, 2014). The dry season starts in November and ends in April respectively. This is the period of harmattan the period where the dust ladders north easterly trade wind from the Sahara deserts has a marked effect on the climate of the area. The mean annual rainfall pattern shows that the amounts range from 700mm to 1000mm (Adebayo, 1999). The temperature characteristic in the area is typical of the West African Savannah climate characterized by high temperature almost throughout the year due to high solar radiation which is relatively evenly distributed throughout the year. Maximum temperature can reach 40^{0}C particularly April, while minimum temperature can be as low as 18^{0}C between December and January. Mean monthly temperature ranges from 26.7^{0}C to 27.8^{0}C (Adebayo, 1999).

This long duration of raining season gives the farmers opportunity to cultivate difference variety of crop, around November to April the pasture available for herders to graze are no longer available which gives herders no option than to depend on crop residue for their herds, and these generate more tension because at that time farmers are busy harvesting.

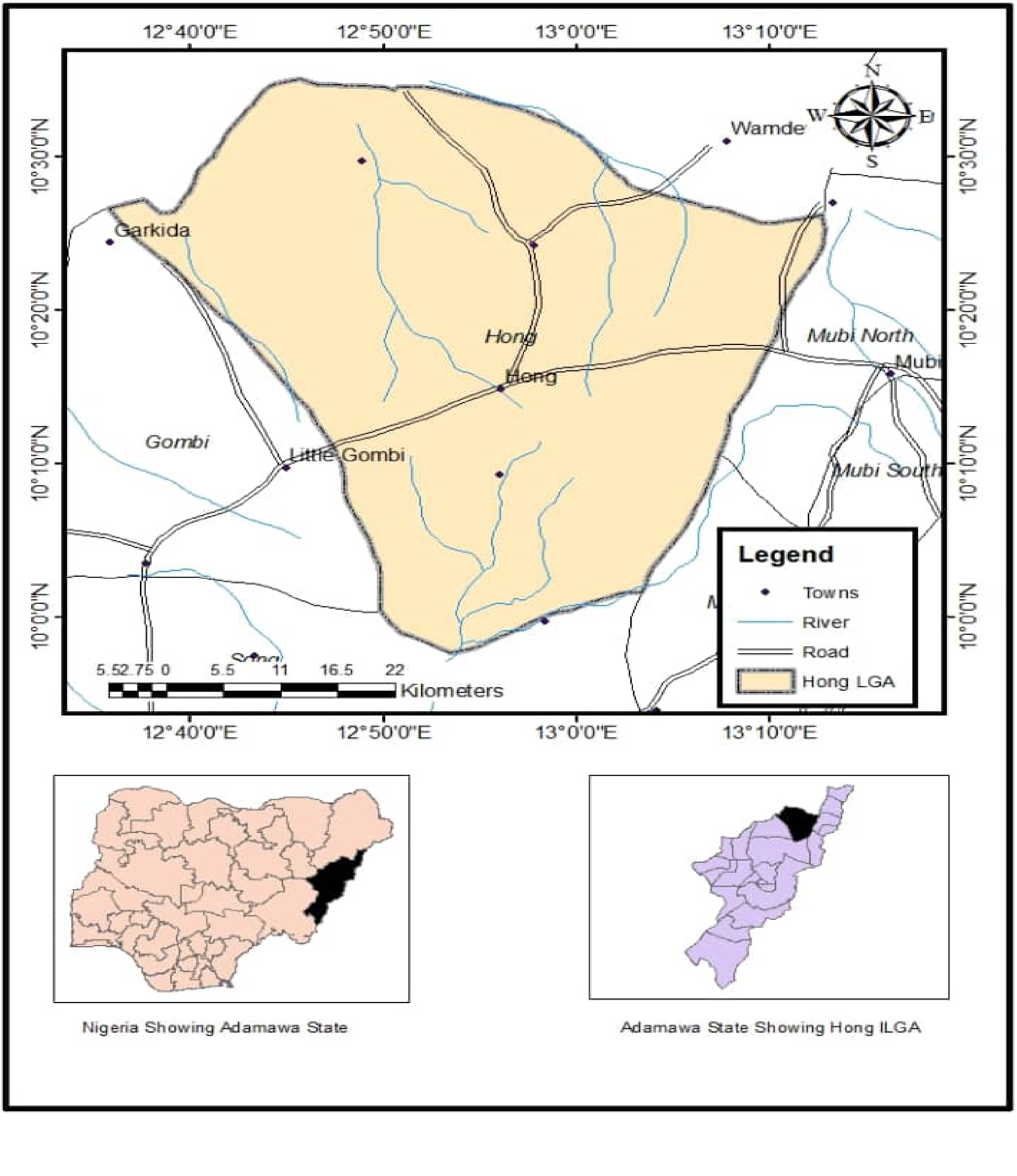

Fig. 1.1: Map of Hong Local Government Area.
Sourec: GIS Lab, Geography Department BUK.

1.8.4 Topography

The dominant relief feature around Hong are the ranges of hills at the foot of which the town lies, the rise to a height of 150-200 meters above the surrounding plain and water shed from numerous stream in to the direction of kwamgwadla stream which flows from east-west (Garkida, Nigeria, sheet, 155). The area for scattered inselberges at the east side of the hills towards Fadama Rake, ranges of hills at the west in Falwainselbergs about 3km away from the town. (Adebayo, 1999).The landscape of the area consists of high plains dominated by compacted residual hills such as Tholbang, Kiratho, Kakahi and Motuchi;and isolated domes of various heights and sizes such as Kingking, Hizza and Duva. The reliefs portray different forms such as long and narrow range of hills such as Hizza, Tholbang, Kulinyi and Motuchi to broad and compacted hills of Shangu'i, Kakahi, Lum, Kiratho and Dlam. Duva,Bashikibi, Kinging and Bubulum among others form the conical hills that are isolated and show higher points above the surrounding flat surfaces. Kukurpu on the other hand is a pile of large granitic boulders. There are stretches of lower surfaces such as Dungkula, Duduku, Gang-Mulia and BabalFida between Motuchi, Jagwatu and Gabadzil hills. The highlands serve as catchment for streams and rivers such as Fa'a, Bubulum, Ngilang among others that are in a dendritic pattern (Garkida, Nigeria, Sheet 155).

1.8.5 Geology and Soil

The basic geology in Hong town include Basement complex and old Granite. Hong being located in the area carried by basement complex the next category of rock type consist of mainly Granite (Garkida, Nigeria, sheet, 155). Rivers are seasonal owing the low annual rainfall. Hong environ are drained by kilanye and shashau river and others river are fa'abubulum, Ngilang, Dogwabaare and Dilputu river which are seasonal, all the rivers get their source from mountain flow down to West from East which lead to the formation of forest. The dominant soil groups in the area are luvisols, regosols, cambisols, vertisols and lithosols derived from basement complex, while few other places are on sandstones, shales and alluvium (Adebayo, 1999).The soil of Hong favour arable farming of crops such as groundnuts, guinea corn, maize, rice, beans and sugarcane (Garkida, Nigeria, sheet 155).

1.8.6 Vegetation

The vegetation in the area of study is wooden savannah land, the grass are tall growing about 4m in height it appears green and fresh in rainy season- in the dry season turns brown and it appears in scattered parches. The common tree species include cultivated mango guava, gum and wild, locust bean tree and shear-butter. And some indigenous species of AdansonaniaDigitata (Baobab), AnogeissusLeiocarpus (African Birch), Combretumspp, BalanitesAegyptiaca (aduwa), TamarindusIndica, Terminaliaspp among others, and abundant grass species are cenchrus species. Shrubs plants like AnnonaSenegalensis (wild apple), SenaSiamea (Siamese cassia) are in abundant. The Sudan region has the greatest human influence on vegetation because of the joint effects of human activities such as bush burning, tree felling, arable farming and pastoralism that lead to varied land cover (Mohammed, 2009).

1.8.7 Population and Land-Use

According to the census conducted in 2006 by National Population Commission, the population of Hong Local Government stands at about 169,183 people with 83,736 males and 85,447 females. The population has been projected to be 183,957 people in 2009, 213,360 people in 2014, and 218,268 people in 2015 and projected 223,176 people in 2016. The population of

Hong has witnessed change over time as it is in other places. The 1999 projected population was about 139, 990 persons and this have risen steadily (Bashir and Raji, 1999). Distribution of population follows the pattern of settlements distribution which are fairly scattered across the local government area. There are concentrations of people in the larger settlements of Uba, Mararraba, Bangshika, Gashaka, Gashala, Uding, Garaha, Hong, Pella and Kala'a among others (Hananiya, 2003).

Gandapa (2014) stated that the reasons for the increase in agricultural land, bare surface and built-up area is due to increase in population from 112,845 in 1976 to 170,542 in 2009, manifested by rise in diverse human activities such as arable farming; construction of road networks and shelters at the detriment of vegetation cover that decreased by 19.79%. This Increased in population raised the density from 45 persons per km to 69 while the land per capita decreased from 2.2 to 1.9 hectares. Agricultural land use also increase by 11.58% from 29.65% to 41.23%, there is need to produce more food to feed family members, considering about 60% of the people practice arable farming. built-up area has also increased to 1.61% from 0.36% due to increase in population manifested by increase in settlements sizes. Settlements like Gaya, Gashala, Hong, Pella, Uding, Bangshika, and Zhedinyi on the have expanded, while vegetation cover also decreased from 66.85% to 47.06 in 2009 (NPC, 2010).

1.8.8 Settlement Structure

The type of settlement in the study area exhibits a linear settlement pattern along Yola-Mubi trunk 'A' road located at the foot of a hill (Adebayo 1999). The indigene-ship among Hong (the Kilbas) coincides with the highlands on which people were living. The pre-colonial settlements were on the prominent highlands, but later on descended to the pediments. Thus, the names of most contemporary settlements have their origins from the highlands. However, on the pediments there are indiscriminate migration and diverse mixing leading to the abandon and adulteration of cultures and traditions.

Settlement site is the most important use of the highlands, the earlier settlements among the Kilbas are Bashikibi, Gaya, Kinging, Krama Hong, Mijili, Kulinyi, Mukahui, Tholbang and Uding among others were confined to some selected prominent hills. These hills (Duva, Krama Hong, Kulinyi, Kwagu, Motuchi, Mukahui, Tholbang and Zum) were found more convenient for establishment of settlements because they have desirable security features such as caves, relatively inaccessible height and high sentry post. Other features include well drained surfaces, and have pools which are reliable sources of water. The hills support socio-economic and traditional activities than the pediment because of their elevation, have rugged surfaces, relatively inaccessible (Gadanpa 2016). The caves (*thol*) have certain security features that attracted people; it was served as room a hide-out for women and children at any time of tribal wars and wild live attack. Serving as a room to Totem (*mutu*) a specific wild animal that is initiated to human being traditionally by synthesis. Gudumbul (2006) stated that totem (*mutu*) is a secret mystic relationship with certain wild animals by means of magical rites, thus, the person and the animal became so identified that each is the alter ego of the other.

1.8.9 The People and Culture

The Kilba people are unique for their rich culture and traditional uses of life which persuade their entire social political and economic co-existence with a positive inclination towards development. Majority of Kilba people are farmers, however some practice crafts and blacksmith in combination with farming, which implies they do multiple occupations. Hong is consider as the only local government in the state with Kilba people being a majority, the major ethnic group of the inhabitants is Kilba, while Margi, Higgi, Bura, Fulani and Hausa are very few in number. The major economic activity in the area is crop farming i.e food crops like maize, rice, sorghum and cassava, while cash crops such as groundnuts, cowpea and sugar cane are produced in large quantities. Some Livestock reared in the area are cattle, sheep, pigs and goats.

CHAPTER TWO

CONCEPTUALFRAMEWORK, THEORETICAL ORIENTATION AND LITERATURE REVIEW

2.1. INTRODUCTION

This chapter reviews the relevant literature on crop residues management, utilization, crop residue and farmers-herders relation and soil nutrients effects, reviews also literature on level of farmers awareness about the effects. The conceptual and theoretical framework relates to crop residue burning and its effect also deal with in this chapter.

