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Vegetation Change Detection Analysis in Babura Local Government Area Northwest Jigawa State, Nigeria

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Abstract

This study utilized LandSat TM of 1987, 1997 and 2017 imageries of Babura Local Government Area of Jigawa State, Nigeria. These were integrated into a GIS environment to analyse the vegetation trends pattern of the area using post-classification change detection approach. In-depth interview were also conducted to individuals to explore their perceptions on vegetation and individual trees planting. Findings revealed that there was massive afforestation by relevant government agencies, ministries and parastatals at Federal, state and local government levels. NGOs and individuals also contribute to afforestation. The post Classification imageries indicate that in 1987, 4291.55 hectares of land were vegetated. By 1997 the vegetation trends increase to 7240.18047 hectares of land covered by vegetation. Meanwhile by 2017 the vegetation trends show dramatic increase to about 8356.72 hectares of land covered by vegetation in the area. The study indicates that there is increase of vegetation owing to the number of afforestation programs at various intervals and natural regeneration.

Keywords: Spatial Analysis, vegetation trends, GIS, Afforestation.

INTRODUCTION

Vegetation is a general term for the plant life of a region and a term without specific reference to particular taxa, life forms, structure, spatial extent or any other specific botanical or geographic characteristics (Abdulhakim, Kabiru, Muhammad, 2017). Vegetation involves the species (populations) of the local flora, which in turn involves different genetic, migration, historical or ecological elements (Daura, 2011).

The vegetation is an essential part in the whole geographical environment, and it is responsible for the important task of material and energy exchange between land and atmosphere. People can use remote sensing technology and Geographic Information System (GIS) to monitor and obtain vegetation health status, coverage changes and other related information, so as to study its relationship with the ambient environmental factors and the comprehensive effect. Vegetation research has important implications for the study of global climate change, and it is beneficial in promoting ecological regulation.

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Vegetation diversity is critical to maintaining the health of any ecosystem, and essential ecosystem functions are better when species diversity is higher. Many ecologists are convinced that species diversity is important for the stability and proper functioning of ecosystems (JSME, 1992).

In Nigeria, plant diversity is lost especially along dry forests, which are important sources of natural products such as fruits, foods and resources for medicine. Additionally, natural and man-made threats as well as direct and indirect consequences of socio-economic development have contributed to the erosion of biodiversity at all levels in the country. It is believed that within the last 25 years, about 43% of the forest ecosystem has been lost through human activities in Nigeria (Federal Government of Nigeria, 2001).

Local and international communities emphasized on the importance of vegetation in climate regulation and carbon storage, soil fixation and support of various forms of life. Various studies have been conducted on vegetation notably by Geographers which are more concern with environment as well as other disciplines. Some disciplines concern with vegetation extent and health, foliage coverage, as well as spatio-temporal vegetation studies among others. Danjibo (2015); Arora (2002); FAO (2003); Ezeobi, (2014); Great Green Wall (2015).The aim of this study is to assess spatio-temporal vegetation trends in Babura Northwest, Jigawa State, Nigeria

MATERIAL AND METHODS

The Study Area

Babura Local Government Area lies between latitude $12^{0}38^{I}$N and $12^{0}46^{I}$N as well as longitude $8^{0}58^{I}$E and 9.50^{I}E. The area has a total of 992km^2 and located north of Jigawa State Nigeria near the Niger Republic border. Babura is about 103.8 kilometers southeast of Kantche, Zinder, Niger Republic.

