

Contribution of the Hadejia-Nguru Wetlands to Rural Livelihoods and Perceived Household Food Security in Northeastern Nigeria

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ABSTRACT

The Hadejia-Nguru Wetlands (HNWs) provide diverse ecosystem resources that support rural livelihoods and food-related needs in northeastern Nigeria. Increasing climatic variability, hydrological alteration and intensifying resource use may, however, affect the availability and sustainability of these resources. This study assessed the contribution of the HNWs to rural livelihoods and perceived household food-security status among wetland-fringe communities. A mixed-methods design combined a cross-sectional household survey with key informant interviews, focus group discussions and direct field observations. Of 350 questionnaires administered, 300 adequately completed questionnaires were retained for analysis, representing an 85.7% usable response rate. Quantitative data were analyzed using frequencies, percentages, mean ranks and Kendall's coefficient of concordance, while qualitative data were thematically analyzed. Crop cultivation was the predominant primary economic activity (70.0%), followed by off-farm and non-farm activities (23.33%). The leading wetland-dependent activities were dry-season irrigation farming (34.67%), fishing (24.00%) and sedge/reed collection and weaving (22.67%). Overall, 95.0% reported direct household dependence on wetland resources for cash income. Climate change ranked highest among factors influencing wetland utilization, with significant agreement among respondents (Kendall's $W = 0.426$, $p < 0.001$). For perceived food-security status, 79.0% classified their households as secure or very secure, whereas 5.33% classified them as insecure or very insecure. Additionally, 98.33% regarded wetland resources as important sources of dietary protein. Stated willingness-to-pay (WTP), expressed as respondents' reported monetary valuation of selected wetland goods, varied across resources; medicinal herbs recorded the highest mean value (₦31.95 per bucket). The findings highlight the multifunctional livelihood importance of the HNWs and support integrated, climate-responsive and community-inclusive wetland management.

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INTRODUCTION

Wetlands are among the most productive ecosystems in the world and provide a wide range of provisioning, regulating and cultural services that support human well-being (Davidson *et al.*, 2023; IPBES, 2018). In rural and semi-arid regions, their importance is particularly evident because wetlands provide water, food, fertile land, fisheries, grazing resources, fuelwood and other materials that contribute directly to household livelihoods and food security (Wakili *et al.*; Rebelo *et al.*, 2018; Scoones, 2021). These benefits are often especially important where households have limited access to diversified income sources and depend strongly on natural resources.

The Hadejia-Nguru Wetlands (HNWs) constitute one of the most important wetland systems in northern Nigeria. Located within the Hadejia-Jama'are-Komadugu-Yobe basin, the wetlands form an extensive floodplain system associated with the Hadejia and Jama'are rivers. The area supports a large population whose livelihoods are closely associated with wetland resources. Documented provisioning services include crop production, fishing, livestock grazing, collection of plant materials and hunting, demonstrating the multifunctional economic and subsistence value of the wetland ecosystem

(Ayeni *et al.*, 2019). The wetlands also provide important ecological functions and habitat for diverse aquatic and terrestrial organisms.

Despite these benefits, the HNWs are subject to increasing environmental pressures. Climatic variability, changes in river flow, upstream water regulation, invasive *Typha* spp., population growth and intensified resource use have altered the availability and accessibility of wetland resources (Bukar *et al.*, 2021; Ibrahim *et al.*, 2025). Upstream regulation associated with the Tiga and Challawa Gorge dams has affected downstream flow regimes, while climate change may further modify the timing and magnitude of water availability. Recent modelling research emphasizes the importance of maintaining adequate downstream environmental flows to sustain wetland productivity and ecosystem functions (Ibrahim *et al.*, 2025). Such changes have implications for communities whose agricultural, fishing and other livelihood activities depend on the seasonal availability of water and wetland resources.

Although previous studies have documented the ecological condition, environmental changes, ecosystem services and economic value of the HNWs, less attention has been given to how households in wetland-fringe communities perceive and

experience these benefits in relation to their livelihoods and food-related needs (Adekola & Mitchell, 2021; Abubakar *et al.*, 2022).

