Geographical Distribution of Kumadugu-Yobe River Basin Wetlands

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Abstract

Understanding the availability and distribution of wetlands is key to conservation, exploitation and better management of wetlands resources. The wetlands of Kumadugu-Yobe river basin are widely spread within the sedimentary formation beyond the famous Hadejia Nguru wetlands. This study identified and map out the spatial distribution of KYRB wetlands using field observation information, the basin base map, the topographical map and high resolution Google image and Advance very High Resolution spectroradiometer (AVHRS) NDVI (Normalized Vegetation Differncial Index) data of 2018, in mapping the wetlands spatial distribution pattern. The findings of the study classified the basin wetlands in to flood plain along the river banks, surface depressions ponds and Oasis. The basin wetlands are spread all over the sedimentary geological formation of the basin. The wetlands of the mid and downstream parts of KYRB are largely spread along river Yobe, river Kumadugu-Gana, small tributaries (Alaraba, Damaturu, Budum-Gana among others), famous Hadejia-Nguru wetlands, Oases at the northern parts of the river Yobe and isolated pockets of ponds. The study recommended for effective geo data base for the wetlands.

Introduction

Wetlands are hydrological buffers found in almost all geographical regions of the world including dry climatic regions. They cover 3.5 million km^2, which constitute only 6% of earth's surface, (Zhangyu, Zongming, Dianwei, Kaishan, Lin Li, Mingming, and Zhi 2014; Shepherd, Wilkinson and Thompson 2000). They are among the most productive ecosystems in the world compared to rain forests and coral reefs (United State Environmental Protection Agency 2016). They play a key role in ecosystem service provisions and function to human livelihoods, biodiversity and ecological stability as well as energy regulation, (Nathan, 2006; Spence, Guan, and Phillips 2011). Empirical evidences reveal that the economic value of wetlands ecosystem services is seven times higher than that of rain forest ecosystem, (World Wide Funds for Nature 2004).Wetlands had been used for crop production for very long human civilization history, with crop fields on river floodplain soils and rice fields as major examples (Verhoeven and Setter 2010). According to United Nations Environment Programme (2010) "Since Africa's water resources are so vital to basic livelihoods and economic growth on the continent, an improved understanding of its availability, distribution and limitations is crucial for its better management". Thus, a need arises for understanding the availability and distribution of Kumadugu-Yobe basin wetlands. The attention of scientific research and decision makers on KYRB water resources largely focus on Hadejia-Nguru wetlands. Little is known on other wetlands site of the basin. The recent conceptual difination of wetlands by Several Scholars and International bodies attempted Wetlands definition, thus most definitions cantered around unique moisture zone or hydrological buffer (Ramsar Convention on Wetlands, 1971; Cowardin and Francis, 1979; Moore, 2008; Ramsar, 2010; Ramsar, 2011; Tiner, 2016; United State Environmental Protection Agency, 2016).

Taking the Ramsar (2010) and USEPA (2016) definitions into consideration, the wetlands in this study include the flood plain along river channels, the isolated surface depressions where water covers the soil,

or is present either at or near the surface of the soil all year or for varying periods of time during the year, irrigated land, oasis, riparian vegetation, permanent marshes, water bodies with or without aquatic plants and seasonal wetlands. Thus, a need for a blue print to provide a spatial distribution of the wetlands for conservation and general water resource planning. Therefore it is against this back drop that this study identified and mapped the spatial distribution of KYRB wetlands.

Theoritical/conceptual Frame

The concept of “Wetlands” came up in an attempt to group marshes, swamps, bogs, floodplains, e.t.c that have been well-known terms for centuries, Cowardin and Francis (1979). Several Scholars and International bodies attempted Wetlands definition, thus most definitions cantered around unique moisture zone or hydrological buffer. The diversity in types and functions of wetlands as well as spatial variation is the major limitations in coining a comprehensive definition of wetlands. Thus it’s possible to define wetland, but single definition cannot incorporate the diversity of wetlands types that exist, (Moore, 2008). Therefore according, Tiner (2016) Wetlands is a generic term for all the different kind of wet habitats, where the land is wet for some time not necessary permanently wet. Wetlands have been defined for specific purposes, such as research studies, general habitat classification, natural resource inventories.

