Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/24539
DOI URL: http://dx.doi.org/10.21474/IJAR01/24539

ISSN (O): 2320-5407
ISSN (P): 3107-4928

RESEARCH ARTICLE

ECOSYSTEM SERVICES OF SAHELIAN WETLANDS: A PERCEPTION-BASED ASSESSMENT IN THE RURAL COMMUNE OF DOGO (ZINDER REGION, NIGER)

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Manuscript Info

Manuscript History
Received: 08 September 2026
Final Accepted: 10 October 2026
Published: November 2026

Keywords:
Ecosystem Services, Wetlands, Provisioning Services, Food Security, Dogo, Zinder, Sahel, Niger

Abstract

Sahelian wetlands are highly productive ecosystems that underpin rural livelihoods, yet the goods and services they deliver are rarely documented at the local scale. This study analyses the ecosystem services of the wetlands of the rural commune of Dogo (Zinder Region, Niger). It extends a prior remote-sensing inventory that identified 2,003 wetlands across the commune by assessing, for the first time, how local users perceive and exploit their functions. A stratified random sample of 33 wetlands was drawn from the 322 units of the central-eastern sector, and 42 wetland users were surveyed with structured questionnaires; responses were processed in Excel and SPSS and interpreted within the Millennium Ecosystem Assessment framework (provisioning, regulating and supporting services; cultural services were not assessed). The assessment therefore reflects users' perceptions rather than direct biophysical measurements. Provisioning services dominated local perceptions. Water resources supported market gardening (83.3%) and fishing (88.1%), livestock watering (47.6%), natron extraction (19.0%), water abstraction (16.7%) and brick making (16.7%). Market gardening was the principal activity and provided both food and cash income for all market-gardening respondents. Wetland vegetation was used as livestock fodder (92.4%), food (83.3%), fencing (81.0%), traditional medicine (61.9%), organic manure (23.8%) and handicrafts (4.8%). Wetlands also delivered supporting services-habitat, feeding and breeding grounds for diverse aquatic and terrestrial fauna and flora-and regulating services, including microclimate moderation, shade, aeolian-sand trapping and biological control of crop pests.

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These results demonstrate that Dogo's wetlands are pivotal to household food security and income, and provide an evidence base for their sustainable, collective management and possible inclusion in wetland-conservation frameworks.

Introduction:-

An ecosystem is a functional unit made up of a community of living organisms (the biocenosis) and the physical environment in which they live (the biotope). Wetland ecosystems are widely recognised as genuine engines of development, supporting many of the production systems found in river basins and, in particular, in the Niger basin (Malam Boukar, 2019). In the Nigerien context, wetlands are natural or artificial areas where water is stagnant or flowing, permanent or temporary; they include ponds, lakes, artificial reservoirs, watercourses, floodplains and oasis systems (Awaïss & Seydou, 1999) cited by (DFCAP, 2021).

The Ramsar Conventionon Wetlands(Ramsar Convention on Wetlands, 2018) provides the international framework for their conservation and wise use, recognising their economic, environmental and socio-cultural value (Skinner et al., 1994). Wetlands harbour exceptional biological diversity and supply water and food to people and livestock; through these functions they help drive local economies and secure household food supplies. In semi-arid countries such as Niger, their importance has been keenly felt since the Sahelian droughts of the 1970s, which severely affected rainfed agriculture. The closed depressions (locally, "cuvettes") that form part of these wetlands are densely concentrated in the geological regions of Mounio (Zinder) and Manga (Diffa)(Barké, 2017). In this paper, 'wetland' is used as the generic term; 'depression' (locally 'cuvette') designates the closed interdunal basins that host these wetlands, and 'oasis depression' refers to the cuvettes of the Manga and Mounio regions described in the literature.

The rural commune of Dogo, in the southern Damagaram (Zinder Region), possesses an immense wetland potential, part of which remains in a near-natural state while another part is under cultivation. A recent remote-sensing inventory counted 2,003 wetlands in the commune in 2023 and showed that their number has roughly doubled over the last decade, driven by a rising water table under improved rainfall(Moussa Lawali, 2024). These wetlands play a decisive role in supplying water to people and livestock and in supporting irrigated cropping (Ibrahim Malam Sani, 2021; Malam Boukar, 2019; Moussa Lawali, 2024), yet they remain poorly exploited and managed by local communities. However, the remote-sensing inventory documents the number and extent of these wetlands but not the services they provide. No study has yet assessed, at site level, how local users perceive and exploit these services; this perception-based assessment is therefore needed to link the spatial inventory to livelihood outcomes and management priorities.

Numerous studies(Chillasse et al., 2001; Nazoumou et al., 2016; Zare, 2015) have shown that wetlands perform a wide array of functions and that the management and conservation of these environments cannot be achieved without accounting for the functions and services they provide (Skinner et al., 1994; Zare, 2015). Because wetlands are highly diverse and do not all perform the same functions, there is a need to characterise the specific services delivered by those of the commune, so that stakeholders can update their status and make informed management decisions. Whereas the previous inventory (Moussa Lawali, 2024) addressed the spatial typology and dynamics of these wetlands, the present paper turns to their functional dimension. Its objective is to analyse the ecosystem services of the wetlands of the rural commune of Dogo, structured according to the provisioning, regulating, supporting and cultural service categories of the Millennium Ecosystem Assessment (2005).

Materials and Methods:-

Study area

The rural commune of Dogo lies between longitudes 8°45′ and 9°9′E and latitudes 13°13′ and 13°34′N, in the southern part of the Mirriah Department, Zinder Region (Figure 1). The climate is semi-arid, tropical in type, with two contrasting seasons: a rainy season from June to September-October (400-600 mm) and a dry season for the remainder of the year (Moussa Lawali, 2024). Mean monthly temperatures range from about 17°C (December-January) to 38°C in the hot dry season (April-May). According to the 2012 census, the commune had 58,331 men and 55,116 women, distributed across 165 villages and hamlets. The present study focuses on the central-eastern sector of the commune, where wetlands are most abundant; Sentinel 2 satellite imagery was used to identify and delimit them.

