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ABBREVIATIONS AND ACRONYMS

Symbols	Description
°C	Degree Celsius
°F	- Fahrenheit
ACReSAL	Agro Climatic Resilience in Semi- Arid Landscapes
ADP	Agriculture Development Program
AfDB	African Development Bank
AMSL	Above Mean Sea Level
ATA	Agricultural Transformation Agenda
AWF	African Water Facility
BCM	Billion Cubic Metre
CBDA	Chad Basin Development Authority
CCAFS	Climate Change, Agriculture and Food Security
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station.
CJTF	Civilian Joint Task Force
CMCs	Catchment Management Committees.
CN	Curve Number
DEM	Digital Elevation Model
EA	Executing Agency
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EU	European Union
FAO	Food and Agriculture Organization of United Nations
FDC	Flow Duration Curve
FEPA	Federal Environment Protection Agency
FGD	Focus Group Discussion
FMAFS	Federal Ministry of Agriculture and Food Security
FMEEnv	Federal Ministry of Environment
FMLD	Federal Ministry of Lands and Development
FMWR	Federal Ministry of Water Resources

GBV	Gender-based violence
GCM	Global Climate Model
GEFC	Global Environmental Flow Calculator
GIS	Geographic Information System
GPS	Global Positioning System
GRDB	Global Runoff Data Base
GRDC	Global Runoff Data Centre
Ha	Hectares
HJ	Hadejia Jama'are
HJKYB	Hadejia Jama'are Komadugu Yobe Basin
HJKYB-TF	Hadejia Jama'are Komadugu Yobe Basin - Trust Fund
HJRDBA	Hadejia-Jama'are River Basin Development Authority
HNW	Hadejia-Nguru Wetlands
HNWCP	Hadejia Nguru Wetlands Conservation Project
HVDP	Hadejia Valley Development Project
HVIP	Hadejia Valley Irrigation Project
HVIS	Hadejia Valley Irrigation Scheme
IAR	Institute of Agricultural Research
ICRC	International Committee of the Red Cross.
IDPs	Internal Displace Person's
IP	Irrigation Project
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
IWRMD	Integrated Water Resources Management and Development
IWRMP	Integrated Water Resources Management and Planning
JICA	Japan International Cooperation Agency
KCWS	Kano City Water Supply
KII	Key Informant Interview
KRIP	Kano River Irrigation Project
KRIS	Kano River Irrigation Scheme
KSMWR	Kano State Ministry of Water Resources
KYB	Komadugu Yobe Basin

LCBC	Lake Chad Basin Commission
LGAs	Local Government Authorities
LGP	Length of Growing Period
LPCs	Local Peace Committees
LUA	Land Use Act
LULC	Land Use Land Cover
M	Meters
M&E	Monitoring & Evaluation
masl	Meters above sea level
MCM	Million Cubic Meter
MDG	Millennium Development Goal
MSF	And Médecins Sans Frontières
MSL	Mecon Services Limited
MSMD	Ministry of Solid Minerals Development
NAERLS	National Agricultural Extension and Research Liaison Services
NASRDA	National Space Research and Development Agency
NCRS	National Center for Remote Sensing
NCWR	National Council on Water Resources
NDE	National Directorate of Employment
NDVI	Normalized Different Vegetation Index
NEAZDP	North East Arid Zone Development Programme
NEMA	National Emergency Management Agency
NESREA	the Nigerian Environmental Standards and Regulations Enforcement Agency
NFDP	National <i>Fadama</i> Development Program
NGO	Non-Governmental Organization
NGSA	Nigerian Geological Survey Agency
NHISA	Nigeria Hydrological Services Agency
NIMET	Nigerian Meteorological Agency
NIP	National Implementation Plan
NIWRMC	Nigeria Integrated Water Resources Management Commission
NNJC	Nigeria-Niger Joint Commission

NRCS	Natural Resources Conservation Service
NRW	Non-Revenue Water
NSE	Nash-Sutcliffe Efficiency
NW	North West
NWRMP	National Water Resource Master Plan
OSGOF	Office of Surveyor General
PET	Potential Evapotranspiration
PIM	Participatory Irrigation Management
PMT	Project Management Team
PPT	Precipitation
PSC	Project Steering Committee
PWD	Projected Water Demand
RBDA	River Basin Development Authority
REA	Rural Electrification Agency
RRR	Ministry of Reconstruction, Rehabilitation, and Resettlement
RUWASA	Rural Water Supply and Sanitation Agency
SAP	Strategic Action Plan
SAPDWR	Strategic Action Plan for the Development of Water Resources
SCIP	South Chad Irrigation Project
SCS	Soil Conservation Service
SEMA	State Emergency Management Agency
SESA	Strategic Environmental and Social Assessment
SGS	Streamflow Gauging Station
SHA	Sub Hydrologic Area
SMA	State Ministry of Agriculture
SME	Small Medium Enterprise
SMEDAN	Small and Medium Enterprises Development Agency of Nigeria
SMEnv	State Ministry of Environment
S.M.L	Short term (0-2 years), Medium term (2-5 years), Long term (5-10 years)
SMM	Soil Moisture Method (<i>Hydrology rainfall-runoff model within WEAP</i>)
SMWR	State Ministry of Water Resources
SSEA	Strategic Social and Environmental Assessment

SUBEB	Small Medium Enterprise
SWA	State Water Agencies
TAP	Technical Advisory Panel
TOR	Terms of Reference
TRIMING	Transforming Irrigation Management in Nigeria
UBE	Universal Basic Education
UNESCO	United Nations Educational Scientific & Cultural Organization
UNICEF	United Nations Children’s Fund
UTM	Universal Traverse Mercator
VAPP	Violence against Persons Prohibition
WASH	Water, Sanitation, and Hygiene
WBG	World Bank Group
WEAP	Water Evaluation and Planning
WHO	World Health Organisation
WMO	World Meteorological Organization
WRA	Water Resources Act
WRM	Water Resources Management
WSS	Water Supply and Sanitation
WSSSRP	Water Supply and Sanitation Sector Reform Programme

EXECUTIVE SUMMARY

The Hadejia-Jama'are (HJ) Catchment is a critical sub-basin of Lake Chad. It spans approximately 123400 km² (12.34 million hectares) and stretches across northern Nigeria's Bauchi, Jigawa, Kano, and Yobe States. The two major rivers (Hadejia and Jama'are) exhibit seasonal flow variability that significantly impacts downstream communities. This catchment is pivotal in regional agricultural productivity, water resource management, and biodiversity conservation. It is home to the internationally recognized Hadejia-Nguru Wetlands, a Ramsar site covering 600,000 hectares, which supports diverse ecosystems and serves as a vital stopover for migratory birds. The catchment's dynamic ecological balance, characterized by seasonal flooding, underpins a range of socio-economic activities, including farming, fishing, fuelwood, and pastoralism, which are vital to the livelihoods of local communities. In general, the catchment provides essential ecosystem services that shape the well-being of the people living in the watershed and downstream.

Despite its ecological and socio-economic significance, the catchment faces numerous challenges relating to its various watershed services from both climatic and socio-economic drivers. These include the degradation of its land, biodiversity, and water resources and socio-political instability due to rapid population growth, high poverty rate, and weak governance. Another extant factor is climate change. The catchment's population is rapidly growing, with significant increases projected by 2050, placing pressure on water resources, land use, and infrastructure. Key activities like agriculture and aquaculture are vulnerable to climate change, and infrastructure such as dams and irrigation schemes requires improved maintenance and adaptation to meet future demands. Given these threats to the Catchment, a sustainable watershed management plan, considering a sound balance between conservation and development, is imperative.

This plan marshals various activities and initiatives to enhance climate resilience, promote socio-economic development, and protect natural resources in the Hadejia-Jama'are catchment for its socio-economic and environmental development. The purpose of this watershed plan is to help decision-makers and practitioners at local, basin, state, and national levels to understand the HJ Catchment's status, problems, issues, risks, and opportunities, as well as leverage investments for improving watershed management in short, medium and long-terms. The methodology for developing this plan would also be relevant to other watersheds in the

ACReSAL Project’s areas of northern Nigeria. The successful implementation of such a plan at the watershed level can also support integrated river basin management of larger river basins in the country.

Past and Ongoing Development Initiatives in the Catchment Area

To put the Plan in proper perspective, Table ES1 and Figure ES1 and ES2 depicts some past and ongoing development initiatives by different partners in the HJ Catchment.

Table ES1: Past and Ongoing Initiatives by Governments and Development Partners in the Catchment

LOCATION	PAST INITIATIVE	ONGOING INITIATIVE
Komadugu Yobe	<p>Project: Komadugu Yobe Basin (KYB) project Agency- Nigerian government, UNDP and other partners Focus: Addressing water resource challenges, including conflict resolution among water users, improving water flow regulation, and enhancing agricultural productivity</p>	<p>Project: Agroclimatic Resilience in Semi-Arid Landscapes (ACReSAL) Agency – Federal and state governments, world bank. Focus: Enhancing agro-climatic resilience, improving water resource management, reforestation, and sustainable land use practices</p>
Within the entire catchment	<p>Project: National Fadama Development Project (NFDP) Agency: Federal Ministry of Agriculture and Food Security with World Bank Focus: Community-driven agricultural development, irrigation schemes, and improving rural livelihoods through sustainable land and water management.</p>	
Lake Chad Basin	<p>Project: Lake Chad basin Commission (LCBC) Projects</p>	



	<p>Agency: Member states of the Lake Chad Basin Commission</p> <p>Focus: Regional water resource management, biodiversity conservation, and climate adaptation measures in the broader Lake Chad Basin</p>	
Borno, Katsina, kano, Jigawa, Bauchi, Yobe, Adamawa		<p>Project: Great Green Wall Initiative (GGWI)</p> <p>Agency: African Union, Nigerian government</p> <p>Focus: Combating desertification, restoring degraded landscapes, and promoting sustainable land use in northern Nigeria, including the catchment area.</p>
Katsina, Adamawa		<p>Project: Water, Sanitation, and Hygiene (WASH) Programs</p> <p>Agency: Federal Ministry of Water Resources, UNICEF, and other partners.</p> <p>Focus: Improving access to clean water, sanitation facilities, and hygiene awareness in rural and urban areas within the catchment.</p>
katsina state		<p>Project: Climate Resilience Projects by UNDP and GIZ</p> <p>Agency: United Nations Development Programme (UNDP), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).</p> <p>Focus: Building climate resilience, promoting sustainable agriculture, and supporting alternative livelihoods to reduce pressure on natural resources</p>



		<p>Project: Renewable Energy and Livelihood Programs</p> <p>Agency: Federal Ministry of Environment, international partners like the EU and USAID.</p> <p>Focus: Promoting solar energy solutions, supporting rural electrification, and providing alternative livelihoods to reduce dependency on natural resources.</p>
Kano state		<p>Project: Nigerian Erosion and Watershed Management Project (NEWMAP)</p> <p>Agency: Federal Ministry of Environment, World Bank, and other partners.</p> <p>Focus: Addressing severe erosion and watershed degradation in targeted areas, including parts of the Hadejia-Jama'are catchment.</p>
Kaduna and Plateau		<p>Project: Lake Chad Recovery and Development Initiative (LCRDI)</p> <p>Agencies: Lake Chad Basin Commission (LCBC), African Development Bank (AfDB).</p> <p>Focus: Restoring water flow and ecosystem health in the Lake Chad Basin, with indirect benefits for the Hadejia-Jama'are sub-basin.</p>
Hadejia-Jama'are River Basin	<p>Project: Wetland Restoration and Biodiversity Projects</p> <p>Agencies: BirdLife International, Nigerian</p>	

	<p>Conservation Foundation (NCF), and Wetlands International.</p> <p>Focus: Protecting the Hadejia-Nguru Wetlands and promoting biodiversity conservation.</p>	
<p>Yobe, Jigawa, kano and Borno states</p>		<p>Project: Hadejia-Jama'are Komadugu-Yobe Basin Trust Fund (HJKYBTF)</p> <p>Agencies: Nigerian government and international partners.</p> <p>Focus: Promoting integrated water resource management in the Komadugu-Yobe Basin, including Hadejia-Jama'are</p>
<p>Staple Crops processing zones (SCPZ)- Kano-Jigawa,</p>	<p>Project: Agricultural Transformation Agenda (ATA)</p> <p>Agency: Federal Ministry of Agriculture and Food Security.</p> <p>Focus: Modernizing agriculture through value chain development, improved irrigation, and enhanced farmer productivity.</p>	
<p>Chad Basin Development Authority: Kano, Jigawa, Yobe, Borno, Bauchi, Plateau, Adamawa</p> <p>Hadejia-jama'are River basin Development Authority: kano, Jigawa, Yobe, Borno, Bauchi, Plateau, Adamawa</p>		<p>Project: Integrated River Basin Development Programs</p> <p>Agencies: NEMA, SEMA, and international partners.</p> <p>Focus: Reducing disaster risks from floods and droughts through improved early warning systems and disaster preparedness</p>
<p>Within the entire catchment</p>		<p>Projects: UN Women's Gender and Social Inclusion Projects</p>



		<p>Agencies: UN Women, Federal Ministry of Women Affairs.</p> <p>Focus: Promoting gender equality in resource management and empowering women in rural communities.</p>
Within the entire catchment	<p>Projects: Private Sector and Community-Based Interventions</p> <p>Agencies: NGOs and private organizations like Oxfam, ActionAid, and Dangote Foundation.</p> <p>Focus: Supporting local livelihoods, providing microfinance for women, and promoting community-led resource management</p>	

Despite the aforementioned initiatives, there remains a widespread concern that most of the interventions within the catchment did not effectively address the development challenges in a cohesive manner. Numerous projects appeared to lack the necessary integrated approach to tackle the interconnected issues that arise from the same environmental and socio-economic development challenges. As a result, the catchment continues to face various biophysical and social problems, some of which are noteworthy as highlighted below.

