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# ASSESSING THE NATURE OF FADAMA ECOLOGICAL SERVICES IN BIU PLATEAU REGION OF BORNO STATE

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***Abstract***: *The study examined Fadama ecological services in Biu Plateau region with a view of addressing its types and their locations and proffer measures for improvements. The objectives assessed the types and the locations of Fadama ecological services in the study area. For this study, provisioning, regulating, supporting and cultural services were our major concern. Digital elevation model, sentinel 2 data, Landsat imagery, climate data, geology and soil data all from USGS were analyzed in ArcGis 10.6.The result of the research showed that all the ecological services were found in the study area such as provisioning services were identified in Biu plateau along river Shani, peta, Hawul, Ndivana and Gongola. Food ecological services such as Fruits, Vegetable,and Tubers were also in existence in Peta, Yimirdlalang, Shani, Bargu, also medicinal plants were found in the study area, Livestock rearing were captured along river Briyel, also in the study area includes flood control through plants and grasses were in the study area, soil fertility restoration through decomposition of leaves and grasses, cultural services such water for navigation and plantations around Bayo unveiled the aestheticism of the area. Abundant sunlight for photosynthesis to the plants were identified.*

***Keywords:*** *Nature, Fadama, Ecological, Services.*

## 1.0 INTRODUCTION

The science of ecology is the study of the way organisms interact with each other and with their nonliving surroundings. Ecology deals with how organisms are adapted to their surroundings, how they make use of these surroundings, and how an area is altered by the presence and activities of organisms. These interactions involve energy and matter flow extraction and use (Enger and Smith, 2006); human benefits in a multitude of ways from ecosystem to ecosystem (Gretchen, Alexander, Paul, Larry, Lubchenco, Matson, *et al.,* 1997). An ecosystem is a dynamic complex of plants, animals, and microorganism communities and the nonliving environment, interacting as a functional unit, humans are an integral part of ecosystems (Antonio and Laura, 2018). The ecosystem could be defined as the conditions and process through which natural ecosystems and the species that comprise them sustain and fulfil human well-being (Hassan, Shi, and Zhu, 2020).

Humankind fully depends on the earth's ecosystems and the services they provide, such as food, water, disease management, climate regulation, spiritual fulfillment, and aesthetic enjoyment (Oguh, Obiwulu, Umezinwa, Ameh, Ugwu and Sheshi, 2021). Collectively these benefits are known as ecosystem services. Ecosystem services are regularly involved in the provision of clean drinking water and the

decomposition of waste. Ecological goods and services are benefits arising from the ecological functions of the ecosystem. Such benefits accrue to all living organisms, including animals, plants, and humans.

However, there is a growing recognition of the importance to society that ecological goods and services provide for health, social, cultural, and economic needs (Millennium Ecosystem Assessment, MEA 2005). Ecosystem services are the benefits obtained from the ecosystem (Hele, Kieron, Malcolm, and Kate, 2017, Xin, Sylvie, Luyuan, Pieter, 2019). Ecological services are widespread but each ecological system has its specific services that human society can depend on. Forest ecological systems provide services that are different from water-related ecological systems such as the marshy (Fadama) areas along the rivers and lakes. Ecosystem services also called environmental services or nature's services are benefits provided by ecosystems to humans, which contribute to making human life both possible and worth living (Oguh, Obiwulu, Umezinwa, Ameh, Ugwu, and Sheshi, 2021).