One of the early attempts of wetland definition is that of Cowardin, Francis, and Edward, (1979) that defined wetlands as lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Among the recent definitions of Wetland concept is that of United State Environmental Protection Agency (2016), that wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. While Clean Water Act Section 404 defined wetlands as “Area inundated or saturated by surface or groundwater sufficient enough in supporting a prevalence of vegetation typically adapted for life in saturated soil conditions”. Ramsar Convention on Wetlands (1971) produced an international, intergovernmental treaty which defined wetlands. Article 1 states that wetlands include" areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" The 1971 definition was later expanded in 2011 Article 2 the area of land covered by this treaty was later expanded, providing that wetland areas “ may incorporate riparian and coastal zones adjacent to the wetlands and islands” (Ramsar 2011). The Ramsar Convention (2010), defined wetlands as a “wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves, and seagrass beds, but also coral reefs and other marine areas no deeper than six metres at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs”

Study Area And Methodoogy

STUDY AREA

Geographically, Kumadugu-Yobe basin is located approximately between latitude 10°N to 14°20'N and 7°25E to 13°E. The basin has a total area of 145 833Km^{2}. The Hydrological boundaries of the Basin traverse the States of Kano, Jigawa, Bauchi, and Yobe and to a lesser extent, Plateau, Kaduna, Katsina and Borno in Nigeria and Diffa region in Niger Republic (Tanko 2014). With a combined catchment area of 148,000 km2 shared between Nigeria (north-east) and Niger (south-east). Fifty seven percent (57%) of basin area is in Nigerian territory covering 84,138 km2 (International Union for Conservation of Nature, nd). The basin is bordered by Agadez region of Niger Republic to the North, Damagaram region of Niger Republic; Katsina and Kaduna states of Nigeria to the west, Bauchi and Plateau states to the south and Gombe state; southern Yobe state and Borno state to the east. The map of the basin is show in Fig. 1.

METHODOOGY

Data used and source

Data Used	Source
2018 high resolution google image	Pro4.4 google earth software
March 2018 AVHR NDVI data	USGS website
Basin base map and Topo-map	KYRB Authority
Ground truething information and Phographs	Field observation

Data analysis

This study used high resolution google image covering the study area, Kumdugu Yobe river basin map and DEM (digital Elevation Model) map of West Africa in mapping the wetlands. The imagery and maps were geo-reference to Clark 1880 UTM (Universal Tranverse Mocato) projection Minna Datum. The basin boundary was sub-set from the imagery. The DEM map and drainage maps were over laid on the imagery. The wetlands were identified base on vegetation, soil color and surface water. The analysis was carried out in QGIS software environment.

Results/discussion

Spatial Distribution of Kumadugu-Yobe River Basin (KYB) Wetlands

The findings of this study revealed that wetlands of KYB are largely concentrated within the sedimentary formation of the chad basin. The wetlands are predominantly spread along river Yobe, Kumadugu-Gana, small tributaries, famous Hadejia-Nguru wetlands, Oases at the northern parts of the river Yobe and isolated pockets of ponds, as it can be seen in fig 2, plate 1 and plate 2. The wetlands fall within the

political boundries of Borno, Yobe, Bauchi, Jigawa and Kano States within Nigeria. Some of Oases of Northern part river Yobe largely falls within the Diffa region of Niger republic. The concentration of the wetlands is largely within the sedimentary formation of the basin, where the relief is below 400m above sea level.

Hadejia-Nguru wetlands which include Nguru Lake, Marma channel complex, Dagona water sentinary are the major hydrological land mark of the basin, which is one of the Ramsar Convention on wetlands sites. The Nguru wetlands is formed by river Hadijia, Jamaare and Budum Gana seasonal flooding. The vast wetland site stretched from Auyo and Kafin Hausa local government areas of Jigawa State to Nguru, Bade, Karasuwa and Jakusko Local Government Areas of Yobe state. This confirmed the report of Blench (2013), that Hadejia-Nguru wetlands falls principally within Jigawa, Yobe and Bauchi States. As it can be seen in plate 5.1, the wetland is a vast jewel in a dryland ecosystem. Map showing the spatial distribution of the KYRB wetlands is presented in Figure 2.

Riparian wetlands are formed along the river bank of river Yobe and its tributaries. The vast flood plain wetlands of river Yobe are largely concentrated at Baderi communities (Dachia, Dagona, Girgir, Gashua and so forth), as it can be seen in Figure 2. After Gashua town, the wetlands form a linear pattern along the river bank up to Lake Chad. Thus there are larger concentrations at Gaidam and Abadam Local Govermnet Areas of Yobe and Borno State respectively. The flood plain wetlands are formed from seasonal flooding but the flood water dry within 3-4 months after the rainfall cession, as it can seen in Plate 3. Thus flooded areas harbour green plants and irrigated crops. Plate 2 and 3 present the flood plain wetland during rainy season and dry season respectively.