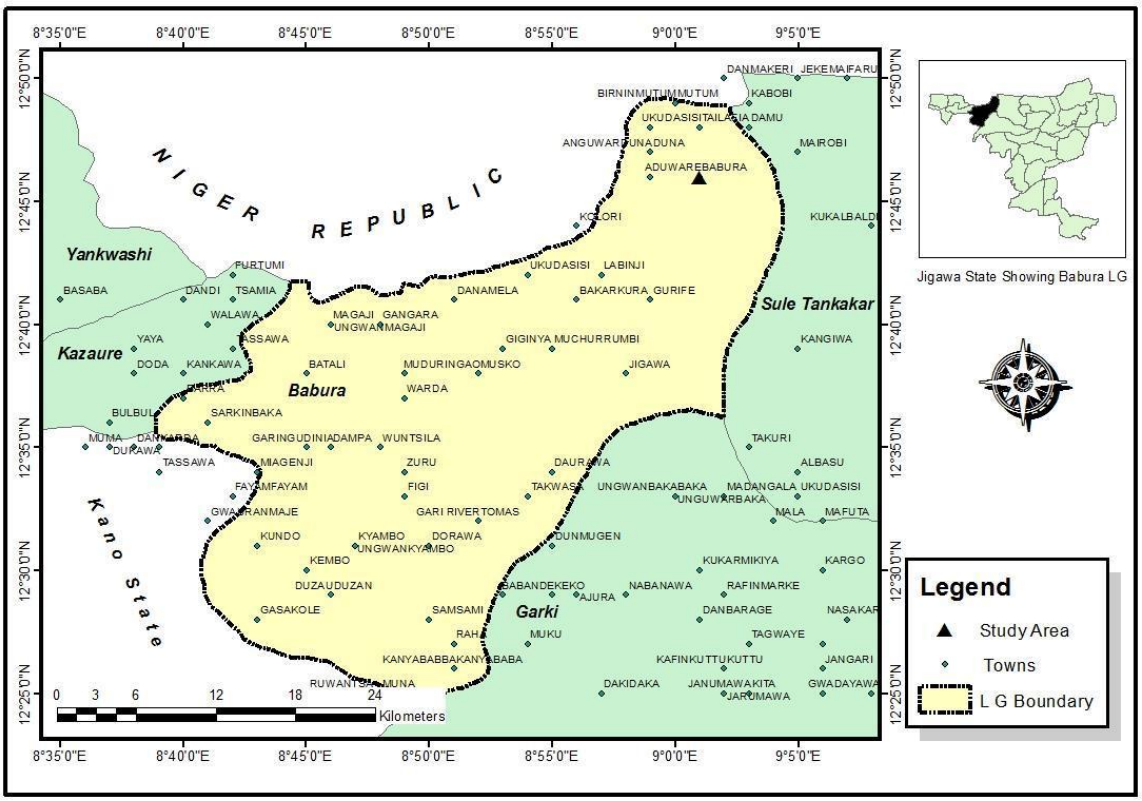

Figure 1: Babura Area, northwestern Nigeria

Source: Adapted from (Abdulhakim et al, 2017)

The study area which has a population of 20,8101 people (NPC, 2006) lies in a climatic zone described as Tropical hot, semi-arid zone with high temperatures (average daily maximum more than 33.5°C). The highest mean maximum temperature (40°C) is recorded during the period March to May, whereas, the lowest mean temperature is recorded in January (33.1°C). The annual average rainfall is about 600mm, while the natural vegetation of the study area is the Sudan Savanna type. Vegetation of the area is typically sparse, comprised of annual and perennial grasses, other herbaceous plants, shrubs, and small trees. (Abdulhakim, Kabiru, Muhammad, 2017).

Babura area is home of farming and livestock breeding. These two livelihood activities are the major economic activities in the area. The dominant crops grown are staple ones including guinea corn and millet.

Methods

The study use both primary and secondary data. The primary data involved the use of ERDARS IMAGINE software version 4.2 which produced classified Landsat imageries. However, personal observations of the natural and man-made vegetation were assessed. The secondary data involved the use of documented records of various afforestation programs at the study area. Review of related journals and documents from Jigawa State Ministry of Environment.

Method of Data Analysis

The following steps were used to analyze all the relevant data for the study:

Table 1: Showing land use classification

CLASSES	
Urban/Built-up	The residential and commercial area made up this class
Bare surface	This includes uninhabited land, mainly desert-like area or features and agricultural lands
Vegetation	This is made up of forest, shrubs, herbs and grasses
Water body	Includes rivers, ponds, streams and water shed.