Ecosystem services is the term given to the goods and services provided by a natural modified ecosystem that benefits, sustains, and supports the wellbeing of people, they include the production of food and medicines, regulation of climate and disease, soils production and clean water and landscape opportunities for recreation and spiritual benefits. These services come from an ecosystem made up of a combination of soil, animals, plants, water, and air, it is obvious the variance of these elements differs across the ecosystem from the undisturbed natural area such as tropical forests to highly modified agricultural landscapes. Fadama ecological services are impacted by over-exploitation and unsustainable agricultural practices (United Nation, 2022). The Biu Region in Borno State, Nigeria is significantly endowed with Fadama ecological resources that have the potential to contribute to community development. However, there is lack comprehensive research addressing the specific ecological services provided by Fadama Ecosystem region and their direct impact on community well-being. There is lack of comprehensive understanding regarding the assessment of ecological services and their potentials for community development in the region. The challenges faced by Biu Plateau region, including socio-economic disparities, environmental degradation, and the impacts of insurgency and displacement underscore the need to explore alternatives approaches for sustainable development and community resilience. To address this knowledge gap, it is imperative to carry out this study. The aim of this research is to examine ecological services in Biu Plateau region with a view of addressing types and their locations and proffer measures for improvement. The objectives is to assess the types and the locations of ecological services in the study area.

## 2.0 Location and Extent

The study area lies between latitudes 10° 2′ 33″ and 11° 5′ 53″ N of the Equator and longitudes 11° 31′ 41″ and 12° 35′ 45″ E of the Greenwich Meridian. The region covers a total area of 8,583.88 km2. Biu Plateau occupies 2, 271.09 km2 of the total land of the study area, which is about 27.59% of the study area. The area is bounded in the northwestern part by Yobe State, northeast by Damboa LGA in Borno State, in the west by Yobe and Gombe State, in the south by Adamawa State and in the eastern part by Adamawa State, Askira/Uba and Chibok LGAs in Borno State (Fig. 1).