Main Biophysical and Socio-economic Challenges

Based on biophysical assessments and stakeholder engagement, the following are the key biophysical and socio-economic issues of the HJ Catchment:

1. **Water resources deterioration:** Climate change has led to extreme flooding and drought, straining the already limited water resources in the catchment. Declining groundwater recharge and siltation, along with upstream diversions, worsen water availability and quality. During the short rainy season, local communities face issues with turbidity and sediment in drinking water.
2. **Environmental degradation:** Deforestation, desertification, and the encroachment of invasive species into wetland areas have degraded ecosystems critical for biodiversity and livelihoods of the catchment. As there is a high dependency on forest resources for cooking, the felling of trees around the water resources is negatively impacting the

biodiversity and ecosystem services (including water services) and contributing to a high rate of sedimentation and turbidity of the HJ Catchment.

3. **Unsustainable agriculture and livestock practices:** The current over-reliance on irrigation for agriculture is depleting the catchment's water resources. Using inorganic fertilizers also leads to soil degradation and groundwater pollution. Poor water use practices upstream result in imbalances in water distribution.
4. **Climate change:** Increasing temperatures, erratic rainfall, and frequent floods and droughts threaten the catchment's agricultural productivity and water security. The catchment's temperature and rainfall are projected to increase in variability towards the end of the century, with attendant climatic extremes that are likely to impact the watershed's biophysical characteristics and ecosystem functions with critical socio-economic implications. The region's lack of adaptive measures exacerbates these vulnerabilities.
5. **Socio-economic disparities and unsustainable livelihood practices:** High poverty rates, weak governance, and limited infrastructure access hinder the catchment's sustainable development. Over 70% of local government areas (LGAs) in the catchment experience high or very high poverty levels.
6. **Weak governance:** Weak institutional frameworks, lack of coordinated water management, ineffective policy enforcement, and insufficient funding for infrastructure hinder the sustainable development of the catchment. Limited stakeholder engagement and inadequate involvement of traditional governance structures further complicate resource management. Although institutions aim to be inclusive, they fail to empower women and marginalized groups to challenge existing power structures and norms. For sustainable development in the Misua-Komadugu Gana Catchment, active participation and inclusiveness of all stakeholders are essential, requiring effective coordination and robust upstream-downstream linkages to serve as a model for other river basins in the country.

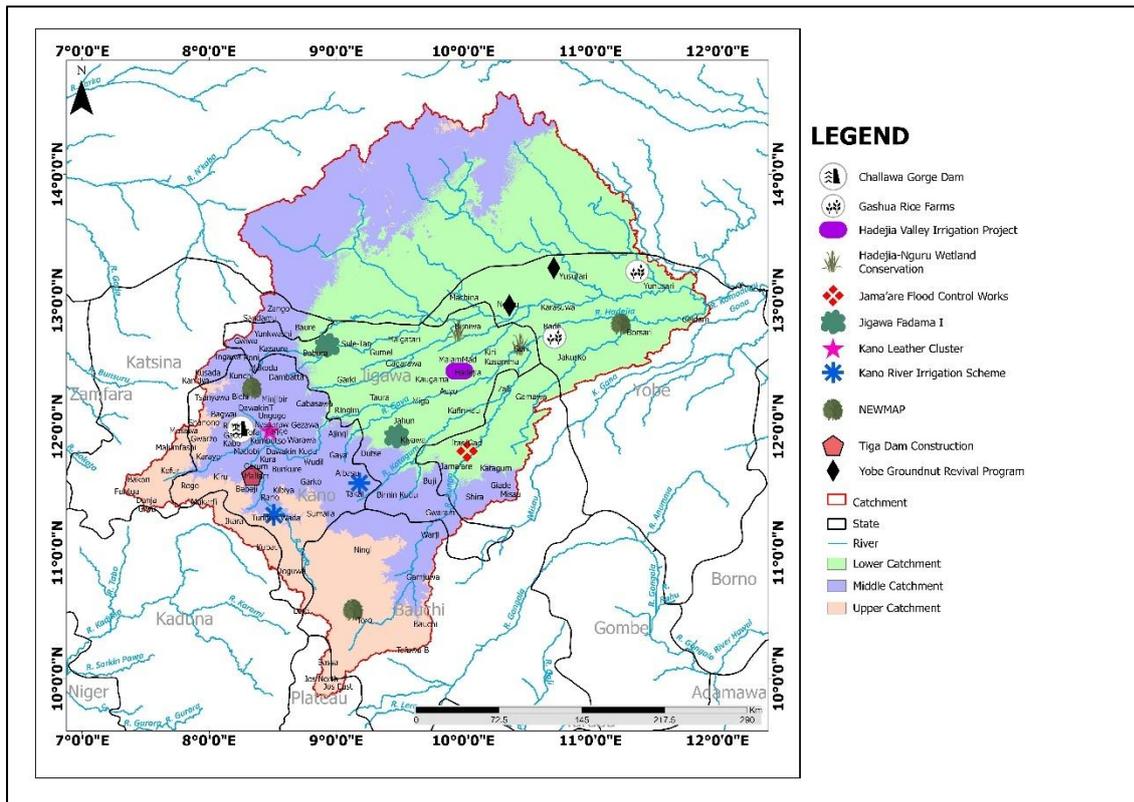


Figure E.S.1: Hadejia Jama'are Catchment Showing Past interventions (Source: MSL, 2024)

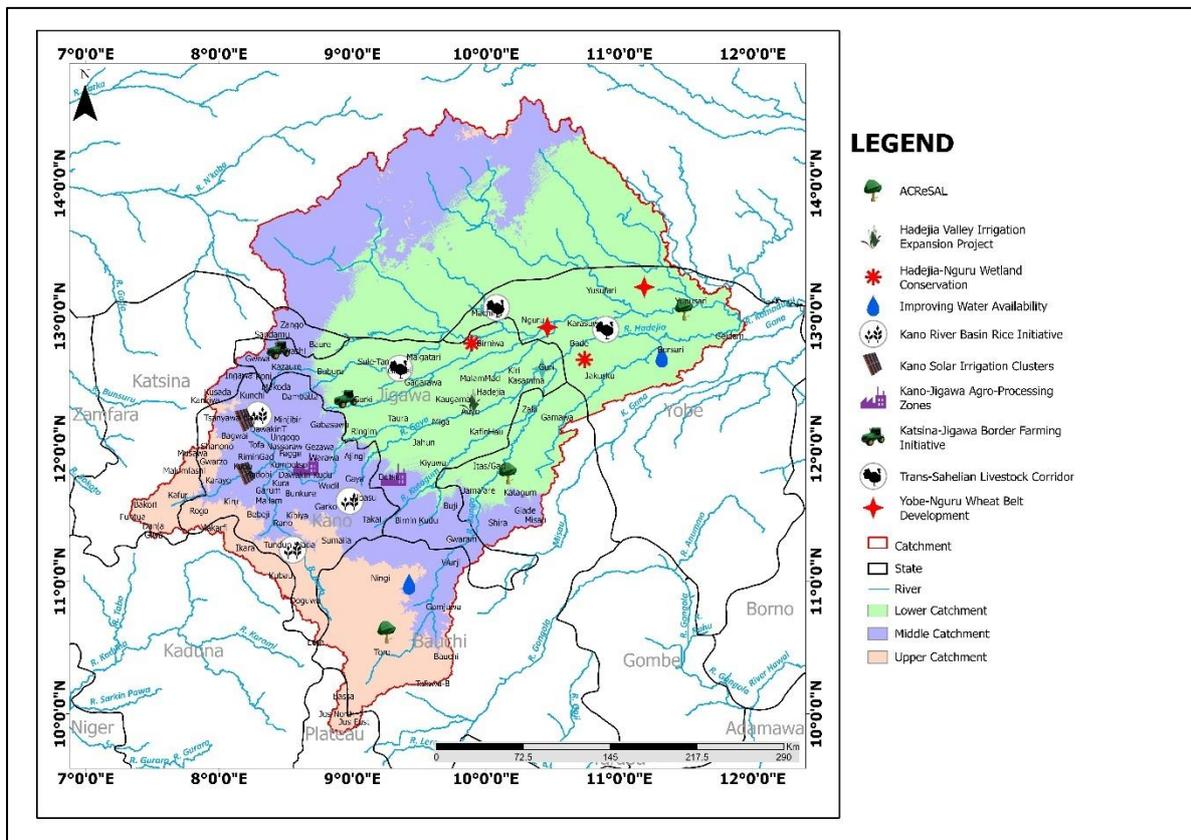


Figure E.S.2: Hadejia Jama'are Catchment Showing Ongoing Interventions (MSL, 2024)

Elements of the Catchment Management Plan

The elements of the catchment management plan are captured through the lenses of the following strategic vision and objectives:

Strategic Vision

The strategic vision of the Catchment Plan is to manage natural resources sustainably, promote ecosystem services, and improve local livelihoods while preserving the ecological integrity of the Hadejia-Jama'are catchment.

Strategic Objectives

Aligning with the vision of the Catchment Plan, the strategic objectives are to:

- i. **Improve water resources and flood risk management** to ensure the sustainable management of water resources, including protecting water sources, efficient water use, and mitigating flood and drought risks.
- ii. **Preserve and restore critical ecosystems and services** by protecting and restoring ecosystems, including forests, wetlands, and wildlife habitats, to maintain biodiversity, support ecosystem services, and promote ecological resilience.
- iii. **Promote sustainable agricultural** and livestock practices, including conservation agriculture, agroforestry, and integrated water management, to reduce environmental degradation and improve livelihoods.
- iv. **Enhance climate resilience** by implementing climate-resilient practices, including climate-smart agriculture, disaster risk reduction, and ecosystem-based adaptation, to enhance the catchment's resilience to climate change.
- v. **Improve livelihoods and well-being of the various stakeholders in the Catchment**, including women and youth, through improved access to education, healthcare, and economic opportunities.
- vi. **Strengthen inclusive governance and stakeholder partnerships for** coordinated and effective management of the catchment by building institutional and technical capacity at all levels of governance (Federal, State, Local Government and Communities)

This strategic vision and objectives provide a framework for managing the Hadejia-Jama'are catchment's natural resources, promoting ecosystem services, and improving livelihoods while maintaining ecological integrity. They constitute the guiding directives for identifying the following strategic interventions or components of the Catchment Plan.

Catchment Policies

For harmonious relationship and engagement of stakeholders regarding equitable utilization of inter-state water resources the following treaties, policies, and laws need to be recognized, and ratified treaties further domesticated.

Treaties

- Vienna Convention on the Law of Treaties on principle of binding nature of treaty once signed, ratified and inforce (*pacta sunt servanda*),
- UN Watercourses Convention on non-navigational use of shared watercourses, application to surface water and connected groundwater,
- UNECE Water Convention on relevance to both surface and ground water as well as application to all uses of the shared watercourse,
- Niger Basin Water Charter as principal treaty of the Niger River Basin,
- Lake Chad Water Charter as principal treaty of the Lake Chad Basin.

International Policies That Affect Water Resources

- 1971 Stockholm Declaration on Human Environment
- 1992 Dublin principles on water and sustainable Development,
- 1992 Rio Declaration on Environment and Development and Agenda 21
- 2008 ECOWAS Water Resources Policy
- Draft Articles on the Law of Transboundary Aquifer

National Laws and Policies

- 1999 Constitution of Federal Republic of Nigeria
- 1993 National Water Resources Act
- 2016 National Water Resources Policy
- 2016 National Policy on Environment
- National Climate Change Policy for Nigeria (2021-2030)
- Nigeria's Agricultural Transformation Agenda (ATA)
- Nigeria's National Forest Policy (2006)

Plan Components

To achieve the outlined goal and objectives to ameliorate the challenges in the catchment, the following are the strategic components or intervention areas of the Plan:

Component 1: Sustainable conservation, management, and use of water resources: The emphasis will be on the optimal utilization of water resources for sustainable development; equitable distribution and use of water resources to reduce conflict; mitigation and reduction of environmental degradation and disasters; development of water storage for post-wet season economic activity; and sustainable groundwater and surface water monitoring.

