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Land Suitability for Herders' Settlements Development: Nomads' Resettlement Scheme in North-Central (Phase I)

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ABSTRACT

Conflict between sedentary farmers and nomadic cattle herders in the country has become the 'gravest security challenge' facing Nigeria. This study aims to identify suitable areas for herder resettlement in Jigawa and Niger States. Key objectives include spatio-temporal analysis of grazing land use, assessment of nomadic livelihoods, and conducting a land inventory for identifying appropriate settlement areas for herders. Satellite images from Landsat ETM+ (2000) and Landsat 8 (2020) were the primary data sources. Both unsupervised and supervised classification methods were used for image classification, resulting in six land use categories. Focus group discussions gathered information on Fulani herders' economic and social life, livestock, and crop farming practices. Experienced farmers who transitioned from nomadism were also interviewed to gather detailed crop farming data. The finding revealed that Fulani are nomads but willing to adopt new cattle-rearing methods if their livestock's feed is ensured. The Fulani youths are open to alternative economic activities, including farming. While nomadic, they settle for extended periods in areas with sufficient animal feed and engage in small-scale crop farming. Crops include cowpea, maize, onions, peanuts, potatoes, and vegetables, primarily grown for subsistence. Settled Fulani, who have ceased migration, engage in both cash crops and subsistence farming. They practice mixed cropping with crops like cassava, millet, onions, sorghum, rice, and yams. Intercropping and rain-fed agriculture are prevalent, with irrigation farming mostly limited to floodplains. Environmental impact was analyzed, showing that certain crops, like cowpea, have better nutrient and water-use efficiency, while crops such as rice and maize require more chemical inputs. In 2020, 84.48% of Jigawa's land was allocated to crop farming, with little remaining land suitable for herder settlement. Therefore, Niger State, a larger region with abundant water resources and diverse land cover, was identified as a potential alternative for developing herder settlements. Its extensive grassland, mixed vegetation, and proximity to rivers and reservoirs make it ideal for supporting year-round livestock grazing and irrigation-based agriculture. This study concludes that while Jigawa State is now predominantly used for crop farming, Niger State offers significant potential for developing sustainable herder settlements.

Keyword: Land Suitability; Herders; Nomads; Settlements.

INTRODUCTION

Northern Nigerian States have seen conflicts resulting in thousands of deaths and displacements due to confrontation between pastoralists (herders) and local farmers in several communities. In January 2018 alone, Amnesty International reports indicated that 168 people were killed because of herdsmen-farmer clashes (Godwin, 2018). The herder-farmer conflict has become more significant in the last two years. Although the government had in the past taken some measures to address this phenomenon, the increasing desertification and the effects of climate change have further increased the drive for the herdsmen to move further south in search of grazing land and pasture for their livestock.

These southward movements always pitch them against farmers and the host community whose crops are

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regularly invaded and destroyed by the cattle during this seasonal movement. Expectedly, with the depletion of arable land for subsistence farming largely because of increasing urbanization and the adverse effect of climate change, there is increased struggle between herdsmen and farmers, leading to violent confrontations and conflicts, deaths and forced displacement, as well as the destruction of agriculture and livestock (Mercy Corp, 2019).

In recent years, the insecurity has worsened due to the activities of militias, known locally as "bandits". These are loosely organized armed groups, reportedly over 120 factions with 28 to 2,500 members (Buba, 2023). They are now deadlier than the well-known Boko Haram, which operates in north-eastern Nigeria. Apprehension of these types of bandits has been difficult because they disguise as nomads since they are mostly Fulanies. Preventing the nomads from migration by settling in one place such as developing *RUGA* is likely the best solution. The *RUGA* development was suspended due to a number of reasons. This study looks into the issue and proffer solution by utilizing space technology to identify suitable lands for herders' settlements development in Northern Nigerian States Phase One.

The aim of the project is to determine the potential areas for developing herders' re-settlements scheme for the entire Northern Nigerian States starting with Phase One (Jigawa State). The specific objectives are: to carry out spatio-temporal analysis of grazing land uses; to assess nomadic livelihood; to carryout land inventory; to determine the suitable area for new settlements development for herders with various land uses i.e. agriculture, conservation, etc. using state of the art algorithm.

Study Area

Jigawa State was the area chosen for the project as phase one of the North Western Geo-political Zone (NWGPZ). However, Niger State was also assessed due to availability of space for the settlement development, among other reasons. Jigawa State is one of the 36 states of Nigeria, located in the northern region of the country. It was a part of Kano State and was located in the northeastern-most region of Kano State. Created on 27 August 1991, the State is situated in the northwestern part of the country between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. The State borders Kano State for 355 km and Katsina State for 164 km to the west, Bauchi State to the east and Yobe State for 193 km to the northeast. Jigawa in the north, shares an international border with Zinder Region in Niger Republic for 70 km, which is a unique opportunity for cross-border trading activities.

Most parts of Jigawa lie within the Sudan Savannah with elements of Guinea Savannah in the southern part. Total forest cover in the state is below national average of 14.8%. Due to both natural and human factors, forest cover is being depleted, making the northern part of the state highly vulnerable to desert encroachment. The state enjoys vast fertile arable land to which almost all tropical crops could adapt, thus constituting one of its highly prized natural resources. The Sudan savannah vegetation zone is also made up of vast grazing lands suitable for livestock production.