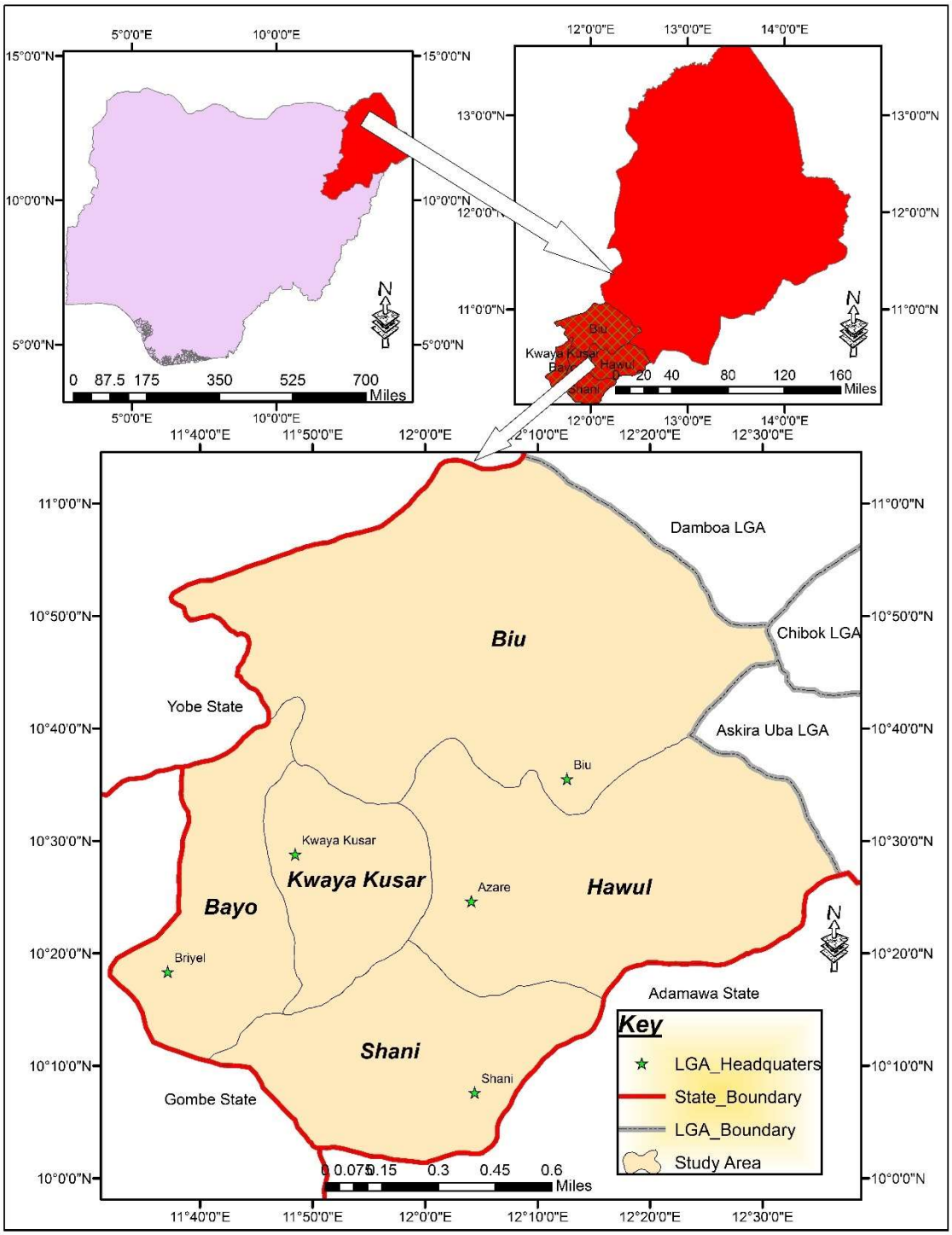


**Figure 1.1. Borno State depicting the Study Area**

Source: Political map digitized from Reference map of Borno State (OCHA, 2017); Biu Plateau generated from SRTM DEM data.

**3.0 Methodology**

Table 1 below summarized the method of data acquired in the field.

**Table 1:Objectives, Data Types, Data Sources and Data Analysis**

| S/No | Objectives | Data types | Data Sourcing | Data Analysis |
|---|---|---|---|---|
| I | Examine the nature of Fadama Ecological services | Surface lakes and rivers, vegetation types, soil units, climate | Geospatial techniques/ field observation and GPS and FGD and GPS for capturing the types and locations of some Fadama services | Linking the coordinates to the generated Fadama areas. |
| ii | analyse the problems associated with the use of ecological services. | Erosion.Receeding of river and flooding. | Geospatial techniques/ field observation | Analyzed with GIS |

**Source: Prepared by the researcher, 2025**

## RESULTS AND DISCUSSION

### 4.1Nature of Fadama Ecological Services

The four major types of ecological services; provisional, regulating, cultural, and supporting were obtained from the study area. The summary of Fadama ecological services, their types, locations, and LGAs within the Biu Plateau region is presented in Table 5.1. The 12 sampled Fadama ecological services from five communities (Briyel in Bayo LGA, Peta, and Yimirdlalang in Kwaya Kusar LGA, Bargu, and Shani in Shani LGA as shown in Table (5.2) all fell within the Fadama sites as shown in Fig. 5.1.

**Table 5.1: Sampled Fadama Ecological Services**

| S/N | X axis | Y axis | Place | LGA | Services |
|---|---|---|---|---|---|
| **1** | 10.0842 | 11.9614 | Bargu | Shani | Provisioning (Irrigation/Water for Cattle) |
| **2** | 10.0946 | 11.9603 | Bargu | Shani | Provisioning (Rice Farming) |
| **3** | 10.0905 | 11.9604 | Bargu | Shani | Provisioning (Domestic Uses) |
| **4** | 10.217 | 12.0617 | Shani | Shani | Provisiong (Fishing) |
| **5** | 10.2169 | 12.0638 | Shani | Shani | Provisioning (Irrigation) |
| **6** | 10.2169 | 12.0637 | Shani | Shani | Provisioning (Sugar Cane Farming) |
| **7** | 10.2258 | 11.9659 | Shani | Shani | Provisioning (Wildfood) |
| **8** | 10.362 | 11.925 | Peta | Kwaya Kusar | Provisioning (Orchard) |
| **9** | 10.3952 | 11.8431 | Yimirdlalang | Kwaya Kusar | Provisioning (Orchard) |
| **10** | 10.3479 | 11.6135 | Briyel | Bayo | Provisioning (Fishing) |
| **11** | 10.3455 | 11.6134 | Briyel | Bayo | Provisionimg (Water for Animal) |
| **12** | 10.3478 | 11.6135 | Briyel | Bayo | Provisioning (Orchard) |