Source Field Survey, 2019

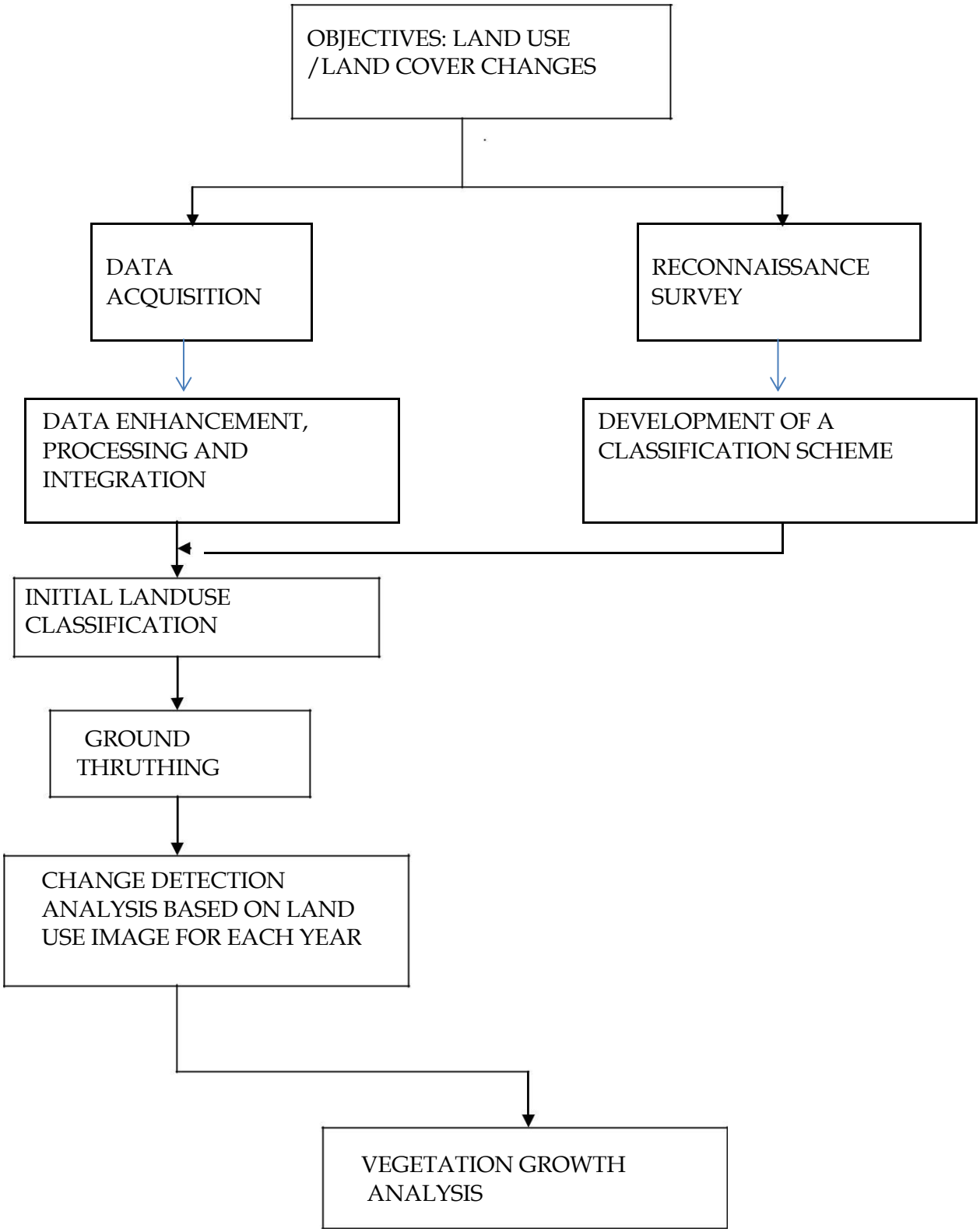

Figure 2: Change detection approach

RESULTS AND DISCUSSIONS

This study utilized Landsat imageries of 1987, 1997 and 2017 to observe vegetation trends in the area.

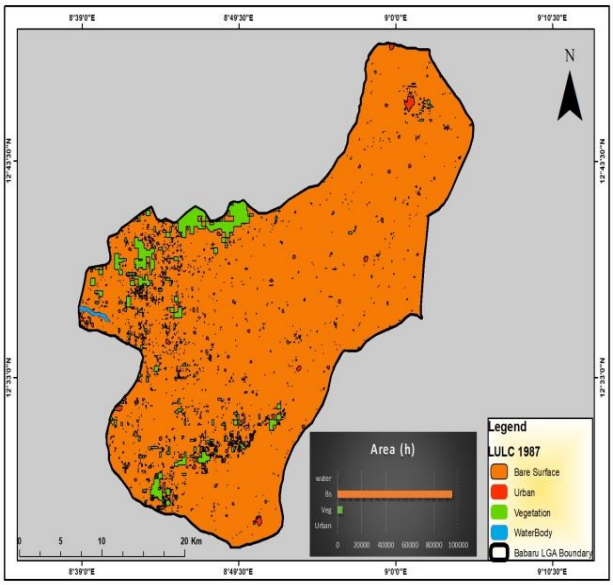

Figure 3a: Classified LandSat TM of 1987 showing vegetation cover of the study area