Existing documentation of ecosystem services establishes what the wetlands provide, but does not necessarily capture how households perceive their contribution to livelihood opportunities, resource use, dietary protein and household food-security status. Evidence from northeastern Nigeria also demonstrates that locally available biological resources can have interconnected nutritional, socioeconomic and ecological importance (Wakili *et al.*, 2026b), reinforcing the need to examine natural-resource dependence from both livelihood and food-security perspectives.

This study assessed the contribution of the Hadejia-Nguru Wetlands to household livelihoods and perceived food-security status among selected wetland-fringe communities in northeastern Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in selected fringe communities of the Hadejia-Nguru Wetlands (HNWs), a major floodplain wetland system in the semi-arid zone of northeastern Nigeria. The wetlands extend across parts of Jigawa and Yobe States and are associated with the Hadejia and Jama'are river systems. The system supports a wide range of ecosystem services and resource-dependent livelihood activities, including crop production, fishing, livestock grazing, collection of plant materials and hunting (Ayeni *et al.*, 2019).

The study covered four wetland-fringe communities, namely Dagona, Gorgoram, Baturiya and Nguru. The area experiences a semi-arid climate characterized by distinct wet and dry seasons, relatively low and variable annual rainfall, and high temperatures. These climatic and hydrological conditions make wetland resources particularly important to local communities for agriculture, fishing, livestock production and other livelihood activities. Previous studies have documented pressures associated with climate variability, water regulation, invasive *Typha* spp. and increasing resource demand within the HNWs (Bukar *et al.*, 2013; Salako *et al.*, 2016; Ayeni *et al.*, 2019).

Research Design

A mixed-methods research design was adopted to examine the contribution of the HNWs to household livelihoods and perceived household food-security status. The quantitative component involved a cross-sectional household survey, while the qualitative component comprised key informant interviews (KIIs), focus group discussions (FGDs) and direct field observations. The combination of quantitative and qualitative evidence provided complementary information on livelihood dependence, resource use and community perceptions (Abdullahi *et al.*, 2014; Creswell & Creswell, 2018; Creswell & Hirose, 2019).

The qualitative component was informed by a constructivist orientation, recognizing that local perceptions and experiences provide contextual information for understanding wetland-resource use, livelihood dependence and responses to environmental change.

Sampling Framework and Sample Size

The sampling frame for the household survey comprised households residing within the four selected wetland-fringe communities of Dagona, Gorgoram, Baturiya and Nguru. The communities were purposively selected because of their geographical association with the HNWs and the dependence

of residents on wetland resources for livelihood and subsistence activities. The estimated household population across the four communities was approximately 2,800 households and constituted the population from which the household sample was drawn.

The minimum quantitative sample size was determined using Yamane's (1967) simplified formula for a finite population:

$$n = N / [1 + N(e)^2]$$

where n is the required sample size, N is the estimated household population (2,800), and e is the specified level of precision (0.05). Thus:

$$n = 2,800 / [1 + 2,800(0.05)^2]$$

$$n = 2,800 / [1 + 2,800(0.0025)]$$

$$n = 2,800 / (1 + 7)$$

$$n = 2,800 / 8$$

$$n = 350 \text{ households}$$

Accordingly, 350 households were targeted for the survey. Of the 350 questionnaires administered, 300 were adequately completed and retained for analysis, giving a usable response rate of 85.7%.

Within each community, households were selected using systematic sampling with a random starting point. The sampling interval was determined from the available household listing or enumeration of eligible households in each community. One eligible adult respondent per selected household was interviewed. Eligibility required the respondent to be at least 18 years old and sufficiently knowledgeable about household livelihood activities and use of wetland resources.

For the qualitative component, key informants were purposively selected on the basis of their knowledge of wetland resources, livelihood activities, environmental conditions and local or institutional management. Focus-group participants were also purposively recruited to obtain diverse community perspectives, with approximately 6–10 participants per group. Qualitative sampling continued until the information obtained was considered sufficiently repetitive to provide thematic coverage of the issues investigated.