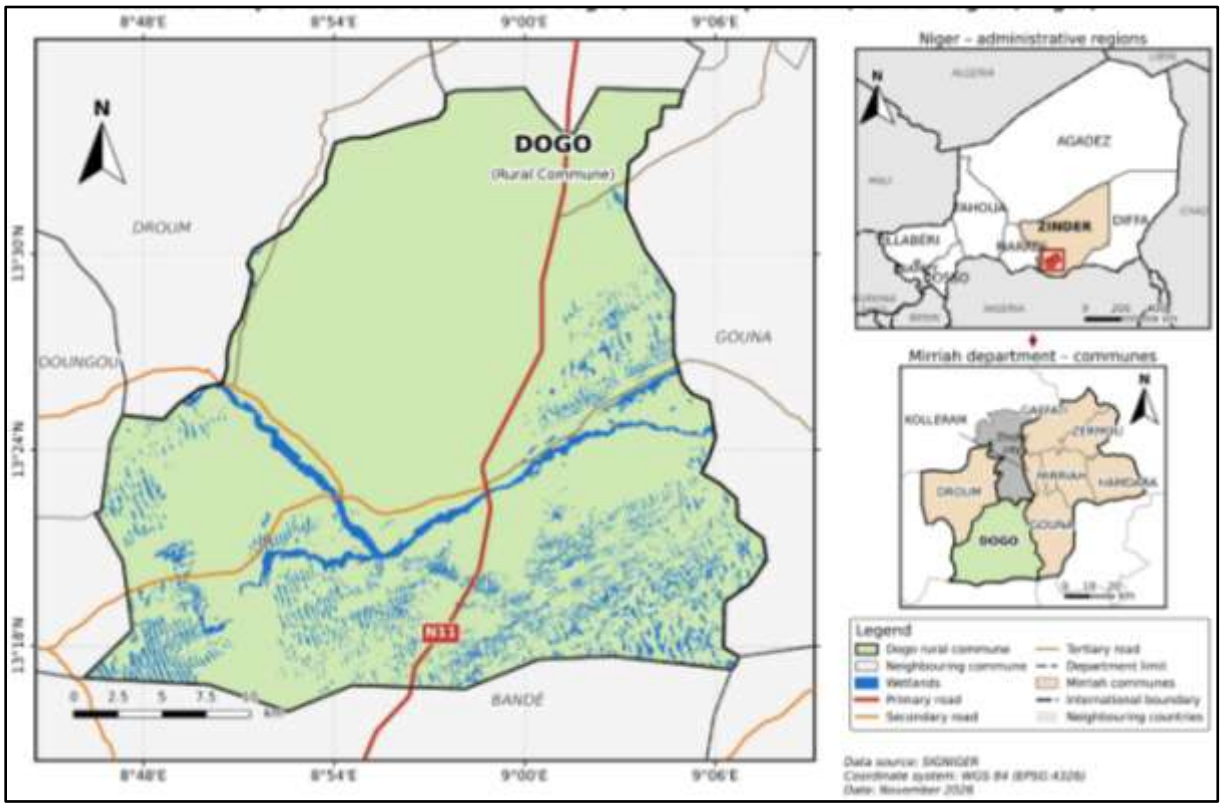


Figure 1. Location map of the rural commune of Dogo (Mirriah department, Zinder region, Niger). Source: Authors, from SIGNIGER data and Sentinel 2 imagery.

Documentary Review:-

A documentary review was carried out at the library of André Salifou University and through scientific databases and search engines (Google, Google Scholar). It drew on internship reports, master's dissertations and theses relevant to the theme, and provided the conceptual orientation of the study.

Sampling Design:-

The sampling frame comprised the 322 wetlands of the central-eastern sector (Figure 2), extracted from the 2023 remote-sensing inventory of 2,003 wetlands (Moussa Lawali, 2024), stratified by size class following the typology of Moussa Lawali (2024): small (< 1 ha), medium (1-5 ha) and large (> 5 ha). A sampling rate of 10% of the total number of wetlands was applied, yielding a sample of 33 wetlands. To obtain a representative sample, a stratified draw was performed by wetland type. The sampling fraction (f_i) was computed as:

$$f_i = n/N \quad (1)$$

with f_i the sampling fraction, n the sample size and N the total number of wetlands.

Applying this fraction proportionally to each size class produced a sample of 22 small, 9 medium and 2 large wetlands; individual sites were drawn at random within each stratum in Excel using the RANDBETWEEN function. The spatial distribution of the sampled wetlands is shown inFigure 2.