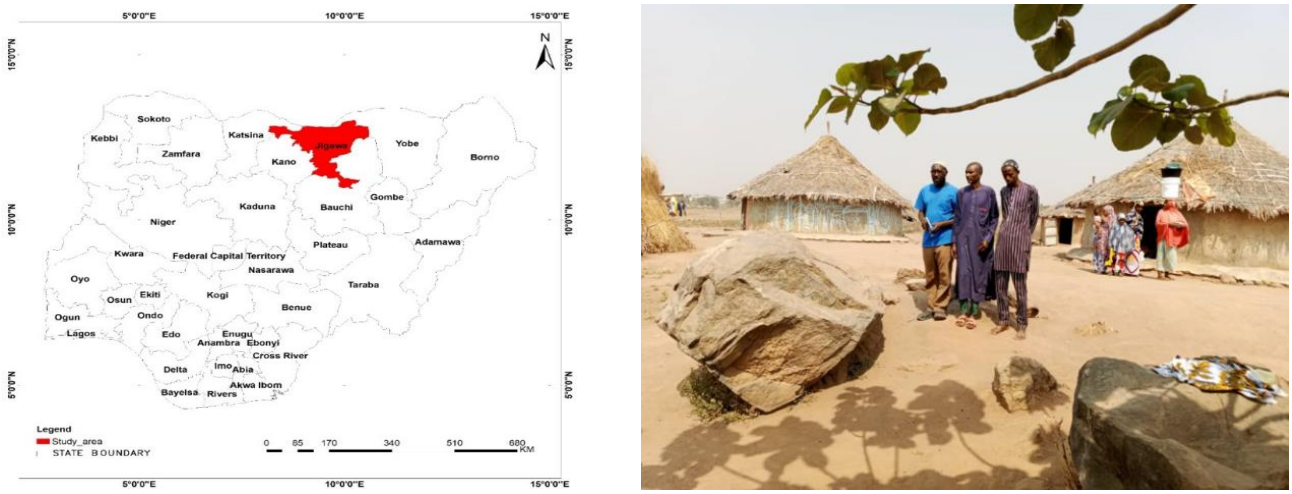


Figure 1: The study area

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024

DATA AND METHODOLOGY

Data Used: Satellite images from Landsat ETM+ (2000) and Landsat 8 (2020) were the primary data sources. Ancillary data like climatic factors and SRTM from USGS Earth Explorer were also used.

Land Use Change Analysis: Data processing involved geometric, atmospheric, and radiometric corrections of satellite imagery. Both unsupervised and supervised classification methods were used for image classification, resulting in six land use categories. The accuracy of these classifications was verified by ground truthing.

Nomadic Livelihood Assessment: Focus group discussions gathered information on Fulani herders' economic and social life, livestock, and crop farming practices. Experienced farmers who transitioned from nomadism were also interviewed to gather detailed crop farming data.

Land Inventory: Mapping of land use patterns provided a land inventory for Jigawa State, revealing it was unsuitable for herder settlements. Niger State was then assessed as an alternative.

Suitability Assessment: Various factors were considered to determine suitable areas for settlement, such as slope, proximity to water, and other land uses like forest reserves.

The assessment also ensured the suitability of organic farming practices for the nomads.

RESULT AND DISCUSSSION

This study, which is aimed at determining the potential areas for developing herders' re-settlements scheme for the entire Northern Nigerian States starting with Phase One (Jigawa State), is to be achieved through the study objectives that include; conducting spatio-temporal analysis of grazing land uses; assessing nomadic livelihood; conducting land inventory; determining the suitable area for new settlements development for herders with various land uses.

The adopted processes by which these objectives were carried out have been explained in section 5. They include land use land cover (LULC) change analysis to determine the spatio-temporal changes that the grazing land uses went through; assessment of nomadic livelihood through focus group discussion (FGD); land use and land cover mapping to determine the land inventory; suitability assessment to determine suitable areas for new settlements development for herders with various land uses i.e. residential, agriculture, conservation, etc. In this section therefore, the results are discussed, providing answers to the research questions.

The section begins with presentation of the nomadic livelihood and crop farming practices, which was said to have been conducted through FGD, followed by the presentation of the result of the LULC change analysis, which presents spatio-temporal changes of grazing reserves in the area. The land inventory is then discussed.

Assessment of nomadic livelihood through FGD

The nomadic fulanis were found to be Muslims mainly and they usually marry more than one wife. This is widely observed practice among the fulanis. The interview revealed that nomads are willing to accept new development and any newly introduce cattle rearing system. They expressed interest in settling in one place provided their animal feed can be obtained. In terms of the behavior of youth among the fulanis, it was found that the youths are willing to be engaged in any other economic activities that include cattle rearing and farming.

Although fulanies are most parts of the year moving, there are periods that they settle in one place for more than a year. This usually happens where the source of their animal feeds avails for long time. They in such areas carry out certain farming activities. A wide variety of cereal, tuber crops and vegetables are grown by them with regard to the preferences of a particular herder. The common crops being cultivated by the nomadic fulanies are cowpea, maize, onions, peanut, potato, tomato and vegetables. According to them, the primary objective of farming by them is to augment cattle rearing for their subsistence needs and no surplus is sold.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024

Therefore, areas being cultivated are generally small, usually less than 15 by 15 meters. Cropping activities like sowing of seeds are done manually. Cattle, sheep and goat are being reared.