Questionnaire Development, Pretesting and Administration

The structured questionnaire was developed from the study aim, the relevant wetland-livelihood literature and the specific dimensions of household dependence on wetland resources identified in previous studies. The instrument comprised sections covering socio-economic characteristics, primary economic activities, dependence on wetland resources, wetland-dependent livelihood activities, factors influencing wetland utilization, perceived household food-security status, perceived contribution of wetland resources to dietary protein, and stated willingness to pay for selected wetland goods and resource-use opportunities.

Before the main survey, the questionnaire was pretested among a small group of respondents from a wetland-dependent community outside the final study sample. The pretest was used to assess the clarity, comprehensibility, sequencing and contextual appropriateness of the questions, particularly the food-security and willingness-to-pay items. Ambiguous or poorly understood questions were revised before the main administration.

The final questionnaire was administered through face-to-face interviews by trained field assistants. The purpose of the study was explained to respondents before participation, and responses were recorded using the questionnaire. Completed questionnaires were checked for completeness before data

entry. Questionnaires with substantial missing information were excluded from the final analysis, resulting in 300 usable questionnaires.

Measurement of Perceived Household Food-Security Status

Household food security was assessed as a perceived status, rather than as an objectively measured food-security outcome. Respondents were asked to rate the food-security status of their household based on their own assessment of the household's ability to meet its food needs. Responses were recorded on a four-category ordinal scale: very secure, secure, insecure and very insecure.

For descriptive reporting, the first two categories represented perceived food-secure status, while the latter two represented perceived food-insecure status. These responses therefore reflect respondents' perceptions and should not be interpreted as equivalent to standardized household food-security measures based on food consumption, expenditure, dietary diversity or validated food-insecurity experience scales.

Willingness-to-Pay Elicitation

Willingness to pay (WTP) was assessed as a stated monetary valuation of selected wetland goods and resource-use opportunities. Respondents were presented with the specified wetland goods or opportunities and asked to state the amount of money they would be willing to pay for each item under the conditions described in the questionnaire. The relevant physical unit for each good was specified during the interview, and respondents' stated amounts were recorded in Nigerian naira (₦).

The WTP values therefore represent respondents' stated valuations and not observed market prices, actual expenditures or verified payments. For each wetland good or resource-use opportunity, the arithmetic mean of the valid stated monetary values was calculated and reported in the corresponding unit. Where respondents did not state a monetary value, the response was treated as missing for the WTP calculation and was not assigned an assumed value.

Qualitative Data Collection and Coding

KIIs and FGDs were conducted using semi-structured guides covering livelihood dependence, wetland-resource use, perceived changes in resource availability, food-related benefits and factors influencing wetland utilization. Direct observations were used to document relevant livelihood activities and visible patterns of wetland-resource use.

Qualitative information from KIIs and FGDs was organized, transcribed where applicable and coded manually using a thematic coding framework. Initial codes were developed from the research questions and recurrent issues emerging from the field accounts. Related codes were grouped into broader themes, which were reviewed for consistency and relevance to the study aim. The final themes were used to identify recurring explanations and contextualize patterns observed in the quantitative survey. Thematic analysis followed the general procedure described by Braun and Clarke (2006).

Quantitative Data Analysis

Quantitative data were coded and analyzed using SPSS version 22 and Microsoft Excel. Descriptive statistics, including frequencies, percentages and mean ranks, were used to summarize respondents' characteristics, livelihood activities, perceptions and resource-use patterns.

Kendall's coefficient of concordance (W) was used to assess the degree of agreement among respondents in ranking the factors influencing wetland utilization. The analysis was based on the $n = 300$ respondents who provided complete rankings of the, $k = 5$ factors. Where respondents assigned the same rank to two or more factors, tied ranks were assigned their average rank before computation of Kendall's W. The null hypothesis of no overall agreement among the rankings was tested using the chi-square approximation, with statistical significance evaluated at the 5% level ($\alpha = 0.05$). Kendall's W ranges from 0 to 1, with higher values indicating greater agreement among respondents (Field, 2005).