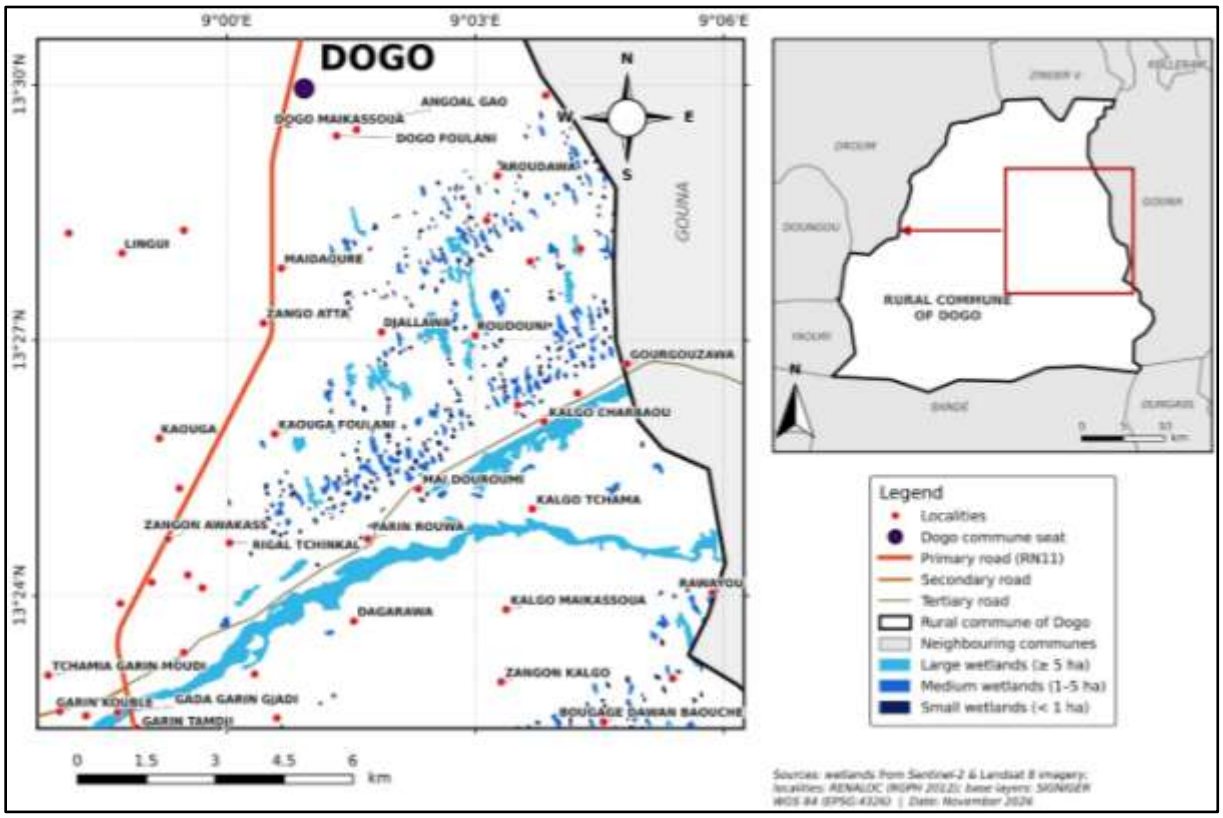


Figure 2. Spatial distribution of the sampled wetlands within the study sector, by size class (small, medium, large). Source: Authors, from Sentinel-2 imagery.

Field survey:-

For each sampled site, the geographic coordinates recorded in ArcGIS were used, together with a hand-held GPS, to locate the wetland in the field. The owner or main user of each site was then identified, and a structured questionnaire was administered to these respondents (hereafter 'wetland users', i.e. the persons holding or operating each site). During fieldwork, the owners of two sites declined to participate. To compensate, a non-response rate of 5% of the sample was applied:

$$Nr = n \times 5/100 \quad (2)$$

with Nr the number of non-responding sites to be replaced and n the sample size.

The result (1.65, rounded to two sites) led to the replacement of the two non-responding sites by two sites drawn at random from the same size classes. The final sample comprised 42 respondents, as a single site may be exploited by one or several operators. The questionnaire comprised 69 questions organised in eight sections: respondent profile; hydrological, climatic, plant and animal functions of the wetland; cultivation practices; agricultural development of the site; and constraints and adaptation strategies. It combined closed single- or multiple-choice questions with open-ended questions. The questionnaire is available from the corresponding author upon request. The questionnaire, written in French, was administered orally in Hausa in March and April 2024 (dry season), and responses were recorded in French. Oral informed consent was obtained from all respondents before each interview; no formal ethical review was sought for this non-interventional survey.

Data analysis:-

Questionnaire data were compiled and analysed with Excel and SPSS, based on respondents' knowledge and perceptions of the ecosystem services of the wetlands. Analyses were essentially descriptive and exploratory, expressed as response frequencies. Response frequency (%) is the proportion of the 42 respondents citing a given item; as several items could be cited, frequencies are not additive and may exceed 100% when combined. Unless otherwise stated, all results derive from interviews. The field equipment comprised a mobile phone, a GPS receiver, a laptop (Word, Excel, ArcGIS, SPSS), writing materials and the survey sheet.

Results:-

Socio-demographic profile of respondents:

Respondents were overwhelmingly men (97.6%). By age, 38.1% were between 25 and 45 years, 45.2% between 45 and 65 years and 16.7% over 65 years. Agriculture was the main economic activity for all respondents (100%), supplemented by livestock keeping (54.8%), trade (16.7%), crafts (11.9%), fishing (2.4%) and domestic work (2.4%). Educational attainment was low: 78.6% of respondents had never attended formal school and 42.9% had a Quranic-school background, while only 16.7% had reached primary and 2.4% secondary level. This male dominance reflects local land-tenure patterns and may under-represent women's uses of wetland resources, notably for food and medicinal plants.

Provisioning services:-

Provisioning services are the most fundamental for the local population. They were analysed through three components: water resources, vegetation and soil. Frequencies indicate the share of respondents citing each use, not the quantities or economic value of the resources obtained.

Water resources:-

According to all respondents (100%), the wetlands are fed directly by rainfall; 71.4% additionally cited groundwater resurgence and 31% surface runoff. The hydrological regime was reported as permanent by 95.2% of respondents, semi-permanent by 2.4% and intermittent by 2.4%. Standing water persisted for 9-12 months, 6-8 months and 3-5 months according to 95.2%, 2.4% and 2.4% of respondents, respectively. The high-water period occurred in August (81%) and September (19%), while the low-water period fell in March (7.1%), April (50%) and May (42.9%). The uses developed around these wetlands were market gardening (83.3%), fishing (88.1%), livestock watering (47.6%), natron extraction (19.0%), water abstraction (16.7%) and brick making (16.7%) (Figure 3).

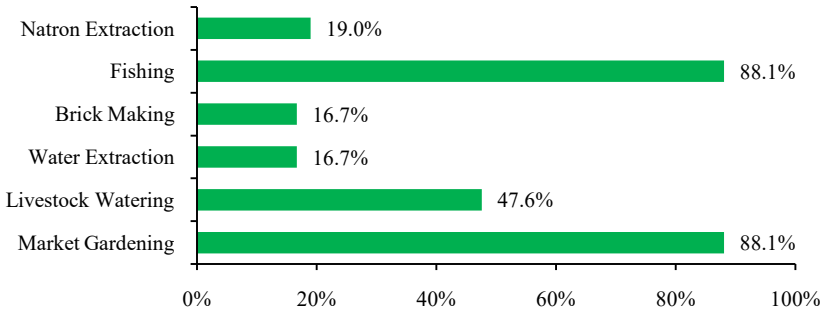


Figure 3. Types of use of wetland water resources (frequency of responses, %). Source: Authors' field survey.