**Source: Field survey (2021)**

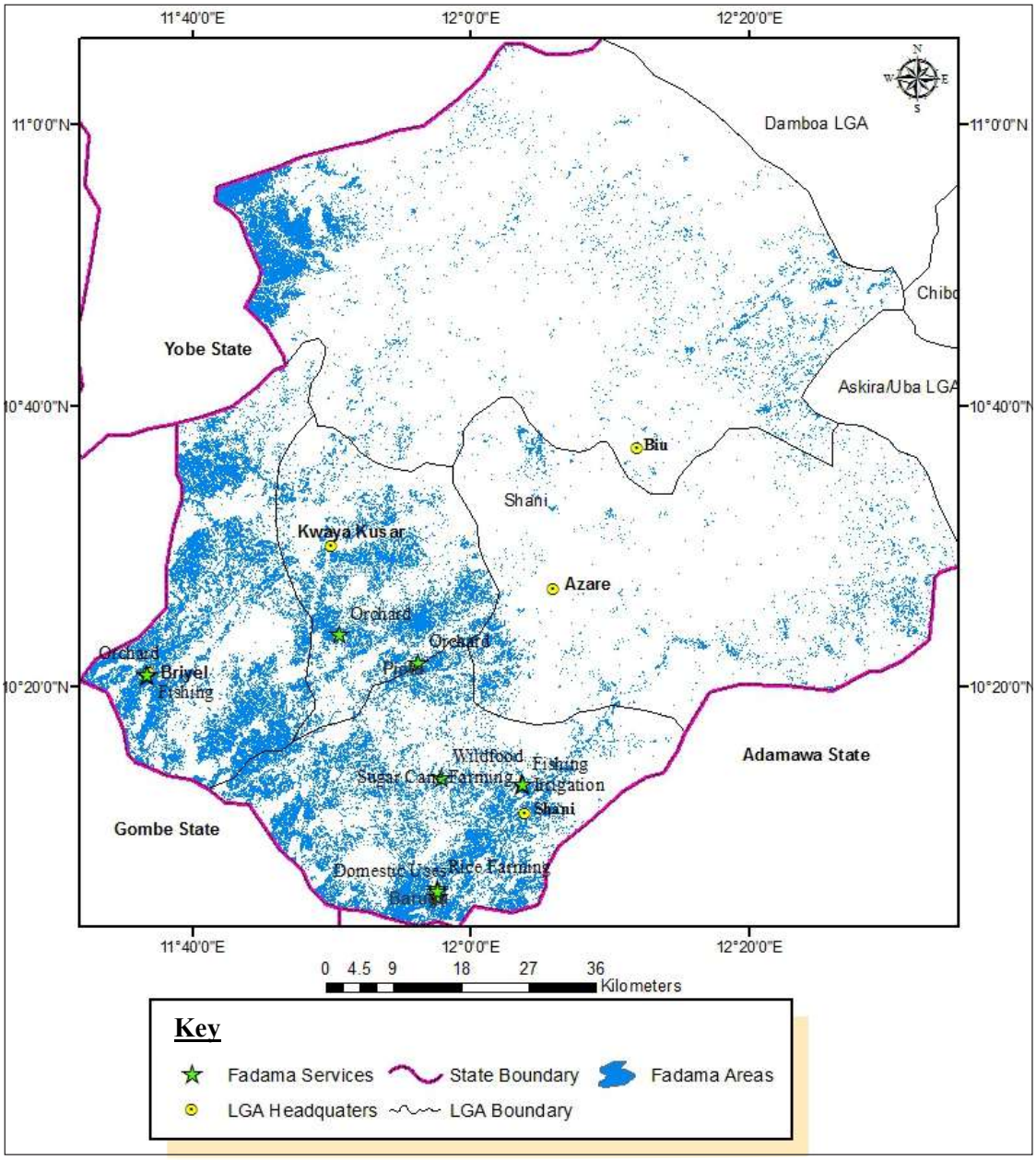


**Figure 1: Fadama Ecological Services**

**Table 2: Inventory of Fadama Ecological Services in Biu Plateau Region**

| Ecosystem Services | Fadama Services | Places | LGAs |
|---|---|---|---|
| **Provisioning Services** | **Water** | | |
| | (i) Domestic Water Supply | Rivers Gongola, Hawul & Ndivana | Bayo, Kwaya Kusar and Hawul |
| | (ii) Fishing | Rivers Gonogola and Hawul | Bayo and Hawul LGAs |
| | (iii) Water for Animals | Rivers Gonogola and Hawul | |
| | (iv) Irrigation | Bargu, Shani, Pieta and Briyel | Shani, Kwaya Kusar and Bayo |
| | **Food** | | |
| | (i) Fruits (Mangoes, Guava, Oranges, Water Melon, Sugar Cane) | Peta, Yimirdlang, Shani, Bargu, Briyel | Kwaya Kusar, Shani, Bayo |
| | (ii) Vegetables (Cabbage, Onion, Pepper | Bargu, Shani, Pieta, Kwaya Kusar | Shani, Kwaya Kusar |
| | (iii) Tubers (Onions, Carrot) | Pieta, Yimirdlalang, Shani, Barugu, Bri yel | Kwaya Kusar, Shani, Bayo |
| | **Medicinal** | | |
| | Herbs, Fruits, Leaves, Grasses, | Biu Plateau Region | Bayo, Biu, Hawul, Kwaya Kusar & Shani |
| | **Livestock** | | |
| | Animal Rearing (Cattle, Goats & Sheep) | Bargu Briyel and the valleys of Rivers Gongola and Hawul | |
| **Regulating Services** | **Environmental Hazards** | | |
| | **Soil Erosion & Flood** | Flood and soil erosion control plants at Gully sites in Briyel, Shani & Kwaya Kusar | Bayo, Shani and Kwaya Kusar |