Mean stated WTP values were calculated separately for each selected wetland good or resource-use opportunity and expressed in the monetary and physical units specified during data collection.

RESULTS AND DISCUSSION

Primary Economic Activities of Respondents

Crop cultivation was the predominant primary economic activity among respondents, accounting for 70.0% ($n = 210$) of the 300 respondents (Table 1). Off-farm and non-farm activities, including trading and processing, constituted the second-largest category (23.33%, $n = 70$). Only 3.0% ($n = 9$) reported having no primary economic activity, while fishing accounted for 2.67% ($n = 8$) and formal paid employment for 1.0% ($n = 3$).

Table 1: Primary Economic Activities of Respondents in the Hadejia-Nguru Wetlands (N = 300)

Primary economic activity	Frequency (n)	Percentage (%)
Crop cultivation (farming)	210	70.00
Off-farm/non-farm activities	70	23.33
Unemployed/no primary activity	9	3.00
Fishing	8	2.67
Formal paid employment	3	1.00
Total	300	100.00

Note: Percentages are based on the total sample of 300 respondents. each respondent was assigned one primary economic activity; therefore, categories are mutually exclusive.

Perceived Influence of Wetlands on Livelihood Options

All respondents perceived the Hadejia-Nguru Wetlands as influencing the livelihood options available to local communities. Specifically, 34.0% ($n = 102$) of the 300 respondents strongly agreed and 66.0% ($n = 198$) the 300

respondents agreed with the statement that the wetlands determine or strongly influence local livelihood options, while none selected either the disagree or strongly disagree category (Table 2).

Table 2: Respondents' Perceptions of the Influence of Wetlands on Livelihood Options (N = 300)

Response category	Frequency (n)	Percentage (%)
Strongly agree	102	34.00
Agree	198	66.00
Disagree	0	0.00
Strongly disagree	0	0.00
Total	300	100.00

Note: Percentages are based on the total sample of 300 respondents. this was a single-response question, and the response categories are mutually exclusive.

Wetland-Dependent Livelihood Activities

Respondents reported a range of livelihood activities directly or indirectly associated with wetland resources. The most frequently reported activities included dry-season irrigation farming, fishing, sedge/reed collection and weaving, fish marketing and processing, and hunting or wild-resource harvesting (Table 3). Because respondents could participate in more than one livelihood activity, the responses represent

multiple selections rather than mutually exclusive livelihood categories. Dry-season irrigation farming was reported by 104 respondents (34.67%), followed by fishing (24.00%), sedge/reed collection and weaving (22.67%), fish marketing and processing (11.00%), and hunting and wild-resource harvesting (7.67%). each percentage is based on the total sample of 300 respondents, rather than on the number of responses.

Table 3: Most Frequently Reported Wetland-dependent Livelihood Activities among Respondents (N = 300)

Wetland-dependent livelihood activity	Frequency (n)	Percentage of respondents (%)
Dry-season irrigation farming	104	34.67
Fishing	72	24.00
Sedge/reed collection and weaving	68	22.67
Fish marketing and processing	33	11.00
Hunting and wild-resource harvesting	23	7.67

Note: Percentages were calculated using the total number of respondents (N = 300). Because respondents could report more than one livelihood activity, the categories are not mutually exclusive and percentages for the complete set of livelihood activities may exceed 100%.

Factors Influencing Wetland Utilization

Kendall's coefficient of concordance indicated statistically significant agreement among respondents in the ranking of factors influencing wetland utilization ($W = 0.426$, $p < 0.001$). The ranking was based on 300 respondents who provided rankings for all nine factors as analysed. Climate change had

the lowest mean rank (2.71), indicating the highest priority in the ranking, followed by income status (3.17) and soil fertility at the site (3.32). Household size had the highest mean rank (6.80), indicating the lowest priority among the factors assessed (Table 4).