The ichthyofauna of the central-eastern sector comprised three main species (Table 1). Fish were caught mainly by local fishers rather than by wetland owners, and the activity remained rudimentary and informal. The catch was destined for consumption (97.62%) and sale (83.33%). A range of aquatic birds (e.g. *Plectropterusgambensis*, *Sarkidiornis melanotos*, *Gallinula chloropus*, *Egretta garzetta*), reptiles (*Varanus niloticus*, *Varanus exanthematicus*, *Pelusiosniger*) and small mammals (*Rattus rattus*, *Atelerixalbiventris*, *Lepus capensis*, *Xerus erythropus*, *Herpestes ichneumon*) were also reported by respondents to be occasionally trapped and consumed. In addition, 73.81% of respondents reported that parts or carcasses of certain species-particularly rodents-are used in traditional medicine.

Table 1. Fish species recorded in the study sector

Local name	Scientific name	Response frequency (%)
Bakin kifi / Tarwada	*Clarias gariepinus*	97.62
Carfasa	*Oreochromis niloticus*	95.24
Gaywa	*Protopterusannectens*	57.14

Source: Authors' field survey.

Vegetation:-

The wetland ecosystems host a diversity of plant communities that play a major role for the local population.

Animal fodder:-

In the wetlands of Dogo, plant species are widely exploited to feed livestock; 92.36% of respondents reported this use. The dominant species were *Typha australis* (95.24%), *Cyperus sp.* (85.71%) and *Spartina maritima* (73.81%), located in the innermost ring of the depressions. Species such as *Cenchrus biflorus* (54.76%), *Eragrostis tremula* (52.38%) and *Alysicarpusovalifolius* (47.62%) were moderately cited and occur at the periphery of the wetlands. The species used and the plant parts consumed are summarised in Table 2, and illustrated in Figure 4 and Figure 5.

Table 2. Fodder species: response frequencies and plant parts used, as reported by respondents (92.36%)

Local name	Scientific name	Freq. (%)	Part used
Kacela	*Typha australis*	95.24	Young shoots
Jiji	*Cyperus sp.*	85.71	Young shoots
Tattakiya	*Spartina maritima*	73.81	Leaves
Karanguiya	*Cenchrus biflorus*	54.76	Whole plant
Komaya	*Eragrostis tremula*	52.38	Whole plant
Gadagui	*Alysicarpusovalifolius*	47.62	Whole plant
Gao	*Faidherbia albida*	40.48	Leaves
Kalgo	*Piliostigmareticulatum*	42.86	Leaves (young shoots)
Garaji	*Brachiaria spp.*	38.10	Whole plant
Ceceko	*Sesbania pachycarpa*	28.57	Whole plant
Shemé	*Brachiaria mutica*	23.81	Young shoots
Kununguru	*Commiphora balsamifera*	21.43	Whole plant
Gamba	*Andropogon gayanus*	19.05	Leaves
Daniya	*Sclerocaryabirrea*	16.67	Leaves
Malahiya	*Corchorus tridens*	14.29	Whole plant
Gudu-gudu	*Dactylocteniumaegyptium*	14.29	Whole plant
Yakuwa	*Hibiscus asper*	14.29	Whole plant
Dumniya	*Vitex doniana*	14.29	Leaves
Faru	*Lanneafruticosa*	14.29	Leaves
Tamulkutaye	*Ipomoea heterotricha*	11.90	Whole plant

Source: *Authors' field survey.*

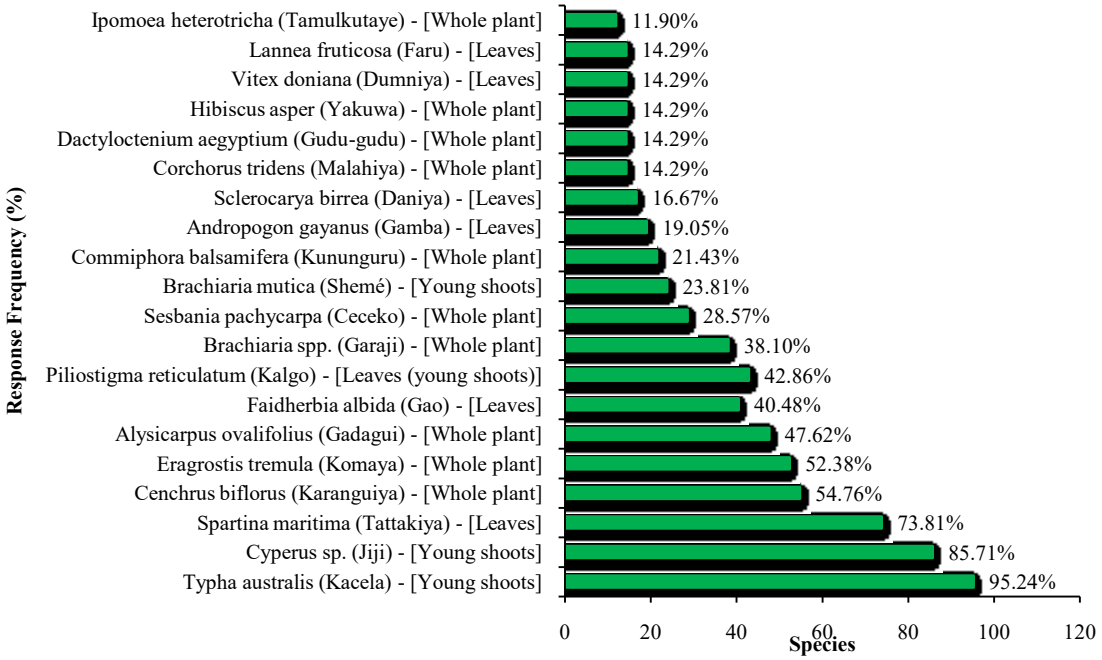


Figure 4. Fodder species: response frequencies and plant parts used, as reported by respondents (92.36%)



Figure 5. Wetland plant communities in the study area (field photographs). Source: Photographs by the authors, March 2024.

Traditional medicine:-

Parts of several plant species are used in traditional medicine, according to 61.9% of respondents. *Mangifera indica* leaves were the most frequently cited (66.67%), followed by *Eragrostis tremula* (52.38%), *Nymphaea spp.* (45.24%) and *Psidium guajava* (45.24%). The species and plant parts used are listed in Figure 6.