Assessment of crop farming practice

It was explained at section 5 that detailed crop farming practice was inquired from the fulanies that have stopped seasonal migration and have settled in one place for more than 10 years. These fulanies were found to be engaged in several economic activities that include trading and cash crop farming. Several types of the predominant crops of the northern Nigeria are being cultivated by these types of fulanies. These include cassava, cowpea, maize, millet, onions, peanut, pepper, potato, rice, sorghum (also called guinea-corn), sugarcane, tomato, vegetables and yam. The animal feed can be sourced from beans leaves, cassava leaves, potato leaves, peanut and their leaves, millet, sorghum, yam leaves, maize and rice leaves.

Mixed cropping system is widely practiced by farmers among the fulanies. The farmers have developed greatly diversified cultivation patterns through combining crops of various growing periods. Two (2) types of crops are the common intercropping by them. This simultaneous cultivation of two or more crops on the same piece of farmland is common among them. The most intercropping are carried out in the flood plains. Yields are generally proportionate to the additions of organic fertilizers, manure in particular. Rain-fed cultivation of crops is the predominant form of farming by the fulanies. Irrigation farming is found in the river flood areas within the buffer zone of about 200 meters. This indicates that irrigation farming is being carried out throughout the study area. Rice according to the participants of the FGD is mainly cultivated at the flood plain.

According to the settled farmers among the fulanis, most of areas, were shrubs and grasses. The places put to crop farming activities were scanty and dispersed in the past. Hence, fallowing and crop rotation was then the main crop farming practice in the State. They observed that even the farmers that were not fulanis, used to engage the nomads to rear their cattles in the harvested farms in order to fertilize it. Due to this symbiotic relationship, the major land use feature in the state in the past was a mixture of grazing and crop farming. Cultivation period for each crop i.e. growing period from planting to harvest is presented in table xxx based on content analysis. These include the cropping period (crop cultivation season), duration of cultivation from sowing to harvest, crop water requirement, the type of implement that is required for the cultivation of a particular crop, the type of fertilizer that can satisfy the crop nutrient requirement, whether certain chemical is required by a crop, the level at which the crop is demanded in market, and lastly, whether the crop requires special preservation. In order to differentiate levels of advantage of each crop with regard to each of the characteristics, colours were used. The red colour was used portray the most unfavourable characteristic, meaning the least advantageous, while the green colour is used to portray the most favourable advantage of being sustainable and profitable. It was obtained that most of the crops can be planted at any time of the year, except cowpea (beans), sorghum, millet and potato that are seasonal. They are seasonal because they cannot survive high rainy season.

The maximum number of months for the cultivation of each crop, from planting to harvest revealed that cowpea (beans), onions, pepper, and tomato have better advantage. These crops are being cultivated within the maximum of 3 months, hence they can be cultivated up to four (4) time in a year provided there is availability of water i.e. through irrigation. Maize, millet, peanut, potato, rice and sorghum can be cultivated twice in a year, if all things being equal. They are being grown within the maximum period of 6 months. Therefore, they are next with shorter cultivation duration as presented in the content analysis table. Cassava and yam take about 9 months while sugarcane could last up to one year. They can only be cultivated once pear year. Hence they have the least advantage with regard to duration of crop cultivation.

It was obtained that crops being cultivated that have best advantage due to less water requirement are cassava, millet, pepper, potato, sorghum and yam, while maize, onions, peanut, rice, sugar cane and tomato require much water, hence they are not advantageous in this regard. There are some crops that require much water at the sowing stage, but after the development of the crop, their need for water reduces. Cowpea was found to have this habit. It was assumed that crops with shorter cultivation duration could be grown anytime of the year. Contrariwise, cowpea is one of the crops that are being cultivated in very short period, yet could not be planted except during the rainfall peak period. This is because the water requirement for cowpea at the seeding period

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024

is very high.

It was understood from the FGD with the stationed Fulani farmers that various crops have different nutrient requirements. In this regard, cowpea was found to have the best advantage of requiring less fertilizer. It was obtained that the soil fertility can be maintained with manures alone if it is available in sufficient quantity, for the growth of most crops except rice and maize. 3 types of agrochemical substances are used by the stationed Fulani farmers. They include herbicides, pesticides and inorganic fertilizers when manure is not available in sufficient quantity. It was obtained that the traditional means of controlling weeds by manual labour through the use of hoe for weeding and cutlass for slashing have been replaced by the use of herbicides.

The use of herbicides was observed to be cheaper than employing manual labor. The crops that require the application of herbicides for weeding only, were found to be millet, onions, pepper, sorghum, sugarcane, and tomato. There are some crops that require the application of insecticides in addition to herbicides because they are being attacked by insects. These crops are Cowpea, maize and rice. Some other crops require the application of pesticides and herbicides. They include cassava, peanut, potato and yam. These findings revealed that the crops that are more environmentally friendly are millet, onions, pepper, sorghum, sugarcane and tomato. This is because they are not usually attacked by insects; hence do not require the application of pesticides. They only require fertilizers and weeding using herbicides.