The flood plain wetlands of river Kumadugu-Gana are largely concentrated between Zidiwa village of Bauchi state and Dapchi town of Yobe State. The flood plain wetlands along river Kumadugu-gana form on crossing the geological divide between Keri-Keri formation and Chad sedementry formation. The wetlands along this river stretch from Gamawa Local Government Area of Bauchi state and narrowed along few meter around river bank buffer after Dapchi, as it can be seen in Figure 2.

The surface depression wetlands are the widely spread type of wetlands at the down stream part of the basin. They form by small surface flow around the pond. The relative flat terrain of the area enables the formation of the wetlands types. One of the surface depression wetlands site is presented in plate 4

The wetlands distribution map in Figure 2 and 3, revealed that the dry river that has its source from Zandar high lands in Niger republic and flows through Nguru wetlands joins river Yobe at Gaidam also has some wetlands along it banks. The drying of Zandar river affects the continuous flow of river Hadejia beyond Nguru. Oases are formed along the bank of the dry river as it can be seen in Figure 2. The Oases are largely spread at the Northern part of Yobe State and Diffa region of Niger republic. The larger concentration of the oases are within the political boundry of Niger republic specifically Gudumaria Distric of Diffa region. The most prominent Oases sites within the Nigerian boundry includes Tulotulo, Kaska, Sosono, and Maimalari among several others. Some schoolars refer these Oasis as Manga grassland Oasis. Plate 5 present the image of Tulotulo wetland site at Yusufari Local government area of

Yobe state. Although previous studies on wetlands of KYRB largely focused on Hadejia-Nguru wetlands. The Oasis as part of the basin hydrological land mark was under reported.

Conclusion

The study revealed that, although Hadejia-Nguru wetlands are the hydrological landmark of KYRB, the basin wetlands are spread all over the sedimentary geological formation of the basin. The wetlands of the mid and downstream parts of KYRB are largely spread along river Yobe, river Kumadugu-Gana, small tributaries (Alaraba, Damaturu, Budum-Gana among others), famous Hadejia-Nguru wetlands, Oases at the northern parts of the river Yobe and isolated pockets of ponds. Therefore there is need for a compressive geo data base of the wetlands and also the focus of the decision maker and scientific research beyond Hadejia-Nguru wetlands.

References

1. Cowardin, M.L., Francis, C.G. and Edward, T.L.(1979). Classification of Wetlands and Deepwater Habitats of the United States. *https://www.fws.gov/wetlands/Documents/ Classification-of-Wetlands-and-Deepwater-Habitats-of-the-Unit*
2. Moore, Peter. D (2008). Wetlands: Revised Edition. Bang Hermitage (Facts on File, Inc.), New York. 270 p.
3. Nathan, Manning (2006). Long term hydrology patterns and plant community composition of disturbed and undisturbed wetlands in the cuyahoga valley national park, ohio, USA. A Thesis Presented to The Graduate Faculty of the University of Akron
4. Ramsar Convention on Wetlands (1971). Convention on wetlands of international important especially as water fowl habitat. *http://sedac.ciesin.org/entri/texts/ramsar.Wetlands.waterfowl.habitat.1971.html*
5. Ramsar Convention on Wetlands (2010). Wise use of wetlands: concepts and approaches for the wise use of wetlands**.** *Ramsar handbooks for the wise use*
6. Ramsar, (2011). The Ramsar Manual, Ramsar and Its Mission, Brief History. http://www.ramsar.org/cda/en/ramsar-march11/main/ramsar/1%5E25044_4000_0_Last accessed March 31, 2011.
7. Shepherd, I, Wilkinson, G and Thompson, J. (2000). Monitoring Surface water storage in the north Kent Marshes using LandsatTM images. nt. j. remote sensing, 2000, vol. 21, no.9, 1843–1865 International Journal of Remote SensingISSN 0143-1161 print/ISSN1366-59012000 Taylor & Francis Ltd http://www.tandf.co.uk/journals
8. Spence, C., Guan, X.J. and Phillips, R (2011). Hydrological function of a boreal wetlands. Wetlands Journal Vol.31,no.1, pp,75-85,2011
9. Tiner, W. Ralph. (2016): "Wetland Delineation: Overview". *115.10.1007/978-94-007-6172-8_353-1*.