2.2 CONCEPTUAL FRAMEWORK

2.2.1 Concept of Agricultural Crop Residues

Agricultural crop residues include both field and processing residues. Field residues consist of materials such as stalks and stubble (stems), leaves, and seed pods, left in the agricultural field after crop harvesting. Processing residues, including husks, seeds, bagasse and roots, are the materials left after the processing of the crop into a usable resource. Harvesting of cereals, vegetables, and fruits generates huge amounts of crop residues (Pandey et al., 2000). Residues are the biomass left in the field after harvesting of the economic components i.e. grain. Large quantities of crop residues are generated every year, in the form of cereal straws, woody stalks, and sugarcane leaves/tops during harvest periods. Processing of farm produce through milling also produces large amount of residues. These residues are used as animal feed, thatching for rural homes, residential cooking fuel and industrial fuel (Niveta*et al.* 2014)

Naturally, crop residue supplies vary according to agro-ecological zone and crop type. Arid and semi-arid zones thus have more cereal and legume residues than wetlands, where roots and tubers thrive. Most importantly, as a whole, despite some variations across countries, cereal residues supplies have increased significantly over the past five years, with a preponderance of sorghum and millet, while legumes and root and tubers peel supplies are significantly less. However, cereal residues supplies per animal are declining, while those of legumes are increasing. The main constraints to the use of these residues are technical in the sense that well-known technologies designed to improve their nutritional value are still not commonly applied in West Africa (FAO 2014)

The crop residues generated due to agricultural activities are exploited by several countries in different ways. They are utilized in processed or unprocessed form, depending on the end use. The possible options include its use as animal feed, composting, production of bio-energy and deployment in other extended agricultural activities such as mushroom cultivation (Hayashi *et al*. 2014). Crop residues are materials left on cultivated land after the crop has been harvested. Retention of crop residues after harvesting is considered to be an effective anti-erosion measure. Crop residues can improve soil structure, increase organic matter content in the soil, reduce evaporation, and help fix CO_2 in the soil (Clark 2015).

2.2.2 Concept of Crop Residue Burning

After harvesting, the crop residues are burnt in situ by the farmers to speed up the crop rotation. This burning of residues also releases nutrients for the next growing season as the ashes of crop straw contains potassium (Gangwar*et al*., 2006 and Yang *et al*., 2006). Therefore, the burning of crop residue adds to the fertility of the soil because of the high mineral contents of the ashes.

This also controls insects, diseases, and the emergence of invasive weed species. However, Gupta *et al*. (2004) pointed out that residue burning causes nutrient and resource loss and adversely affects soil properties. Jitendra*et al*. (2017), reported that 80% of the crop residue burning took place during the post-harvest period of April-May and November-December. The reason behind this is attributed to the crop patterns used to ensure higher economic returns which leave limited time between two consecutive crop cultivations. Some farmers even resort to a cycle of three crops a year with a short gap between harvesting and sowing.

Clark (2015) reported that for several decades' farmers have burned stubble, crop residues and rangelands as an inexpensive and effective way of controlling weeds, insects, diseases and excess crop residues. Prescribed burnings can also help prevent catastrophic fires by reducing fuel loads. Ease of tillage, seeding and other field operations can be enhanced by burning excess crop residue.

According to Bhattacharya *et al*. (2017) farmers burning Crop residue as convenient way to get rid of the residue, because of narrow window between the wet season harvest and the dry season cropping, that force the farmers to burn the residues to vacate the fields. However, because of increased mechanization, particularly the use of combine harvesters, declining numbers of livestocks, long period required for composting and unavailability of alternative economically viable solutions, farmers are compelled to burn the residues in India (IARI 2012). Burning crop residues is usually done in an attempt to obtain a seedbed that is easy to work, to minimize impediment to the growth of a new crop, to reduce diseases where crop residues serve as a host for pathogens, and to control weeds and insects (Smil 1999).

2.2.3 Concept Soil Nutrients and Crop Residues

Plant essential nutrients are required for profitable and sustainable agricultural production. An insufficient amount of any essential nutrient will lead to poor crop or pasture growth and limit production, reducing profit for growers. Residue addition to soil in conventional or conservation tillage systems may also have positive effects on organic matter level and quality in soil (Alvarez 2005). Moreover, the effects of residue return to soil and associated tillage on soil physical, chemical and biological properties occur concurrently and hence are difficult to separate from each other (Chan *et al*. 2003).

A single straw burn resulted in immediate decreases in fungal and bacterial densities of 95% and 70%, respectively, in the top 1 cm of soil, but there was no effect of burning on microflora at a depth of 1–4 cm (Biederbeck et al. 1980), Long-term burning reduces total nitrogen and carbon, and potentially mineralized nitrogen in the 0-15 cm soil layer. About 25% of N and P, 50% of S and 75% of K uptake by cereal crops are retained in crop residues, making them viable nutrient sources (Singh 2003). Therefore crop residues are a good source of plant nutrients and are important components for the stability of the agricultural ecosystem. However the burning of crop residues may lead to considerable nutrient loss. Despite the obvious economic and practical benefits of the burning of crop residues, the environmental and health impact of this activity remains uncertain (Hays *et al*., 2005).

Crop residues are good sources of plant nutrients and are important components for the stability of agricultural ecosystems. Farmers were being benefited through improving soil health, reducing fertilizer use, saving irrigation water, decreasing soil erosion, enhancing crop productivity, etc. Rice residue burning results in extensive impacts both on and off farm, e.g., losses in soil nutrients, soil organic matter, production and productivity, air quality, biodiversity, water, energy efficiency, human health and animal health (Kumar *et al*. 2015). One of the recognized threats to the rice-wheat cropping system sustainability is the loss of soil organic matter as a result of burning. The straw collected from the fields is of great economic value as livestock feed, fuel and industrial raw material.

2.2.4 Concept of Resource Conflict

Conflict arises whenever individuals have different values, opinions, needs, interests and are unable to find a middle way.Conflict is defined as a clash between individuals arising out of a difference in thought process, attitudes, understanding, interests, requirements and even sometimes perceptions. A conflict results in heated arguments, physical abuses and definitely loss of peace and harmony. A conflict can actually change relationships (Prachi 2015).

Conflict is the result of disagreement between actors on the basis of perceived incompatible goals. Conflicts are often analysed at different levels, interpersonal, group/community and national and in terms of how the levels interact with each other. They can turn into violent conflict when 'there are inadequate channels for dialogue and disagreement (Fisher *et al*., 2000). Conflicts can be of many types like verbal conflict, religious conflict, emotional conflict, social conflict, personal conflict, organizational conflict, community conflict and so on.

According to De Haan (2002), destruction of crops by cattle and other property (irrigation equipment and infrastructure) by the pastoralists themselves are the main direct causes for conflicts cited by the farmers, whereas burning of rangelands and fadama and blockage of stock routes and water points by crop encroachment are important direct reasons cited by the pastoralists. Also noted that antagonistic perceptions and beliefs among farmers and herdsmen could compound conflict situation, especially due to failing institutions and fierce competition for resources.

2.3 THEORETICAL ORIENTATION

The study anchored on frustration-aggression theory and conflict theory, because the theory is relevant and best explain the phenomenon that lead to high rate of immediate burning of crop residues, which affect and decrease interdependency relations by increase tensions and escalate conflict between farmers and herders in Hong.

2.3.1 Frustration-Aggression Theory

The theory of frustration–aggression was originally formulated by Dollard, Doob, Miller, Mowrer, and Sears (1939) stated that the occurrence of aggressive behavior always presupposes the existence of frustration, and contrariwise, that the existence of frustration always leads to some form of aggression. They first equated aggression with the desire to hurt or injure others and or as interference with a goal response. Interference was felt to be through punishment or goal inaccessibility, further confusing frustration as blockage with frustration as deprivation. With regard to the intensity of the aggression, Dollard *et al*. (1939) put forth the suggestion that the strongest aggressive reactions are those directed toward the perceived sources of the frustration. Aggression toward the source of the frustration is one type of retaliatory behavior (Zillmann& Cantor, 1976). However, the aggressive response to a frustration can also be directed toward individuals not responsible for the interference with the attainment of a goal (Geen, 1968). This is one of the cases in which the type of aggression is commonly described as displaced. The hypothesis further expanded by Berkowitz (1989) suggesting that negative effect and personal attribution play a major role in whether frustration instigates aggression behavior. Naturally, it also matters how much the frustration actually interferes with the attainment of the desired outcome. Berkowitz (1989) emphasized that competitive encounters are at least partly frustrating as the contestants block each other's attempts to reach the disputed goal and threaten each other with a total loss. While this mainly applies to zero-sum games, in which the victory or gain of one party implies the loss of the other, it can also result from multiple parties with different goals competing over shared or limited resources.

Gregory Bateson observed the frustration aggression hypothesis under culture angel. According to him, culture was implicitly involved in the hypothesis itself as it was dealing with human behavior which is always formed and influenced by the environment be it social or cultural. Ted Gurr (1970) argues that, both on an individual and at societal level, the repeated and prolonged experience of frustrations can lead to an outburst of aggression and violence. On the societal level, such frustrations can be characterized by severe economic recessions, a lack of or restricted access to resources, or systematic and/or institutional discrimination against certain groups. Ted Gurr's (1970) pointed out that we must understand relative deprivation as creating the potential for collective violence. This is because relative deprivation is a frustration that leads to aggression. Thus initially we have the assumption that relative deprivation causes frustration.

The intensity and scope of the frustration in turn lead to the potential for collective violence. The goal of every farmer during planting season is to have bountiful harvest, then sell the farm produce and make profits. On the other hand, the herdsmen would always want to have well fed and healthy cattle and be able to make profits as well. When any of these expectations was not realizable, either by the herd (cattle) eating up and destroying the farmers' crops or that the farmer encroached on grazing reserves or use water reserved for cattle to irrigate their farms, aggression would be triggered. Either of the parties that felt frustrated to achieving their economic goals may decide to reprise as to show their displeasure and as a result conflict will occur. (Oli*et al*. 2018).

In application to this study, is that the aim of each group is to secure its livelihood to maximize profits any move to block or interference cause frustration and consequences to aggression. Either by farmers blocked the route for cattle or use water reserve for cattle to irrigate farms or herders' herds graze or destroying farmers' crops aggression would be triggered. Some farmers' burn crop residue out of anger to deprive herders' herds fodder for destruction of their farms, and this frustrate herders, increase farm destructions of burning the crops or graze on crop farm, thereby increase tension and escalate conflict.

2.3.2 Conflict Theory

The lead proponent of this theory is Karl Marx (1818-1883). He was a victim of marginalization due to his revolutionary ideas and the misery of his alienation was seen through his two radical most famous works: Marx's conflict ideology is an analysis of inequality under capitalism and how to change it through confrontation (Ritzer&Stepnisky, 2014). They argued that in capitalism, there is an inherent conflict of interests between two opposing classes. Triggs*et.al* (1997) submits that the most basic cause of the conflict between two groups is usually over access to material resources. However, the basic tenet of the theory is that two opposing groups in the society always struggle for limited or scarce resources. Each group struggles to attain or acquire more resources and because they are scarce, struggle ensues between them. Every group tries to protect its own interest, thus blocking the progress of another in accessing that (Idowu, 2017).

The land resources (such as farm lands, crops, grass/pasture, fresh water etc.) are scarce in Nigeria and needed by both farmers and herdsmen for sustenance of their various sources of livelihood. Conflict, however, would not only occur between herders and farmers as both strive with another in pursuit of these resources; but as either of the groups tries to intrude or exploit another's already secured and long acquired resources.