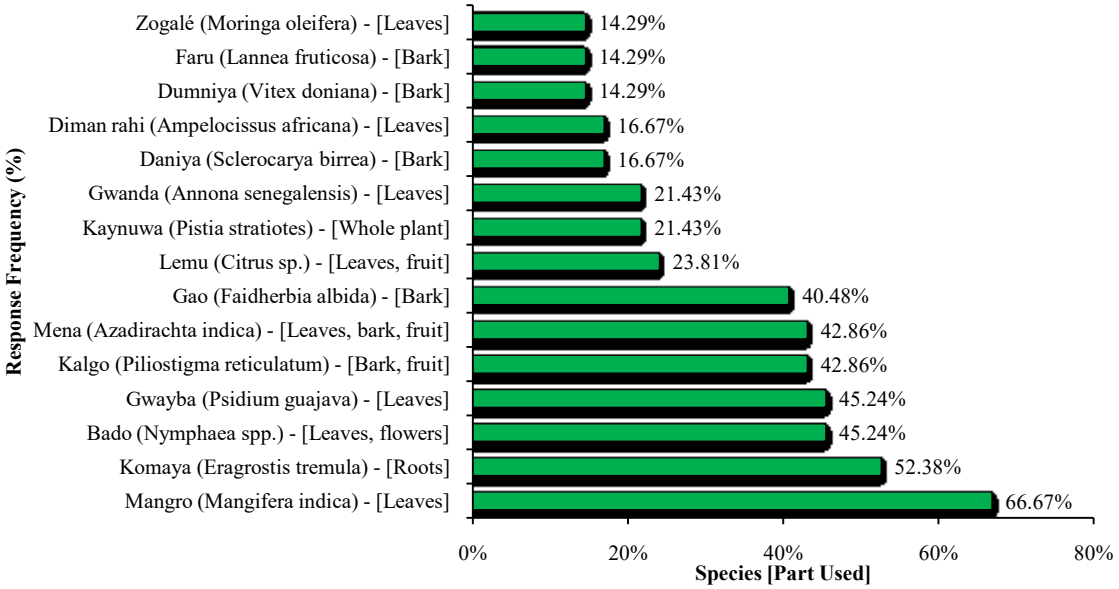


Figure 6. Plant species used in traditional medicine: response frequencies and parts used (Local name (Scientific name)- [Parts used]). Source: Authors' field survey.

***Food*:-**

According to 83.33% of respondents, the fruits, leaves and seeds of several species are used for human food (Figure 7). *Typha australis*-present in almost all wetlands of the central-eastern sector (95.24%)-produces seeds eaten by riparian communities. Fruit trees such as *Mangifera indica* (66.67%), *Hyphaene thebaica* (59.52%), *Psidium guajava* (45.24%), *Piliostigmareticulatum* (42.86%) and *Phoenix dactylifera* (35.71%) were the most frequently cited; they provide fruits partly consumed directly and partly sold. According to 4.76% of respondents, part of the harvest is shared within the family as a gift. Species located at the periphery of the wetlands survive, whereas those at the bottom of the depressions die from waterlogging (asphyxia). Woody-species arrangements are illustrated inFigure 8.

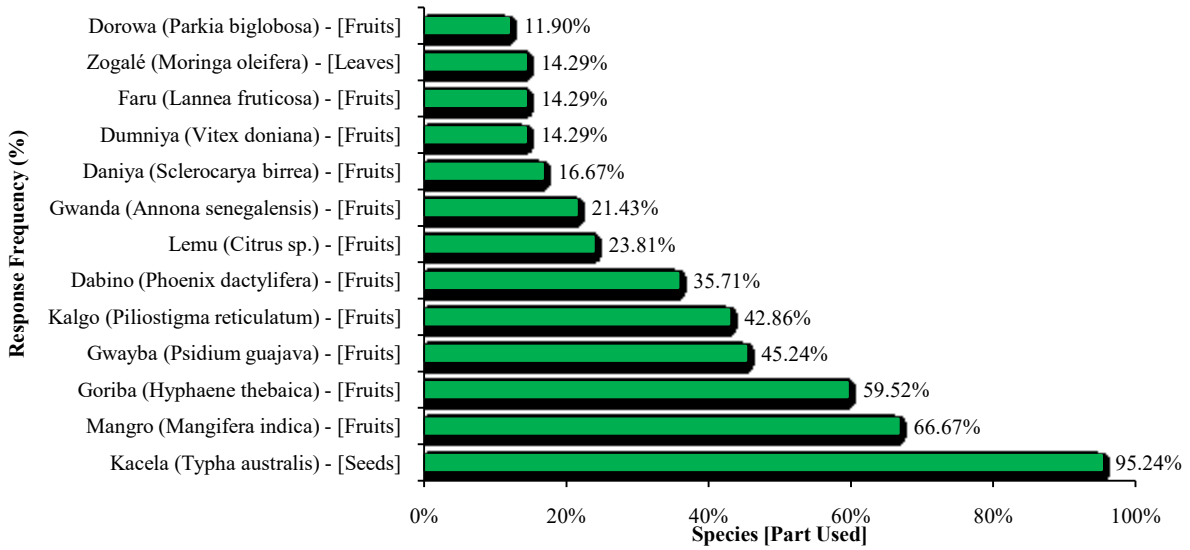


Figure 7. Plant species used for food: response frequencies and parts used (83.33% of respondents) (Local name (Scientific name)- [Parts used]).*Source: Authors' field survey.*



Figure 8. Arrangement of woody species in and around the wetlands (field photographs). Source: Photographs by the authors, August 2024 (complementary field visit outside the survey period).

Fencing, wood, organic manure and handicrafts:-

Typha australis (*kacela*) was reported as fencing material ("seko") by 80.95% of respondents. Wood harvested from the wetlands was used as firewood (52.38%), construction timber (57.14%) and for sale (47.62%). Weeded plants and cut *Typhaaustralis* were transformed into organic manure (compost, fresh organic matter) by 23.81% of respondents. Finally, the young leaves of *Hyphaene thebaica* growing on the dune fronts bordering the wetlands were used in handicrafts (rope, mats, etc.) by 4.76% of respondents.