It was obtained from the stationed Fulani farmers that cassava, maize, millet, peanut, pepper, rice and sorghum are being processed using the traditional method and therefore they have great preservation advantage. They also have storage advantage because they do not require any special storage facilities after they have been processed and they last more than a year. The crops that are required most, due to high demand are cowpea, maize, onions, peanut and rice. The market demand for cassava, pepper, sorghum and yam were said to be low, while the market demand for millet, potato, sugarcane and tomato were said to be moderate.

Spatio-Temporal Analysis of Grazing Land Uses

It was gathered during the FGD with the nomads that the only vegetation area that is prohibited from grazing, is the cropland. Hence, in the year 2000, five (5) land feature areas, covering the total area of 20,872.27 Km^2, were mostly used for grazing.

Table 01: Crop Characteristics Content Analysis Table

Crop Types	%	Total input cost in Naira	Net profit in Naira	Cropping period S=seasonal A=anytime	Planting to harvesting period (month)	Water requirement M=much L=low	Implement, M=manual D=draftpowerM=machinery	Fertilizer, O=organic I=inorganic	Chemical; I=insecticide H=herbicide P=pesticide	Market certainty H=high M=medium L=low	Preservation advantage H=high M=medium L=low
Cowpeas	10.3	11,384	30,359	S	<4	L	M & D	O	I & H	H	M
Cassava	4.8	168,000	47,736	A	7 to 9	L	M & D	I	H & P	L	M
Maize	18.2	90,475	12,925	A	4 to 6	M	M & D	I	I & H	H	H
Millet	1.6	129,870	43,290	S	4 to 6	L	M & D	I	H	M	H
Onions	3.2	56,860	151,940	A	<4	M	M	I	H	H	L

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024

Peanut	4.8	3,954	15,375	A	4 to 6	M	M & D	I	H & P	H	M
Pepper	9.6	25,461	101,844	A	<4	L	M	I	H	L	H
Potato	4.2	30,450	30,450	S	4 to 6	L	M & D	I	H & P	M	M
Rice	15.4	29,680	29,681	A	4 to 6	M	M & D	I	I & H	H	H
Sorghum	14.7	22,423	16,017	S	4 to 6	L	M & D	I	H	L	H
SugarCane	3.7	3,052	13,528	A	>9	M	M	I	H	M	M
Tomato	6.0	51,231	281,769	A	<4	M	M	I	H	M	L
Yam	3.5	71,175	118,625	A	7 to 9	L	M & D	I	H & P	L	M

This constitutes approximately 89.64% of the total area of Jigawa State (figures 02 and 03). The land cover classes include; shrubs mixed with grasses and trees covering about 4,473.93 Km^2 representing 19.22% of the total area; bare-surface with scanty grasses covering 1,346.87 Km^2 (5.78% of the area); natural forest area referred to as undisturbed forest covering about 3.22 Km^2 (0.01%); forest plantation covering 202.25 Km^2 (0.87%); and the basic grazing area traversed by rain fed crop farming activities (a mixture of grazing and scanty crop farming), which covers the highest portion, with 14,845.87 Km^2 i.e. 63.76% of the total landmass of the Jigawa State.

The finding which indicated that there was a mixture of grazing and crop farming as a class of land use in year 2000, stated above, proves the claim of the FGD that most places were put to both grazing and scanty crop farming activities, due to symbiotic relationship between farmers and herders. This was seen to be about two-third (63.76%) of the state. 10.04% of the total land area, which is 2,337.01 Km^2 of the State, was a flood plain and was put to crop farming in 2000 (figure 04). This is indicative of a strong presence of rice cultivation in that year, since flood plain has been observed during the FGD, to be the major crop being cultivated at flood plains. The area put to irrigation project in the year 2000 was very small, it then occupied 37.89 km^2, representing 0.16% of the total area (figure 04).

Jigawa State had witnessed drastic change of land use and land cover features within the span of 20 years. The area that was mostly used for grazing, comprising shrubs mixed with grasses and trees; bare-surface with scanty grasses; undisturbed forest; forest plantation; and the basic grazing area mixed with scanty crop farming, which was found to be 89.64% of the state in year 2000, was found to have mostly been replaced by rain-fed- crop farming in 2020.

The rain-fed crop farming was approximately 17,330.71 Km^2, representing 74.44% of the total land mass of the State in 2020. Furthermore, 2,337.01 Km^2, which represents 10.04% of the State, is flood plain and being used for crop farming (figure 05). In year 2000, built up areas covered the total area of 35.36 Km2 approximately (Figure 06). This was 0.15% of the Jigawa State. However, this land use rose to 158.65 Km^2 in 2020, representing 0.68% of the total land mass (figure 07). This finding justifies the claim of the participants of the FGD when they said that there were abundant land for fallowing and grazing in the past. This may be attributed to population increase as well as increase in developments. The census figures of 2006 put the population of the State at 4,361,002 persons. However, the projected population rose to about 7,499,100 persons in 2020.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024