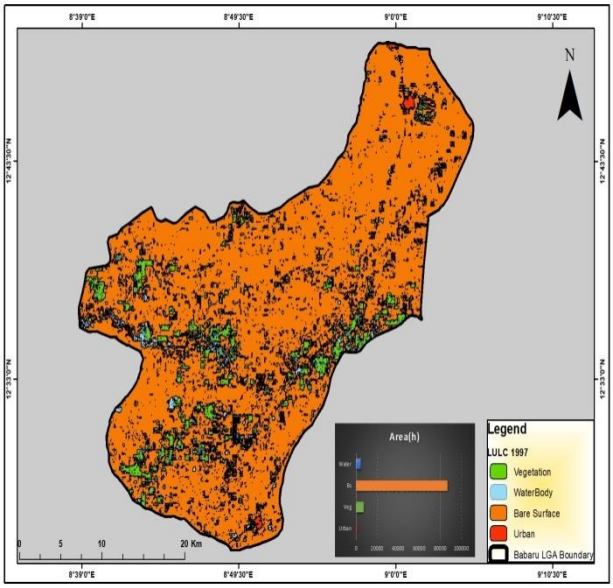

Figure 3b: Classified LandSat TM of 1997 showing vegetation cover of the study area

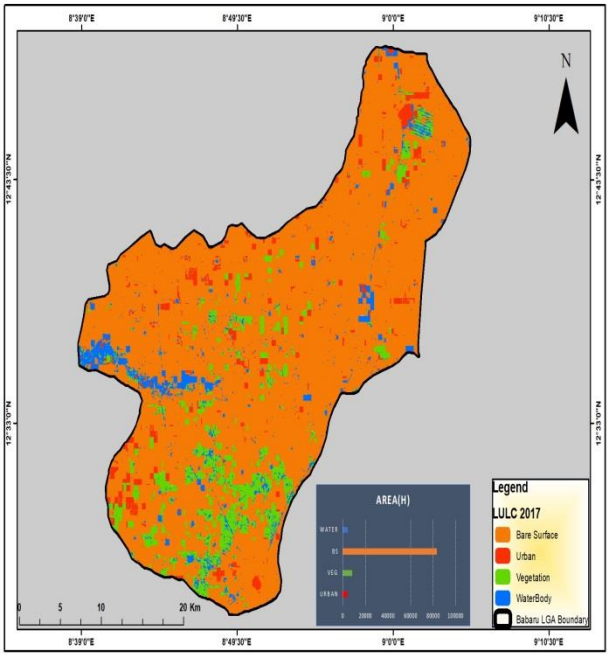

Figure 3c: Classified LandSat TM of 2017 showing the vegetation cover of the study area

Table 2: Trends of vegetation changes

Classes	1987	1997	2017
Urban/Built -up	529.7 hectares	839.32 hectares	4045.22 hectares
Vegetation	4291.55 hectares	7240.18047 hectares	8356.72 hectares
Bare Surface	94985.69 hectares	87134.4 hectares	83227.44 hectares
Water	311.3 hectares	4904.28 hectares	4488.82 hectares

Source: Landsat imageries analysis, 2019

Prior to1987 a lot of afforestation programs have been carried out by the then Kano state and Federal Government of Nigeria to tackle the menace of desertification and fire incidences. Oral tradition revealed that atimes there was a wildfire incidence which engulfed nearby thatched houses there by causing damages to life and properties. Owing to these, government decides to establish shelterbelts to attack the desert encroachments. Therefore, in 1973 the then Kano state government established 20km shelterbelt of neem tree (*Azadirachta indica*) in Babura North, bordering Niger Republic. Subsequently in 1976 at Babura South also 20km of shelterbelts where established made up of *Eucalyptus camaldulensis*. Subsequently the operations continue in 1984 a 10km (*Azadirachta indica*) shelterbelt established at Uku da Sisi a village neighbouring Niger Republic. At Yan Maulu village 20km shelterbelts of *Eucalyptus camaldulensis* was established in the year 1984, 1985 and 1986 respectively.