Table 4: Ranking of Factors Influencing Wetland Utilization Based on Kendall's Coefficient of Concordance (N = 300)

Factor	Mean rank	Rank order
Climate change	2.71	1
Income status	3.17	2
Soil fertility at site	3.32	3
Size of land available	4.38	4
Level of education	5.57	5
Gender	6.12	6
Marital status	6.28	7
Age	6.66	8
Household size	6.80	9

Kendall's $W = 0.426$; $p < 0.001$.

Note: N = 300 respondents. lower mean ranks indicate greater priority. the nine factors were ranked by respondents, and the ranking data were analysed using kendall's coefficient of concordance.

Household Dependence on Wetland Resources and Perceived Food Security

A total of 285 respondents (95.0%) of the 300 respondents reported that their households depended directly on wetland

resources for cash income (Table 5). The 95.0% measure represents household dependence on wetland resources for cash income and is a distinct livelihood/income indicator; it is not a measure of household food security. Regarding

perceived household food-security status, 237 respondents (79.0%) classified their households as either secure or very secure, while 16 respondents (5.33%) of the 300 respondents classified their households as insecure or very insecure. A further 47 respondents (15.67%) described their households

as somewhat secure. The food-security responses were therefore analysed as a separate perception measure and were not combined with household wetland-income dependence or perceived dietary-protein contribution.

Table 5: Perceived Household Food-security Status in the Hadejia-Nguru Wetlands Area (N = 300)

Perceived food-security status	Frequency (n)	Percentage (%)
Very secure	61	20.33
Secure	176	58.67
Somewhat secure	47	15.67
Insecure	11	3.67
Very insecure	5	1.66
Total	300	100.00

Note: Percentages are based on the total sample of 300 respondents. this was a single-response question. “very secure” and “secure” responses represent perceived food security, whereas the 95.0% household dependence on wetland resources for cash income is a separate indicator and is not included in this table.

Perceived Contribution of Wetlands to Dietary Protein

Respondents overwhelmingly perceived the wetlands as an important source of dietary protein. Of the 300 respondents, 207 (69.0%) of the 300 respondents strongly agreed and 88 (29.33%) agreed that wetland resources constitute an important source of dietary protein (Table 6). Only five

respondents (1.67%) were neutral, while none disagreed or strongly disagreed. Thus, 295 of 300 respondents (98.33%) expressed agreement with the statement, but this represents perceived dietary-protein contribution and should not be combined with the 95.0% household cash-income dependence or the 79.0% perceived food-security indicator.

Table 6: Respondents' Perceptions of Wetlands as an Important Source of Dietary Protein (N = 300)

Response category	Frequency (n)	Percentage (%)
Strongly agree	207	69.00
Agree	88	29.33
Neutral	5	1.67
Disagree	0	0.00
Strongly disagree	0	0.00
Total	300	100.00

Note: Percentages are based on the total sample of 300 respondents. This was a single-response question. The 98.33% agreement level is a perception of the contribution of wetland resources to dietary protein and is not a composite measure of household income dependence or food security.

Willingness to Pay for Selected Wetland Goods and Resource-Use Opportunities

Respondents expressed varying levels of stated willingness to pay (WTP) for selected wetland goods and resource-use opportunities (Table 7). WTP values are reported in nigerian naira (₦) and are expressed per specified unit of the good or

resource-use opportunity, as indicated in table 7. The highest mean WTP was reported for medicinal herbs (₦31.95 per bucket), followed by building materials such as sedges and reeds (₦25.00 per donkey cart) and livestock grazing access (₦21.35 per day). Conversely, the lowest mean WTP was recorded for animal watering (₦2.67 per bucket).