Component 2: Preservation and restoration of critical ecosystems and services for sustainable land use; including sustainable agricultural and livestock practices: The integrity of the ecosystems of the HJ Watershed is essential to its sustainable development. However, human activities have exerted a lot of pressure on the land resources of the basin. There is a high dependency on forest resources for cooking, leading to the felling of trees, especially around water resources, that could also lead to fragmentation and degradation of forests. This would impact biodiversity and ecosystem services, including essential water services, and contribute to triggering sedimentation and turbidity of the watershed. Enhancing the quality of land resources through ecosystem restoration will be a significant initiative of this component of the Plan.

Component 3: Improved diversification for enhanced sustainable livelihoods and well-being: Agriculture is the primary source of livelihood for many households in the HJ Watershed. The small landholdings and poor agricultural practices have resulted in low-income levels and are increasing the resource dependency level of the region's people. Sometimes, it pushes people, especially men, to migrate to urban or semi-urban areas, resulting in a labor shortage for agriculture and natural resource management in the watershed. Capacity building for resource management, expanding the economic base of the people, and improving people's access to sustainable natural resources are some of the necessary initiatives for this component.

Component 4: Climate change, disaster risk management, and climate-resilient infrastructure: The HJ Watershed is highly vulnerable to the impact of climate change. In particular, temperature and precipitation are projected to increase towards the end of the century along with climatic extremes, which are likely to impact the watershed characteristics

and functions with socio-economic implications, particularly with respect to a possible increase in the frequency of climate-induced disasters and the imperative for climate-resilient infrastructure. Thus, the emphasis in this component will be to identify initiatives that, if implemented, will make development in the Catchment sustainable and climate resilient to reduce the impacts of climate change-induced disasters.

Component 5: Strengthening institutional mechanisms and project coordination

mechanisms: Although many institutions are operating and managing different initiatives, they are not actively coordinating their activities for meaningful stakeholder convergence in the implementation phase with a suitable horizontal coordination mechanism, as well as for meaningful impact. Mechanisms for robust upstream and downstream linkages and an understanding of the roles and responsibilities of these institutions need to be drawn up and their capacities enhanced to coordinate the watershed management activities and mobilize local leaders for collaborative actions. The main interventions for this component of the Plan will address some of these challenges to ensure that much of the development challenges of the current institutional arrangements and mechanisms in the water basin are overcome.

Component 6: Mainstreaming gender equality and social inclusion (GESI) mechanism:

In the watershed, there has been a significant change in gender roles and responsibilities (see chapter 4 of this report), where women are held responsible for household activities. However, their work has extended to the agriculture sector due to the increasing out-migration of male members. The possible switch from subsistence farming to commercial cultivation will increase women's entrepreneurship in the watershed, resulting in a need for the economic empowerment of women, with some unexpected socio-economic consequences that will need to be incorporated into the new management approach to the sustainable use of the natural resources in the watershed to reduce women's vulnerability,

Component 7: Research and extension: This component will emphasize action research on pertinent issues such as Indigenous knowledge and practices, nature-based solutions, the effectiveness of soil conservation measures, watershed services for integrated water management (IWM), sediment yield, climate change on vegetation, pests, micro-finance, and others for an evidence-based watershed management plan and strategies.



Component 8: Effective coordinated monitoring, evaluation, and reporting mechanism and system. The emphasis will be on capacity building to effectively undertake periodic monitoring of periodic monitoring of watershed services, as well as the monitoring and evaluation of the plan

Table ES2 shows the significant issues in the watershed and the proposed solutions, including the local, state, and national implementing partners.



Table ES2: Summary of Components and Activities of the HJ Catchment Plan

Component	Activities	Key Indicators	Responsibility/ Partners
<p>Sustainable conservation, management and use of water resources:</p>	<p>Rehabilitate existing dams and reservoirs (including the extensive removal of typha grass, to improve water retention and release.</p> <p>Construct small-scale water storage facilities and enhance rainwater harvesting techniques.</p> <p>Establish water allocation plans that balance upstream and downstream needs.</p> <p>Construct embankments and improve drainage systems in high-risk areas.</p> <p>Develop early warning systems and conduct flood risk assessments regularly.</p> <p>Strengthen the network of groundwater monitoring systems and hydromet stations</p>	<p>Reports, implementation and supervisions</p> <p>Reports on a comprehensive water study, policy enactment, implementation and enforcement.</p> <p>Reduction in environmental risk and disaster</p> <p>Better Socio-economic engagement</p>	<p>Three tiers of government encompassing the RBDA's, FMWR and allied agencies</p> <p>As above, NIWRMC</p> <p>NHISA, NIMET</p> <p>NHISA, The three tiers of government encompassing the RBDA's, FMWR and allied agencies</p>



	<p>Enhance public awareness and preparedness for flood events.</p> <p>Implement integrated water management practices that address seasonal variability, optimize groundwater recharge, and enhance surface water distribution to meet agricultural, domestic, and industrial demands.</p> <p>Define and operationalize a set of technical standards for water efficiency (conservation, reuse, recycling) for recreation and - other uses based on best practices</p> <p>Assessment of demand and supply of drinking water</p> <p>Construction and maintenance of pipelines and water tanks</p> <p>Construction of recharge structures to rejuvenate drying and dried springs.</p> <p>Roof rainwater harvesting and improved water use efficiency</p>	<p>Routine Reports</p> <p>Reports</p>	<p>NHISA, NIMET, MOA, CBO's</p>
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	<p>Conservation and preservation of water recharge areas, along with planting of appropriate tree and plant species which assist in increasing the abundance of water sources.</p>		
<p>Preservation and restoration of critical ecosystems and services for sustainable land use (to include sustainable agricultural and livestock practices)</p>	<p>Restoration of 30% to 40% of degraded land through afforestation</p> <p>Restore 25% and improve agricultural degraded land</p> <p>Restore and maintain wetlands to stabilize hydrological cycles and support biodiversity.</p> <p>Enforce the protective boundaries of national parks and valuable reserves such as Nguru</p> <p>Increase agricultural productivity by 40% through climate-smart agriculture, capacity building, and data gathering</p> <p>Improve soil fertility management, and apply soil and water conservation to reduce erosion</p>	<p>Increase in agricultural productivity</p> <p>As above</p>	<p>Federal, state and local government MDA's on agriculture and food security, livestock, water resources and environment</p> <p>As above</p>



	<p>Support smallholder farmers through training and access to improved technologies</p> <p>Encourage the use of micro-irrigation facilities</p>	<p>Increase in number of farmers.</p> <p>Increase in agricultural productivity</p>	<p>Bank of agriculture, NGOs and other international agencies. CBOs</p> <p>As above</p>
<p>Improved diversification for enhanced sustainable livelihoods and well-being</p>	<p>Ensure the proper conditions for the effective organization of fish farming in floodplains of rivers, natural and artificial reservoirs;</p> <p>Provide training programs for sustainable farming, fishing, and aquaculture practices.</p> <p>Facilitate access to credit and market opportunities for smallholder farmers and fisherfolk.</p> <p>Develop community-based tourism and eco-friendly economic activities.</p> <p>Improve access to sustainable natural resources, low-cost energy, better sanitation and hygiene practices</p>	<p>Improved quality of living.</p> <p>Improved funding</p> <p>Improved income/job creation.</p> <p>Availability of renewable energy and improved standard of living.</p>	<p>Federal, state and local government MDAs, CBOs</p> <p>Donor agencies, banks and cooperatives</p> <p>CBOs and the three tiers of government</p> <p>As above</p>



	<p>Promote farming of high-value agricultural products such as high yielding climate resilience seeds such as maize, sorghum, SAMNUT-22, millet</p> <p>Providing comprehensive training on irrigation techniques, preparation of compost manure, water ponds for irrigation,</p> <p>Integrated Pest Management (IPM) and other technical skills to women, men, and marginalized communities to reduce the pollution of the main water resources.</p> <p>Promote of multi-year crops to improve the average income of the people living in the catchment.</p> <p>Promote the use of water as an alternative to road transport system</p>		
<p>Climate change, disaster risk management, and climate-</p>	<p>Promote the use of local runoff of small rivers to mass-arrange water bodies and provide water measures</p>	<p>Reduction in climate change induced disaster</p>	<p>Federal, State and local Government MDAs, NGOs, donor agencies,</p>



<p>resilient infrastructure</p>	<p>to combat climate change-induced drought.</p> <p>Expand early warning systems and enhance the capacity for disaster response</p> <p>Construct resilient infrastructure to address flood risks and water distribution challenges.</p> <p>Support the adoption of drought-resistant crop varieties and efficient irrigation technologies.</p> <p>Promote afforestation programs to combat desertification and stabilize soils.</p> <p>Implement community-based initiatives for floodplain management and watershed protection.</p> <p>Prepare risk sensitive Land-use Plan (RSLUP) and implementation for identified degraded areas</p> <p>Revitalise erosion-affected areas, including stream banks and gully</p>	<p>Reduction in environmental degradation and climate change disaster</p> <p>Improved agricultural output and increased employment</p> <p>Decrease in soil erosion, improved NDVI</p> <p>Reduction in environmental degradation.</p> <p>Designated livelihood areas and updated reports</p> <p>Increase in land resources available</p>	<p>multi-lateral financial institutions, CBOs</p> <p>Federal, State and local Government MDAs, NGOs, donor agencies.</p>
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	<p>stabilization in the upstream micro-catchment vulnerable areas</p> <p>Promote green roads through bioengineering in erosion-prone areas</p> <p>Creating a green infrastructure system to protect ecosystems, ecologic corridors and natural landscapes in the water bodies</p> <p>Focus on both structural (bioengineering, retaining walls) and non-structural (hazard/susceptibility, vulnerability, risk maps, early warning systems) measures for infrastructure failure mitigation and preparedness</p> <p>Undertake hazard and risk assessment to minimize the risk.</p> <p>Conducting EIA/IEE of major development projects to minimize impact on ecosystem.</p> <p>Undertake effective and timely review and monitoring of infrastructure development projects</p>	<p>for livelihoods in updated reports.</p> <p>As above</p> <p>Updated reports</p> <p>Updated reports and increase in harmonious engagement with stakeholders</p> <p>Updated reports</p>	
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<p>Strengthening institutional mechanisms and project coordination mechanisms:</p>	<p>Establish a regulatory framework for integrated water resource management at the catchment level.</p> <p>Strengthen coordination among federal, state, and local agencies.</p> <p>Ensure community representation in decision-making processes and management committees.</p> <p>Strengthening the watershed management committee to implement the watershed management plan.</p> <p>Implementing production-based incentives and monitoring mechanisms for agricultural land management.</p> <p>Developing mechanisms to ensure effective implementation and management of springshed and recharge areas, particularly on public and private land.</p>	<p>Reduced conflict and equitable distribution of water resources</p> <p>Reduced conflict among stakeholders and better institutional collaboration</p> <p>Increase in agricultural output</p> <p>Policy formulation and Implementation</p>	<p>Federal, state and local government MDAs, NGOs, donor agencies, multi-lateral financial institutions, CBOs.</p>
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<p>Mainstreaming gender equality and social inclusion (GESI) mechanism</p>	<p>Ensure equitable distribution of roles and responsibilities to women, men and marginalized communities during the planning, implementation and evaluation of any projects/plans/activities</p> <p>Provide training and exposure visits to both women and men in order to enhance their understanding on water conservation technologies and economic development.</p> <p>Identify vulnerable areas and communities (with gender and social disaggregated data) to disaster and climate risk and develop focused projects to address identified challenges</p> <p>Promote women and marginalized communities to leadership positions through participatory approaches.</p> <p>Establishing counseling centers for handling domestic violence, grievances, and psychosocial services for supporting the well-being of women, men, and marginalized communities.</p>	<p>Comprehensive participation of all stakeholders</p> <p>Better outputs of environmental conservation</p> <p>Updated Reports on key social issues within a community</p> <p>More women participation</p> <p>Improved psycho-social status of victims of abuse</p>	<p>Federal, state and local government MDAs, NGOs, donor agencies, multi-lateral financial institutions, CBOs.</p>
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	<ul style="list-style-type: none">✓ Structures and developing rational methods for their operation.✓ Inclusion of gender and social aspects in projects' development and implementation✓ Monitoring and evaluation of the plan		
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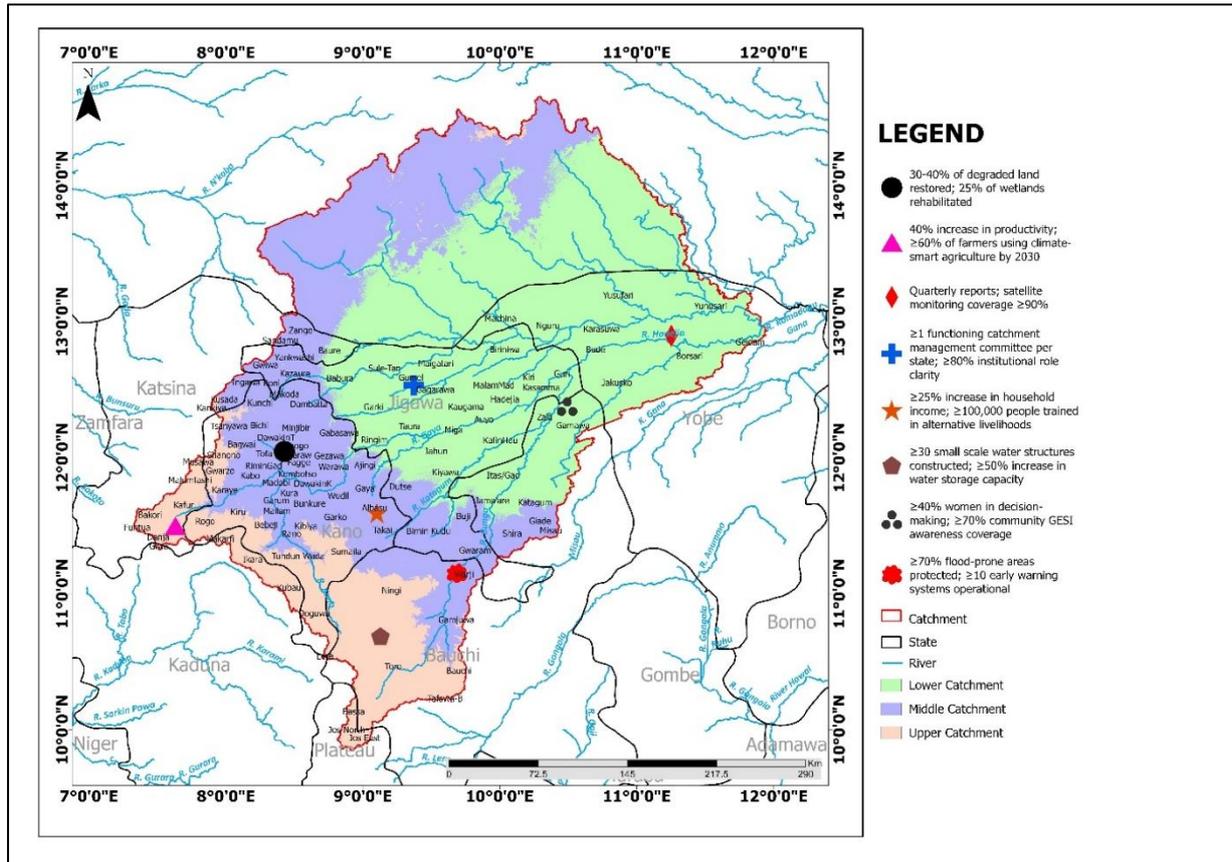