| | **Soil Fertility Restoration** | Decomposition of leaves, grasses and woods on the soils | LGAs in Biu Plateau Region |
| **Cultural Services** | **Recreation** | Bargu, Bayo | Shani, Bayo, and Hawul |
| | (i) Bargu Irrigation Scheme | | |
| | (ii) Rivers Gongola, Hawul & Ndivana | | |
| .; | **Aesthetics** | | Shani, Bayo, and Hawul |
| | (i) Bargu Fadama vast area | Bargu | Shani |
| | (ii) Mango Plantation | Peta, Yimirdlang | |

**Table 2: Inventory of Fadama Ecological Services in Biu Plateau Region (Ctd)**

| Ecosystem Services | Fadama Services | Places | LGAs |
|---|---|---|---|
| **Supporting Services** | **(i) Water** Domestic and irrigation purposes for man, habitat for fish, support plant growth. | | |
| | (ii) Sunlight Photosynthesis for plants, light to man | Rivers Gongola, Hawul & Divana | Bayo, Kwaya Kusar and Hawul |
| | (ii) Land/Soil Habitat for plants and vegetation, provison of food to man, | Rivers Gonogola and Hawul | Bayo and Hawul LGAs |
| | (iii) Vegetation Harvesting of friuits, tubers and leaves for human consumption, timber harvesting, fuelwood harvesting, medicinal materials, grasses and leaves for roofing | All LGAs in Biu Plateau Region | LGAs in Biu Plateau Region |

**Source: Obtained from Field survey, field observation, personal interview and FGD and FUGs**

The observed ecological services according to their domain as well as their actual positions (obtained through GPS) and the pictures of some samples of the services are discussed in this section.