2.4 LITERATURE REVIEW

2.4.1The Uses of Crop Residue

The utilization of crop residues varies across different states of the country. Traditionally crop residues have numerous competing uses such as animal feed, fuel, roof thatching, packaging and composting. The residues of cereal crops are mainly used as cattle feed;rice straw and husk are used as domestic fuel or in boilers for parboiling rice. Farmers use crop residues either themselves or sell it to landless households or intermediaries, who further sell them to industries (IARI, 2012). The crop residues generated due to agricultural activities are exploited by several countries in different ways. They are utilized in processed or unprocessed form, depending on the end use; the possible options include its use as animal feed, composting, production of bio-energy and deployment in other extended agricultural activities such as mushroom cultivation (Monfort, 2013). According to Lohan*et al*. (2018) many countries such as China, Indonesia, Nepal, Thailand, Malaysia, Japan, Nigeria and Philippines utilize their crop residues to generate bio energy and compost.

According to McKendry (2002), Crops residues include remnants obtained during harvesting and crop processing waste. With advances in biotechnology and bioengineering, some resources, which could have been classified as waste, now form the basis for energy production it is estimated that, Nigeria has about 71.2 million hectares of available agricultural land, out of which about 36 million hectares of land are being currently utilized for agricultural production. The large quantities of crop residues produced in Nigeria can play a significant role in meeting its energy demand. Most of these residues are biomass, which contains enormous amounts of energy (Fapetu, 2000). However, it is unfortunate that these residues are neither utilized efficiently nor properly managed effectively in all developing countries, including Nigeria (Jekayinfa, and Omisakin, 2005).

Waste from the agricultural industry can be beneficially utilized in various agro-based applications and other industrial processing. However, the cost of collection, processing and transportation can be much higher than the revenue from the beneficial use of such waste. Crop residues are an important constituent of agriculturalwaste that can actually be used for the benefit of the society due to its organic composition. The otherimportant reason is that the volume of crop residue, with unsustainable management practices createshigh adverse environmental impacts (Ross 2018).

Globally, rice is the most consumed food. Thus, rice is grown in large areas and generates a huge amount of residue in the form of straw. In Asia, a large amount of rice straw undergoes field burning (NPMCR, 2014). Kim and Dale (2004) reported that 668 tonnes of rice residues have the potential to generate 708.7 liters of bio ethanol. Therefore, the burning of rice straw results in virtually complete loss of potential energy from bio-ethanol. With increased fuel prices, frequency of weather fluctuation (or debate on climate change), air pollution and greenhouse gases, there is considerable interest among researchers for alternative uses of field-based residues for energy applications (Kumar *et al*. 2015). The crop residues of cereals may be left in the field as grazing material for livestock. They may be used as mulch, transported to the homestead for stall feeding, used as fencing, building, or roofing materials, or as fuel. The legumes on the other hand could be harvested and conserved either for dry-season feeding for the farmers' animals or for sale to other farmers during the critical period of feed scarcity in the mid-to-late dry season (Singh and Tarawali, 1997).

Crop residues are primarily used as bedding material for animals, livestock feed, soil mulching, bio-gas generation, bio-manure/compost, thatching for rural homes, mushroom cultivation, biomass energy production, fuel for domestic and industrial use, etc. However, a large portion of crop residue is burnt on-farm primarily to clean the field for sowing the next crop (NPMCR, 2019). The problem of on-farm burning of crop residues is intensifying in recent years due to shortage of human labour, high cost of removing the crop residue from the field and mechanized harvesting of crops (NPMCR 2019). According to Sabiiti, (2005), the by-products of agricultural activities are usually referred to as agricultural waste because they are not the primary products. Agricultural wastes are widely available, renewable and virtually free, hence they can be an important resource. Crop residues comprise straws and stovers obtained after harvesting the crops; it can be converted into heat, steam, charcoal, methanol, ethanol, bio diesel as well as raw materials (animal feed, composting, energy, and biogas construction). Crop residues are the major resource for feeding of livestock in Nigeria.

2.4.2 The Impact of Crop Residue on Soil Properties

Retaining instead of burning residues provides several potential benefits (Hartemink, 2008 andRayment, 2003) such as improving soil physical, chemical and biological properties, and reducing fertilizer requirements through recycling nutrients in the residues, sequestering Carbon etc. Successful integration of crop residue management strategies into cropping systems requires understanding of how crop residues influence cycling of nutrients from soil and fertilizers, as well as their effects on soil chemical, physical and biological properties, and crop production (Malhi*et al*., 2006).

The residue burning increases the temperature of the soil to a significant extent, which results in rapid changes in the carbon–nitrogen (C– N) equilibrium in the upper 3 inches of soil (Gupta *et.al*, 2004). The carbon is emitted to the atmosphere in the form of CO2, and nitrogen is converted to nitrate. Wang *et al*. (2010) observed the relations between fungal hyphae and cellulosic organic matter both increased the aggregation and aggregate stability in soil. Gupta *et al*. (2004), reported that farm residue burning elevated the soil temperature up to 33.8– 42.2◦C, up to a depth of 1 centimeter (cm), which affects soil ecology. Thus, because of the elevated soil temperature, about 23–73% of the nitrogen in various forms is removed from the soil, and the beneficial microbial population also declines to the depth of 2.5 cm in the soil. It is estimated that burning of one tonne of rice straw accounts for loss of 5.5 kg Nitrogen, 2.3 kg phosphorus, 25 kg potassium and 1.2 kg sulphur besides, organic carbon (NPMCR, 2019). Generally crop residues of different crops contain 80% of Nitrogen (N), 25% of Phosphorus (P), 50% of Sulphur (S) and 20% of Potassium (K) (NPMCR, 2014). If the crop residue is incorporated or retained in the soil itself, it gets enriched, particularly with organic C and N. Heat from burning residues elevates soil temperature causing death of beneficial soil organisms. Frequent residue burning leads to complete loss of microbial population and reduces level of N and C in the top 0-15 cm soil profile, which is important for crop root development (NPMCR, 2014).

Fuentes *et al*. (2009) reported that one of the benefits of retaining residues in the plots subjected to zero and conventional tillage was the reduction in both moisture spatial variability and soil mechanical resistance, but as no residues remained on the soil surface water flowed more easily and the surface was sealed because of the decreased aggregate stability. So, straw retention treatment combined with no tillage kept high soil moisture, rather than no straw retention treatment in the top soil (0-15 cm depth) as it was reported by Malhi and Lemke (2007), which is very important, especially for the arid areas. Aggregation is a key factor for soil structural development and sustainability and thus, soil functions that require retention of crop residues to foster soil organic carbon levels for soil aggregate and structural stability. Aggregation of soils are dominantly affected by soil management practices and considerably mediated by soil organic carbon content.

Many authors (Malhi*et al*., 2006, Fuentes *et al*., 2009,Verhulst*et al*., 2011, Soon and Lupwayi, 2012, Li *et al*., 2013) have reported the effects of crop residues when they were retained on the top soil, especially when this practice was combined with crop rotation and soil tillage (minimum tillage or no tillage/zero tillage). Moreover, incorporation of crop residues, such as straw, into the soil, builds up soil carbon (C) as well as soil nitrogen (N) and returns valuable nutrients to the ecosystem. Such build-up of soil C and N will not take place if the straw is removed from the soil (Nguyen *et al*., 2013). Not only crop residues are a primary substrate for the replenishment of soil organic matter, but they also serve as an important source of plant nutrients (Lal, 1995). And the returning crop residue associated with some other agronomic practices, such as no tillage and crop rotation may improve soil quality and productivity, and may also be useful for the environment (Malhi*et al*., 2006 and Fuentes *et al*., 2009).

Crop residues have traditionally been incorporated into the soil as a source of nutrients and organic matter (Redy*et al*., 2001,Soon and Lupwayi, 2012). Crop residues are a renewable and vital organic resource for maintaining soil productivity. Intensive cropping with no return of crop residues and other organic materials results in loss of soil organic matter and that is not sustainable (Singh *et al*., 2007).

Management practices that simultaneously improve soil properties and yield are crucial to sustain high crop production and minimize detrimental impact on the environment. Crop residues are important in the maintenance and protection of soil quality (Kludze*etal*., 2013). Residue burning affects nutrient budget and resource loss and harm soil properties, thus calling for improvement in harvesting technologies and sustainable management of paddy-wheat system. Carbon, nitrogen and sulphur present in straw are entirely burnt and lost to the atmosphere burning. The retained crop residues enrich the soil, predominantly with organic carbon and nitrogen (Singh *et.al,* 2015) these nutrients then have to be replenished through organic or inorganic fertilizers, which come at a cost. Therefore, loss of soil organic matter through burning has a great potential to reduce soil fertility to poor levels (Hemwong*et al*. 2008).

2.4.3 Crop Residues Resource and Farmers-Herders Relations

Crop residues thereby provide an interface among crop, livestock and the environment, and its allocation and use likely involves trade-offs in terms of immediate livelihood interests and long term environmental sustainability (IITA 2010; Bationo and Buerkert 2001).

In many parts of Africa, particularly in arid and semi-arid regions, crop residue is shared among farmers and livestock herders, a mutual beneficial and co-operative relationship existed in which herders were encouraged to graze on farm residue (Moritz, 2010). Livestock had access to much-needed nutrition ahead of the dry season, while the farmers benefitted from animal manure and nutrients for their soil, enabling them to remain in continuous production for much longer. This symbiotic relationship offered a strong framework for local socio-political relationship that enabled farmers and herders to co-exist peacefully (Meera, 2018).

The relationship between herdsmen and farmers is dynamic, transforming and always evolving from one form to another. Historically, it is not uncommon for scholars to conceive the relationship between these two groups of resource users to be initially symbiotic, Host-Client or Host-Stranger in nature (Tonah, 2006, Moritz, 2010; Azeez, Micheal and Ufo, 2015). This symbiotic relationship usually promotes interdependence and reciprocity as demonstrated by Mboror Herders and Gbaya farmers in the Adamawa province of Cameroon (Moritz, 2008) in which gifts and items were exchanged among members of these groups for many years of coexistence. Blench (2010) also analyzed this relationship as an economic exchange of diary product for grains, access to local markets and the provision of manure on arable land while the cattle consume crop residues. However, this relationship turned sour as a result of the scarcity of environmental resources which often brings farmers and herdsmen into competition for the available resources and resultant conflicts which often lead to violence.

There should be diverse interactions between various crop and livestock components of mixed systems during the intensification process (Kristjanson and Thornton, 2004). Ensuring sustainable intensification and economically profitable integration of crop-livestock farming to meet the welfare and environmental goals of people is paramount (Williams *et al*., 1999; Place et al., 2003; Makinde*et al*., 2007). Better utilization of organic manure from livestock has the potential to ensure sustainable crop-livestock intensification for poor agro-pastoralists, especially as they often cannot afford to buy expensive inorganic fertilizers (Bationo*et al*., 2004 andMakinde*et al*., 2007). Efficiently applied, crop and livestock activities would not only contribute to income generation but also to higher crop productivity and better environmental health through supplying nutrients to soils without relying on external resources. A better understanding of diverse interaction of crop and livestock components and which of them are more associated with welfare and manure application should be a first step toward developing more effective extension services.

Crop residue burning has significant effect on environment socioeconomic life of people, soil nutrient, displacement of micro-organism, livelihood, it further destruct the mutual trust and interdependency/traditional relationship which accelerate violence between farmers and herders. This activities of burning is been increase year by years as a technique of farm clearing or as a result of conflict between farmers and herders which directly and indirectly affect the social and economy of the two groups. The destruction has direct impact on the peoples' livelihood as their economic activities are tied to these environmental resources like water, land (soil), and vegetation (herbs and food crops) (Bello, 2013).

2.4.4 Resource Use and Farmers-Herders Conflict

Farmers and pastoralist in many localities in different countries make their livelihood within the same geographical, political, and socio-cultural conditions which may be characterized by resource scarcity (Braukämper, 2000) or political inequality (Bassett, 1988). Farmer-pastoralist conflicts have been associated with the conflict of land resource use exacerbated by dwindling resources (Blench, 2004). Some researchers have linked this crisis to the theory of eco-violence (Okoli and Atelhe, 2014), where environmental factors and exploitation of scarce resources leads to conflict and violence.

The land resources of farm lands, crops, grass/pasture, and fresh water are scarce in Nigeria and needed by both farmers and herdsmen for sustenance of their various sources of livelihood.