Figure E.S.3: Hadejia Jama'are Catchment showing the Recommended interventions (Source: MSL, 2024)



Table E.S.3. Upper Catchment of the Hadejia-Jama’are Strategic Catchment – Spatial Challenges and Intervention Matrix

Upper Catchment	LGA/Town(s)	Specific Challenges	Proposed Intervention	Appropriate Tool(s) For Sustained Monitoring and Evaluation	Responsible Agency	Expected Outcome
	Toro, Bassa, Tafawa Balewa, Ningi	Severe gully erosion and surface runoff due to steep slopes Insecurity	Terracing, gully control structures, check dams Conflict management plan	GIS slope analysis, drone surveillance, erosion mapping. Interviews, CBO tracking	ACReSAL, Bauchi State Ministry of Environment. Bauchi State Ministry of water resource. Bauchi ministry of tourism. National integrated water resource management commission (NIWRMC) ACReSAL	Stabilized land, reduced erosion, better water retention Resolve the crisis by consistent dialogue and conflict resolution and integration of displaced people
	Jos North, Jos South	Urban expansion causing deforestation and biodiversity loss.	Urban greening, forest buffer zones, afforestation campaigns.	NDVI satellite imagery, urban planning GIS Terracing, gully control	Plateau State Ministry of Environment, Plateau State ministry of Tourism, federal Ministry of	Reduced land degradation and restored biodiversity



		Flash flood and gully erosion	Biodiversity Conservation Construct embankment and improve drainage system in high-risk area	structures, check dams	environment department of Forestry Commission	Stabilized land, reduced erosion, better water retention
	Doguwa, Kubau, Rogo, Kiru	Water scarcity during dry season	Rainwater harvesting, construction Water storage reservoirs	Satellite images and Ground truth measurement	Kano State RUWASA, HJRBDA NIHSA, ACRoSAL , FMWR (NIWRMC)	Improved year-round water access for communities
	Lere, Makarfi, Ikara	High youth unemployment and limited economic opportunities	Youth agro-enterprise training, off-season farming schemes	CBO feedback	SMEDAN, NDE, Kaduna State Agricultural Development Programme (ADP)	Reduced youth unemployment, increased rural income
	Funtua, Bakori, Kafur, Malumfashi	Declining agricultural productivity due to slope and soil degradation	Climate-smart agriculture, land contouring, organic soil improvement	Soil mapping tools, extension services	, Katsina ADP ACRoSAL	Improved productivity, better soil health



	Tundun Wada, Sumaila	Limited road access to markets in rugged terrain. Limited access to credit facility	Construction of feeder roads and slope-stable tracks. Facilitate access to credit and market opportunities for smallholder farmer and fisherfolk.	Road alignment planning software, GGPS surveys. Micro finance bank, Cooperative	Federal, Kano State Ministry of Works. Donor Agencies, Bank and Cooperative	Enhanced mobility, economic integration. Purchasing power of the people
	Gwoza, Shanono, Musawa	Climate-induced conflicts over land/water use	Community mediation platforms, shared water infrastructure	Stakeholder analysis tools, GIS conflict mapping	NEMA, Peace Commission, local NGOs	Peaceful coexistence, shared resource governance
	Musawa, Malumfashi, Ningi	Poor sanitation infrastructure in scattered rural settlements	Mobile toilet systems, hygiene education campaigns	CLTS apps, sanitation monitoring dashboards	Ministry of Health, UNICEF, RUWASSA	Better public health and reduced disease burden
	All towns (cross-cutting)	Inadequate data for planning and monitoring	Community-based Hydro-Metrological station	Hydrological and climatological measuring stations.	National Water Resources Institute (NWRI), Local Gov'ts National integrated water resource	Data-driven decisions and more efficient planning



					management commission (NIWRMC)	
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Table E.S.4: Middle Catchment of the Hadejia-Jama’are Strategic Catchment – Spatial Challenges and Intervention Matrix

Middle section	LGA/Town(s)	Specific Challenge	Proposed Intervention	Appropriate Tool(s) For Sustained Monitoring and Evaluation	Responsible Agency	Expected Outcome
	Zango, Sandamu, Kazaure, Gwiwa	Seasonal flooding during peak rains Flash Flooding Gully Erosion	Construction of retention basins and improved drainage systems Terracing, gully control structures, check dams. Build flood-resistant infrastructure like drainage system, retention basins, and raised road and also improved water distribution	Flood mapping software, remote sensing GIS slope analysis, drone surveillance, erosion mapping.	HJRBDA, NEMA, FMEnv LGA’s ACReSAL CBDA.	Reduced flood impact and property loss. Stabilized land, reduced erosion, better water retention



	Misau, Giade, Shira, Gamawa	Water scarcity and poor irrigation infrastructure	Drilling of boreholes, upgrading small-scale irrigation schemes and small water conservatory	Groundwater /surface water measurement by satellite imaginary. drone mapping and ground measurement	Bauchi State RUWASSA, FMAFS. CBDA FMWR FMAFS ACRoSAL. NIWRMC	Reliable water supply and increased crop yield
	Yankwashi, Ingawa, Roni, Kasada	Land degradation and poor soil quality Loss of Biodiversity	Integrated soil fertility management, afforestation and Conservation effort	Consistent Soil testing (NDVI, and periodic land use land cover) drone monitoring, GIS maps	Jigawa ADP, (FMAFS) ACRoSAL, LGA's	Improved land productivity and environmental restoration
	Makoda, Kunchi, Dambatta, Tsanyawa, Bichi	Limited access to markets due to road conditions	Rural road rehabilitation, feeder road expansion	Road condition mapping,	Kano State Ministry of Works, LGA, FERMA	Increased market access and lower post-harvest loss
	Rimingado, Fagge, Warawa, Ajingi	Poor waste management in semi-urban areas	Establishment of community recycling and composting centers	Consistent measurement of the atmosphere and waste measurement tracking, community mapping	LGA'S, NESREA	Cleaner environment and increased recycling awareness



	Kabo, Karaye, Kumbotso, Madobi	Youth unemployment and rural-urban migration	Skills training in agro-processing and digital agribusiness	CBO, Focus group discussion, measurement of standard of living	SMEDAN, NYSC-CDS, NDE	Job creation and rural economic stimulation
	Dawakin Kudu, Kura, Wudil, Gaya	Overdependence on rain-fed agriculture	Promotion of dry-season farming and irrigation support Climate smart Agriculture, drought resistant and fast maturing seedlings	Consistent measurement of Agricultural productivity	Kano ADP, FMAFS, HJRBDA, CBDA, ACRReSAL	Year-round farming and food security
	Dutse, Garum, Bunkure, Mallam Madori	Conflicts over farmland and water access	Formation of community water user associations (WUAs)	Consistent Stakeholder dialogue, GIS boundary tools	Local Peace Committees, NEMA	Conflict reduction and cooperative resource use
	Kibija, Rano, Garko, Albasu	Deforestation from fuelwood demand	Promotion of LPG/biogas and community woodlots	Remote sensing of forest cover,	SMEnv, REA	Alternative energy access and forest regeneration
	Takai, Birnin Kudu, Buji, Gwaram	Lack of reliable agricultural extension services	Deployment of mobile extension agents and e-extension platforms	Agricultural advisory apps (e.g., Nuru, FarmKonnnect)	FMAFS, ADPs	Increased farmer knowledge and improved farming practices



Table E.S.5: Lower Catchment of the Hadejia-Jama’are Strategic Catchment – Spatial Challenges and Intervention Matrix

Lower section	LGA/Town(s)	Specific Challenge	Proposed Intervention	Appropriate Tool(s) For Sustained Monitoring and Evaluation	Responsible Agency	Expected Outcome
	Nguru, Guri, Guri, Hadejia, Auyo	Frequent and prolonged seasonal flooding from river overflow	River channel desilting, embankment construction, early warning systems	Hydrological models, flood risk maps, satellite imagery	HJRBDA, NEMA, Jigawa State MEnv, CBDA, NIHSA, ACRoSAL	Reduced flood damage and improved settlement safety
	Geidam, Yunusari, Yusufari, Borsari, Machina	Water scarcity due to arid conditions and groundwater depletion	Drilling deep borehole, rainwater harvesting, water conservation education water resource allocation plan	Groundwater modeling, Surface and groundwater monitoring	Yobe RUWASSA, UNICEF, FMAFS NIHSA CBDA	Improved water availability and resilience to drought
	Bade, Jakusko, Katagum, Jama’are	Agricultural decline due to salinization and poor soil health	Soil reclamation techniques, salt-tolerant crop introduction	Soil salinity maps, soil health assessment k	Bauchi ADP, FMAFS,CBDA, NAERLS	Improved soil productivity and higher crop yield



	Gumel, Sule-Tankarkar, Kaugama, Gagarawa	Poor rural road connectivity impacting food transport	Construction of rural feeder roads and bridges	GIS-based road planning tools, local contractor mapping	FERMA, Jigawa State Ministry of Works	Enhanced market access and reduced post-harvest loss
	Ringim, Kiyawa, Jahun, Garki	Increasing deforestation for fuelwood	Promotion of energy-efficient cookstoves and woodlots	Forest cover change detection, biomass energy apps	FMEnv, REA.	Forest preservation and energy diversification
	Kafin-Hausa, Taura, Maigatari	High youth unemployment and migration	Agro-based entrepreneurship support, digital vocational training	Local Government authority e-learning platforms, mobile job-matching apps	NDE, SMEDAN, State Youth Ministries	Increased employment and rural income retention
	Zaki, Gamawa, Itas/Gaidam, Kasamma	Overreliance on seasonal rain-fed farming	Expansion of dry-season farming and irrigation schemes	Drip irrigation tech, seasonal crop calendar tools	Bauchi ADP, FMAFS, CBDA HJRBDA	Stable food production and year-round farming
	Baure, Baure, Guri, Jakusko	Community conflict over grazing and water rights	Grazing route demarcation, community water sharing plans	Participatory mapping, stakeholder dialogue tools	National Boundary Commission, LPCs	Peaceful cohabitation and fair access to resources



	Katagum, Jama'are, Guri, Garki	Weak land use planning leading to settlement in flood zones	Enforced zoning laws, relocation from high-risk zones	LIDAR elevation models, risk-sensitive land use plans	Ministry of Lands Housing Urban Development And Regional Planning	Reduced disaster exposure and safer communities
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Expected Outcomes

The successful implementation of these interventions will result in:

- Improved water availability and reduced seasonal scarcity.
- Enhanced resilience of agricultural systems to climate variability.
- Restoration of critical ecosystems and enhanced biodiversity.
- Strengthened governance structures and stakeholder engagement.
- Reduced flood vulnerability and minimized socio-economic disruptions from extreme weather events.