Table 7: Mean Willingness to Pay for Selected Wetland Goods and Resource-use Opportunities

Wetland good / resource-use opportunity	Unit of measurement	Mean WTP (₦)
Medicinal herbs	Per bucket	31.95
Building materials (sedge/reeds)	Per donkey cart	25.00
grazing access	Per day	21.35
Cropping land access	Per acre	17.95
Wild game meat	Per kg	12.71
Water fetching	Per 200-L drum	7.49
Fishing access	Per day	6.05
Animal watering	Per bucket (Keg)	2.67

Note: WTP is expressed in nigerian naira (₦) per the unit specified for each good or resource-use opportunity. Because the units differ across items, the mean wtp values should not be directly interpreted as an aggregate or like-for-like monetary value.

Discussion

Livelihood Structure and Dependence on the Wetlands

The predominance of crop cultivation among respondents demonstrates the central role of agriculture in the livelihood structure of communities surrounding the Hadejia-Nguru Wetlands. This finding is consistent with earlier research showing that farming constitutes one of the principal provisioning services of the HNWs, alongside fishing, grazing, collection of plant materials and hunting (Ayeeni *et al.*, 2019; Soneye *et al.*, 2021). The dominance of agriculture in the present study therefore reflects the multifunctional character of the wetland landscape, where wetland resources support both direct production and associated off-farm economic activities.

The 23.33% participation in off-farm and non-farm activities further indicates that household livelihoods are not confined to a single resource-use pathway. Trading, processing and other income-generating activities can complement agricultural production and provide alternative sources of income when agricultural opportunities are constrained. Such livelihood diversification is particularly relevant in environments where climatic variability and changes in water availability can affect the reliability of primary production (Bukar *et al.*, 2013; Scoones, 2021).

The wetland-dependent livelihood activities identified in Table 3 reinforce this interpretation. Dry-season irrigation farming was the most frequently reported additional wetland-dependent activity, followed by fishing and the collection and processing of wetland plant materials. These activities should not be interpreted as primary occupations, because respondents could report more than one wetland-dependent activity in addition to their primary economic activity. These activities correspond closely with the range of provisioning services previously documented for the HNWs, including dry-season crop production, fishing and material collection (Ayeeni *et al.*, 2019). The finding also illustrates the importance of the wetland as a source of both subsistence and market-oriented livelihood opportunities.

Perceived Influence of the Wetlands on Livelihood Options

The complete agreement recorded in Table 2 indicates a strong community perception that the wetlands shape available livelihood opportunities. This finding is consistent with the documented dependence of Hadejia-Nguru communities on wetland resources for agriculture, fishing, grazing, material collection and other activities (Ayeeni *et al.*, 2019). However, the result should be interpreted as a measure of perceived livelihood influence rather than as independent evidence that the wetlands causally determine household livelihood outcomes.

The finding is also consistent with research showing that environmental change within the HNWs has implications for livelihood choices and resource-use strategies. Bukar *et al.* (2013) reported that climatic variability, population pressure and changes in resource availability have influenced livelihood options and adaptive responses among wetland communities. Thus, the strong perception recorded in the present study is plausible within the broader ecological and socio-economic context of the wetlands. Nevertheless, the present cross-sectional survey cannot establish a causal effect of wetland conditions on livelihood outcomes.

Climate Change and Other Factors Influencing Wetland Utilization

Climate change received the lowest mean rank among the factors assessed, indicating that respondents placed it at the highest priority in relation to wetland utilization. The statistically significant Kendall's W (0.426, $p < 0.001$) indicates a moderate degree of agreement among respondents in the overall ranking of the nine factors, although it does not establish that climate change causes changes in wetland utilization.

The prominence assigned to climate change is consistent with evidence that the HNWs are sensitive to changes in rainfall, water availability and hydrological regulation. Climatic variability, hydrological alteration and anthropogenic pressures have been identified as important drivers of changes in wetland condition and resource availability in the hnws. Earlier research similarly reported that environmental change and declining resource availability have affected local livelihood activities and encouraged communities to develop adaptive responses (Bukar *et al.*, 2013).