Conflict, however, would not only occur between herders and farmers as both strive with another in pursuit of these resources; but as either of the groups tries to intrude or exploit another's already secured and long acquired resources (Oli*et.al*2018). In recent times, there have been prevalent cases of herders-farmers clashes in Nigeria. Ofuoku and Isife (2009) noted that in Demsa, Adamawa State, 28 people were killed; while about 2,500 farmers were displaced and rendered homeless in a clash between them. Similarly, Idowu (2017) submits that the violence has displaced more than 100,000 people in Benue and Enugu States and left them under the care of relatives some in makeshift Internally Displaced Persons (IDPs) camps while many are still struggling to rebuild their lives. However, among the Tiv and other farmers in the North-Central, South-South, South-East and North-Eastern regions, cases of conflicts with herdsmen are endless. The resultant effects are usually loss of lives and crops, destruction of properties, displacement of persons, decline in income/savings; as well as threat to food and national security.

Farmers and herdsmen conflict have remained the most preponderant resource-use conflict in Nigeria (Ajuwon, 2004; Fasona and Omojola, 2005). The necessity to provide food of crop and animal origin, as well as raw materials for industry and export in order to meet ever-growing demands, has led to intensification of land use (Nyong and Fiki, 2005). The competition between farmers and herdsmen, however, has often times turned into serious hostilities and social friction in many parts of Nigeria.

All over Nigeria there is an emphasis on the need for the promotion of agriculture as an alternative to oil as a major source of national revenue. A lot of agricultural programmes are put in place by governmental and non-governmental organization, due to this emphasis on agricultural production, many people are going into farming; likewise more people are going into livestock and cattle breeding in particular(Ajibo*et al.* 2018). The effect of this agricultural surge is that there is a competition for the available land resources between farmers and herdsmen. A dimensional problem arises as cattle graze on the farms and farmers in retaliation attacks the cows of the herdsmen. The herdsmen go on a reprisal attacks on the farmers largely because they value their cows immensely. So the attacks and reprisal attacks by farmers and herdsmen leads to destruction of lives and properties and also precipitate national disintegration (Ajibo*et al.* 2018).

2.4.5 Crop Residue and livelihood of Farmers

Traditionally crop residues have numerous competing uses such as animal feed, fodder, fuel, roof thatching, packaging and composting. The residues of cereal crops are mainly used as cattle feed. Rice straw and husk are used as domestic fuel or in boilers for parboiling rice. Farmers use crop residues either themselves or sell it to landless households or intermediaries, who further sell them to industries (Pathak*et al*., 2011) however, a large portion of unused crop residues, were burnt in the fields. The practice of burning is not a new idea but started many generations ago with the burning of grasslands.

The potential of cereal crop residues as animal feed is enormous if all the different types of cereal crops are considered and if appropriate methods of improving their nutritional value are employed. According to Lal, (2008) the amount of crop residues produced was estimated at 0.5 billion Mg in USA and 4 billion Mg in the world. These residues contained 11 × 106 Mg of NPK in USA and 81 × 106 Mg in the world. Legume crop residues, such as groundnut haulms, cowpea vines, and cowpea husks have higher crude protein content and are generally used as supplements in addition to the grazing of ranges and cereal crop residues (Singh *et al*., 2003).

The major crop residues which are grazed or stockpiled for ruminant feeding are millet and sorghum stalks, cowpea vines, cowpea husks, maize stover, maize husk, and groundnut haulms.

Singh and Tarawali (1997) stated that the crop residues of cereals may be left in the field as grazing material for livestock. They may be used as mulch, transported to the homestead for stall feeding, used as fencing, building, or roofing materials, or as fuel. The legumes on the other hand could be harvested and conserved either for dry-season feeding for the farmers' animals or for sale to other farmers during the critical period of feed scarcity in the mid-to-late dry season

Many authors including (McIntire and Gryseels, 1987; Latham, 1997; Erenstein and Thorpe, 2010; Moritz, 2010) had identified two major uses of crop residues use as livestock and use as mulch and opined that residue use as livestock feed exerts a competitive pressure on residue use as soil mulch. It is a paradox that burning of crop residues and scarcity of fodder coexists in this country, leading to significant increase in prices of fodder in recent years. Industrial demand for crop residues is also increasing. To manage the residues in a productive and profitable manner, conservation agriculture (CA) offers a good promise. With the adoption of conservation agriculture-based technologies these residues can be used for improving soil health, increasing crop productivity, reducing pollution and enhancing sustainability and resilience of agriculture (IARI, 2012).

The straw collected from the fields is of great economic value as livestock feed, fuel and industrial raw material. In northern India, wheat straw is preferred while in Southern India paddy straw is fed to livestock (Hegde, 2010). The residue generated from the rice- wheat cropping system can be put to many uses, but this is possible if the residue is separated from the grain and carried out of the field. The problem of on-farm burning of crop residues is intensifying in recent years due to shortage of human labour, high cost of removing the crop residues by conventional methods and use of combines for harvesting of crops. The residues of rice, wheat, cotton, maize, millet, sugarcane, and groundnut are typically burnt on-farm across different states of the country (IARI, 2012). Total health cost losses was far higher if expenses on averting events, productivity loss due to illness, monetary value of uneasiness and usefulness could be calculated and the economic cost of motor vehicle accidents caused by low visibility and blocking or slowing down traffic especially on countryside roads. Total annual welfare loss in values of health damages due to air pollution triggered by the incineration of paddy residue in Punjab state sums to Rs. 76 millions (Kumar, 2015).

Open burning of agricultural residues is an inexpensive means to advance crop rotation and control insects, disease, and the emergence of invasive weed species. While the economic and practical benefits of burning agricultural residues are apparent, the environmental and health risks of this activity need to be fairly recognized (Nilanthi, Badara and Patrick, 2010).Burning of agricultural residues also emits polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs), because of the presence of Chlorine in the residue (USEPA, 2000). USEPA (2000) reported that open burning usually occurs at low temperatures of 250–450 °C and in uncontrolled conditions, which are favorable for forming incomplete combustion products, and, thus, more PCDD/Fs are emitted than those from high-temperature and well controlled burnings.

2.4.6 Crop Residue Management

To manage the residues in a productive and profitable manner, conservation agriculture (CA) offers a good promise. With the adoption of conservation agriculture-based technologies these residues can be used for improving soil health, increasing crop productivity, reducing pollution and enhancing sustainability and resilience of agriculture. The resource conserving technologies (RCTs) involving no or minimum tillage, direct seeding, bed planting and crop diversification with innovations in residues management are the possible alternatives to the conventional energy and input-intensive agriculture (IARI, 2012).

Ojeniyi and Ighomrore (2004) as well as Owolabi*et al.* (2003) observed that some of the residue management techniques had varied effects on soil organic matter (SOM) contents. Similarly, Omoeti (2003) observed that the management of residues after land clearing influences the fate of soil organic matter (SOM). Opara-Nadi*et al*. (2003) stated that soil fertility can be maintained through maintenance of appropriate levels of SOM, the observed improvement in soil properties in residue management treated plots could be attributed to the effects of these treatments on soil conditions. Power *et al*. (1998) showed that covering the soil surface with layers of residue increased infiltration and prevented formation of compaction caused by raindrop impact on bare soils. Mbah (2009) observed that, there was improved soil condition and temperature in mulched plots relative to non mulched plots. The improved soil conditions due to crop residue addition resulted in higher plant heights and grain yield relative to the control in both cropping seasons.

Some countries have developed strategies for successful management of crop residues to avoid on-farm burning. In China, where about 700 Mt crop residues are generated annually, 31% of crop residues are left in the field, 31% are used for animal feed, 19% are used for bioenergy generation and 15% are used as fertilizer (Jiang *et al*. 2012). In USA on farm burning has been regulated in some of the states. For example, in California farmers require a permit for crop residues burning, which can be carried out only on ‘burndays’ determined by the local authorities in consultation with the California Air Resource Board. The crop residues are also required to be shredded and piled where possible. The crop residues are used as a source of energy in some countries like Indonesia, Nepal, Thailand, Malaysia, Philippines, Indonesia and Nigeria; for composting in Philippines, Israel and China; as animal feed in Lebanon, Pakistan, Syria, Iraq, Israel, Tanzania, China and countries in Africa; for mushroom cultivation in Vietnam and even burnt on-farm in China, USA, Philippines and Indonesia.

Crop residue management is a growing public concern in many countries in Africa, including Nigeria (Abebaw 2008). The first goal of any crop residue management system is to maximize the economic benefit from the waste resource and maintain acceptable environmental standards. Imposing a ban on burning of crop residue in some region such as India may not be fruitful unless growers are enlightened regarding the negative effects it has on human, animal, and soil health; crop biodiversity; climate change; etc (IARI, 2012). In developed countries, intentional open burning of wastes is strictly controlled and has long been considered as an outdated technology (Andreae and Merlet, 2001).

The National Policy for Management of Crop Residue (NPMCR), formulated adoption policy intervention for crop residues management with the following major objectives; (i) Control of burning of crop residue to prevent environmental degradation and loss of soil nutrients and minerals by promotion of in-situ management of crop residue; (ii) Diversified use of crop residue for various purposes, (iii) Capacity building and awareness about the effects of crop residue burning and its effective utilization and management; and Formulation and implementation of suitable law and legislative/policy measures to curb burning of crop residue (NPMCR, 2014).

2.4.7 Adverse Consequences of Burning Crop Residues

Burning of crop residues generates numerous environmental problems. The main adverse effects of crop residue burning include the emission of greenhouse gases (GHGs) of carbon dioxide, methane and nitrous oxide that contributes to the global warming, increased levels of particulate matter (PM) and smog that cause health hazards, loss of biodiversity of agricultural lands, and the deterioration of soil fertility, loss of plant nutrients like N, P, K and S (Lohan*et al*.2018). Crop residue burning significantly increases the quantity of air pollutants such as CO2, CO, NH3, NOX, SOX, Non-methane hydrocarbon (NMHC), volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs) and PM (Mittal, 2009). The environmental consequences of field burning residues are not seen only in terms of air pollution, but also in terms of intake decreasing of organic matter in the soil, that is important to increase soil fertility and to improve its physical, chemical and biological properties which consequently affect the agricultural productivity (Gupta *et al*. 2004).

Burning of crop residues is wastage of valuable resources which could be a source of carbon, bio-active compounds, feed and energy for rural households and small industries (Kumar *et al*. 2015). Field burning of crop residue converts a great deal of nutrients to gaseous form, which is then lost from the site (Haider, 2013).Burning crop residues directly produces heat, wave emissions of which may cause potential of ground level ozone to react with different gaseous emissions of soil nutrients, thus resulting in climate change (Auffhammer*et al*. 2006; EIA, 2008). Burning of crop residue is an important source of air pollutants, such as particulate matter (PM), sulfur dioxide (SO2), nitrogen oxides (NOX), carbon monoxide (CO), black carbon (BC) and volatile organic compounds (VOCs), which may have remarkable negative effects on climate change (Zhang *et al*. 2008), regional air quality (Cheng *et al*. 2014; He *et al*. 2015; Huang et al., 2013, Li et al., 2010) and human health (Gadde*et al*. 2009; Zhang *et al*. 2016). The emission of smoke from residue burning which when added to the gases present in the air like methane, nitrogen oxide and ammonia can cause severe atmospheric pollution. These gaseous emissions can pose health risks, aggravating asthma, chronic bronchitis and decreased lung function. Burning of crop residue also contributes indirectly to increased ozone pollution (kumar, 2015).

Burning of agricultural biomass residue, or Crop Residue Burning (CRB) has been identified as a major health hazard. In addition to causing exposure to extremely high levels of Particulate Matter concentration to people in the immediate vicinity, it is also a major regional source of pollution, contribution between 12 and 60 percent of PM concentration as per various source apportionment studies. In addition, it causes loss of vital components such as nitrogen, phosphorus, sulphur and potassium from the topsoil layer, making the land less fertile and unviable for agriculture in the long run. (Mukerjee, 2016).As has already been mentioned, farm residue burning causes off-site health hazard impacts, such as coughing, emphysema, asthma, bronchitis, eye irritation, corneal opacity, and skin diseases. The inhalation of small particles can also intensify persistent cardiac and pulmonary ailments, and furthermore, is related to the premature deaths in people who are already suffering from these illnesses. According to the Organization for Economic Co-operation and Development (OECD), it is estimated that in Delhi alone, approximately 20,000 premature deaths occur annually due to air pollution, and this amount may increase to 32,000 by 2025 and 52,000 by 2050 (OECD, 2016).