CHAPTER 1 : INTRODUCTION

1.1 Purpose of the Plan

The Hadejia-Jama'are catchment is a critical ecosystem that supports the livelihoods of millions of people in Northern Nigeria. However, the catchment faces numerous challenges, including:

- i. **Environmental degradation:** Deforestation, soil erosion, and pollution threaten the catchment's ecosystem services and biodiversity.
- ii. **Water scarcity:** The catchment's water resources are under pressure due to increasing demand, climate change, and inefficient use.
- iii. **Poverty and inequality:** Many communities in the catchment live in poverty, with limited access to basic services, such as healthcare, education, and sanitation.
- iv. **Climate change:** The catchment is vulnerable to climate change, with projected changes in temperature and precipitation patterns likely to exacerbate existing challenges.

1.2 Rationale for a Strategic Catchment Plan:

In response to these challenges, a strategic catchment plan is necessary to:

- a. **Promote sustainable development:** The plan will promote sustainable development in the catchment, balancing economic, social, and environmental objectives.
- b. **Improve water resources management:** The plan will address water scarcity and improve water resources management, ensuring equitable access to water for all users.
- c. **Enhance ecosystem services:** The plan will protect and restore ecosystem services, including forests, wetlands, and wildlife habitats, to maintain biodiversity and ecological integrity.
- d. **Support climate change adaptation and mitigation:** The plan will support climate change adaptation and mitigation efforts, reducing the catchment's vulnerability to climate-related hazards.
- e. **Foster stakeholder engagement and collaboration:** The plan will foster stakeholder engagement and collaboration, ensuring that all stakeholders, including local communities, civil society organizations, and government agencies, work together to achieve the plan's objectives.

1.3 Expected Outcomes:

The strategic catchment plan is expected to achieve the following outcomes:

- a) Improved water resources management and reduced water scarcity.
- b) Enhanced ecosystem services and biodiversity conservation.
- c) Increased climate change resilience and reduced greenhouse gas emissions.
- d) Improved livelihoods and reduced poverty and inequality.
- e) Strengthened stakeholder engagement and collaboration.

The Strategic Catchment Management Plan (SCMP) for Hadejia Ja'amare will ensure the sustainable management of the catchment's natural resources. Some of the key roles are as follows:

1.4 Environmental Roles

1. Conservation of natural resources: the SCMP helps to conserve natural resources, such as water, soil, and biodiversity, for future generations.
2. Protection of ecosystem services: The plan protects ecosystem services, including water filtration, flood control, and carbon sequestration.
3. Mitigation of climate change: The SCMP helps to mitigate the impacts of climate change by promoting sustainable land use practices, conserving water, and protecting biodiversity.

1.5 Socio-Economic Roles

1. Improved livelihoods: The SCMP can improve livelihoods by promoting sustainable agriculture, forestry, and fisheries practices.
2. Enhanced food security: The plan will help to enhance food security by promoting sustainable agriculture practices, improving water management, and protecting biodiversity.
3. Increased economic benefits: The SCMP can increase economic benefits by promoting eco-tourism, sustainable forest management, and other environmentally-friendly activities.

1.6 Governance and Institutional Roles

1. Coordination and collaboration: The SCMP will promote the coordination and collaboration among stakeholders, including government agencies, local communities, and civil society organizations.

2. Policy and legislative framework: The plan will provide a policy and legislative framework for managing the catchment's natural resources.

3. Monitoring and evaluation: The SCMP will establish a monitoring and evaluation framework to track progress, identify challenges, and make adjustments to the plan as needed. By so doing, the SCMP will help to mitigate and sustain the following:

- Disaster risk reduction
- Human health and well-being
- Cultural heritage conservation

Catchment Policies

For harmonious relationship and engagement of stakeholders regarding equitable utilization of inter-state resources including water, the following treaties, policies, and laws need to be recognized, and ratified treaties further domesticated.

Treaties

- Vienna Convention on the Law of Treaties on principle of binding nature of treaty once signed, ratified and inforce (*pacta sunt servanda*),
- UN Watercourses Convention on non-navigational use of shared watercourses, application to surface water and connected groundwater,
- UNECE Water Convention on relevance to both surface and ground water as well as application to all uses of the shared watercourse,
- Niger Basin Water Charter as principal treaty of the Niger River Basin,
- Lake Chad Water Charter as principal treaty of the Lake Chad Basin.

International Policies That Affect Water Resources

- Stockholm Declaration on Human Environment (1971)
- Dublin principles on water and sustainable Development (1992)
- Rio Declaration on Environment and Development and Agenda 21 (1992)
- ECOWAS Water Resources Policy (2008)
- Draft Articles on the Law of Transboundary Aquifer

National Laws and Policies

- Constitution of Federal Republic of Nigeria (1999)
- National Water Resources Act (1993)
- National Water Resources Policy (2016)
- National Policy on Environment (2016)

- National Climate Change Policy for Nigeria (2021-2030)
- National Agricultural Policy (2016)
- Nigeria's Agricultural Transformation Agenda (ATA)
- Nigeria's National Forest Policy (2006)

The Strategic Catchment Management Plan can integrate with existing regional and national policies in Nigeria by aligning with their stated objectives. For instance, the SCMP can do so with the policy objectives of the National Water Resources Policy (2016) which is to ensure sustainable water resources management and protecting the environment. Another policy is that of the National Environmental Policy (1999) which the SCMP can integrate with to promote conservation, protection, and restoration of the environment. For the National Agricultural Policy (2016), the SCMP can align with the policy's objectives, such as promoting sustainable agricultural practices and improving food security.

On a regional scale, the SCMP can be integrated with the Niger Basin Authority's (NBA) Water Charter: which aims to promote sustainable water resources management in the Niger Basin. It can also integrate with the Economic Community of West African States (ECOWAS) Water Resources Policy objectives, such as promoting regional cooperation and sustainable water resources management. There are sectoral policies such as the Nigeria's Agricultural Transformation Agenda (ATA) and the Nigeria's National Forest Policy (2006). The SCMP can integrate with these two policies by promoting sustainable agricultural practices and improving food security for the former while promoting sustainable forest management and conservation for the latter.

Integration Mechanisms

- Establish a coordination committee: Set up a committee comprising representatives from relevant government agencies, regional organizations, and stakeholders to ensure coordination and integration.
- Conduct policy gap analysis: Identify gaps and inconsistencies between the Strategic Catchment Management Plan and existing policies, and develop strategies to address them.
- Develop a monitoring and evaluation framework: Establish a framework to track progress, identify challenges, and make adjustments to ensure the plan's alignment with national and regional policies.

- Engage stakeholders: Involve stakeholders, including government agencies, regional organizations, and local communities, in the planning and implementation process to ensure ownership and buy-in.

The catchment area is well-acquainted with various development and intervention initiatives, including the Multisectoral Crisis Recovery Projects (MCRP) aimed at rehabilitating and enhancing critical infrastructure such as roads, bridges, hospitals, and water resources. The North Eastern Development Commission (NEDC) oversees several initiatives, including Newmap projects, initiatives from the Lake Chad Commission, the Upper Benue River Basin Development Authority, the Hadeija-Jamare River Basin Authority along with its Trust Fund, and the Rural Access and Mobility Project, FMWR-TRIMING project among others.

However, the Strategic Catchment Management Plan is anticipated to integrate the essential components of the catchment as outlined in this report, facilitating a comprehensive development approach for the region. This integration is crucial considering the interconnectedness of these components, thereby ensuring that the interventions are strategically planned with regard to the spatial relationships of these factors. The plan's development in this integrated fashion is expected to foster cohesive growth across the entire region, as opposed to conducting interventions in isolation.

Several noteworthy examples of successful strategic catchment management plans include South Africa's National Water Act, the Mpanga Catchment Conservation Project, and the River Rwizi Catchment Management Plan, all located in Uganda. Additionally, the Tana Catchment Area Management Plan, the Ngarelan Springs Catchment Area Management Plan, and the Dik Dik Catchment Management Plan are prominent initiatives in Kenya.

CHAPTER 2 : CHARACTERISTICS OF THE CATCHMENTS

2.1 Location

2.1.1 Location and Boundary

The catchment covers parts of Kano, Jigawa, Bauchi, and Yobe states, located between latitudes 9°51'25"N and 14°39'2"N, and longitudes 7°18'44"E and 11°56'13"E. It is bordered by the Rima, Sarkin Pawa, Gongola, and Misau-Komadugu catchments..

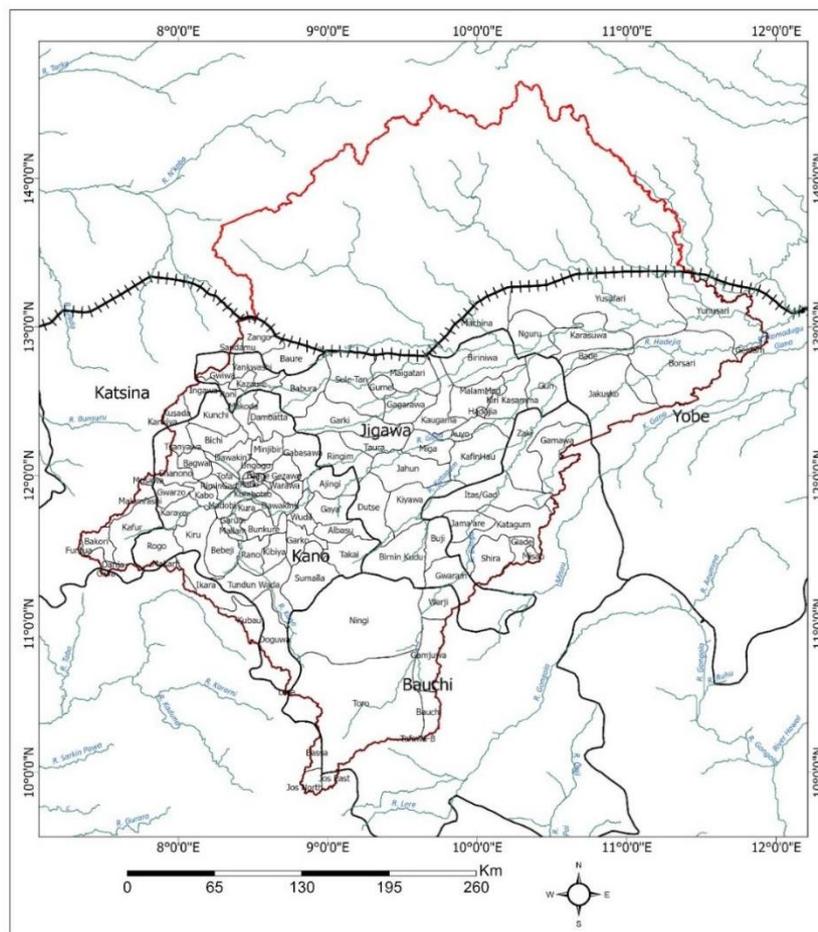


Figure 2.1: Hadejia Jama'are Catchment Showing the LGA's (Source: MSL, 2024)

The Strategic Catchment Management Plan is based on a detailed scientific report that utilized data collected from various sources, including online research, fieldwork, focus group discussions, interviews, secondary literature, and stakeholder engagements.

2.2 Precipitation, Temperature, Sunshine and Relative Humidity

The catchment has a tropical climate with distinct wet and dry seasons, where precipitation, temperature, sunshine, and humidity influence its hydrological and ecological dynamics.

2.2.1 Precipitation

Precipitation in the catchment is seasonal, influenced by the Inter-Tropical Convergence Zone (ITCZ). The wet season runs from June to September, peaking in August. Southern areas like Bauchi and Kano receive more rainfall (800–1,000mm annually) than northern regions such as Yobe (300–600mm), indicating a gradient from semi-arid to sub-humid conditions in the basin.