Meanwhile the program continues in Babura Local Government Area. In Gurfai village 10km, Haladawa and Bule village 30km of (*Azadirachta indica)* tree shelterbelts were established in 1989. 10km of neem tree shelterbelt were also established in Babande by the year 1990 to check the menace of desertification.

However, there was an establishment of forest reserves of about 295 hectares. That is the Muni forest reserve 116 hectares and Jabirawa forest reserve 179 hectares. There was also natural regeneration of various plant species which are not planted by government, either exist naturally or planted by farmers at individual farms especially as farms demarcation.
After the creation of Jigawa state in 1991 there were various programs of afforestation carried out. The most effective and successful is "Jigawa State Afforestation Program" (Second Forestry) (JIGAP II). This program is a world bank assisted program and was responsible for afforestation coverage in Jigawa state till 1996 when the program elapses. The state afforestation program established various nurseries across the state for seedlings production and distribution. In Babura local government area two central nurseries were established namely Babura nursery and Kanya-Babba nursery in 1991.

Table 3: The Central Nurseries Seedling Production of 1992

Nursery	Target Seedlings	Achieved	Distributed Seedlings
Babura	200,000	192,000	192,000
Kanya-Babba	100,000	92,000	92,000

Source: Forestry Department, Babura LGA, 2019

By the year 1992 five community nurseries were also established at various locations of the local government with same seedling production capacity.
The year 1992 recorded the following; distribution of seedlings for shelterbelts, individual and communities planting
62,82,316 seedlings for shelterbelts
6,860 seedlings road side planting
27,439 seedlings for marginal land
32,01 government organizations for planting
180,600,230 individual collections
10,019 NGOs collection
Source: Forestry Department, Babura LGA, 2019

There was also expansion of afforestation in Kanya-Babba Phase C while phase A and B in Babura town.

Table 4: Community Nurseries Seedlings Production of 1992

Community nurseries	Target seedlings	Achievements	Distributed Seedlings
Kafa Ruwa	5000	4000	4000
Bakar Kuka	5000	3000	3000
Unguwar Gawo	5000	4500	4500
Tsamiyar Kwance	5000	4000	4000
Haladawa	5000	3000	30000

Source: Forestry Department, Babura LGA, 2019

By the year 1993, there were a lot of afforestation programs in various schools as indicated in Table 5.

Table 5: Seedlings Productions in School Nurseries, 1993

Location	School	Target	Achieved	Planted seedlings
Babura	GDSS	5000	4160	4160
Babura	GGASS	5000	4000	4000
Kanya-Babba	GSS Kanya	5000	310	310

Source: Forestry Department, Babura LGA, 2019

Natural Regeneration

In the year 1993, 135 farmers were registered on natural regeneration campaign program of Jigawa State Afforestation Program (JIGAP) forestry II sponsored by the World Bank. Farmers were encouraged to embark on afforestation and discouraged deforestation through community campaign and sensitization. Under JIGAP program each farmer was given incentives of four naira for each tree left to regenerate in his farm. These encourage farmers to allow natural regeneration in their farms. After incentives farmers were also given seedling, fertilizer and fencing wire to fence trees in case of plantation at farms. Two hundred naira allowances were also paid for watering in various plots to farmers that accept to do plantation of various tree species. The money was paid by the World Bank (Forestry Department, Babura LGA, 2019)

In the year 1993, an association "Afforestation Participant Help Group, a voluntary organization participated in 1993 afforestation and produced the number of seedlings as shown in table 6.

Table 6: Seedlings Produced by Voluntary Organizations, 1993

LGA	Name of Volunteers	Location	Produced Seedlings	Distributed Seedlings
Babura	Matasa/Youths	Kafa Ruwa	500	500
Babura	Matasa/Youths	Faru Mai Taya	1250	1250
Babura		Haladawa	680	680
Babura	Matasa/Youths	Bakar Kuka	325	325
Babura	Matasa/Youths	Unguwar Gawo	460	460
Babura	Matasa/Youths	Tsamiyar Kwance	320	320

Source: Forestry Department, Babura LGA, 2019

Marginal Land Plantation

By the year 1993, Babura local government gave 2hectares of land for (*Azadirachta indica)* tree plantation which was successful. 1km road side planting was also carried out along Babura-Kano road

In 1994 there was no shelterbelt establishment due to paucity of fund. There was only 1km (*Azadirachta indica*) tree road planting and woodlot plantation at Unguwar Gawo village and marginal land plantation (*Azadirachta indica*) of 3hectares of land.