Soil and market gardening:-

Characterisation of market gardening:-

Access to land was mainly through inheritance (71.4%), followed by purchase (21.4%), loan (9.5%) and rental (4.8%). Market gardening-the fundamental activity in the study area-started in September (9.5%), October (52.4%), November (14.3%), December (4.8%) and January (2.4%), and ended in May (71.4%), June (7.1%) and July (4.8%); 16.7% of respondents reported that their wetlands were not used for market gardening. The tools used were traditional (daba, hoe, rake, hilary, machete, weeding hoe). Irrigation was carried out manually (57.1%), with a motor pump (7.1%) or with both (21.4%). To improve soil fertility, farmers applied organic manure (81%) and chemical fertilisers (78.6%).

Role of market gardening:-

Two categories of off-season crops were identified: annual crops (cassava and sugarcane) and seasonal crops (onion, lettuce, cabbage, tomato, watermelon, squash, sweet potato, potato, melon, chili pepper, etc.). Part of the production was used directly for daily food and part was sold, according to all market-gardening respondents (n = 35). The

cultivated crops and their frequencies are shown in Figure 9 and illustrated in Figure 10. Onion, cassava and sugarcane were the most widespread (78.6% each), followed by tomato (66.7%) and squash (61.9%).

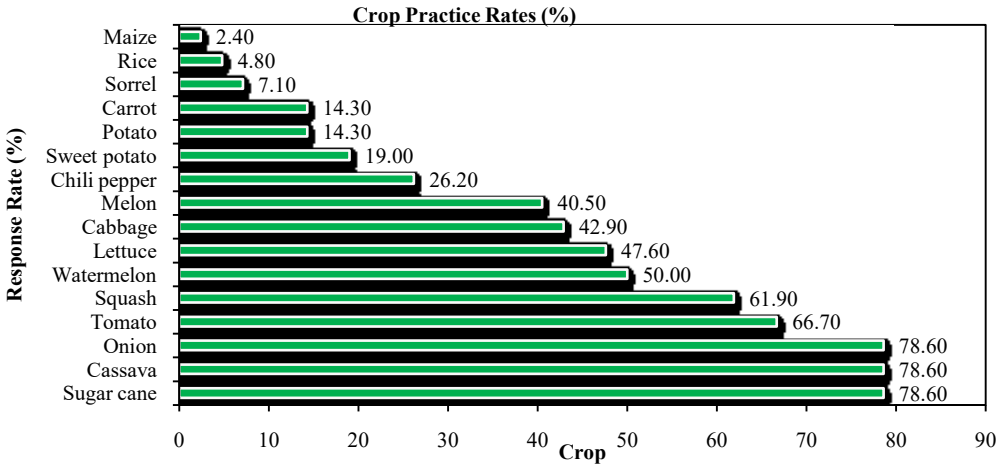


Figure 9. Frequency of crops cultivated in the wetlands (% of respondents). Source: Authors' field survey.



Figure 10. Sugarcane and cassava cultivation in the wetlands (field photographs). Source: Photographs by the authors, April 2024.

In terms of cropping intensity, 40.5% of farmers achieved one production cycle per year, 47.6% two cycles and 4.8% three cycles. Gross income (sales revenue before deduction of production costs) per production cycle (Figure 11) was 50,000-100,000 XOF for 26.2% of respondents and 20,000-50,000 XOF for 23.8%; 11.9% earned 100,000-150,000 XOF and another 11.9% earned 150,000-200,000 XOF, while only 7.1% earned more than 500,000 XOF per cycle.

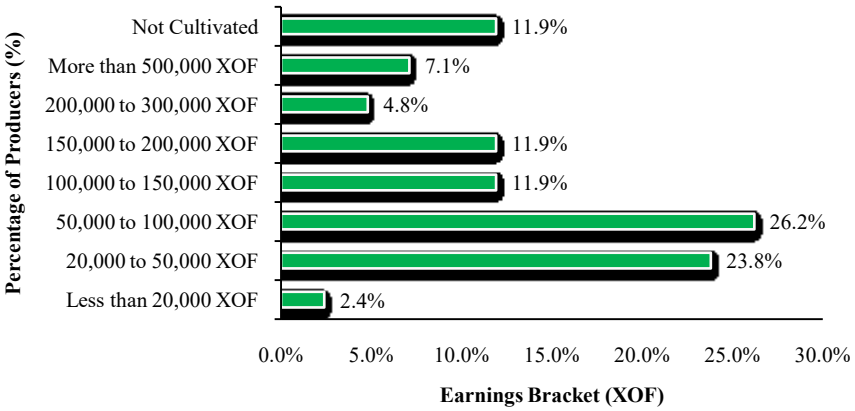


Figure 11. Frequency distribution of market-gardening income per production cycle, as reported by respondents. Source: Authors' field survey.

Supporting services:

Wetlands are among the richest reservoirs of biodiversity from an ecological standpoint, hosting an exceptional diversity of animal and plant species (DFCAP, 2021). The faunal records presented below are based on respondents' reports and do not constitute a comprehensive biodiversity inventory.

Faunal habitats in the wetlands:

The wetlands provide shelter for local fauna, with species establishing their habitats where prey and feeding opportunities are available. The habitat locations reported by respondents, together with the species concerned and response frequencies, are presented in Table 3 and Figure 12.

Table 3. Location of faunal habitats in the wetlands, by species, and associated response frequencies.

Habitat location	Species (local / scientific)	Freq. (%)
In the water	*Clarias gariepinus (bakinkifi/tarwada)*	88.10
	Oreochromis niloticus (carfasa)	88.10
	Protopterusannectens (gaywa)	88.10
	Rhinella marina (kwado)	95.24
	Platydemusmanokwari (zarbina)	83.33
	Varanus niloticus (guza)	64.29
	Pelusiosniger (kunkuru)	47.62
In the water (in reeds)	*Gallinula chloropus (kazarruwa)*	83.33
	Sarkidiornis melanotos (agwagwarruwa)	61.90
	Egretta garzetta (zarbé)	26.19
On grasses	*Locusts (Nomadacris sp., Oedaleus senegalensis, Kraussariaangulifera)*	57.14
	Coniestaignefusalis (tsutsa)	54.76
	Gryllus campestris (tsagna)	16.67
	Aedes aegypti (sabro)	16.67
On trees	*Bubulcus ibis (belbela)*	64.29
	Ciconia nigra (shamuwa)	64.29
	Psittaciformes (kalo)	52.38
	Sarkidiornis melanotos (agwagwarruwa)	50.00
	Oena capensis (bardo)	50.00
	Plectropterusgambensis (dumniya)	47.62
	Egretta garzetta (zarbé)	47.62
	Quelea quelea (tsuntsuwa)	40.48
In burrows	*Arvicanthis niloticus (bera)*	73.81
	Rattus rattus (gafiya)	73.81
	Xerus erythropus (kuregué)	45.24
	Snakes (Naja nigricollis, Bungarus sp., Gongylophiscolubrinus, Malpolonmoilensis)	35.71
	Varanus exanthematicus (damo)	30.95
	Lepus capensis (zomo)	16.67
	Reticulitermes lucifugus (zago/gara)	14.29
	Herpestes ichneumon (tunku)	7.14
	Atelerixalbiventris (bishiya)	4.76
Underground	*Reticulitermes lucifugus (zago/gara)*	16.67
	Gryllus campestris (tsagna)	9.52
In the grass	*Lepus capensis (zomo)*	14.29