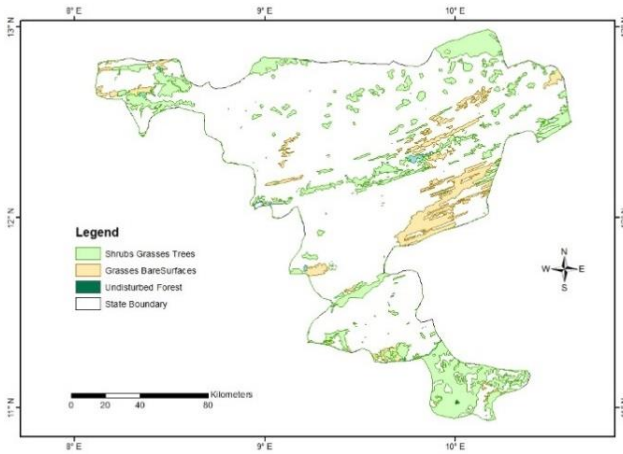


Figure 02: Natural vegetation in 2000

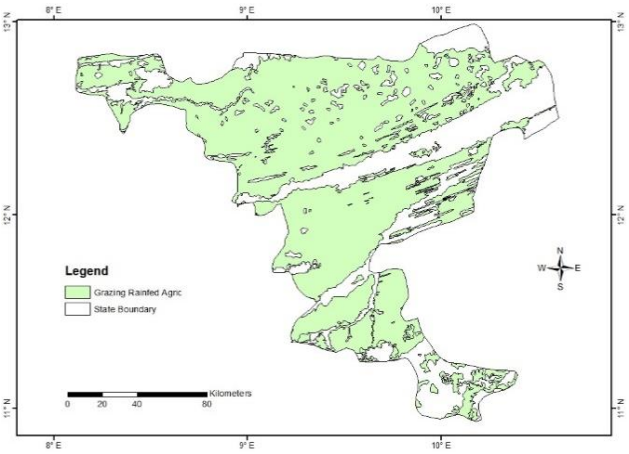


Figure 03: Predominant grazing with scanty cropping area in 2000

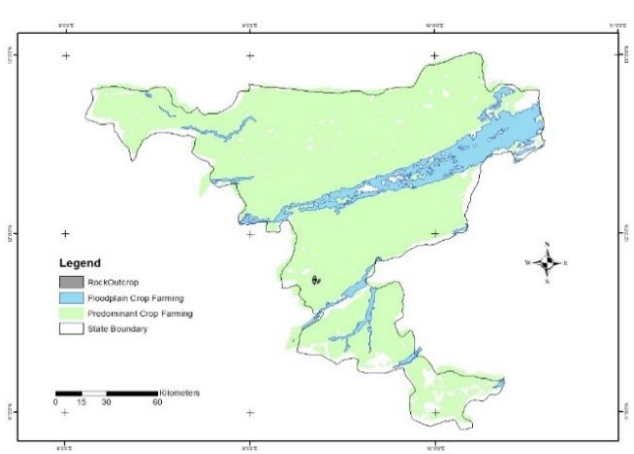


Figure 04: Predominant cropping area in 2000

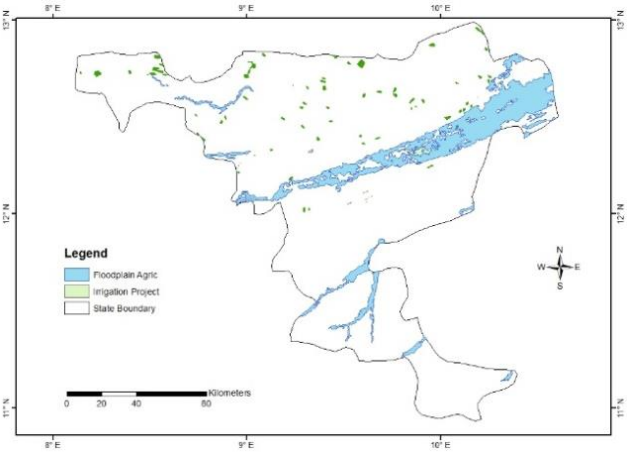


Figure 05: Predominant cropping area in 2020

Land use and land cover mapping to determine the land inventory

Jigawa, a State covering the total area of 23,282.4 Km^2 approximately was in year 2020 found to have been largely put to crop farming. As seen in the previous section, 19,667.72 Km^2, which represents 84.48% of the total land mass of the State, was found to be occupied by crop farming. This constitutes the dry land and flood plain agriculture as presented in figure 5. All other land cover features that comprised shrubs mixed with grasses and trees; bare-surface with scanty grasses; undisturbed forest; forest plantation; and the basic grazing area mixed with scanty crop farming was seen to have been largely replaced by the crop farming. This suggests limited forested regions, which may result from agricultural expansion and land conversion for farming purposes. This aligns with the state's predominant economic activity, which is centered on farming.