10. United State Environmental Protection Agency (2016). Why are wetlands important?. *https://www.epa.gov/wetlands/why-are-wetlands-important*
11. Verhoeven. J. T. A, & Setter. T. L (2010). Agricultural use of wetlands: opportunities and limitations. *Annals of Botany,105(1),155–163. http://doi.org/10.1093/aob/mcp172*
12. World Wild life Fund. 2004. The Economic Value of the World's Wetlands. *www.panda.org/livingwaters*
13. Zhangyu, D., Zongming, W., Dianwei. L, Kaishan, S., Lin. L, Mingming. J, Zhi. D (2014). Mapping wetland areas using landsat-derived NDVI and LSWI: A case study of west Songnen plain, Northeast China" *Journal of the Indian Society of Remote Sensing September 2014, Volume 42, Issue 3, pp 569–576*

Figures

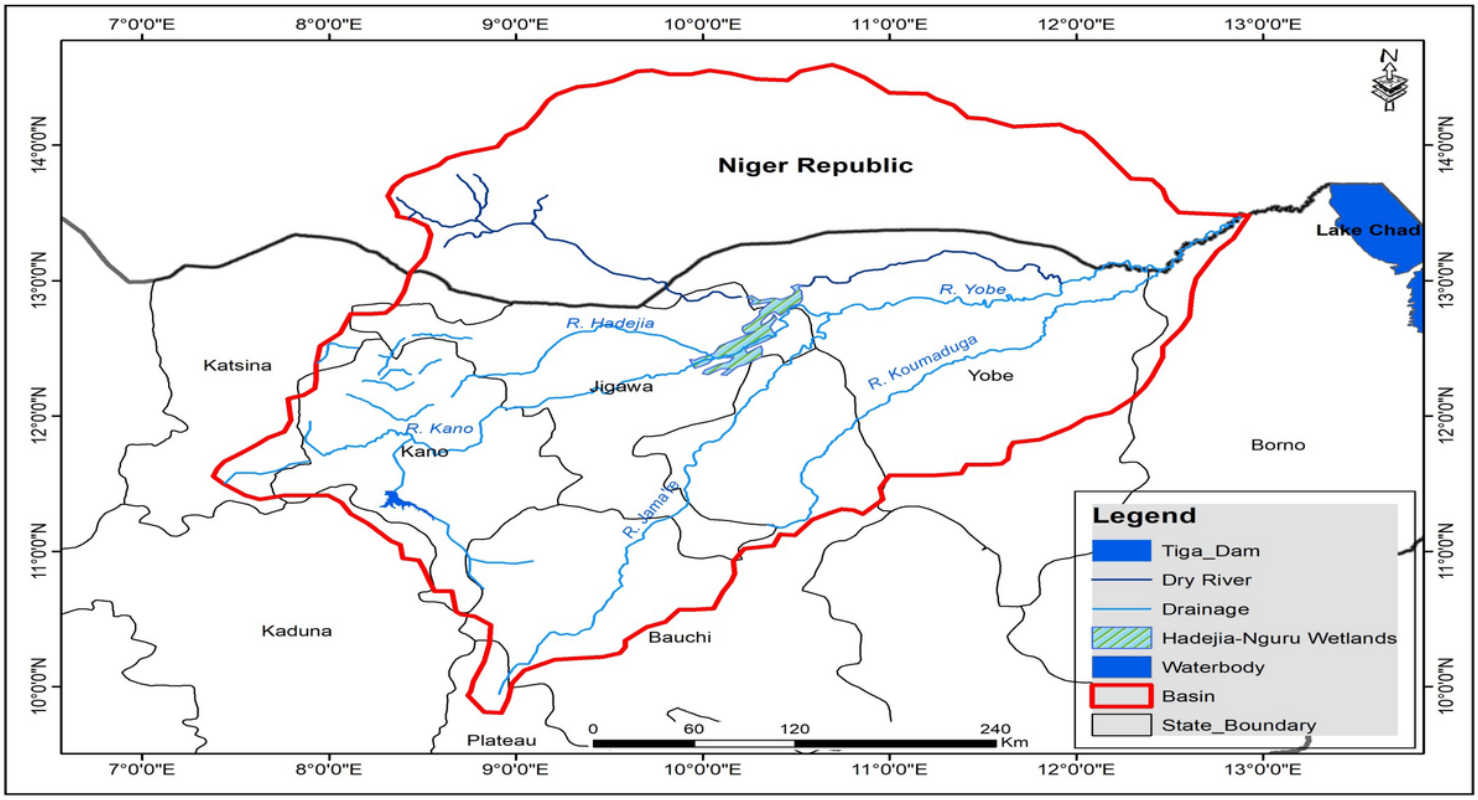

Figure 1

Kumadugu-Yobe River Basin

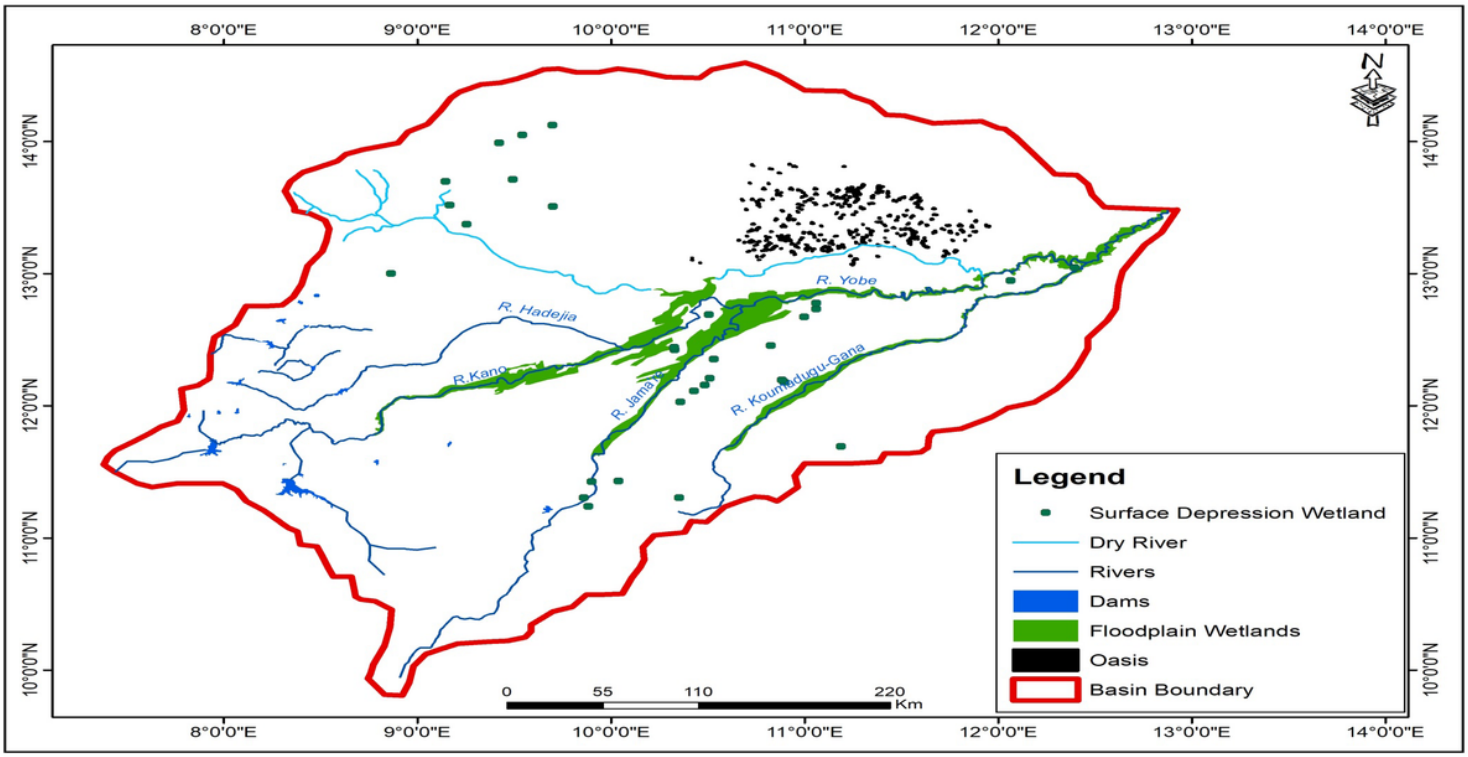

Figure 2

Kumadugu-Yobe River Basin Wetlands Spatial Distribution Pattern

Source: Google Image 2018.