Source: Authors' field survey.

Fauna-wetland interactions:-

A close relationship links wetlands and fauna: some species prefer to live in the water, while others visit only the periphery or the surrounding dry land to feed or rest. According to all respondents (100%), the species listed in the first row of

Table **4** live in the water and those in the second row at the water's edge; 19% confirmed that the species in the third row live away from the water.

Table **4** summarises the reasons for the establishment of faunal species in each setting.



Figure 12. Location of faunal habitats in the wetlands, by species, and associated response frequencies.

Table 4. Reasons for the establishment of animal species in different settings of the wetlands

Setting	Species concerned	Reasons for establishment
In the water	*Clarias gariepinus, Oreochromis niloticus, Protopterusannectens, Varanus niloticus, Platydemusmanokwari, Pelusiosniger, Rhinella marina, Sarkidiornis melanotos, Gallinula chloropus, Egretta garzetta, Plectropterusgambensis*	Aquatic species (food is in the water); bathing
At the water's edge	*Locusts (Nomadacris sp., Oedaleus senegalensis, Kraussariaangulifera), Coniestaignefusalis, Aedes aegypti, Bubulcus ibis, Ciconia nigra, Bungarus sp., Naja nigricollis, Gongylophiscolubrinus, rodents*	Seeking food, drinking water and humidity; avoid excess water; egg-protection strategy for some species
Away from the water	*Malpolonmoilensis, Naja nigricollis, Gongylophiscolubrinus, Grylluscampestris, Oena capensis, Psittaciformes, Quelea quelea, Coniestaignefusalis, rodents*	Habitats located nearby; food available in this zone

Source: Authors' field survey.

Water-vegetation relationships:-

Vegetation is inseparable from water and grows according to its position within the wetland. According to all respondents (100%), aquatic species grow in the water, as do the less water-demanding species of the water's edge, while 73.8% noted that certain species grow away from the water (Table 5).

Table 5. Reasons for the establishment of plant species in different settings of the wetlands

Setting	Species concerned	Reasons for establishment
In the water	*Typha australis, Spartina maritima, Cyperus sp., Brachiaria mutica, Nymphaea spp., Pistia stratiotes*	Aquatic species (adapted to survive in water; water-demanding)
At the water's edge	*Cyperus sp., Cenchrus biflorus, Brachiaria spp., Sesbania pachycarpa, Dactylocteniumaegyptium, Corchorus tridens, Phoenix dactylifera, Ampelocissusafricana, Hibiscus asper*	Non-aquatic species (intolerant of standing water; seeking humidity; adapted to this zone)
Away from the water	*Cenchrus biflorus, Eragrostis tremula, Alysicarpusovalifolius, Commiphora balsamifera, Andropogon gayanus, Corchorus tridens, Ipomoea heterotricha, Sclerocaryabirrea, Vitex doniana, Lanneafruticosa, Faidherbia albida, Piliostigmareticulatum, Annona senegalensis, Psidium guajava, Citrus sp., Mangifera indica, Azadirachta indica, Moringa oleifera, Hyphaene thebaica, Parkia biglobosa*	Species intolerant of excess humidity; adapted to survive in this zone

Source: Authors' field survey.

Regulating services:-

Temperature (microclimate):-

Temperature acts as a regulating variable around the wetlands. At the onset of the dry season, 19% of respondents described the wetland environment as hot, 69% as cool and 11.9% as temperate. As the season progressed, respondents reported the temperature as increasing (35.7%), decreasing (61.9%) or stable (2.4%). Respondents consistently noted a perceptible change in temperature on approaching the wetlands, which they associated with their regulating role. No instrumental measurements of temperature or humidity were made; these results therefore reflect perceived rather than measured regulation.

Shade:-

According to 9.52% of respondents, woody species provide resting and refreshment spots after work.

Aeolian-sand trapping:-

The wetlands of the study area formed downstream of dune areas whose fronts are dominated by *Hyphaene thebaica*. According to 7.14% of respondents, this species is perceived to act as a barrier to wind-blown sand, preventing the wetlands from being filled in.

Biological control of invasive/pest species:-

According to 4.76% of respondents, reptiles (*Malpolonmoilensis*, *Naja nigricollis*, *Varanus niloticus*, *Pelusiosniger*, *Varanus exanthematicus*), aquatic birds (*Egretta garzetta*, *Bubulcus ibis*, *Ciconia nigra*, *Gallinula chloropus*) and amphibians (*Rhinella marina*) prey on the invasive insects that hinder market gardening, which respondents perceived as a natural pest-control service.

Discussion:-

Interpreted within theMillennium Ecosystem Assessment (2005) framework, the results show that the wetlands of Dogo deliver a coherent bundle of provisioning, supporting and regulating services, dominated in local perceptions by provisioning functions. Cultural services (spiritual, aesthetic, recreational and heritage values) were not covered by the questionnaire and are therefore not analysed here. This pattern is characteristic of Sahelian oasis depressions, where water and vegetation directly sustain household economies(Illou, 2018; Malam Boukar et al., 2016; Zare, 2015). The prominence of market gardening (reported by 83.3% of respondents) and fishing echoes findings from comparable systems in the Manga and Mounio regions (Barké, 2017; Dan Habou et al., 2018) and confirms that these small, dispersed wetlands are central to off-season production and to the integration of the commune into local and sub-regional trade.