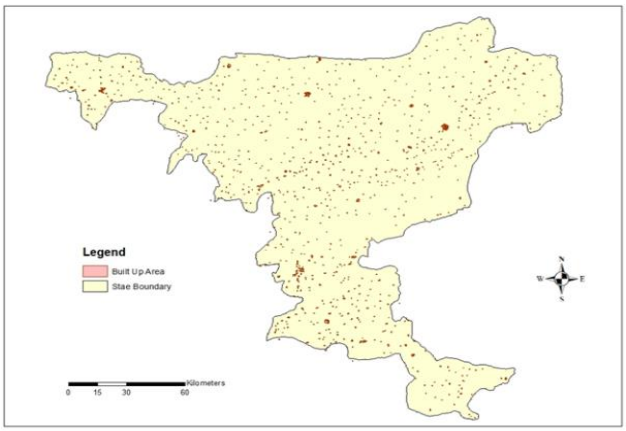


Figure 06: Built ups in 2000

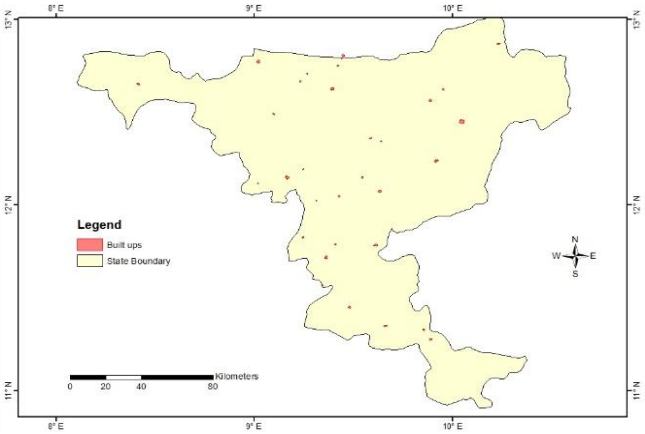
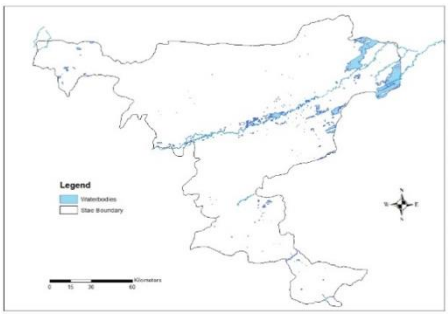


Figure 07: Built ups in 2020

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024



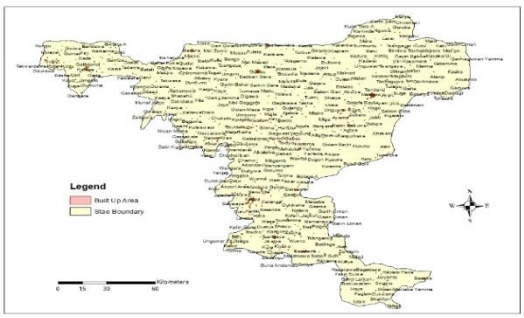


Figure 08: labeled Built ups areas of 2020 Figure 09: Water bodies

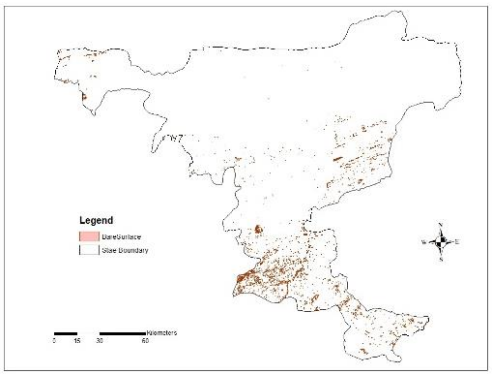
During the satellite imagery classification and features extraction, there were patched of bare surfaces found mostly at the southern part of the State (figure 08). However, these land cover features were found to be cropland that have dried up.

This rapid growth of crop farming activities is most likely due to population increase and government policy. Although the last population census in the country was conducted in 2006, population projections have pointed to the rise in population figures of the State. Furthermore, the increase in built up areas, from approximately 35.36 Km^2 i.e. 0.15% of the State's land in year 2000 to 158.65 Km^2 in 2020, representing 0.68% (figure 07) indicates population growth (figure 07). Since the main occupation of the inhabitants of Jigawa State is crop farming, rise in their population is directly related to the rise in crop farming, thus, the expansion in crop farming. The government policies that most likely promoted the rise in cropland were the farming incentives provided by the Federal and State Government and banning of food crops importation in 2015. The remaining 3,456.03Km^2 consisting of LULC other than cropland and built up areas in Jigawa State, cannot accommodate the intended herders' settlement development. Therefore, another State in Nigeria was assessed for the proposed herders' settlement development to serve as a prototype as mentioned. This is Niger State discussed in the subsequent section.

LULC mapping to determine the land inventory in Niger State

Niger State was chosen due to a number of reasons. First of all, the State is one of the largest states in Nigeria (Figure 11) covering about 72,200 km^2 representing about 9.3% of the total land area of the Country. The State houses the largest water reservoirs in the country namely Kainji and Shiroro dams. The major economic activity in the State is agriculture: farming, fishing, and cattle rearing.

There are many major rivers in the state. River Niger and Kaduna are among them. Figure 12 displays location of reservoirs, rivers and other natural water bodies in Niger State. The figure shows that the state is traversed by a variety of water bodies. This indicates that the source of water for year round crop farming through irrigation is available, hence advantageous for the creation of the proposed herders' settlement development. Flood plain agriculture and irrigation are among the crop farming taking place in Niger State. This is proved by figure 12. Rock outcrop are found scattered mostly in the northern parts of the state. Other land formations found scattered in the state is gully erosion (figure 13).