The position of income status and soil fertility immediately after climate change suggests that livelihood decisions are shaped by both environmental and household economic considerations. These factors should therefore not be treated independently: access to productive land, household income and environmental conditions can interact in determining the attractiveness and viability of different wetland-based activities. These rankings represent respondents' perceptions of the relative importance of the factors and should not be interpreted as empirical estimates of their independent effects on wetland utilization.

Wetland Resources, Household Income and Perceived Food Security

The finding that 95.0% of respondents reported direct household dependence on wetland resources for cash income provides evidence of the reported economic importance of wetland resources to households in the study area. This result is broadly consistent with Barbier *et al.* (1991) and Ayeeni *et al.* (2019), who documented substantial monetary contributions from several wetland-based activities, particularly fishing and farming. Their findings demonstrate that wetland resources have economic value beyond subsistence consumption and can contribute directly to household income.

The present study also found that 79.0% of respondents perceived their households as either secure or very secure in food-security terms. However, this finding should be interpreted cautiously because the study used a perception-based classification rather than a validated multidimensional food-security instrument (Coates *et al.*, 2007). The result therefore indicates respondents' assessment of their household food-security condition rather than an independently measured prevalence of food security.

The 95.0% household dependence on wetland resources for cash income and the 79.0% perceived food-security status represent distinct constructs. The present analysis does not establish that wetland income dependence caused or predicted the reported level of food security. The coexistence of high reported wetland income dependence and relatively favourable perceived food-security status may suggest that wetland-based livelihoods could contribute to household

livelihood resilience, although this interpretation requires further analytical testing.

Agriculture, fishing, wild-resource use and associated processing and trading activities can provide food directly as well as income with which households obtain food and other necessities. Nevertheless, dependence on a natural-resource system that is subject to hydrological and ecological change may also expose households to livelihood risks when resource availability declines (Chiwaula & Waibel, 2009).

Wetland Resources and Dietary Protein

The very high proportion of respondents who perceived wetland resources as an important source of dietary protein highlights the nutritional dimension of wetland-resource use. Fishing and other aquatic-resource activities can provide direct access to animal-source foods, while income derived from wetland-based activities may also improve households' ability to purchase food. This broader food-security perspective is consistent with evidence from northern Nigeria showing that locally adapted indigenous crops can contribute to household nutrition and food-security objectives (Wakili *et al.*, 2026a).

The result is consistent with the established importance of fishing and other provisioning services within the HNWs (Ayeni *et al.*, 2019). However, because the present study did not quantify food consumption, dietary diversity or nutrient intake, the 98.33% response should be interpreted as a perceived importance of wetland resources for dietary protein, rather than a measured contribution to household protein intake.

The 98.33% agreement should also be interpreted independently of the 95.0% reported household cash-income dependence and the 79.0% perceived food-security status. These three results address different dimensions of wetland-household interactions and should not be combined into a single indicator of household well-being.

Economic Value and Willingness to Pay for Wetland Goods and Uses

The variation in stated WTP across wetland goods and resource-use opportunities indicates that respondents attached different monetary values to different forms of wetland access and resource use. Medicinal herbs recorded the highest mean stated WTP, while animal watering recorded the lowest. However, these values are expressed for different units—including per bucket, per donkey cart, per day, per acre, per kilogram and per 200-l drum—and therefore should not be ranked as if they represented the same quantity or type of economic value. The values provide an indication of perceived economic value within the survey context but should not be interpreted as market prices or as directly comparable economic values.

The economic importance of wetland resources is well established in the HNWs. Ayeni *et al.* (2019) demonstrated substantial monetary contributions from wetland-based activities and reported changes in the economic value of several provisioning services over time. The present WTP results complement that evidence by demonstrating that respondents also attach monetary values to access to particular wetland goods and uses (Adekola *et al.*, 2012).

The WTP results should nevertheless be interpreted with caution. Stated WTP represents respondents' expressed monetary valuation under the conditions presented in the questionnaire and does not necessarily correspond to actual expenditure or observed market transactions (Carson & Groves, 2007). Consequently, the values are most appropriately used as indicative measures of stated economic

value for the specified units, rather than as estimates of the total economic value of the wetland.