CHAPTER THREE

RESEARCH METHODS

3.1 Research Design

This study employed mixed methods, the first part of the research consisted of series of well structuredquestionnaire, key informant interview (KII) and focus group discussion (FGD). The other part consists of lab analysis of four soil sample from two different farms site maize and rice at depth of 0-10cmm, before and after burning. Hence the study used descriptive research design to describe the effects on CRB on farmers-herders relations, soil nutrients as well as level of farmers' awareness regarding the effect. Toaddress the study objectives, this research involved the use of primary data source which was collected using both qualitative and quantitative approach. The qualitative data was used to support the quantitative data analysis and result.

3.2 Types and Sources of Data

Both qualitative and quantitative data was used to generate the data on the effects of crop residues burning on farmer-herders relations and soil nutrients. This study was based on Primary data source which was obtained through key informant interview (KII) with stakeholders, traditional rulers and community heads, focus group discussion (FGD) was carried outfor participants in each district for both groups of rural farmers and herders. The quantitative data was obtained using survey questionnaire for data collected on effects of crop residue burning on farmers-herders relations and the level of farmers' awareness on the effects. Data on the factors responsible for change in crop residue management (CRM), effects of CRM on farmers-herders relation and level of farmers' awareness was sourced from primary source. Survey and focus group discussion with respondents was used to source the data for analysis.

Effects of crop residue burning on soil nutrients and organic carbon was sourced from primary source used quantitative means of soil sample test. Soil sample was carried out from two different farm maize and rice, before and after burning at depth of 0-10cm each.

3.3 Population and Sample Size

Sampling constitutes an important part of research. All rural crop farmers' in Hong Local Government Area constitute the population for this study. Krejcie and Morgan (1970) sample determination size was used to come up 384 as the sample for the study from a population of 226100. The sampling frame for this study consists of 384 rural crop farmers in seven district of Hong LGA. Considering the homogeneous nature of the districts in term of size, population and economic activities, total sample was divided by district 384/7=55. In each district 55 respondents were randomly selected to constitute sample for the study, Simple random sampling was used in selecting 55 crop farmers in each district across Hong Local Government area Pella, Gaya, Uba, Dugwaba, Kulinyi, Hildi and Hong to give each and every member a chance of participation.

3.4 Procedure andInstrumentsfor Data Collection

3.4.1 Reconnaissance Survey

Before the commencement of field work, preparation for data collection, a reconnaissance survey of the study area was carried out. This reconnaissance survey was carryout on 6^{th} to 12^{th} September covered all the seven districts of Hong LGA, Dugwaba, Gaya, Hildi, Hong, Kulinyi, Uba and Pella. The purpose of the visit was to familiarize the researcher with stakeholders, traditional rulers, farmers/herders and to be acquainted with the environment. This helped the researcher to make specific observation for the research work.

3.4.2 Instrument for Data Collection

A Questionnaire survey, focus group discussion (FGD), key informant interview (KII) was used to collect data for the research. Both close and open ended questions were administered. The questionnaire was grouped into 4 sections, section (A) the socio-economic characteristic of respondents. (B) Factors that prompt crop residue burning (C) the effect of crop residue burning on farmers-herders relations, and (D) the level of farmers' awareness regarding crop residues.

Survey Questionnaire

Questionnaires were used in collecting data on factors responsible for changes in group residue management; survey was also used in collecting data from respondents on the level of awareness on the effects of residue burning.

Focus Group Discussion (FGD)

Focus group discussion of 7 respondents per group were organized for youth, women and elders in both herding and farming communities to obtained data on effects of residue burning on farmer-herders relations in the area.FGD was also used to compliment the data gathered through survey questionnaire on causes of change in residue management and awareness level of respondents.

Key Informant Interview (KII)

ey informant interview was used in obtaining data from traditional ruler and stakeholder. The data were used to complement data obtained through questionnaire and FGD on the effects of CRB on farmers-herders relation as well as the factors responsible for change in residue management.

Soil Sample Collection

Container, hoe, and measuring tape were used for collecting soil sample, sampled was collected from maize and rice farm plot before and after burning at depth of 0-10cm to evaluate the effects on nutrients and organic matter. Soil sample was carried before the burning and after burning.

Procedure for soil nutrient test

Different method of soil nutrients determination was used to determine the effect of crop residue burning on soil nutrients and organic matter, the methods used depended on the parameter. Kjerdahl distillation method (Kjerdahl&Mulvaney, 1982) was used for nitrogen (N) content, Ammonium acetate method (Thomas 1982) for Potassium (K), BRAY I method (Olsen and Sommers, 1982) for phosphorus(P) and Graduated cylinder method was used for determination of particle size, while Walkley-Black wet oxidation method (Nelson and Sommers, 1982) was used for organic carbon.

Kjerdahl distillation method was used for determination of nitrogen N: distillation was used to get the final burette reading, and calculate using the formulabelow:

%N= 0.014xNxVOx100XTV/A.D x W.S

0.014 is the mill equivalent of nitrogen and is calculated as 14/1000=0.014

N= is normality of H_2so_4 used (0.025N)

VD= volume of digest made

TV= filter value after filtration

AD= aliquate taken during distillation

W.S= weight of sample.

BRAY I method used for available phosphorus P : weigh 1g of soil sample and put into a centrifuging tube or 100ml plastic bottle, measure 7ml of p extract and pour it into the centrifuge, then filter the content using what man filter paper, measure 3 to 4ml of the filtrate and pour it into a 100ml volumetric flask, Add 10ml of distilled water, Add 4ml of reagent B(Reagent A+Ascorbic Acid), Prepare blank using the same procedure using 0.2, 0.4, 0.6 and 0.8N. Measure the absorbance using spectrometer at 860nm wave length.

Calculation of phosphorus P.

P(mg/kg): Absorbance/slope * VE

Where VE = volume of digest which is 100ml.

Ammonium acetate method use for determination of Potassium K: Measure 5.0g of soil sample using analytical balance; transfer the measured soil into 100ml plastic bottle. Add 50ml of Ammonium acetate into the plastic bottle shake the mixture for about 30minute; filter the mixture using whatman filter paper. Use flame photometer to measure the absorbance of the potassium.

Walkley-Black wet oxidation method use for determination of Organic carbon: 1.0g weight of soil sample was obtained and transfer it into 500ml conical flask, add 5ml of potassiumhepaoxod ichromate (Kcr2 O7) into the conical flask. Add 10ml of concentrated sulphuric acid, and allow the content to stay for about 30minutes. Then add 100ml of distilled water into the flask (phenanthrolein). Prepare two black using the above procedure, filtrate the content against 0.5N ferrous sulphate. The content will change to maroon red when the end point reached.

Calculation

O.C (%) = (B-T)xNx1.33x0.003x100/W.S

Were B= black filter (volume of Fe S04)

T= sample filter

N= Normallity of feso4

1.33 is organic carbon correction factor

0.003 mill equivalent weigh of carbon 12/4000=0.003

W.S= weight of sample.

3.5 Data Analysis

The data processing and analysis was based on the data types, for the purpose of this research quantitative data was analyzed using SPSS, excel and office word format, the analysis focused on numerical/quantitative data analysis. Prior to the analysis, data was coded using Statistical Package for the Social Sciences (SPSS 20) to ease the analysis of data obtained, which involve identifying , classifying and assigning a numerical or character symbol to data. While qualitative data of KII and FGD was used to support the findings, the analysis has been incorporated with the quantitative discussion result in the data analysis part.

For the purpose of identifying the factors that causes change in residue management among farmers, descriptive statistic was used to analyze the data, frequency table, chart and percentage were used for the analysis.The effects of crop residue burning (CRB) on farmers herders relation was analyzed using percentage, table and plates.Frequency table and percentage was used in evaluating the effects of CRB on soil nutrients and organic matter.Percentage was used in analysis to ascertain the level of farmer's awareness on the effect of crop residue burning.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents and discusses the result of the findings based on the study research objectives, the results were discusses under demographic characteristic of respondents, management practice of crop residue, factors which causes change in crop residue burning, effects of CRB on farmer-herders relations, effects of crop residue burning CRB on soil nutrients and the level of farmers awareness on the consequences of burning crop residue

Three hundred and eighty four (384) questionnaires were distributed for this study, but 357 (93%) were retrieved and used for the analysis, the remaining wasrejected due to more missing value in the responses and some were no been able to collect due absence of some respondents during collection, and security challenges in some areas at the time of collection.

4.1.1 Demographic and Socio-Economic Characteristic of Respondents

The study revealed that two-third of respondents are below the age of 40year, with only one-thirds are above 50year, this indicated that the area is made up of very active and productive people, the age have been found to determine how active and productive a society would be. This high involvement of youth in crop farming affects the way residue is been managed, this as a result of high improvement in cultivation and demand of rice and maize. Table 4.1 shows that majority of respondents approximately four-fifth has formal education with about 50% attended high level of education ND/NCE and BSC/HND/MSC, and about one-thirds attended primary and secondary school. Educational background of farmers in study area gives them knowledge about the effect of residue burning. Only few, 19%of respondents do not have formal education. Education of the society is another socioeconomic factor which also fall under human capital, it expected that the higher the level of education the more productive that society should be, it also determine the level of opportunity available to improve livelihoods.

Table 4.1 shows that farmers in study area are predominantly male, with about four-fifths are male, only one-fifths being female; approximately half are married, less than half are single and 3%, 3% are divorce and widow respectively. About two-thirds of respondents attested that they cultivated an average of 1-5 (ha), with 2% cultivate of above 20 (ha) as shown on table 4.1. This indicated that farmers in Hong are predominantly subsistence based. The findings revealed that majority of farmers in Hong are youth and thishigh involvement of youth in crop farming increased reprisal attacks which is directly and indirectly link with the escalation of conflict, due to lack of knowledge of traditional dialogue mechanism to settle dispute. The findings revealed majority of respondents approximately two-thirds earnedannual income of 0-400,000 naira from crop farming, only 6% earned above 400,000 naira.

Educational background and youthful nature of farmers in study area does not allow them to dependonly on crop farming, majority of respondents do engaged in multiple occupations other than farming to improve their income and standard of living for sustainable livelihood. High percentage do engaged in business others are civil servant, livestock production among others in addition to farming. Othersare students; only 19% are solely depending on crop farming as means of livelihood. The study revealed that crop farming is the culture and passion of Hong community almost everybody farmed despite their engagement in various occupation,business, livestock production and schooling.

Table 4.1: Demographic and Socio-economic Characteristic of Respondents

SEX	FREQUENCY	PERCENTAGE (%)
Female	71	20
Male	286	80
Total	***357***	***100***
AGE		
Below 20	55	15
20-30	112	31
31-40	82	23
41-50	79	22
51-60	20	6
Above 60	9	3
Total	***357***	***100***
MARITAL STATUS		
Married	184	51
Single	154	43
Divorce	9	3
Widow	12	3
Total	***357***	***100***
EDUCATIONAL LEVEL		
No formal education	67	19
Primary	35	10
Secondary	94	26
NCE/ND	116	32
HND/BSC/MSC	45	13
Total	***357***	***100***
FARM SIZE (h)		
Less than 1	63	18
1-5	226	63
6-10	46	13
11-20	13	4
Above 20	9	2
Total	***357***	***100***
OTHER ACCUPATION THAN FARMING		
Business	96	27
Civil servant	70	19
Livestock	35	10
Student	78	22
None	67	19
Other	11	3
Total	***357***	***100***
INCOME		
Less than 100,000	138	39
100,000-200,000	120	33
200,001-300,000	54	15
300,001-400,000	24	7
Above 400,000	21	6
Total	***357***	***100***

Source: Field survey, 2019.