***Surface Drainage Ecological Services in the Fadama Areas***

Surface drainage in the Fadama region of the study area includes rivers, streams, and ponds. The three main rivers within the Fadama areas are Hawul, Ndivana, and Ruhu. The numerous tributaries to these main rivers constitute the streams in the area. The swampy areas also contain many ponds which

may be natural or man-made. Surface drainage provides numerous ecological services such as the provision of water for domestic activities like drinking or washing ( Plate 3). Fishing activities are also carried out in the area especially at Shani along River Hawul and along River Ruhu at Briyel (Plate 1 & 2). Surface water is also used to irrigate farmland, especially during the dry season. Within the study area, irrigation agriculture is carried out in Shani and Bargu in Shani LGA as shown in Plates 4.7. Godwin and Choji, (2017) have pointed out the role of surface drainage in Fadama in addition to providing a source of water for livestock during the dry season (Plate 4 & 5), also supports large and diverse reside nt or transient wildlife including herbivores, carnivores, and migratory birds. They concluded that Fadama lands are widely used for irrigation farming in the Northern parts of Nigeria. Plates 7

Plate1. Fishing activities in River Hawul at Shani in Shani L.G.A

Plate 2: Fishing activities in Briyel, Bayo L.G,A

Plate 3: Water for domestic purposes at Shani in Shani LGA.

Plate 4: Water Provision for Cattle along River Briyel in Bayo L.G.A

Plate 5: Water Provision for Cattle along River Hawul at Barugu in Shani LGA.

**Soils Ecological Services in Fadama Areas.**

Plates 6 and 7 show some of the soil based ecological services in the area.

Soil is the base of almost all the ecological services in Fadama zones because all other services such as water, vegetation, and agricultural practices depend on the nature of the soil in the area. For instance, in other parts of the world, the soils of the Fadama region in the study area provide water, vegetation, and agricultural services. For instance, the Fadama part of the study area due to its swampy nature of the soils provides water for both humans and animals, enables agricultural practices during the dry season, and also helps in the growth of tree crops. The natural vegetation also provides wild food, fuel wood, and medicinal herbs. European Community, (2006) has emphasized the importance of soils on the ecosystem that soil is the foundation of all terrestrial ecosystems and the agricultural and forestry provisioning services, as well as being the structural medium for supporting the terrestrial biosphere and infrastructure. European Community concluded that the ecosystem services provided by soil are linked to its key functions which include: the protection of biomass, storage, infiltration and transformation of nutrients, substance, and water, provision of habitat, species, and genetic biodiversity, provision of physical and cultural environment for humans and their activities, provision of raw material, carbon storage and cycling, protection of archeological heritage.

The three most important ecological services that are based on soils are agricultural practices, water-related services, and vegetation-based services. Both rainfed and dry-season farming are practiced in the Fadama areas. For instance, the Fadama land in Bargu and Shani in Shani LGA as well as those around Briyel and Kwaya Kussar in Kwaya Kusar LGA are heavily utilized for farming, especially for the growth of vegetables, grains, rice, and sugarcane. River Gongola is a perennial river that provides water for domestic and irrigation agriculture. River Hawul also retains water for longer periods than the other rivers (Plate 1 & 3) like Ndivana which are also utilized for both domestic and irrigation agriculture. The natural vegetation provides wild food for man and animals, fuel wood, regulation of weather, timber, and grasses for roofing and medicinal purposes.

Plate 2: Rice farming in Bargu Town Shani L.G.A

Plate 6: Rainfed Rice farming in Bargu, Shani L.G.A

Plate 7: Rice and Sugar Cane Irrigation Farming in Bargu, Shani L.G.A

The Fadama nature of the area has helped in the practice of both rainfed and irrigation agriculture in the area (Table 5&7). Other related ecological services based on soils are the protection of biomass, provision of habitat, species, and genetic biodiversity, provision of physical and cultural environment for humans and their activities, provision of raw material, and protection of archeological heritage.