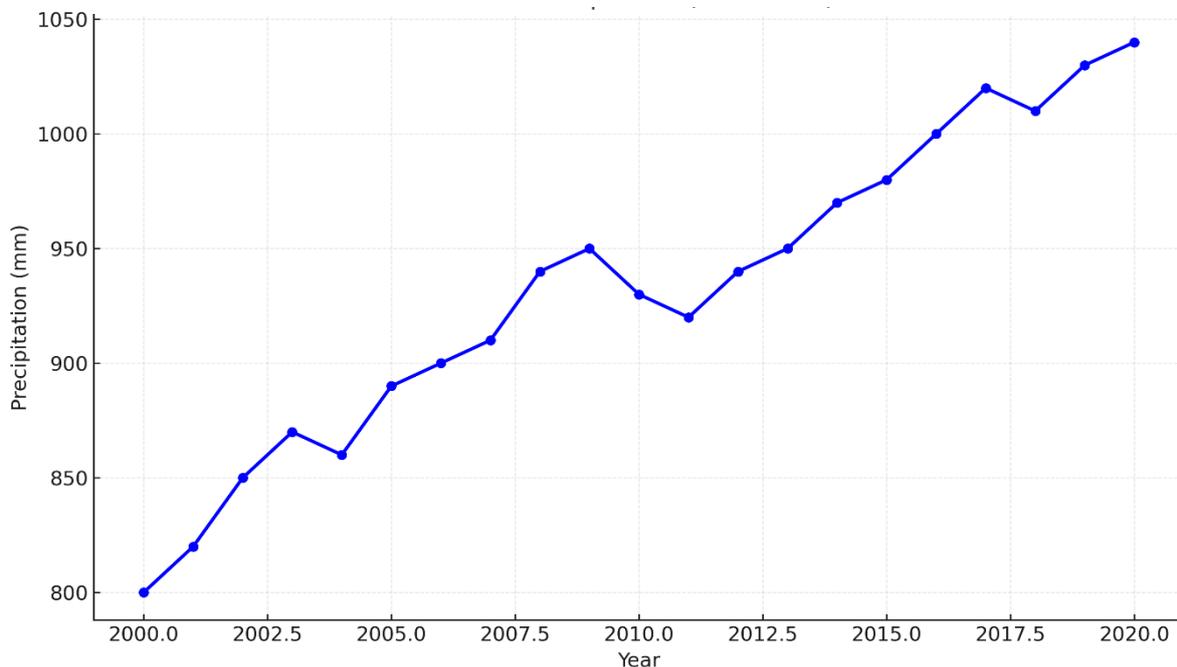


Figure 2.2: Annual precipitation of the Catchment (2000 - 2021) (Source: CHIRPS, 2015)

2.2.2 Temperature

The catchment experiences consistently high temperatures year-round, averaging between 26°C and 32°C. The hottest months are from March to May, with temperatures often exceeding 40°C in northern regions. Cooler conditions occur during the harmattan season (December to February), where temperatures can drop to 15°C, especially in Bauchi and Kano.

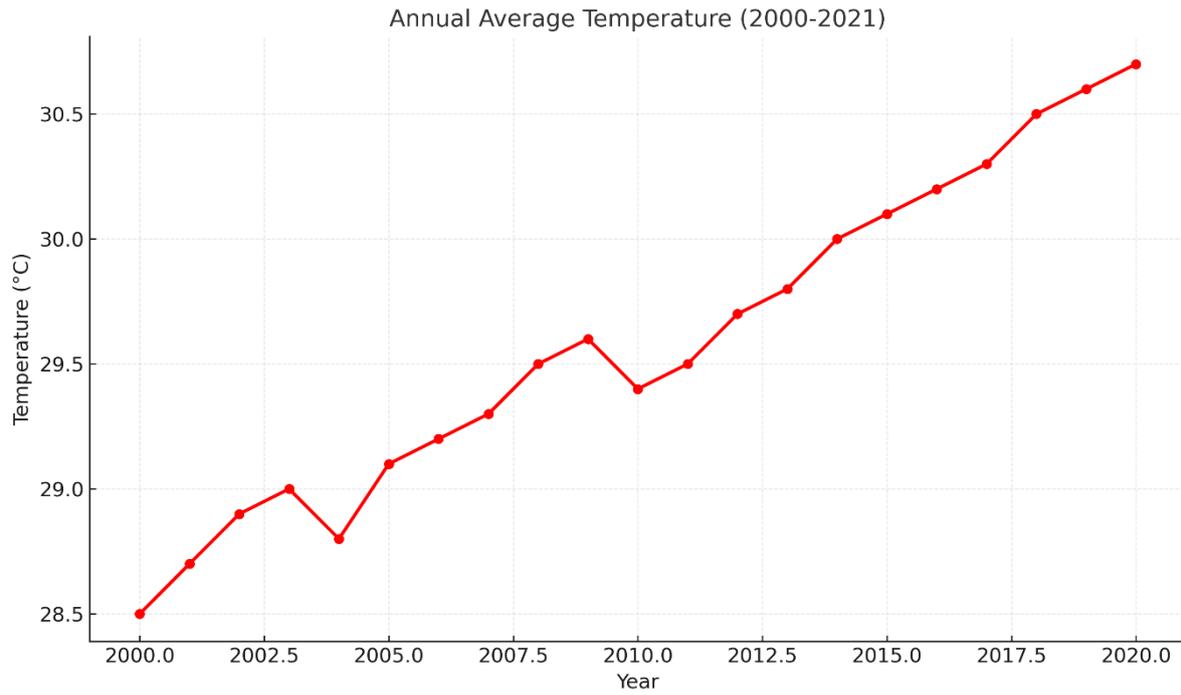


Figure 2.3: Annual Temperature of the catchment (2000 - 2021) (Source: NIHSA, 2023)

2.2.3 Sunshine Duration

The region enjoys 7-9 hours of sunshine daily, especially during the dry season, leading to high evaporation rates and potential water loss. This climate significantly impacts crop growth and the choice of drought-resistant varieties.

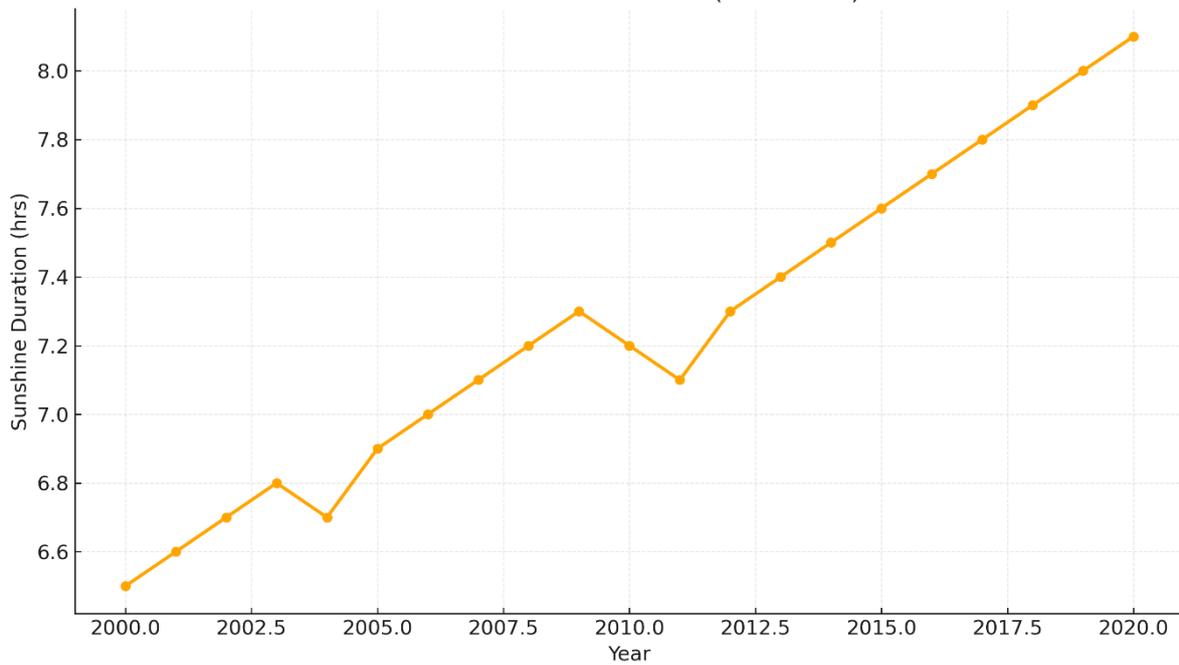


Figure 2.4: Annual Sunshine Duration (2000 - 2021) (Source: NIMET, 2023)

2.2.4 Relative Humidity

Relative humidity in the catchment varies seasonally, influenced by dry continental or moist maritime air. In the wet season, it ranges from 70-80%, benefiting rain-fed agriculture and groundwater replenishment. In contrast, during the dry season, humidity can drop to 10-20%, increasing evapotranspiration and causing water stress for crops and livestock.

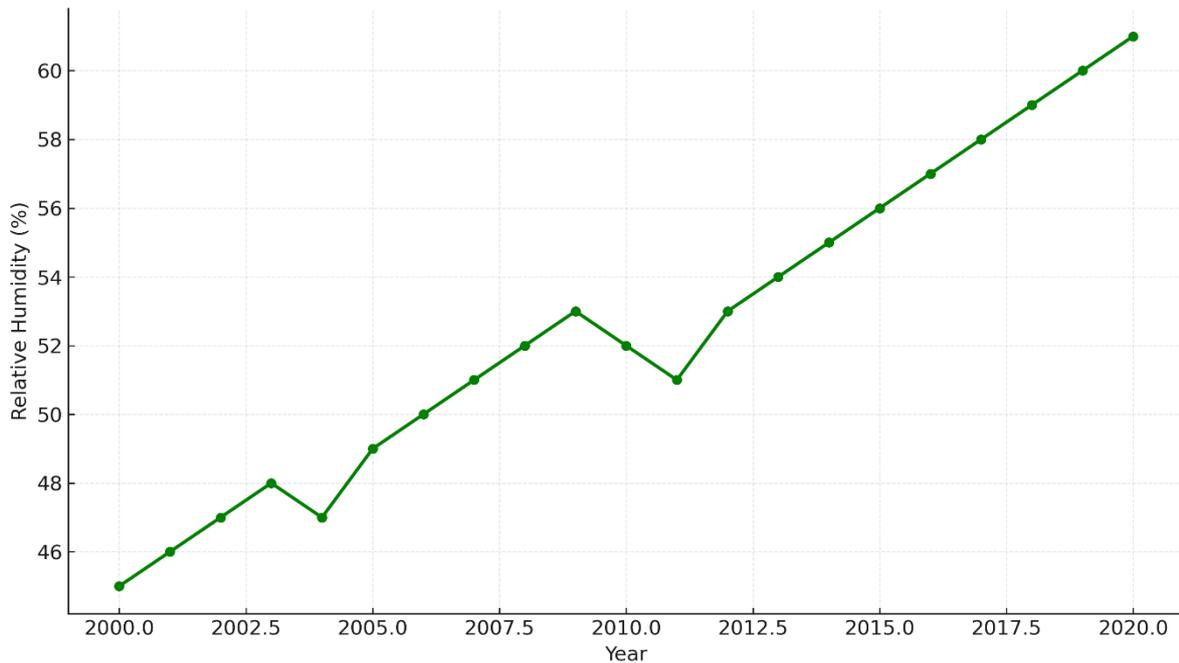


Figure 2.5: Annual Relative Humidity of the Catchment (2000 - 2021) (Source: NIHSA, 2023)

2.3 Topography, Drainage, Geology and Soils

The Hadejia Jama'are catchment is vital to Northern Nigeria's hydrological and ecological dynamics. It impacts agriculture, flood patterns, and ecosystem sustainability.

The catchment features low to moderate relief, with elevations from 600 meters in the upper basin (Bauchi and Kano states) to about 200 meters near the Yobe River and Lake Chad. It primarily consists of flat plains with some scattered hills and inselbergs.

The southern catchment in Bauchi and Kano has elevated terrains with hills that affect local water flow. Moving north, the terrain flattens into extensive floodplains, particularly in Jigawa and Yobe, which are susceptible to seasonal flooding.