4.2 REASON FOR CHANGES IN RESIDUES MANAGEMENT AMONG FARMERS IN HONG

The result in table 4.2 revealed that more than two-thirds of the respondents agreed that there is change in crop residue management in study area; conflict was found to be the major factor as attested by 50% respondents, others are soil fertility enhancement, engagement of farmers into livestock, lack of awareness among others. Historically crop residue was been given free to herders in Hong for herders to graze in exchange for manure to be deposited on farm,but the system changed when the competition become high, farmers began to sell their residue, later burning. This time burning become a major management practice due to high tension, escalation of conflict, high cost of inorganic fertilizer, high production of cereal crop and high cost of management of crop residue by farmers among others. However the management of crop residue varies with the types of residue.

> *"High increase in crop residue burning in the area comes into play in current decade as conflict between farmers and herders escalate, farmers begin to burn their residue immediately after harvest to deprive herder." said respondent No.2 (famers FGD in Dugwaba) 11/10/2019.*

About one-third of respondents revealed that the factors accounted for this change in residue management is quest for improving soil fertility, many farmers particularly riceproduction farmersburn crop residue immediate after harvest due to high cost of managing, short period between harvest and next planting for irrigation farmers, others are it low market value. Burning said is to be beneficial to soil, it improve soil fertility forgetting the environmental effect of such terrible act.

Very few 5% respondents revealed that high involvement of farmers inlivestock production also changed management of crop residue in Hong, a lot of residue used to be stored for animals feeds by farmers. Awareness is also one of the factors which accounted for change in residue management in Hong; it exposed farmers to more available economic options of residue management, like stocking.

Other factors are high production of cereal crops due to technological advancement, high cost of managing residue, increased in potash production and climate variability of prolong raining season/late cessation a large quantity of residue tend to be affected by rainfall and make it less value or unusable than to burn on farm. All these affect and change the way residue is managed in the study area attested by 12% respondents.

Table 4.2: Factors Causes Changes in Crop Residue Management in Hong

Response	Frequency	Percentage(%)	Factors Responsible	Frequency	Percentage(%)
Yes	271	76%	Conflict	135	50
			Improve Soil Fertility	82	30
			Livestock	14	5
			Awareness	8	3
			Others	32	12
No	86	24%			
Total	**357**	**100**		**271**	**100**

Source: Field survey, 2019

4.2.1 The Major Types of Crops Cultivated In Hong

The findings revealed that four-fifth of crops cultivated in the area are cereals crops like maize, rice and sorghum with high percentage about two-third is maize and rice. This related to high improvement in maize and rice production, high demand for food crop to sustain the growing population and market value among others. These with others factors attracted the attentions of farmers to invest moreon maize and rice production in Hong. Previously groundnut was the major crop cultivatedin Hong as confirmed by the respondents. But as maize and rice productionbecome easier and profitable through modern system of Irrigation and the introduction of herbicides and pesticide, farmers in the area shift their attention to maize and rice cultivation.

Majority of farmers shifted from groundnut to maize and rice. Increase in maize and rice production mean high amount of residue is been generated as cereal crops are the major contributors revealed by the findings of study carried out byAruya*et al*. (2016) in Ikara local government of Kaduna state and that of Kwaghe*et al*. (2011) in Jere local government area of Borno state, where it was found that maize was by far the highest contributor of crop residue. As a large amount of crop residue is been generated in study area which if utilize well and in sustainable way will reduces the problem of fodder scarcity by herders, improve the economy of farmers,improve soil quality and environment in general, and will further strengthen the relationship between farmers and herders in the area.

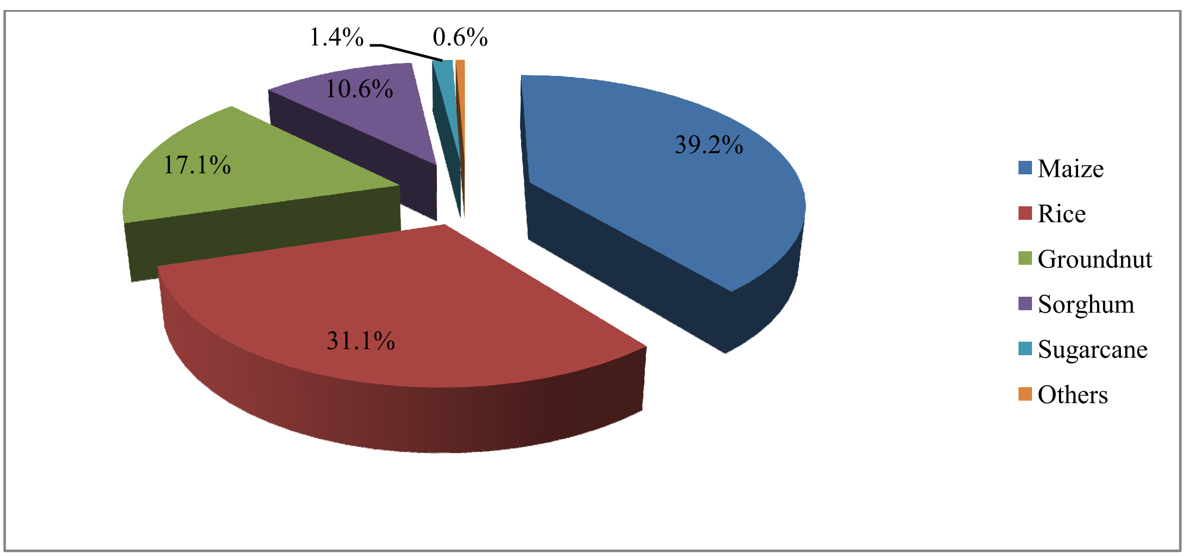

Fig 4.1: Major Crop Farmed In Hong

Source: Field survey, 2019

4.2.2 Management Practice of Crop Residue in Hong

Table 4.3shows that the management of crop residue in Hong is dynamic and varies from district to district in relation to the relationship between farmers and herders, livelihood of the communities, cultural believe among others. Some are sold, some stored as feed for their livestock, some exchanged for manure, others recycle for soil amendment while others are burned out of frustration and anger and some burned for soil fertility enhancement. This study revealed that burning and sales is the predominant management practices by the farmers as attested by about two-third of respondents.

Approximately one-third of respondents do burned their residue after harvest with the high rate in Dugwaba and Gaya, due to high tension and conflict between farmers and herders in the area. Only few respondents 13% do exchange for manure as the major management practice and it has to do with symbiotic relationships that exist between farmers and herders.

The sales are high in Uba, Hong, kulinyi and Hildi where relationship between farmers and the residues users (herders) is cordial and symbiotic. But that does mean conflict does not exist, it do but traditional dialogue mechanisms and negotiation were used in resolving the conflict without getting out of hand. Selling of crop residue was also found to be more economical, apart from earning money or manure it also improve farmers-herders relations as well as livelihood of both groups (farmers and herders).

Table 4.3 shows that Less than one-fifth (16%) of the respondents across all districts adopt storing as the management practice, which related to the types of crops cultivated and the means of livelihood of the farmers. Majority of farmers' that cultivate legume and oil seed crops like groundnut and beans do store their residues for animals feed, some because of the high market value of it at required time. Residue of groundnut and beans were to be sorted and stock then burnt the leftover on-field. Storedresidue for animals feed have been increase due to the involvement of farmers in livestock production. Farmers do store for livestock at home for sustainable livelihood.

High involvement of farmers into livestock business also affects residue management in Hong, as many farmers' practices livestock productions in addition to crop farming to avoid the risk of climate variability. The increase involvement is as a result of climatic irregularities of late onset and early cessation, drought, desertification and destructions of farm by herders.

Exchange of residues for manure and composting are other practice of residue management in study area as attested by 13% and 7% respondents respectively. Decline in the exchange of residue between farmer and herders' affects interdependency and traditional relationshipthat existed between the groups for longtime and consequently increase violence and conflict. Less than one-fifth of respondents revealed that there are other means of managing crop residues in the area.

Table 4.3: The Difference Ways of Managing Crop Residue in Hong

District	Sales	Animals feed	Burn	Exchange For Manure	Composting	Other	Total
Dugwaba	12	8	22	1	3	4	50
Gaya	8	5	29	1	2	5	50
Hildi	17	8	14	8	4	1	52
Hong	19	11	4	10	3	2	49
Kuliyi	18	7	12	7	2	3	49
Pella	12	7	15	14	5	0	53
Uba	20	10	10	7	6	1	54
Total	**106**	**56**	**106**	**48**	**25**	**16**	**357**
Percentage(%)	**30%**	**16%**	**30%**	**13%**	**7%**	**4%**	**100**

Source: Field survey, 2019

Table 4.3, shows that huge amount of residue resource is been burn by farmers in the area, this means that a lot of residue in the area is mismanaged and misused due to the strained relationship, lack of knowledge about the economic importance of residue and quest for soil fertility improvement among others.

4.3THE EFFECT OF CROP RESIDUE BURNING ON FARMERS-HERDERS RELATION IN HONG

The findings revealed that crop residue burning (CRB) does not affect only the herders but destruct farmers-herders relations as well as the means of livelihood of both groups. It was found thatfarmers that exchange and sell residue enjoyed the benefits of not only money and manure from herders but cordial relationship and protections over crops farm. The money earn from selling are used for transporting farm product and acquired some farm tools.

Majority of respondents during FGD revealed that there was symbiotic relation between farmers and herder in the area, as conflict escalates the cordial relations decreases and farmers begin to burn their residue rather than sale or exchange for manure.The soured relationship affects livelihood and economy of both groups as well as the economy of a nation in general. The symbiotic relation between farmers and herders reduces the rate of farm destruction and yield good production output; more fodder would be available for cattle, the problem of fodder scarcity is been minimized. These would attracts more people/investors into agricultural sector, create more job opportunities, reduce the unemployment rate, improve food security, generate more tax and minimize importation of food there by Government spending.

"Crop residue burning seriously affects herders as well as their herds, the act force some herders to relocate to neighboring state some to Cameroon Republic due to the scarcity of fodder for cattle during dry season. Cattle depends on these crop residues for feeds, burning crop residues is a great lost to herders because our cattle have been starved and make them very susceptible to diseases, low milk and this affect their production. This consequently affects farmers too because it do affects economy and livelihood" said respondent No. 3 (Herders FDG in Pella) on 15th October, 2019.

The study revealed that burning crop residue frustrates herders which make some of them to act aggressively by engaging on furtherfarm destruction. Other factors that contributed to farm destructions besides burning are blockages of cattle routes among others. The mutual trust between farmers and herders is declining across the districts; approximately two-thirds of respondents were of the view that the relationship between the two groups is getting bad due to reasons earlier explained.

Less than 12%of the respondents attested that the relationship is cordial and mutually existing, which encourage trade of crop residue to herders to improve the relationship and minimize the burning. Despite the challenges and pressure receivedfor selling residue to herders from fellow farmers' and relatives in conflict affected villages, some farmers still do sale residue to herders to earn money. Those areas attract more herders for better fodder for their animals.Sustainable use of crop residue like selling, exchange for manure and recycling enjoyed the benefit of improving the relationship and the livelihood of the group in general.

"unsustainable management of residues (burning) by farmers is one of the major factor that fueling farmer herders crisis in the area because these crop residue is been served as the major fodder/feed for our animals during dry season more especially maize Stover but farmers do burn it in order to frustrate us, if the problem of post harvest residue burning will be address it will improve farmers-herders relation to great extent and will reduce violence and conflict between the groups" said stakeholder in Hong on 5th October, 2019 KII.

As revealed by some Farmers that they do engaged into immediate burning of crop residues to deprive cattle of feeds as a result of destruction of their farms by herders as a result of escalation of violence between the groups; as such farmers decide to burn down residue than to continue exchange or sales to herders despite all the management option available.Others burn for soil fertility enhancement, some for seedlings and weed control.

This is quite contrary with the study carried out byEl-Haggare*et al*.(2004)where the researchers found that farmers burn residue because they view the practice of residue utilization as an extra cost with small return and therefore the best way to get rid of the residues is by burning.Majority of Farmers prefer to burn their residue than other economic options available, more especially in high conflict areas not just to get rid of it but for soil fertility enhancement.