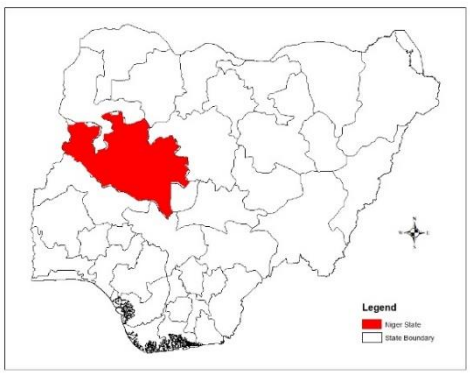
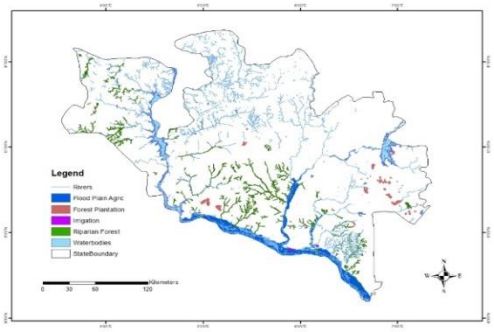


Figure 10: Bare Surfaces in 2020 Figure 11: Niger State

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XI November 2024



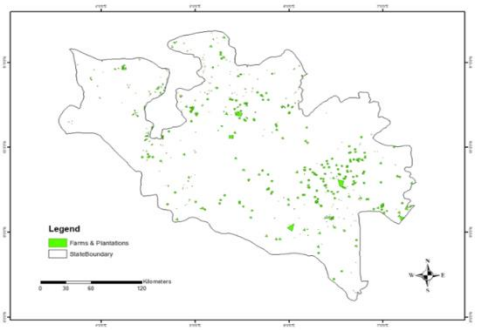
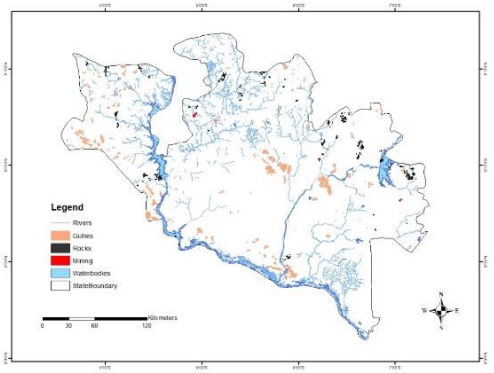


Figure 12: Water bodies, Aquatic Veg. and Farming Figure 13: Rocks, Gullies, Mining & Water bodies

Figure 14 indicates that rain-fed crop farming is carried out in most parts of the State. This is indicative of good soil fertility in the State.

The LULC inventory exercise revealed that there are several built up areas in the State covering the total area of about 328.7 KM^2. These are settlements that include; towns, villages, hamlets, as well as other urban land uses that contain impervious surfaces (figure 15).



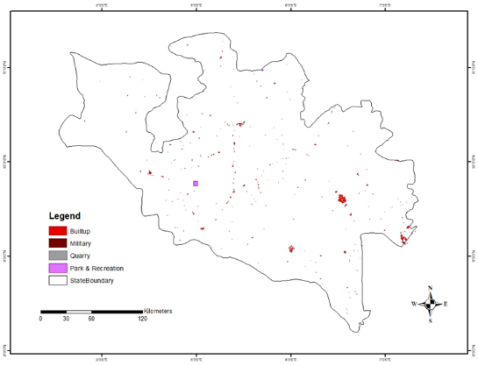
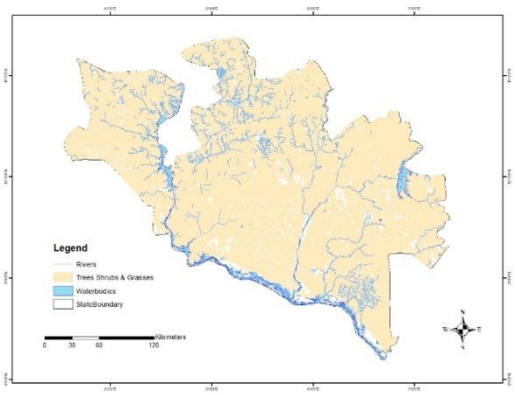


Figure 14: Rain-fed crop farming Figure 15: Built ups & Urban Land Uses

It was obtained through the LULC features extraction that shrubs, grasses and trees covering about 65,204.3 Km^2 are found in the State. These areas are likely used for grazing livestock and may be associated with pastoralist activities. They likely represent transitional areas between grasslands and more densely vegetated areas, potentially indicating some degree of ecological diversity. These are potential areas for the herders' settlement development. These land features are found in every parts of the State (figure 16).

It is worthy to note that these areas are traversed by rivers hence they are associated with rivers, floodplains, or other water bodies, and play a crucial role in local ecosystems. This includes rivers, lakes, and other aquatic features. They serve as essential sources for both human and livestock.