Implications for Sustainable Wetland Management

Taken together, the findings demonstrate that the Hadejia-Nguru Wetlands function as a multifunctional livelihood landscape in which agriculture, fishing, material collection, processing, trading and other resource uses are interconnected. The importance of these activities is consistent with previous assessments of HNW provisioning services and livelihood dependence (Ayeni *et al.*, 2019).

At the same time, the high ranking assigned to climate change highlights the perceived vulnerability of these livelihood systems to environmental change. Previous research has identified *Typha* invasion, hydrological alteration and dam-related changes among the pressures affecting wetland resources and livelihood opportunities (Salako *et al.*, 2016; Ayeni *et al.*, 2019). Sustainable management therefore requires approaches that recognize both the ecological functions of the wetland and the legitimate livelihood dependence of surrounding communities, as well as the nutritional and socioeconomic benefits derived from locally available biological resources (Wakili *et al.*, 2026b).

Management interventions should consequently emphasize integrated water-resource management, climate-resilient agricultural practices, sustainable fisheries and controlled harvesting of wetland resources. Particular attention should also be given to managing invasive *Typha* and maintaining ecological water flows, while incorporating local knowledge and community participation into wetland-use planning. Such approaches would help reduce the tension between resource conservation and livelihood needs and support the continued provision of wetland ecosystem services. However, these management implications should be viewed as evidence-informed recommendations arising from the livelihood and perception findings, rather than as directly tested intervention effects of the present study.

CONCLUSION

The study demonstrates the substantial livelihood importance reported by respondents in the sampled communities within and around the hadejia-nguru wetlands. Crop cultivation was the predominant primary economic activity, while irrigation farming, fishing, sedge/reed collection and weaving, fish marketing and processing, and wild-resource harvesting represented important additional wetland-dependent livelihood activities. Most respondents perceived the wetlands as strongly influencing available livelihood options, and 95.0% reported direct household dependence on wetland resources for cash income.

A large majority of respondents reported their households as secure or very secure in terms of perceived food-security status, while 98.33% agreed that wetland resources were an important source of dietary protein. These findings represent self-reported perceptions and should not be interpreted as evidence that wetland dependence caused food security or as direct measures of household dietary intake. Similarly, the high reported dependence on wetland resources for cash income represents a distinct livelihood indicator and should not be combined with perceived food security or dietary-protein importance.

Climate change received the highest priority among the factors ranked as influencing wetland utilization, indicating a strong perceived importance of climate change among the respondents in the study sample. The findings therefore reinforce the multifunctional role of the HNWs within the

sampled communities and highlight the need to reconcile livelihood dependence with ecological sustainability.

Given the reported pressures associated with climate variability, hydrological alteration and resource-use intensification, sustainable management should protect wetland functions while maintaining equitable access to resources that support local livelihoods. These implications apply principally to the sampled communities and should not be generalized to every household or community across the wider hadejia-nguru wetland system. Further studies covering a broader range of communities and incorporating objective measures of household food security, dietary intake and livelihood outcomes would strengthen understanding of the relationships between wetland resources and household well-being.

RECOMMENDATION

- i. Management agencies should strengthen coordination among water, agriculture, fisheries and environmental institutions to maintain adequate ecological flows and sustain the seasonal productivity of the Hadejia-Nguru Wetlands.
- ii. Communities should be supported through improved dry-season agricultural practices, efficient water use, livelihood diversification and locally appropriate adaptation measures that reduce vulnerability to climatic variability.
- iii. Community-based arrangements should be developed for fisheries, grazing, harvesting of reeds and other wetland products, with locally agreed harvesting periods and access rules.
- iv. Priority areas affected by *Typha* invasion and hydrological degradation should be identified for targeted management and ecological restoration.
- v. Local resource users should be actively involved in wetland planning, monitoring and conflict-resolution mechanisms so that conservation measures are compatible with legitimate livelihood needs.

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