Plate 1: Farmer burning sorghum residue at Dugwaba
Source: Field survey, 2019

Plate 2: Farmer burning rice straw at Hong (Waja)
Source: Field survey, 2019

However some farmers still burn crop residues not because of conflict but for soil fertility and low market value of the residue, especially rice straws farmers tend to burn it to boost/improve soil fertility. Some farmers use expired tyres to burn with residues in order to increase the intensity of the burning, burning also ease clearing of farm against next planting season.

Table 4.4: Farmers-Herders Relations Regarding Crop Residue Burning In Hong

Districts	Very Bad	Bad	Fair	Strong	Very Strong	Total
Kulinyi	19	5	11	8	6	49
Hildi	20	18	8	3	3	52
Hong	24	9	12	1	3	49
Uba	28	14	11	1	0	54
Gaya	23	19	3	0	5	50
Pella	23	16	6	5	3	53
Dugwaba	20	24	2	0	4	50
TOTAL	**157**	**105**	**53**	**18**	**24**	**357**
PERCENTAGE(%)	**44%**	**29%**	**15%**	**5%**	**7%**	**100**

Source: Field survey, 2019

As a result of high increase in this act of CRB by farmers, an Interdependent relation between farmers-herders is drastically on decline as attested by majority of respondents. Others said is antagonistic where by each group act against the other, but still some are in the opinion that the relationship is improving and expected to be excellent and symbiotic as it used to be by trade off of residue between farmers and herders.

4.4 THE EFFECT OF CROP RESIDUE BURNING ON SOIL NUTRIENTS

The result in table4.5 shows that crop residue burning have complex effects on soil nutrients, as it lead to increase and decrease in some nutrients. As for example soil nitrogen decreases after burning while phosphorus (P), potassium (K), and organic matter increases. This agreed with the findings of Richard (2001) which finds that crop residue burning increases the short term availability of soil nutrients (phosphorous (P) and potassium (K)) and reduces soil acidity, ultimately leads to a loss of other nutrients (nitrogen (N) and sulfur (S)) and organic matter. The findings of the study show that nutrients are dynamic to burning.

Total Nitrogen (TN):The result in table 5 shows that the percentage value of total Nitrogen (TN) at depth of 0-10cm on both maize and rice farm varied between 0.28-0.21 and 0.63-0.21 before and after burning, with before burning residue having the highest percentage respectively. This is because a lot of soil nitrogen lost by fire through volatilization and particulate transfer to the atmosphere during burning. The result also showsthat there was a difference in TN loss percentages between the maize farm and the rice farm site. These percentages have decreased after burning by about 14% in maize farm and 50% in rice farm; this high variation is due the nature of the soil there and intensity of fire. This is in line with a findings of the study carried out by Baird *et.al* (1999) where is was found that fire contributes to the loss of nitrogen by volatilization and particulate transfer to the atmosphere, but the result disagreed with the finding of Edem and Alphonsus (2013) who observed increased in total nitrogen in burnt soil in continuous cropped arable experimental plots.

Phosphorus (P): The results in Table 4.5 revealed that phosphorus P concentration in maize farm is much higher than rice farm at depth 0-10cm layer. This may be attributed to phosphorus being classified as an immobile element in the soil so that it does not move much down the soil profile (Hungerford *et.al* 1990). Result in Table 4.5 revealed that available phosphorus P in both sampled farms at the depth of 0-10cm ranged between 8.31-12.33 P mg/kg on maize farm site and 7.54-9.24 mg/kg on rice farm site with after burning soil recording the highest valuethan before burning. The values of TP in the maize farm site is higherafter burning than their equivalent values in the rice farm site; this may be due to the density of the residue which is more intensive in the maize farm site that increase available ash.

The result of this study is in consistent with the findings of Tabi*et.al* (2013) where it was found that increase in available P was higher immediately after burning than after one year of cropping relative to the unburned forest vegetation. It's also in line with findings of Van et al. 1995 and that of Kopecky et al. (2012) where it was found an addition increase of ash after burning and that also increases available P. each ton of wood ash could substitute for 13 to 14 kg of phosphate.

Potassium (K**):** the result in Table 4.5 revealed that potassium K ranged between 0.022-9.09 cmol/kg in maize site and 0.01-0.05 cmol/kg on rice farm before and after burn with after burned recording the highest value than unburned at the 0-10cm soil depth.

Organic Matter (OM): Table4.5shows that the percentage values of soil organic matter (OM) greatly increased after burning ranged from 0.57-0.59 on maize farm and 0.59-1.03 in rice farm at depth of 0-10cm with after burning recording highest value. This is because of increase decomposition activity that immediately follows burning.

The result corroborates with the findings of woodmansee (1981) who reported that fire increase the amount and biodegradation rate of readily decomposable soil organic matter and simultaneously increase the resistance of stable portion of soil organic matter. The result also is in line with the findings of Ubuoh*et al*. (2016) who reported that among the selected land use types; bush burning increased the highest amount of SOM leading to an increase in soil fertility.Lee *et al*.(1990) in his finding gave the reason for an increase in the organic matter in surface layers after fire to be due to much dead root biomass.

The result in Table 4.5 shows that there is no much effect of short-term burning of crop residue on soil nutrient N.P.K at depth of 0-10cm on both maize and rice farm site, but there is a slow and steady reduction in soil health that will eventually result in reduced productivity that cannot be overcome with increased additions of mineral fertilizers. General review of the literature indicates that no measurable negative effects are associated with occasional and short-term burning, but that prolonged burning of 15 years above results in a significant loss of soil health and function (Clark 2015). The benefit of retaining crop residue is far better than burning, Crop residue can provide a protective layer from soil erosion by wind and water, can increase the organic matter and water holding capacity of the soil, and can provide feed and forage for earth worms and others organisms. The costs associated with the loss of organic matter and nutrients from burning crop residue exceed its benefits. Ubuoh*et al*. (2016) reported that Crop Residue is good source of plant nutrients and are important component for the stability of agricultural ecosystems. Farmers benefited by retaining crop residue through improving soil health, reducing fertilizer use, saving irrigation water, decreasing soil erosion, enhancing crop productivity.

Table 4.5: Effect of Crop Residue Burning On Some Soil Nutrient (NPK) and Organic Matter

Site	Soil Depth	Condition	N %	O.M %	K cmol/Kg	P Mg/Kg	O.C %
Maize Farm	0-10cm	Before burning	0.28	0.57	0.022	8.31	0.32
	0-10cm	After Burning	0.21	0.59	9.09	12.33	0.34
Rice Farm	0-10cm	Before burning	0.63	0.59	0.01	7.54	0.34
	0-10cm	After Burning	0.21	1.03	0.05	9.24	0.6

Source: soil lab, soil science department

4.5FARMERS AWARENESS OF THE EFFECTS OF POST HARVEST CROP RESIDUE BURNING IN HONG

The results of the findings show that farmers across the seven districts have fair knowledge about the effects of crop residue burning;this is due to educational levelof farmers in the study area. The education level of the respondents in the study influence the way they do manage their crop residue, which indicated that the burning is not related to lack of awareness. Table 6 shows approximately two-thirds of respondents practice agricultural crop residue burning (CRB), only one-third do not.

The result in table 4.6 Shows that approximately 43% of respondents are aware of the consequences of air pollution caused by crop residue burning (CRB), but not aware about greenhouse gases (GHG) emission caused by burning crop residue. Burning of crop residue emit gases like carbon dioxide CO_2, methane CH_4 and nitrogen oxide N_2O into the atmosphere, and these gases ultimately increase the global temperature phenomenon called global warming. This increase in temperature of globe may also be responsible for climate variation and climate change, and this subsequently affects agricultural production and natural resource availability thereby increasing competition over limited available resources.

Approximately half of respondents are aware about the effects for crop residue burning on soil nutrient and a great percentage 58% are also aware about soil fertility and structure effects of crop residue burning. But despite the knowledge, farmers still burn because they only care about the short-term benefit. Less than halfof the respondents were not aware about the effects on soil nutrients and fertility. Some farmers believed that burning increase short-term nutrients and fertility without considering the long-term effectsof burning on soil nutrients as well as soil structure and texture.

This findings in table 4.6 shows that approximately halfofthe respondents in Hong are aware about the effect of crop residue burning on human health, but only few have knowledge about the specific diseases causes by crop residue burning, such as respiratory problem and Asthma. Majority of the farmers know that the smoke been released through CRB affects human health withvery few percentage of the respondents indicated that they do not have knowledge about the effects on human health.

The result of the study in table 4.6 shows that there is no law that guided burning of crop residue in study area, as attested by more than four-fifths of the respondents, no law set by Government or communities leaders to check burning of crop residue in study area, and that's what make the practice uncontrollable and uncheck which is not healthy for the environment.

Table 4.6: Level of Farmers Awareness Regarding Crop Residues Burning In Hong.

DISTRICTS	PARTICULARS																	
	Do you practice agricultural crop residues burning?			Does crop residue burning have any effect on soil nutrients?			Does crop residue burning have effects on human health?			Do you know that crop residue burning affect soil fertility and structure?			Does crop residue burningaffects air quality and increase greenhouse gases GHG?			Is there any law set by government or community to control CRB your area?		
	Yes	**No**	**No idea**	**Yes**	**No**	**No idea**	**Yes**	**No**	**No idea**	**Yes**	**No**	**No idea**	**Yes**	**No**	**No idea**	**Yes**	**No**	**No idea**
UBA	33	21		30	24		31	23	0	38	16	0	24	29	1	3	50	1
HONG	30	19		33	16		26	21	2	37	11	1	19	29	1	4	45	0
HILDI	38	14		26	22	4	26	22	4	27	22	3	20	24	8	4	43	5
KULINYI	27	22		34	15	0	33	14	2	29	20	0	26	22	1	5	43	1
GAYA	35	15		11	36	3	16	33	1	24	26	0	23	27	0	3	47	0
PELLA	29	23	1	31	21	1	36	16	1	30	21	2	16	30	7	8	43	2
DUGWABA	30	20		16	29	5	16	24	10	23	26	1	24	22	4	3	46	1
TOTAL	**222**	**134**	**1**	**181**	**163**	**13**	**184**	**153**	**20**	**208**	**142**	**7**	**152**	**183**	**22**	**30**	**317**	**10**
PERCENTAGE(%)	**62.2 %**	**37.5 %**	**0.3%**	**51%**	**46%**	**3%**	**51%**	**43%**	**6%**	**58%**	**40%**	**2%**	**43%**	**51%**	**6%**	**8%**	**89%**	**3%**

Source: field survey 2019

4.6 Some Major Factors Fueling Conflict between Farmers and Herders in Hong

This Study revealed some factors that increase tension and escalate conflict that cause hostile aggression by farmers to engaged into practice of immediate burning of crop residue after harvest to deprive herders fodder for their animals.

1. Blockage of cattle routes and water points by farmers as a result of farm expansion and high involvement in irrigation gives herders no options than to encroach crop farm to get access to pasture. Most of cattle routes wereconverted to other uses which gave herders poor access to land for grazing, as pasture land shrink and become very difficult for herder to move and graze without veering into crop field. This is in line with the findings of Muhammed *et al.* (2015) where it was found that Intensive crop farming has expanded into grazing lands in many areas over these years and these areas of encroachment are the areas with high incidents of conflict between farmers and herders; Past conflicts were solely due tothe encroachments of cattle routes, where farmers now grow crops on the routes.
2. Burning of crop residue: this act has been on the increase as result of conflict, between resource users, this practice becomes one of the major factors that fuel conflict in study area.

> *".high increase in burning of crop residue by farmers in this present time from 2010 and is attributes to increase farm destruction by herders, farmers then burn their crop residue after harvest instead of selling to improve their economy, and this affects the livelihoods of the community and further escalates the conflict by stakeholder" in Hong town KII, 18th October 2019.*

crop residues is served as the major fodder resource for cattle during dry season, burning it starved cattle and exposed them to various disease which affect the overall production of the cattle.