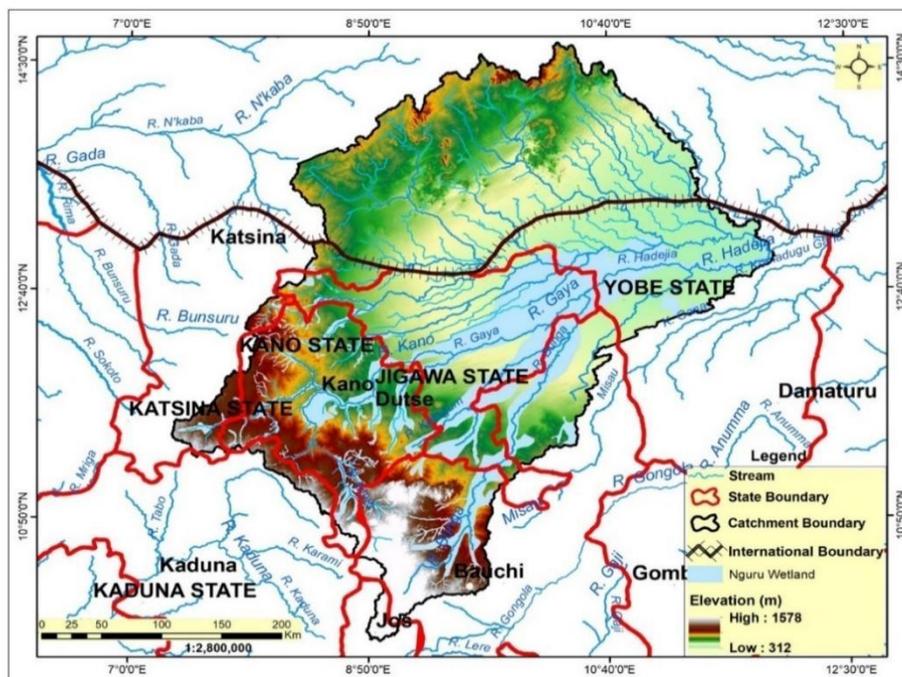


Figure 2.6: Digital Elevation Model (DEM) of the Catchment (Source: MSL, 2024)

2.3.1 Drainage:

- The Hadejia and Jama'are rivers contribute to the Yobe River, flowing to Lake Chad.
- The Hadejia River supports irrigation and creates wetlands, while the Jama'are affects seasonal flows in Bauchi State. Both rivers peak in the rainy season, with dams regulating water flow, playing a crucial role in local livelihoods and water management.

The drainage map is seen in Figure 2.7, while the catchment map showing the recorded gauging stations is seen in Figure 2.8.

STATES OF INFLUENCE

1. Bauchi
2. Jigawa
3. Kano State
4. Yobe State

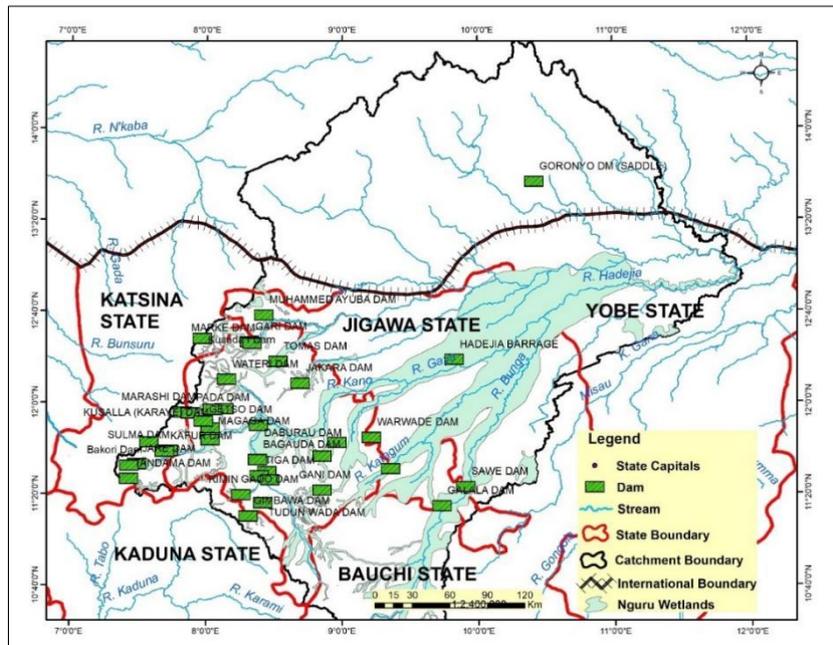


Figure 2.7. Drainage Map of Hadejia-Jama'are Catchment Showing Dams (Source: MSL, 2024)

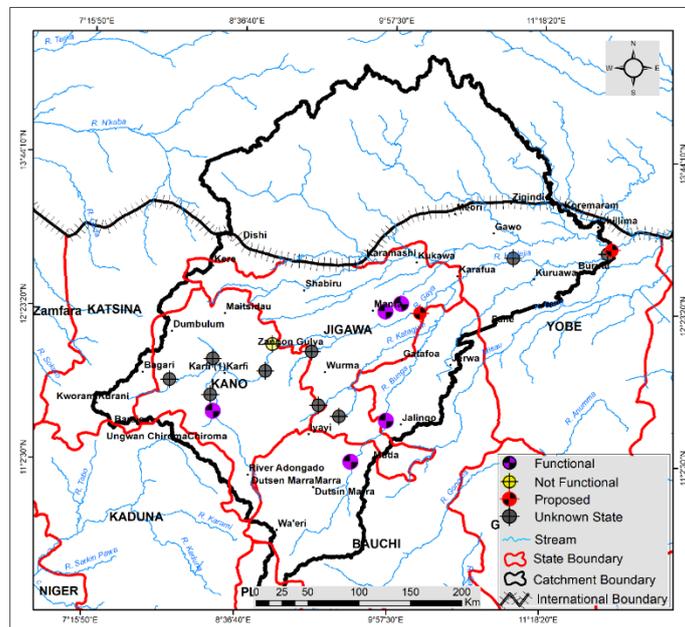


Figure 2.8. The Catchment Map Showing the Recorded Gauging Stations (Source: MSL, 2024)

The World Meteorological Organization (WMO) recommends 384 hydrological stations in Nigeria, but only 237 are recorded. For weather stations, WMO recommends 970, yet only 291 are recorded, with data received from just 54 (NIMET).

Figure 2.9 shows a map of Meteorological Stations in the catchment area

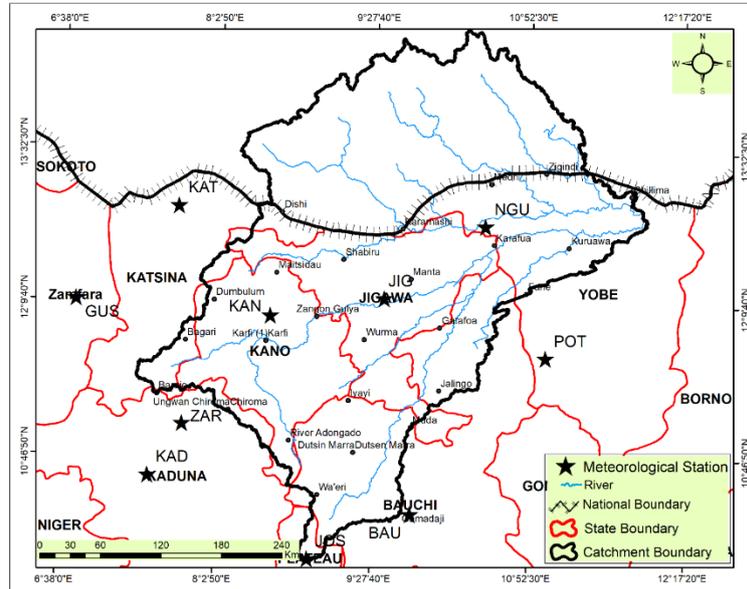


Figure 2.9. Map of Meteorological Stations (Source: Mecon Services, 2024)

2.3.2 Geology and Soil Types

- The Hadejia Jama'are catchment features diverse geological formations that affect soil development and land use.
- The region primarily consists of sedimentary and basement rocks, with soils ranging from fertile alluvial deposits to arid sandy types.
- These characteristics are crucial for the area's agricultural and hydrological dynamics.

2.3.2.1 Geology

The geological framework of the Hadejia Jama'are catchment can be categorized into two significant provinces (Fig 2.10): the **Precambrian Basement Complex** and the **Chad Basin** sediments.

1. Precambrian Basement Complex (Southern Area)
2. Chad Basin Sediments (Northern Area)

2.3.2.2 Soil Types

In the Hadejia Jama'are catchment, soils are classified using the FAO framework, with key types identified based on location and characteristics (Fig 2.11):

1. **Arenosols:** Found in northern areas (Yobe, Jigawa), these sandy soils are low-fertility and require irrigation and fertilizer for crops like millet and sorghum.
2. **Vertisols:** Clay-rich, found in floodplains, suitable for rice but challenging due to water retention and swelling.
3. **Gleysols:** Waterlogged soils in wetlands, ideal for paddy rice but limited for other crops without drainage.
4. **Fluvisols:** Fertile, river-deposited soils, productive for rice, maize, and vegetables.
5. **Leptosols:** Small, stony soils in elevated areas support grazing or low-intensity crops.

Sustainable practices are essential to manage soil fertility, waterlogging, and erosion.

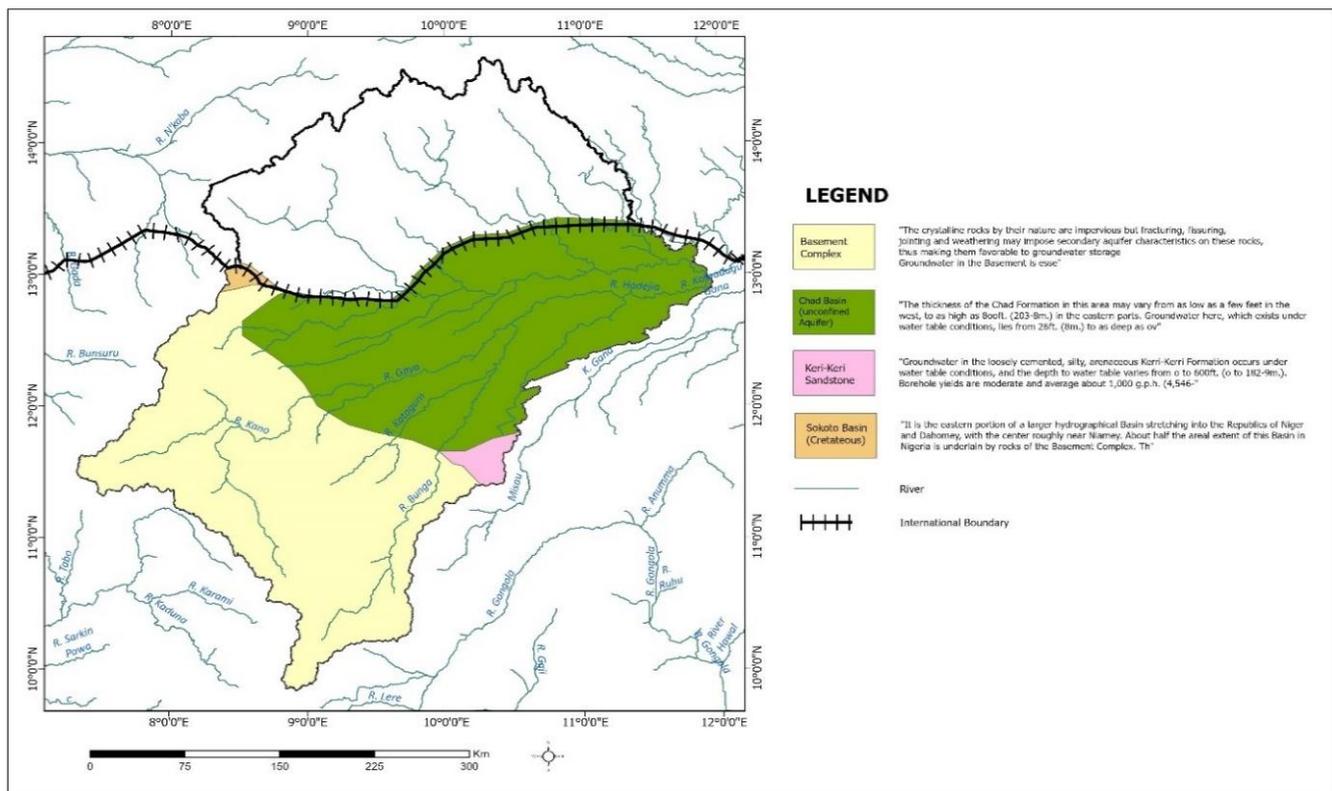


Figure 2.10. Geological Map of Hadejia-Jama'are Catchment (Source: MSL, 2024)

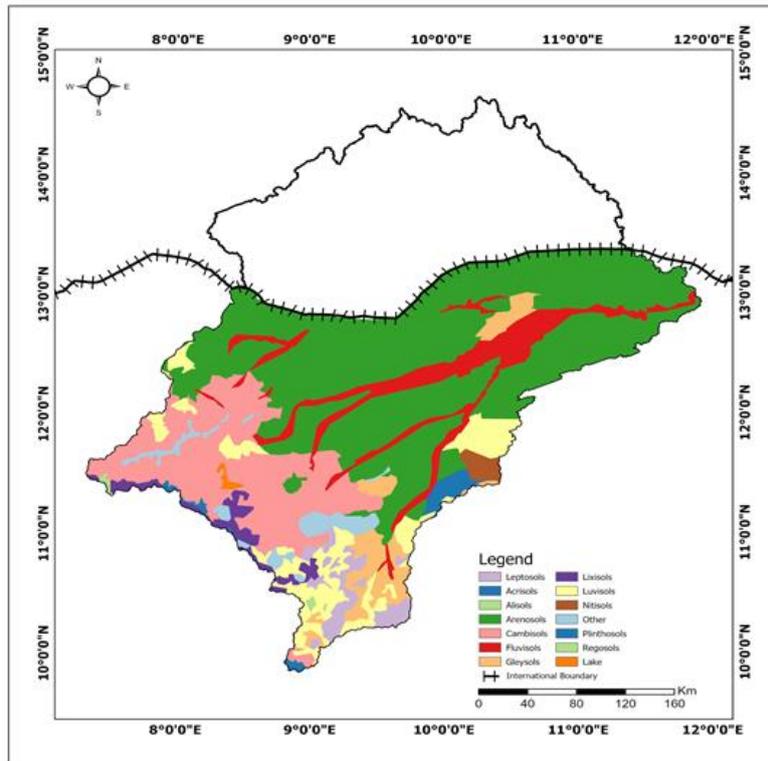


Figure 2.11. Soil Map of Hadejia-Jama'are Catchment (Source: MSL, 2024)

2.4 Land Use and Land Cover

- The Hadejia Jama'are catchment covers a diverse landscape shaped by natural processes and human activities (Fig 2.12).
- The land use and land cover (LULC) within this catchment are influenced by climate, geology, hydrology, and socio-economic activities.
- Agriculture, livestock grazing, wetlands, and human settlements are key components that define the land use dynamics in the region. Over time, human-induced land cover changes, including deforestation and expansion of cultivated land, have altered the natural landscape, with significant implications for the environment and water resources.