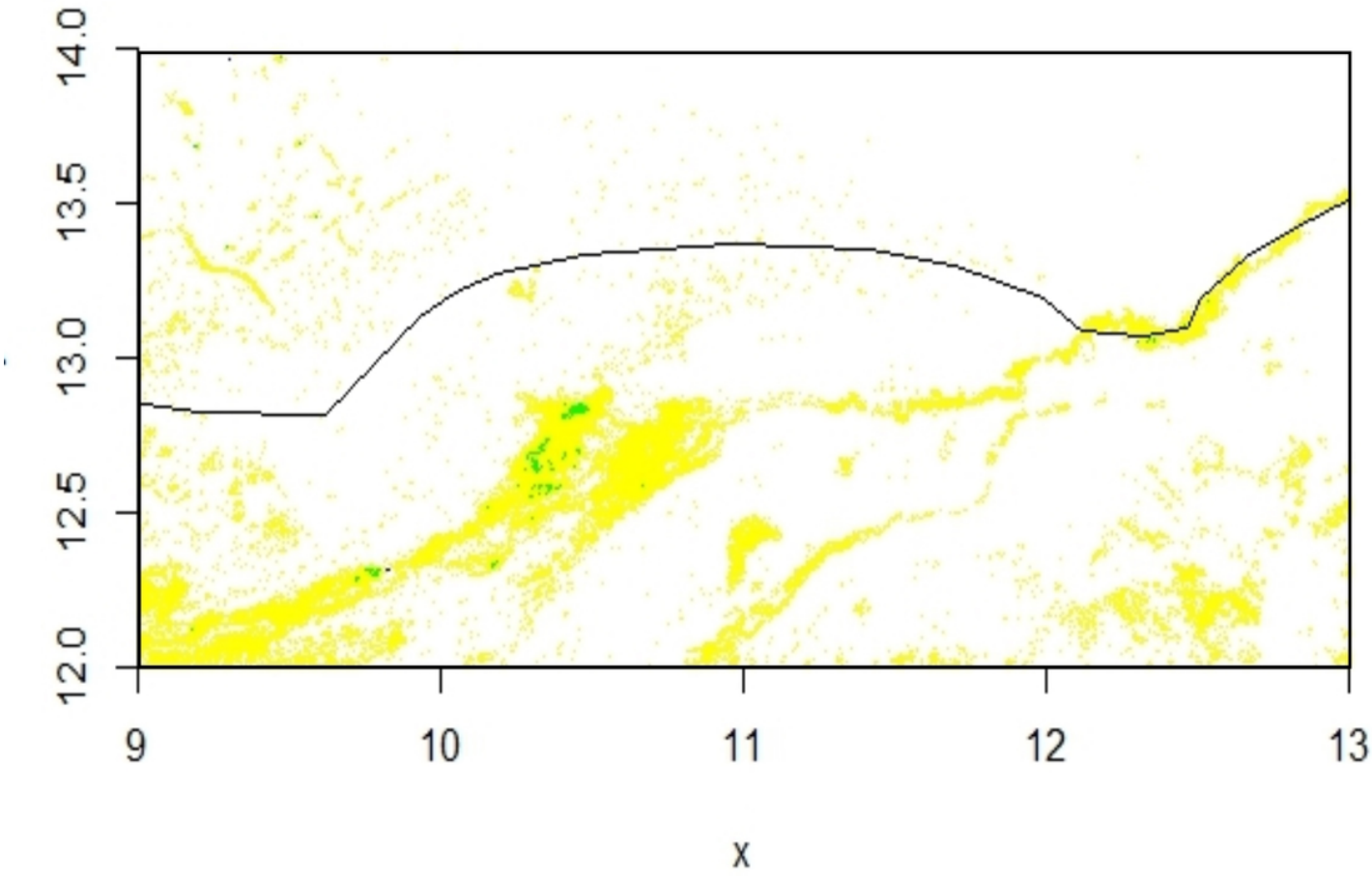

Figure 3

Kumadugu-Yobe River Basin Wetlands Spatial Distribution Pattern

Source: AVHR NDVI data 2018.

Figure 4

Plate 1: Nguru Lake wetland site at Garbi Village. Yobe State

Source: Field survey August 2018.

Figure 5

Plate 2: River Yobe flood plain wetland site at Dagona Village Yobe State

Source: Field survey August 2018.

Figure 6

Plate 3: River Yobe flood plain wetland site at Gashua Yobe State

Source: Field survey December 2018

Figure 7

Plate 4: Surface Depression Pond Wetland Site at Jammel Village, Yobe State

Source: Field survey December 2018.

Figure 8

Plate 5: Oasis wetland site at Tulotula village, Yobe State

Source: Field survey December 2018.