3. Drugs abuse: massive involvement of herders and farmers into drugs contributed to the conflict as revealed by both group, it increase the rate of farm destruction and reprisal attack,

> *"herders sometimes over drug themselves sleep to off there by allows the cattle uncontrolled to graze on farmers crop, and anytime such happen the aggressive youth farmers too carry reprisal attacks, this makes the relations antagonistic. The occurrence of such incident over time causes conflict and sometime result to violent". Said farmers in Dugwaba, FGD on 13th October, 2019.*

4. Injustice by security agencies and traditional rulers, so many incidents of farm destruction, cattle rustlers, reprisal attacks have occurred but there was delayby institutions responsible for action, that frustrate people and givesthem a window to take law into their hands and as a result conflicts degenerate into violence.
5. Avoidance of traditional dialogue and reconciliation mechanism, population explosion and climate change among others which cause a lot of competition over limited resources available.

CHAPTER FIVE

SUMMARY, CONCLUTION AND RECOMMENDATIONS

5.1 SUMMARY

Crop residue burning have been in increase in Hong LGA due to tense relationship between farmers and herders in the area, as a result this work focus on finding the effects of this crop residue burning on farmers-herders relation and soil nutrient, and also to proffer lasting solution between farmers and herders in the study area.

There is change in crop residue management in the study area as attested by76% respondents, and among the factors responsible for the change conflict was found to be the major factor caused the changedas revealed by 50% respondents. Other factors are soil fertility enhancement, increased engagement of farmers into livestock, awareness, high production of cereal crop, high cost of residue management and climate change.

Farmers-Herders relations found to be soured as a result of increases in burning as revealed 73% respondents. Even though some area do enjoyed cordial relations and mutual trust attested by 12% respondents by trade off crop residues between farmers and herders which further improved the relations and gives security over crop farm as well as cattle.

Short-term burning of crop residues affects soil nutrient, soil nitrogen decreases from 0.28-0.21% and 0.63-0.21% before and after burning in maize and rice farm plot respectively due to fire volatilization and particulate transfer. But phosphorus P, potassium K, and organic carbon increases as a result of decomposition activity that follow burning.

Farmers have fair knowledge about the effects of residue burning, 51% of the respondents are aware about the effects on soil nutrient, 51% on human health, 58% soil fertility, and 43% air quality. But despite fair knowledge, high percentage 62% of farmers practice burning due to increase tension and lack of alternative viable economic options available, that compelled farmers to burning. Another reason is absent of law that guide and control residue burning revealed by 89% respondents.

5.2CONCLUSION

There is high increase in conflict between farmers and herders in Hong which result to high change in crop residue management in the area, and the change affect livelihood of the community as well as soil quality.

It can be concluded that burning of crop residue triggers more conflict between farmers and herders in the area, majority of farmer's burn residue to deprive herders which decreases interdependency relationship and mutual trust between farmers and herders.

Burning of crop residues have both positive and negative effect to farmers and the environment, increases short-term soil fertility, reduces grass seedlings in farms which aid greatly in perpetuation of tradition. But has long-term effect on environment.

It can be concluded that there is absent of law enforcement on crop residues burning in the area, which make the act unguarded, and that contributed greatly to increases of burning, not lack of awareness. Controlling crop residue burning improve farmer-herders relations, reduces tensions and conflict in the area.

5.3 RECOMMENDATIONS

I. Traditional rulers, Community leaders, and civil societies should encourage the adoption traditional dialogue and reconciliation mechanisms in settling farmers-herders related problem. This will reduce tension or further escalation conflict.

II. The Ministry of Agriculture of both federal and state should engage on Capacity building and awareness on consequences of residue burning and the economic importance of composting and recycling of residues. This should be done by organizing training for farmers' on adoption of conservation agriculture practices and resource conservation technology. Farmers should adopt, developed crop production and establishing self-help on effective and sustainable management of crop residue for sustainable agricultural practice and environment.

III. Government at all levels(federal, state, local government and community leaders) should set Laws that will ban and curb the intentional burning of crop residues. And this should bethrough incentives and enlightenment, to prevent and ban intentional burning of crop residue, as practice by many countries in the world. Considering high increase in crop residue generation by increases in production rice and maize.

IV. Intervention and support should be given, like Soft loans for both farmers and herders, farm equipment and subsidize fertilizer to enable them to develop and improve their production to modern system, that will reduce the rate of burning for soil fertility and it will also reduce over dependent on crop residue for feeds.

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APPENDIX I: QUESTIONNAIRES

I'm a Geography student from BUK, undertaking a research project on socio-economic effects of postharvest crop residues burning on farmers-herders relations in Hong Local Government Area. Your response is of the utmost important to me. Thank you for your time

Section (A) Demographic and Socio-Economic Characteristic of Respondents

1. Sex
(a) Male (b) Female

2. Ages
(a) Below 20 (b) 21-30 (c) 31-40 (d) 41-50 (e) 51-60 (f) 60 above

3. Marital status
(a) Married (b) Single (c) Divorce (d) widow

4. Education level
(a) No formal education (b) primary education (c) Secondary education (d) ND/NCE (e) BSC/HND/MSC

5. Farm size (ha)
(a) Less than 1 (b) 1-5 (c) 6-10 (d)11-20 (e) 20 above

6. Types of crop farm (grow)
(a) Maize (b) rice (c) sorghum (d) guinea corn (e) groundnut (f) sugarcane (g) others (please specify)

7. Income of farmers?
(a) Less than 100,000 (b) 100,001-200,000 (c) 200,001-300,000 (d) 300,001-400,000 (e) 400,000 above

8. Occupation of farmers other than farming?
(a) Livestock (b) business (c) civil servant (d) student (e) others (f) none.

Section (B) the Causes of Crop Residues Burning

9. How do you dispose/manage your crop residue after harvest?
(a) Sell (b) burn(c) store (d) exchange for manure (e) recycle for soil amendment (f) others

10. If selling, how much do you gain from crop residues annually? And what do you use the income raise from crop residues?...

11. Why do you burn crop residues after harvest?
(a) For farm clearing (b) pest and disease control (c) lack of technology and storage facilities to manage the residue (d) lack of knowledge about economic importance of residue (e) others (please specify)…………………………………………….

12. When do you burn your crop residues?
(a) Immediately after harvest (b) after been graze by livestock (c) at the begin of raining season (e) others (please specify)…………………………………………

13. Is there any change in the way people do manage their residues in the past and in the present time? (a) yes (b) no

14. If there is what do you think has accounted for the changes in the management techniques?...

Section (C), Effect of Crop Residues Burning

15. What advantage/benefits do you gain from burning of crop residues?
16. How will you describe your relationship with herders regarding burning of residues?
(a) Very bad (b) bad (c) fair (e) strong (f) very strong

17. Have you ever experience any conflict from crop residues users? (a) Yes (b) no

18. If you have, in what form does the conflict come?
(a) Farm destruction (b) physical assault (b) economic sabotage/boycott (c) armed raid on your communities (e) others (please specify)

19. How have you responded to the conflict?
(a) Reporting to instituted authorities (b) reprisal attack (c) economic sabotage/boycott(d) others (please specify)

20. How will you describe your interdependency relationship between farmers and crop residues users regarding burning of residues?
(a) excellent (b) Improving (c) neutral (d) declining (e) antagonistic

21. An immediate burning crop residue after harvest has significant effect on mutual trust, traditional/interdependency relationship and also acceleration of violence and conflict between farmers-residues users.

(a) Strongly disagree (b) disagree (c) neutral (d) agree (e) strongly agree

22. How would you rate your satisfaction of the burning of crop residue on your relationship with crop residues users?
(a) Very satisfied (b) satisfied (c) neutral (d) unsatisfied (e) very unsatisfied
23. To what extent does the crop residue burning link with violence and conflict between farmers and crop residues users?
(a) Very great extent (b) great extent (c) some extent (d) low extent (e) not at all
24. What benefit do you drive from allowing the herders to use the crop residues?...............................

Section (D), Level of Farmers Awareness on the Effect Crop Residues Burning

Do you practice agricultural crop residue burning? (a) Yes (b) No

Do crop residues burning have any effect on soil nutrient? (a) Yes (b) no

How burning crop residue does affect human health? ……………………………………………………

Do you know that crop residues burning have effects on soil fertility and structure there? (a) Yes (b) no

Do you know that residue burning increases air pollution and greenhouse gases? (a) Yes (b) No

Why do you choice to burn residues rather than others economic options? ....

What laws does the government/community leaders set to control burning of crop residues in your area?...

APPENDIX II: FOCUS GROUP DISCUSSION (FGD) GUIDE

1 For Farmers

1.1 How do farmers manage their crop residue now i.e. straws, stubble, woody stems, cotton stalks and leaves, and the like? And how is the residue managed in the last decade?

1.2 What changed in the management system? And what caused the changes?

1.3 Why is the practice of crop residue burning on the increase among rural farmers?

1.4 Which crop residue is most commonly burned? And why do farmers burn?

1.5 What are the economic importance/benefits of burning crop residues?

1.6 Does that interdependency relationship of exchange residues for manure and dairy for grain still exist between farmers and herders?

1.7 How will you describe the relationship of those that sell or exchange their crop residues with crop residue users for manure etc. and those that burn theirs?

1.8 Have you ever experienced any violence or conflict as a result of this practice of crop residue burning?

1.9 Does this burning of crop residues have any link with the violence in your community? And how does it relate to the violence?

1.10 Does crop residue burning have effects on soil quality and human health?

1.11 Do you know that burning of crop residue enhances soil erosion, and increases air pollution and greenhouse gases?

1.12 What do you think will be a better ways of resolving this conflicts between farmers and others resource users?

2 For Herders

2.1 What is the importance of crop residue to you?

2.2 Which type of residue are most useful to you and why?

2.3 How do you acquire these residues from farmers? Do they give you out of free will or sold to you, or exchanged for something?

2.4 Do you know other primary uses of residues apart from being used as animal's feeds?

2.5 Why do think farmer's burn their residues?

2.6 Do you ever ask these farmers why they burn their residue?

2.7 Do you know why this practice is on the increase among rural farmers?

2.8 How will you describe the rate of crop residue burning now as compared to the last decade?

2.9 Do these exchanges of residues for manure and grain for dairy still exist between farmers and herders?

2.10 Are these increases in the rate of crop residue burning affecting the fodder availability for your livestock?

2.11 How do you feels when you see farmer's burn their crop residue?

2.12 Have you ever experienced any violence or conflicts as a result of this bridge in interdependency relationship? If yes how does it start?

2.13 What effort have you made to bring that cordial interdependency relationship of exchanging residue for manure?

2.14 What ways will you that can improve farmer-herder relations and mitigate conflicts in your community

APPENDIX III: Key Informant Interview (KII) Guide on effects of crop residue burning on farmers-herders relations in Hong

What are the major economic activities of the people in your community?

Do they farm? If yes what are the dominant crop they are farming?

How do they manage their crop residue after harvest? And how does it benefit farmers and other residue users?

Is there any change in management of crop residue, past and present time?

How will you describe the interdependency relationship between farmers and herders in your community?

Have you ever experience any conflict? If yes how often does the conflict occur, and in what form at what time of the season?

Base on your opinion do you think the conflict have link with crop residue burning?

Do you ever received training/enlightenment or awareness on how to manage residue by extension worker or group of government?

What effort and plans made by Government to resolve and mitigate the conflict if any?

Is there any law set by Government or community to check crop residue burning?

What strategy do you think government, traditional ruler and societies at large should take to minimize this act of intentional burning of crop residues?

Thank you for your time and responses

APPEDIX IV: SOIL SAMPLE TEST RESULT

S/N	Sample ID	N %	O.M %	K cmol/kg	P mg/kg	O.C %
1	Maize before burning	0.28	0.57	0.022	8.31	0.32
2	Rice before burning	0.63	0.59	0.01	7.54	0.34
3	Maize after burning	0.21	0.59	9.09	12.33	0.34
4	Rice after burning	0.21	1.03	0.05	9.24	0.6

APPEDIX V: SAMPLE DETERMINATION TABLE

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970