Table 7: Central and Community Nurseries Seedlings Production and Distribution, 1994

Location	Target	Achieved	Distributed
Babura	20,000	1,500	1,500
Kanya	50,000	45,000	45,000
Unguwar Gawo	5000	4500	4500
Insharuwa	4500	3000	3000
Kafa Ruwa	4800	4123	4123
Litinin Duzau	3900	3600	3600
Kyambo	4000	3000	3000
Manga	4000	3800	3800
Gurfai	5000	2700	2700
S.G Cirimbi	4000	3000	3000
Jarmai	4000	3560	3560
Baba Duro	4000	3500	3500
Jigawa	5000	4900	4900

Source: Forestry Department, Babura LGA, 2019

In the year 1995, there was progress in registration of intending farmers for woodlot plantation and orchard in various farms and plots and massive campaign on natural regeneration and placement of sign board in each farm/plot that accept natural regeneration. The natural regeneration plots/farms amount to a total number of more than 2 million different tree species. From 1995-1996 there were no serious afforestation programs in the study area, only distribution of some seedlings on request to various people, government agencies among others. In 1995 there was plantation of the following plants in Local Government Headquarters

1. Guava 1000 seedlings
2. Eucalyptus cameldalensis 1000
3. Azardiracta indica 2000
4. Acacia nilotica 2,500

Source: Forestry Department, Babura LGA, 2019

Plantation of tree species along mosque and cemetery premises of over of 20,000 seedlings, Young Farmers Club GGASS Babura in 1995 produced seedlings for orchard garden rising more than 10,000 seedlings of Guava, Cashew, Orange and Neem tree.
By the year 1996 some seedlings were produced in various nurseries at different capacities for distribution. A tree campaign program was initiated and executed by Babura Gabas Progressive Association where they planted 3000 *Azadirachta indica* seedlings and 1000 *Acacia nilotica*, subsequently there were no serious afforestation programs.

Table 8: Central and Community Nurseries Seedlings Production and Distribution, 1996

Location	Target	Achieved	Distributed
Kafa Ruwa	1000	800	800
Insharuwa	1000	500	500
Unguwar Gawo	3000	2500	2500
Kyambo	1000	600	600
Kankare	1000	700	700
GGAS	1500	1200	1200
GDSS	1000	500	500
GDSS Jigawa	1000	700	700

Source: Forestry Department, Babura LGA, 2019

By the year 1997-2000 there was no afforestation program only beating up and shelterbelt guard conducted to maintain the available ones.
In the year 2000 the study area began to see improvement in terms of afforestation. At that period the then state government introduced exotic Mangoes from Burkina Faso which were raised in Babura nursery and other three nurseries across the state. A number of seedlings were distributed free of charge for plantation and individual planting. Typical example is at the farm of current governor of Jigawa State 2019, Muhammad Badaru Abubakar. The rest of the farmers that accept Mango plantation in their farms were Alhaji Amadu Mai Yankara, Alhaji Amadu Soja (Dan Namalu), Alhaji Haruna Mai-kanti and Alhaji Sabo Yusuf.

In the year 1991 Babura nurseries produced about 20,000 seedlings of Acacia senegalensis. Due to the effort by the Federal government there were additional 1.3 million seedlings of *Acacia senegalensis* for plantation. However, over 500,000 of indigenous and exotic plants species were produced as shown in table 9.