**Vegetation Ecological Services in the Fadama Area**

Fadama ecological services from vegetation are numerous within the study area. The following ecological services are derived from natural vegetation as observed during the data collection in the field:

i. Harvesting of fuelwood. The study area is mainly rural where the standard of living is low and many cannot afford modern domestic energy such as kerosene stoves or gas cookers where most of the inhabitants depend on the natural vegetation for their domestic energy. Urban areas that are close to the area like Gombe also obtain their fuel woods from the area, most of the fuel woods are derived from the riparian vegetation along the main rivers within and outside the Fadama area.

ii. Timber for construction. Many of the woods that are used for the construction of houses are derived from the forest and woodland areas of the Fadama. The stem of desert palms is also processed for house construction. (iii) Medicinal Purposes includes; roots, barks, and leaves of some trees used for medicinal purposes. Some grasses, shrubs, and climbers are also used for the same purpose. These trees, shrubs, and grasses are obtainable within the Fadama area such as Shani, Kwaya Kusar, and Bayo with thicker vegetation cover.

iii. The grasses in the savanna are also often harvested for roofing of houses or for making gardens and bans for storage.

iv. Provision of wild foods. Some trees within the Fadama area also provide wild foods for both animals and humans. This service is very important because it provides food in terms of fruits, leaves, roots and wild food. The fruits of the desert palm (Plate 8) are harvested for human consumption.

v. Other Fadama ecological services within the Fadama zones in the area include the provision of natural habitat for animals that are consumed by man, modification of microclimate, windbreaks, and soil fertility through decomposition of leaves, grasses, and woods on the soils. Plate 8 shows the desert palm as an example their leaves and roots provide wild food, and are also used for the construction of houses.

Plate 8: Natural vegetation within the Fadama region in the study area.

The following are some of the ecological services derived from man-made vegetation which were identified in the Fadama region within the study area.

a) Orchards: Orchards are very common almost in all the communities within the Fadama region in the study area. The commonest trees in the orchard are mango trees (Plates 9,10 & 11) because of the resistance to draught as well as the monetary benefits to the owners. Other fruit crops like oranges, guava, plantain/banana, and pawpaw are also planted in the orchards.
b) Woodlots: In Kwaya Kusar and Briyel for instance, neem trees are planted to serve as woodlots for fuelwood supply. The branches of the trees are harvested when they are deemed mature. The trees are highly resistant to draughts and quickly regenerate when they are harvested.
c) Microclimate: The orchards help to moderate the weather, especially during the dry season when the weather is hot and unbearable. The inhabitants of this period spend most of their time under the trees because of the cool breeze that is derived from the trees.

Plate 9 Mango Plantation at Peta village, Kwaya Kusar LGA

10: Banana/Plantain Plantation in Yimirdlalang, Kwaya Kusar L.G.A

Plate 11 : Mango plantation in Briyel, Bayo L.G.A

## 5.1 Conclusion

In conclusion the research examined the types and the locations of Fadama ecological services in the study area and assessed the problems of ecological services. For this study, provisioning, regulating, supporting and cultural services were identified. The result of the researched showed that all the ecological were found in the study area such as provisioning services were identified in all part of Biu plateau along river Shani, peta, Hawul, Ndivana and Gongola. Food ecological services such as Fruits, Vegetable, and Tubers were also in existence in Peta, Yimirdlalang, Shani, Bargu, also medicinal plants were found in the study

area, Livestock rearing were captured along river Briyel, also in the study area includes flood control through plants and grasses were in the study area, soil fertility restoration through decomposition of leaves and grasses, cultural services such water for navigation and plantations around Bayo unveiled the aestheticism of the area. Abundant sunlight for photosynthesis to the plants were identified.

5.2 Recommendations

The area with ecological services has been air marked in Biu plateau region for the users to make use of it judiciously.

The government should safeguard the area for benefit of the immediate community in the state.

The fadama users should explore the ecological services potentials for economic development.

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