

# Analysis of Ecological Services in Jere Bowl, Jere L.G.A of Borno State

# Mohammed Musa

Department of Urban and Regional Planning, Ramat Polytechnic Maiduguri Musajoda7@gmail.com

## Shettima Baba Shehu

Department of Urban and Regional Planning, Ramat Polytechnic Maiduguri shettimababshehu@yahoo.com

## Mohammed Danladi

Department of Urban and Regional Planning, Adamawa State Polytechnic Yola lawandanladi@gmail.com

**Abstract:** The study examined various ecological services in Jere bowl, being an ecological zone, in Maiduguri. The nature and characteristics of the ecological potentials were identified and analysed to understand the challenges faced by farmers and possible limitations that were encountered. Data on topography and water resources was collected from USGS comprising Digital Elevation Model (DEM) and Landsat imagery. Questionnaires was also designed and administered to Fadama farmers. ArcGIS 10.6 was utilised to analyse the DEM and Landsat imagery to obtain the nature of the terrain, water resources and vegetation covers of the area. Also, special package for social sciences (SPSS) were used to collate and analyse the data from the questionnaire. Descriptive statistics was run at first and Pearson's correlation was also run to understand the relationship between ecological services and achieved development and problems faced. It was found out that there is abundant water resources to boost ecological services for Fadama agriculture. Provisional services and economic development constitute 40.3% and 71.1% respectively, are prevalent in the study area. Inaccessible credit facilities, inadequate fertilisers are the major problems faced. Also, an increase in ecological services was found to be associated with an increase in the types of goods and services benefited, development achieved and problems identified. It was recommended that effective credit facilities be established, mechanised agriculture, infrastructure provision and established of Agric extension services will help foster ecological services in the region.

*Key words:* Services, Fadama Agriculture, Jere Bowl, Potentials, Water resources

#### 1.0 Introduction

The science of ecology is the study of the way organisms interact with each other and with their non-living surroundings. Ecology deals with the ways in which 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 extraction

and use (Enger and Smith, 2006). Humans benefit in a multitude of ways from ecosystem to ecosystem. Ecosystem as a dynamic complex of plant, animal, and microorganism communities and the non-living environment, interacting as a functional unit, humans are an integral part of ecosystems" (Antonio and Laura, 2018).

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 ecosystem (Hele, Kieron, Malcolm and Kate, 2017, Xin, Sylvie, Luyuan, Pieter, 2019). Ecological services are widespread but each ecological system has its own 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.

#### 2.0 The study area

The Jere Bowl is located in Jere local government area. It is found some 15 kilometers northeast of Maiduguri and covers 15,000 hectares of land. It was originally a region of swampland fed by the Ngadda River. Like other wetlands, it has an integrated farming system (rice), fishing and pastoral economy. The extent of Jere bowl starts from Matakainari in the south to Goniri Amina in the north and from Zabarmari in the west to Koshebe in the east. The bowl extents to three local government Area which include Jere, Konduga and Mafa. The bowl is divided into two of which the first half in south west is in Dusuman and Khaddamari all in Jere and the second half is in Azaya Musari and Masu Lawanti in Mafa Local Government Area of Borno state.



Fig 1. Jere Bowl, Jere LGA, Borno state

## 3.0 Material and Methods

## 3.1 Population

Jere is a local Government Area of Borno State, and the local government headquarter is Khaddamari. It has an area of 868km2 and a population of 211,204 (NPC, 2006) census. Jere comprises of twelve wards, which include. Mashamari, Balle Galtimari, Alau, Ngomari, Khaddamari, Dusuman, Gongulan, Maimusari, Tuba, Old Maiduguri and Zabbamari. Most of the settlements are encapsulated within the bowl. The Borno State Fadama Coordination Office (2017) have a record of 1500 Fadama farmers within the bowl. The major ethnic groups are Kanuri and Shuwa-Arab. Others includes Hausa, Bura, Fulani, and many immigrant settlers from

within and outside Nigeria (BOSADP, 2008). The people engage in agricultural practices such as livestock rearing, fadama farming and fishing, taking advantage of the vast ecological resources present.

#### 3.2 Sampling and Sampling procedure

There are a total of 1500 Fadama farmers in Jere bowl. Since the study is focused on Fadama farmers the sampling will be drawn from this population. Using Taro Yamane (1969), a confidence interval of 95% and an error margin of 6 was utilized. This obtained a total of 210 samples (calculation done in https://surveymonkey.com/mp/sample-size-calculator/). Simple random sampling technique will be employed in selecting the samples to be used for this study. The choice of this method is based on the composition of Fadama Users Group (FUGs) and as well as the number of settlements in Jere Bowl. Two hundred and twenty-seven (210) respondents will be selected randomly from the Fadama users in the study area. A total of 201 questionnaires were retrieved after administration.