Table 9: Indigenous and Exotic Plants Raised in Babura

Botanical Names	Local Names
Adansonia digitata	Kuka
Eucalyptus camaldulensis	Turare
Acacia sieberina	Farar kaya
Azadirachta indica	Darbejiya
Butyrespermum pakii	Kade
Balanitea egyptiaca	Aduwa
Anogeissusleiocarpus	Marke
Parkia biglobosa	Dorowa
Piliostigma reticulatum	Kalgo
Ziziphusspina-christii	Kurna
Fadherbia albida	Gawo
Diosphyros mespiliformis	Kanya
Tamarindus indica	Tsamiya

Source: Adapted from (Abdulhakim et al, 2017)

In 2004 there was an establishment of new ministry "Ministry of Gum Arabic and Shelterbelt". Some people gave their farms for Gum Arabic plantation notable among them are;

1. Honourable Adamu Ibrahim 4000 seedlings 10 hectares of land
2. Alhaji Aminu Infor 4500 seedlings 4 hectares of land
3. Ado Abdullahi 3000 seedlings 1 hectare of land
4. GGASS 200 seedlings half hectare of land
5. Alhaji Bature 3000 seedlings 1 hectare of land
6. Alhaji Mutari Director 4000 seedlings 10 hectares of land
7. District head's farms 2000 seedlings 2 hectares of land

In the year 2005, Greet Green Wall (GGW) raised over 250,000 seedlings of *Azadirachta indica* and planted across the border to check desertification. Tree plantation campaign was conducted in 2003 by the Member House of Representatives in which over 3000 seedlings were planted.

In 2008 there was planting campaign coordinated by the self-help organization "Babura Patriotic Movement" which raised and distributed over 50,000 seedlings of Jatropa curcas in plantation and to individuals. 2008-2009 there was road side plantation from Dorai-Kanya-Babba over 1,000 seedlings and Kwanar Garki road side planting of over 1,000 Mahogany seedlings and also Walawa-Tasawa-Babura road side plantation roughly 1,000 seedlings of *Azadirachta indica*. There was also establishment of 10km shelterbelts along Uku da Sisi to Makeri and Aduware, Insharuwa and Botsotsuwa. It also extends to Kwarin-Masko, Gidan-Kanawa, Gangarar-Hanware and Unguwar-Magaji. It also stretches to Unguwar-Ganji, Tasawa, Gidan-Dawa and Walawa villages. There was also establishment of 2km neem shelterbelts in Babura town.

In 2015 there was massive campaign of tree planting and the than Minister of Environment (Amina Jane Muhammad) was in attendance at that time in a village called "Jan Sa" where one shelterbelt of *Azadirachta indica* established and orchard gardens. In that period three shelterbelts were established from Jarmai-Kwabbani to Zanguna 2km of shelterbelts roughly

10,000 seedlings. The other ones were 2km crossing Jigawa state border to Katsina and Niger Republic border, roughly 11,000 seedlings of neem tree. For example in Damu-Garin-Rakumi-Jan-Sa shelterbelts and community orchards, solar powered bore hole was established for pumping and watering plants. The community nurseries and orchards were established to improve the livelihood conditions of the people in the area community.
In 2017-2018 there was road side planting *Azadirachta indica* along major roads in Babura town covering over 16km by a self-help organization (Babura Unity and Development Forum, 2008)

Natural Regeneration
Natural regeneration is the situation whereby woodlands are restocked by the trees that developed from the seeds that fall and germinate in situ. This is the ability of woodland plants to withstand the negative impacts of climate change, drought and rainfall variability and adapt to the environment. Some plants after bush burning sprout again when the natural condition is favourable. Farmers also play a significant role in terms of plants regeneration as the case maybe in the second forestry of Jigawa State Afforestation Program, where each farmer was collecting four naira incentives for a single tree regeneration.

CONCLUSION

The study concludes that there is increase in vegetation in the area. This is indicated by the satellite imageries and a number of afforestation programs that have been carried out in the area. Natural regeneration also plays a vital role in improving the spatial vegetation coverage as well as sensitization to various communities to encourage afforestation and discourage deforestation.

RECOMMENDATIONS

Based on the findings the study recommends the following

1. There is need for the establishment of additional nurseries to produce more seedlings to increase the number of shelterbelts, woodlots, road side planting and individual planting in the study area which is bordering the Sahara desert of Niger Republic so as to check desert encroachment.
2. Employment of permanent and or temporary nursery personnel to work effectively and produce more seedlings as most of them are retired.
3. Continue with sensitization on individual and communal tree planting and agro-forestry in houses, road side and various farms.
4. Encourage planting drought resistant plants such as Azadiracta indica, Acacia spp, among others which can withstand the impacts of drought.
5. Government at all levels should continue with establishment of shelterbelts, woodlots and orchard in various locations across the study area.

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