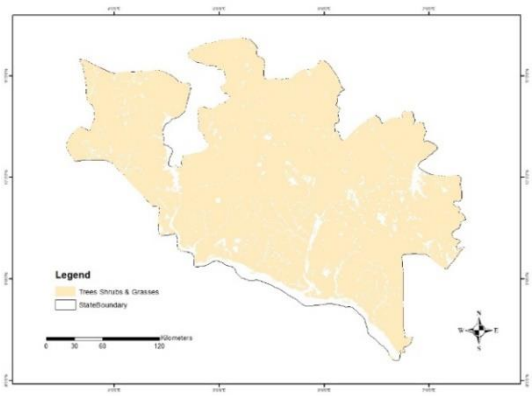


Figure 16: Trees, Shrubs, Grasses & Water bodies Figure 17: Trees, Shrubs & Grasses

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CONCLUSION

Nigeria has decided to be self-sufficient in food production by promoting local crop and livestock farming. In this regard, the governments have increased incentives in farming activities and have banned the importation of some food crops. However, the issue of security and safety of farmers as a result of increased tensions and occasional conflict between sedentary farmers and nomadic cattle herders in the country has become a major national problem. The dispute has been described as the 'gravest security challenge' facing Nigeria. The development of space-based land suitability map to provide optimal location for situating herders' re-settlement scheme was proposed to provide an avenue for lasting solution to this problem.

Furthermore, open grazing system is not sustainable. Therefore a lasting solution needs to be provided. Hence, this project was carried out not only to identify suitable location for grazing reserves but for the development of whole settlement that will accommodate residential, agricultural, commercial, industrial (agro-allied industries) conservation, educational, as well as other land uses required for standard and qualitative livelihood. This is necessary in order to bring an end to the menace of farmer herders' conflict.

The main objective of the project is to determine the potential areas for developing herders' re-settlements scheme for the entire Nigeria but commenced with Northern Nigeria phase one. The research findings shed light on the significant transformation occurring in Jigawa State, Nigeria, primarily driven by the expansion of crop farming activities. The analysis reveals that a substantial portion of the state's land, amounting to 84.48% of its total area, has been dedicated to crop farming, indicating a considerable shift in land use patterns. This shift has largely replaced various other land cover features such as shrubs, forests, and grazing areas, highlighting the impact of agricultural expansion on the natural landscape.

The rapid growth in crop farming activities in Jigawa State can be attributed to multiple factors, including population increase and government policies aimed at promoting agricultural development. Population projections suggest a rising population trend in the state, directly correlating with the expansion of crop farming, which serves as the primary occupation for the inhabitants. Additionally, government incentives and policies, such as farming incentives and the ban on food crops importation, have likely contributed to the proliferation of cropland in the region.

Furthermore, the research identifies Niger State as a potential alternative for herders' settlement development due to its favorable geographical features and agricultural potential. With abundant water resources, including major rivers and reservoirs, Niger State offers opportunities for year-round crop farming through irrigation, making it conducive for the proposed settlement development. The presence of flood plain agriculture and irrigation practices further supports the feasibility of agricultural activities in the region.

Overall, the findings underscore the dynamic interplay between demographic factors, government policies, and environmental conditions in shaping land use patterns and agricultural landscapes in Nigeria. Understanding these dynamics is crucial for informed decision-making and sustainable land management practices in both Jigawa and Niger States. The outcome of the project is a geo-database of all identified suitable locations to situate the new herders' settlement in Northern Nigeria Phase One. This framework could potentially play a considerable role in sustainable development of land use planning and management of future land uses conflict on a long run.

It is intended to lead to the achievement of most of the SDGs particularly, Goal 15 which is to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. It is hoped to assist in combating climate change (Goal 13), promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (Goal 16), among others.

RECOMMENDATION

Certainly! Based on the research findings that emphasize the significant transformation occurring in Jigawa State, Nigeria, and the potential for alternative herders' settlement development in Niger State, several recommendations can be made to address the implications identified in the study.

Firstly, it is crucial for the government and relevant stakeholders to consider sustainable land management practices in the face of expanding crop farming activities in Jigawa State. This could involve implementing land use policies that balance agricultural expansion with the preservation of natural ecosystems. Encouraging agroforestry practices and reforestation efforts may help mitigate the impact of lost forest and shrub areas due to agricultural expansion. Additionally, promoting sustainable farming techniques and efficient water use can contribute to maintaining ecological balance in the region.

Moreover, in response to the potential for herders' settlement development in Niger State, it is important for the government to conduct thorough environmental impact assessments and land suitability studies before implementing any settlement plans. This will help identify suitable areas for settlement development without compromising existing ecosystems and natural resources. Furthermore, investments in infrastructure and irrigation systems should be prioritized to support year-round crop farming, ultimately fostering agricultural sustainability and economic development in Niger State.

Education and awareness programs should also be prioritized to inform local communities about sustainable land management practices, the importance of environmental conservation, and the potential benefits of diversifying agricultural activities. Engaging with local communities and incorporating their traditional knowledge and practices into land use planning can foster a sense of ownership and collaboration, leading to more effective and sustainable land management strategies.

Furthermore, given the interplay between demographic factors and agricultural expansion, there is a need for comprehensive population management strategies that consider the implications of population growth on land use. This could involve investing in education and vocational training programs, and supporting alternative livelihood opportunities beyond agriculture to address population pressures and reduce dependency on cropland expansion.

In conclusion, the recommendations outlined above aim to promote sustainable land management, environmental conservation, and balanced agricultural development in both Jigawa and Niger States. By integrating these recommendations into policy frameworks and decision-making processes, stakeholders can work towards ensuring a harmonious coexistence between agricultural activities, environmental preservation, and the well-being of local communities in the region.

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