#### 3.3 Types and sources of data

Two types of data will be collected for this study. Primary data consisting nature and characteristics of Fadama agricultural practices, problems associated and existing efforts towards ameliorating the problems. Secondary data will be collected also from various repositories. These are shuttle radar topographic mission (SRTM) data, Landsat 8 ETM imagery from United State Geological Survey USGS, sentinel 2 imagery and open street map (OSM) data, and literatures for review. The data required from the secondary sources will be nature and characteristics of ecological potentials within the bowl. This includes the water bodies, vegetation cover, agricultural land, relief amongst others.

#### 3.4 Method of Data Collection

Data for this study will be mainly gathered from primary sources. The primary data will be collected from Fadama farmers in the area using structured and pre-tested questionnaires as Sarantakos (1997) asserted that questionnaire is the leading method of data collection. The secondary data will be collected in two folds, via remote sensing and review of literatures from different authors. These are Landsat imagery, Shuttle Radar Topographical Mission (SRTM) and Digital Elevation Model (DEM) on one hand and journal, Newspapers, magazines and other related literatures on the other. The questionnaire will undergo passive validation before released into the field to ensure the right data is collected.

#### 3.5 Method of Data Analysis

The data to be collected from the various sources will be collated and analyzed using descriptive statistics. The descriptive statistics encompasses percentages, frequency

distribution, charts, graphs will be employed to do the analysis. Collected data will be analyzed with the aid of ArcGIS 10.6.1 as different layers. All data sets that esri shapefiles format will be charted automatically. DEM will be processed to show relief potential, water potential in the area and landuse landcover. Special Package for Social Scientists (SPSS) will be utilized to collate and analyse the questionnaire generated data. Descriptive statistics will be employed to run this data.

#### 4.0 Results and findings

4.1 Potentials of Jere bowl

#### 4.1.1 Water resources

Jere Bowl happens to be the drop point of the two alternating rivers within Maiduguri (Ngadda and Ngadda-bul). For this reason, farmers have over the years utilised these opportunities for Fadama agriculture. Since the water cannot proceed beyond the spread-out area it has served as the life-force for the area retained and dormant.





Fig. 1: Map of stream category in Jere Bowl, Maiduguri.

Fig 1: Length of Stream category in Jere Bowl, Maiduguri

The smaller stream category dominates the study area covering the longest distance. They cover a total of 1768.995km. the main and intermediate streams, having the major carrying capacity for water resources in the area have a total length of 225.641km. The drainage density (total stream length per unit area) for the entire study area is 1.05km/km<sup>2</sup>. This is an indication of abundant surface water resource in the study area which is a major potential for Fadama agriculture.

## 4.2 Vegetation resources

By virtue of the characteristics of the study area having abundant surface water resource, has contributed tremendously to the increase vegetation cover being an indication fertile agricultural land.

Land cover	Area (km²)	%
Built Up	123.36	6.49
Forest	925.50	48.71
Sparse vegetation	27.67	1.46
Grassland	439.58	23.13
Bare ground	240.31	12.65
Water Body	143.68	7.56
Total	1900.10	100

Table 1: Land cover of Jere Bowl, Maiduguri

A total of 6.49% and 12.65% are built-up and Bare ground covers respectively. This indicates that the area is not just in the town's fringe but not suitable for developmental purpose. This is the reason agricultural activities are more pronounced. Given a swarming 48.17% and 23.13% as forest and grassland covers also indicates the potential of an all-year-round agricultural practice. Water bodies on the other hand covers 7.56% being another potent resource for farming activities.



Fig 2: land cover Distribution of Jere Bowl, Maiduguri

4.3 Relief and catchment

Another major complimenting factor for potential resources in Jere bowl is the relief and nature of the watershed catchment (Nyanganji, 1994). Jere bowl is characterised by a gentle slope towards the north eastern part. This has contributed to the retention of water resources in the area.



The slope ranges from 292 meters a.s.l to 312 metres a.s.l. the major agricultural activity area lies between 297 metres and 301 metres. This covers a vast area in conjunction with a gentle slope contributing to retarding continues sediment deposition. This region also houses the main watershed catchments in the study area accounting for the main stream categories. There are four catchment all together in the study area. The main catchments are catchments 1 and 2 covering areas of 889.51 km<sup>2</sup> and 744.06km<sup>2</sup> respectively.

Fig 3: Relief of Jere bowl.



Fig 4: Watershed catchment of Jere bowl

Nature, characteristics and problems of ecological services in Jere Bowl

Table 2: Ecological Services Available

Ecological Service	Frequency	Percentage
Provisioning services	81	40.3
Regulating services	40	19.9
Supporting services	24	11.9
Cultural services	14	7.0
Provisioning/regulating services	36	17.9
Supporting/cultural services	6	3.0
Total	201	100

Source: Field survey, 2022

Table 2 showed that provisioning services constituting 40.3% is dominant in Jere Bowl. Regulating, Supporting and provisioning/regulating services constituting 19.9%, 11.9% and 17.9% respectively are predominant while cultural and a combination of supporting and cultural services are less present. This indicates that farmers have better access to items needed for Fadama farming in the area.