These perception-based results are consistent with earlier work on Sahelian depressions. The range of uses developed around the wetlands agrees with the patterns described by Zare (2015), Illou (2018) and Malam Boukar (2019). The zonation of forage species, with Typha australis, Cyperus sp. and Spartina maritima concentrated in the innermost ring of the depressions, is in agreement with Malam Boukar (2019), who also reported the consumption of Typha australis seeds by riparian communities and its use as fencing material ("seko") and as organic manure. The use of wetland wood as firewood, construction timber and a source of income likewise corroborates Badamassi Malam Abdou (2023). Finally, the incomes recorded per production cycle remain lower than those reported by Badamassi Malam Abdou (2023) and Ibrahim Ibro (2024), consistent with the still largely informal and low-yield exploitation discussed below.

These functional results complement the spatial evidence produced for the same commune by Moussa Lawali (2024), who mapped 2,003 wetlands and demonstrated a near-doubling of their number between 2015 and 2023 under a rising water table. Read together, the two studies suggest that the recent expansion of the wetland resource is being accompanied by intensifying, yet still largely informal and low-yield, exploitation: most respondents obtained modest incomes (below 100,000 XOF per cycle for about half of them), well under the values reported for the better-organised depressions of Goudoumaria and Guidimouni (Badamassi Malam Abdou, 2023; Ibrahim Ibro, 2024). The gap points to a substantial, under-realised potential for value addition through improved water control, input access and collective organisation. Although no monetary valuation was undertaken here, documenting these services echoes long-standing calls to recognise the economic contribution of wetland ecosystems to human welfare (Costanza et al., 1997).

The provisioning services identified here rest on an evident ecological base. The zonation of vegetation from the centre of the depressions (*Typha australis*, *Cyperus sp.*, *Spartina maritima*) to their margins (*Cenchrus biflorus, Eragrostis tremula, Alysicarpusovalifolius*) reflects a moisture gradient that also structures faunal habitats, and underlies the supporting services documented in Table 3 to Table 5. The regulating services perceived by respondents-microclimatic moderation, shade, aeolian-sand trapping by *Hyphaene thebaica* fronts and biological pest control-are consistent with the buffering roles widely attributed to Sahelian wetlands and with the sand-encroachment dynamics described for oasis depressions(Barké et al., 2018; Tychon & Ambouta, 2009). The microclimatic moderation and shade reported by respondents are in line with field studies of Sahelian windbreak systems in Niger, which show that porous vegetation fronts alter temperature, humidity and the radiation regime of the sheltered zone while reducing sandblasting and wind damage (Brenner, 1991). At the same time, the double role of Typha australis-a valued resource (fodder, food, fencing, manure) but also a potentially invasive coloniser-illustrates the fragile equilibrium of these systems and the need for active management. This tension is well documented elsewhere in the region: at the nearby Ramsar site of Lake Guidimouni, hydrological stress has driven the conversion of large areas of irrigated cropland into *Typha*-dominated aquatic grassland (Salifou et al., 2026), and species-distribution modelling confirms that Typha remains widespread across the Sahelian and Sahelo-Sudanian zones of Niger (Adamou Moumouni et al., 2025). Selective mechanical harvesting and the valorisation of *Typha* biomass have been proposed as management levers that turn this disservice into a resource.

From a management perspective, these findings provide an evidence base for integrating wetland services into the commune's Local Development Plan (PDC) and land-use scheme, and for promoting the collective, concerted management advocated byHajib & Bayed (2005). Although individually too small to qualify, the wetland-rich zone taken as a whole could be considered for a wetland-conservation designation, as achieved for the nearby Guidimouni Ramsar site, thereby enhancing the commune's environmental and economic standing.

Several limitations should be noted. The assessment is perception-based and declarative: it captures how users value and exploit wetland services rather than quantified biophysical flows, and the sample (33 sites, 42 respondents) is confined to the central-eastern sector. Respondents were almost exclusively male owner-operators, so gendered and non-owner uses may be under-represented. Some vernacular-scientific name correspondences should be confirmed by botanical and zoological verification. The questionnaire was not pre-tested, interviews were translated orally between Hausa and French, and the survey was conducted in a single period (March-April 2024, dry season), so seasonal variation in perceived services was not captured. Given the sample size, results were not disaggregated by wetland size class or user type, and the analysis remains descriptive. Cultural services (aesthetic, recreational and heritage values), which were not assessed here, deserve dedicated study. Future work should couple this perception-based inventory with quantitative measurements of water quality, productivity and economic value, and with the

remote-sensing time series of Moussa Lawali (2024), to move towards a full valuation of the ecosystem services of Dogo's wetlands.

Conclusion:-

The wetlands of the central-eastern sector of the rural commune of Dogo constitute a precious resource for local communities. Field results show that these environments provide substantial material benefits to the surveyed wetland users and their households. Provisioning services dominate: through water resources, the population practises market gardening (83.3%), fishing (88.1%), livestock watering (47.6%), natron extraction (19.0%), water abstraction (16.7%) and brick making (16.7%); plant resources are exploited for livestock fodder (92.4%), food (83.3%), fencing (81.0%), traditional medicine (61.9%), wood, organic manure and handicrafts. The wetlands further act as supporting environments, providing habitat, feeding and breeding grounds for a wide range of animal and plant species, and deliver regulating services-temperature moderation, shade, aeolian-sand trapping and biological pest control.

By documenting the functional value of these wetlands, this study complements the spatial inventory and dynamics established for the same commune(Moussa Lawali, 2024) and provides local actors with a basis for planning their sustainable use and for attracting development partners (projects, NGOs) willing to invest towards food security. Beyond the perception-based approach adopted here, a full economic and biophysical valuation of these services, together with attention to their cultural dimension and to equitable, collective governance, is recommended as the next step.

Author contributions:-

IBRAHIM YAHAYA Salissou designed and supervised the study, structured the analysis and drafted and revised the manuscript. MOUSSA LAWALI Lawali conducted the fieldwork, administered the survey and processed the data. MALAM ABDOU Moussa contributed to the study design, scientific supervision and critical revision. All authors read and approved the final manuscript.

Conflict of interest:-

The authors declare that they have no competing interests.

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