Table 3: Types of Goods and Services Benefitted

Benefits	Frequency	Percentage
Health need	55	27.4
Social needs	40	19.9
Cultural needs	24	11.9
Economic needs	82	40.8
Total	201	100

Source: Field survey, 2022

Table 3 showed that economic needs constituting 40.8% are more catered for. This is an indication that more economically-inclined supports are made for farmers. Health needs

comprising 27.4% regarding farming activities and the farmers are require attention and improvement so as to achieve sustainability. It is also clear that cultural and social needs constituting 11.9% and 19.9% are somewhat neglected as it serves a important role in the physical, economic and social development for Jere Bowl.

Table 5: Type of Development Achieved

Benefits	Frequency	Percentage
Economic development	143	71.1
Social development	20	10.0
Environmental development	18	9.0
Educational development	20	10
Total	201	100

Source: Field survey, 2022

From the table above, 71.1% agreed to economic development being the dominant form of development achieved in Jere Bowl. Social, environmental and educational development achieved 10%, 9% and 10% respectively. This indicates that other crucial development that will serve as support and protection in the study area has been given little attention.

Table 6: Problems deterring ecological services

Variable	Frequency	Percentage
Inaccessible to credit facilities	87	43.3
High cost of agrochemicals	48	23.9
High cos of fertilizer	44	21.9
Inaccessible to seedlings	8	4.0
High cost of labour	10	5.0
High-cost transportation	4	2.0
Total	201	100

Source: Field survey, 2022

From table 6, inaccessible credit facilities constituting 43.3% was agreed to be the major impediment towards effective ecological services provision in Jere Bowl. High cost of agrochemicals and fertilizers constitutes 23.9% and 21.9% respectively of the problems of ecological services. Sundry/logistics issues comprising inaccessibility of seedlings, labour and transportation costs constituting 4%, 5% and 2% respectively are less effective as problems. This indicates that the major problems of ecological services in Jere Bowl are economically-inclined.

		Ecological services Available
Types of goods and services benefitted	Pearson Correlation	.207**
	Sig. (2-tailed)	.003
	Ν	201
	Sig. (2-tailed)	
	Ν	201
Type of development achieved	Pearson Correlation	015
	Sig. (2-tailed)	.834
	Ν	201

Table 7: Correlation between benefits obtained, development achieved and ecological services.

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Table 7 showed that the correlation analysis at p=0.01 revealed that there is a weak positive correlation between goods and services benefited and ecological services with correlation coefficient r=207. There is also a weak correlation between development achieved and ecological services with correlation coefficient of r=201. This indicates that an increase in the goods and services obtained is found to be associated with an increase in the ecological services. Similarly, an increase in development achieved is also found to be associated with an increase in the increase in ecological services.

		Ecological Services Available
Problems of Ecological Services	Pearson Correlation	.157 <sup>*</sup>
	Sig. (2-tailed)	.026
	Ν	201
	Sig. (2-tailed)	
	Ν	201

Table 8: correlation between ecological problems and ecological services

\*. Correlation is significant at the 0.05 level (2-tailed).

From table 8 above, it showed that the correlation analysis at p=0.05 revealed that there is a weak positive correlation between associated problems and ecological services with correlation coefficient r=157. This indicates that an increase in the associated problems is found to be associated with an increase in the ecological services in Jere Bowl.

#### 5.0 Discussion and Conclusion

Jere Bowl is a strategic location being a wash-end of the rivers Ngadda and Ngadda-bul. This has aligned it with abundant water resources conforming with Umar and Usman (2013). The main stream of the area which covers a length of 225.641km serves as the major supply point which has rendered the area suitable for agricultural activities. Another 72.3% of the area is natural vegetation comprising forest, grassland and sparse vegetation. Such areas are found to have large catchments that will as pointed by Waziri (2009). Jere Bowl has two major catchments that serve as a major collection for abundant water supply as support especially for Fadama agriculture.

As a result, there has been a heavy representation of different ecological services due to the abundant water resources. Provisional, regulating and support services dominate the ecological services present, accounting for economic, health and social benefits enjoyed by the community members. There major challenges are less access to credit facilities, high cost of fertilisers and other agrochemicals which conforms with Sukdev, Wittmer & Miller, (2014) and Lijuan, Hua, Zhi, Lei, Brian, Ruonan, Cong & Linqian, (2019).

Lastly, it is observed that the effectiveness of ecological services give rise to a tremendous increase in goods and services and the general development of the area. It is clear therefore

that Jere Bowl being a potential is suitable for the development of ecological services for the betterment of the region and its environs.

Recommendations

- 1. Suitable credit facilities should be made available for farmers. This should be done in conjunction with both local and state authorities for swift and inclusive delivery. It should also be participatory ensuring farmers guild are major stakeholders in the scheme.
- There is also a paramount need for mechanised agriculture to boost ecological services. The farming type are already at a subsistent level which doesn't have a considerable harnessing of the services.
- 3. As a strategy to foster adequate development for rapid functionality of the services, infrastructures have to be provided. A major infrastructure required for this are enough access roads to connected key sensitive areas within the region.
- 4. Agricultural extension services should be established the area to support and boost the effectiveness of ecological services

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