2.4.1 Natural Vegetation

The natural vegetation in the Hadejia Jama'are catchment varies by region, shaped by climate and soil types:

- **Northern Area (Yobe, Jigawa States):** Dominated by Sudan savannah, with scattered Acacia trees and grasslands. The semi-arid climate and sandy soils limit vegetation growth, leading to overgrazing and desertification in some areas.
- **Southern Area (Bauchi, Kano States):** Characterized by Guinea savannah, featuring denser tree cover like baobab, shea butter, and neem. The area benefits from higher rainfall and better soils, although land is increasingly cleared for agriculture.

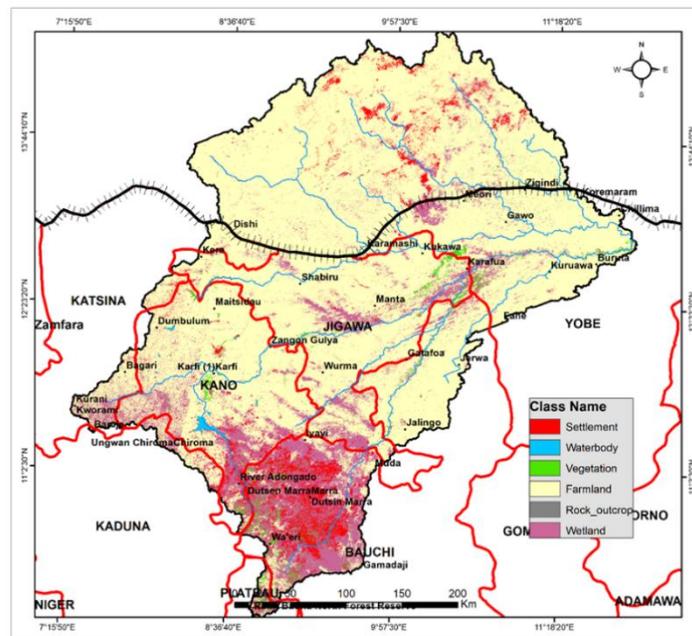


Figure 2.12. Land Use and Land Cover of Hadejia-Jama'are Catchment (Source: MSL, 2024)

Agricultural Land Use:

- **Rainfed Agriculture:** Common in southern areas, with crops like maize, millet, and sorghum. Vulnerable to rainfall variability and droughts.
- **Irrigated Agriculture:** In floodplains and wetlands, irrigation supports high-value crops like rice and vegetables, but stresses water resources.
- **Shifting Cultivation:** Practiced in marginal areas, leading to soil degradation as fallow periods shorten due to population pressure.

2.4.2 Wetlands

The Hadejia-Nguru Wetlands, located in Jigawa and Yobe States, are a vital ecological feature fed by the Hadejia and Jama'are Rivers.

- **Ecological Significance:** The wetlands support diverse bird species, aquatic life, and fish breeding. Recognized as a Ramsar site, they also act as natural flood regulators, storing water during the rainy season and releasing it during the dry season.
- **Agricultural Use:** Rice cultivation thrives in the wetlands, benefiting from seasonal flooding that replenishes soil fertility. However, unsustainable practices, overgrazing, and upstream water diversion threaten the wetlands' long-term viability.

2.4.3 Grazing Land and Pastoralism

Livestock grazing is a key land use in the Hadejia Jama'are catchment, especially in the northern and central regions where pastoralism is central to livelihoods.

- **Pastoralism in Northern Areas:** In Yobe and Jigawa States, pastoralists graze cattle, sheep, and goats in natural grasslands and marginal lands. Overgrazing, combined with reduced rainfall and frequent droughts, has led to land degradation and vegetation loss.
- **Conflict with Agricultural Land:** As agricultural land expands into traditional grazing areas, competition for resources between farmers and herders has increased, leading to conflicts, particularly during times of land and water scarcity.

2.4.4. Human Settlements

Human settlements in the Hadejia Jama'are catchment are concentrated around river systems and fertile agricultural zones, with higher population density in the southern areas, particularly in Kano State.

- **Urban Areas:** Major cities like Kano and Bauchi serve as economic hubs but face urban sprawl, leading to the conversion of agricultural and grazing lands into residential and commercial spaces, putting pressure on surrounding areas.

- **Rural Settlements:** Small villages in rural areas are closely linked to agriculture. However, many face limited access to basic infrastructure such as roads, schools, and healthcare, hindering socio-economic development.

2.4.5. Forest and Woodland Areas

Small patches of **forests and woodlands** are found in the southern parts of the catchment, particularly in Bauchi and parts of Kano State. These areas are generally located in protected reserves or are remnants of the original savannah woodlands (Fig 2.13).

- **Deforestation:** Deforestation has occurred in many parts of the catchment due to the expansion of agricultural land, demand for firewood, and charcoal production. This has led to the loss of biodiversity and contributed to soil erosion and the degradation of water catchment areas.
- **Reforestation Efforts:** In response to deforestation, several reforestation and afforestation projects have been initiated, particularly in areas prone to desertification in the northern parts of the catchment. These projects aim to restore degraded lands, enhance soil fertility, and improve water retention in the landscape.

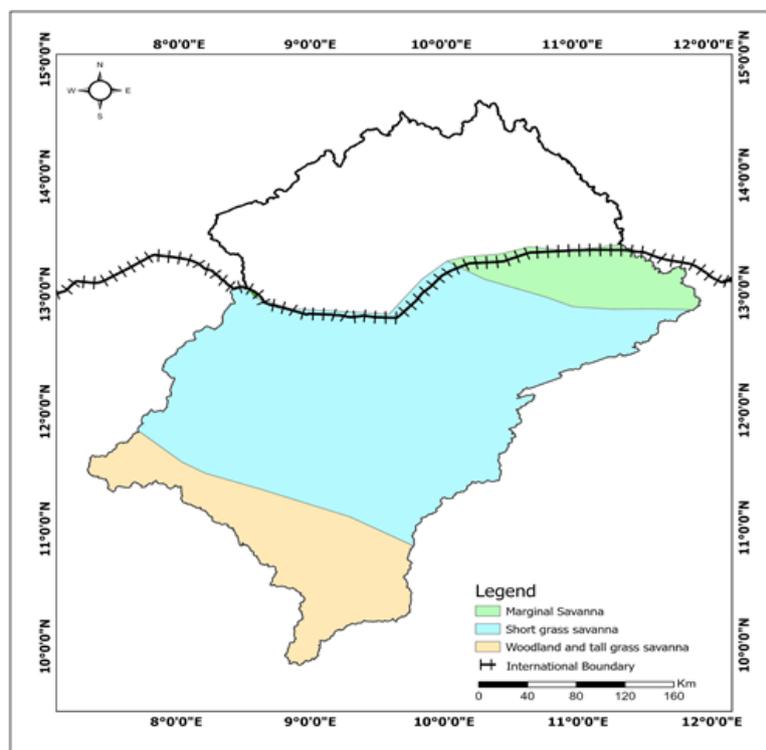


Figure 2.13: Vegetation Map of Hadejia-Jama'are Catchment (Source: MSL, 2024)

2.4.6 Biodiversity

Category	Details
Ecological Zones	Sudan Savanna (south of the catchment in Bauchi and Kano States), Sahel Savanna (north in Yobe and Jigawa). These zones define the catchment's vegetation and wildlife composition.
Key Biodiversity Areas	- Hadejia-Nguru Wetlands (600,000 ha, Ramsar site)- Maladumba Lake and Forest Reserve (Bauchi State)- Riverine and floodplain ecosystems along the Hadejia and Jama'are Rivers
Flora (Plant Diversity)	- Savanna species: <i>Acacia</i> spp. (<i>Acacia nilotica</i> , <i>A. senegal</i>), Baobab (<i>Adansonia digitata</i>), Shea (<i>Vitellaria paradoxa</i>), Neem (<i>Azadirachta indica</i>), and grasses like <i>Andropogon gayanus</i> . - Wetland species: <i>Typha domingensis</i> , wild rice (<i>Oryza longistaminata</i>), and <i>Nymphaea lotus</i> .
Fauna (Wildlife)	- Mammals: Roan antelope, kob, warthog, and historically, hippopotamus in wetlands. - Birds: Migratory and resident species like black-crowned crane, pied kingfisher, African jacana, grey heron, and white-faced whistling duck. - Fish: Tilapia (<i>Oreochromis niloticus</i>), catfish (<i>Clarias gariepinus</i>), <i>Heterotis niloticus</i> . - Reptiles and Amphibians: Nile crocodile, freshwater turtles, and frogs such as the African bullfrog.
Wetland & Aquatic Ecosystems	- Wetlands provide essential ecosystem services: flood mitigation, water filtration, agriculture and fisheries support. - Breeding grounds for birds and fish, especially in the Hadejia-Nguru Wetlands. - Vital to local food security and biodiversity conservation.
Terrestrial Ecosystems	- Savanna grasslands with scattered trees, shrubs, and rich undergrowth in southern parts. - Shrublands and dry plains dominate the northern Sahel zone.
Agro-biodiversity	- Crops: Millet, sorghum, maize, rice, groundnut, and vegetables adapted to semi-arid conditions.

	- Livestock: Cattle, goats, and sheep; indigenous breeds suited to the region’s climate and resources.
Ecosystem Services	- Pollination, carbon sequestration, soil fertility maintenance, climate regulation, and provisioning of food and water.
Endangered Species	- Species like black-crowned crane, Nile crocodile, and some wetland fish species face habitat and population threats due to encroachment, hunting, and water pollution.
Conservation Status	- Ramsar recognition of Hadejia-Nguru Wetlands. - Local forest reserves exist but face degradation from logging, grazing, and agricultural encroachment.
Threats	- Wetland degradation from dam operations (Tiga, Challawa Gorge). - Deforestation, overgrazing, agrochemical pollution, droughts, and invasive species (e.g., <i>Typha</i> overgrowth).
Climate Impacts	- Reduced water flows and prolonged dry seasons have altered ecosystem dynamics. - More intense and erratic flooding is affecting biodiversity and ecosystem resilience.
Policy and Institutions	- Managed under the Ramsar Convention, Federal and State Ministries of Environment and Forestry. - NGOs and international donors support wetland and biodiversity conservation. - ACRoSAL, WB, UNEP, and FAO are key stakeholders in resource management.

2.5 Hydrology and Water Resources

2.5.1 Hydrology

The hydrology of the Hadejia Jama'are catchment is shaped by river systems, seasonal flooding, groundwater, and wetlands.

- **River Systems:**
 - **Hadejia River:** Originating from the Jos Plateau, it flows through Kano, Jigawa, and Yobe States, contributing to the Hadejia-Nguru wetlands. Its seasonal flow is influenced by rainfall, with peaks during the rainy season. Dams like Tiga and Challawa Gorge have altered the flow, reducing downstream water availability.
 - **Jama'are River:** Also originating from the Jos Plateau, it joins the Hadejia River in Jigawa State. It plays a crucial role in recharging wetlands and supporting floodplain agriculture.
- **Flooding and Wetlands:** The Hadejia-Nguru wetlands, formed by both rivers, act as a natural floodplain, storing excess floodwaters, regulating flows, recharging groundwater, and supporting biodiversity and agriculture.
- **Groundwater:** Groundwater is vital, especially in the arid northern regions, sourced from Chad Basin aquifers in the north and basement complex aquifers in the south.

2.5.2 Hydrograph/Water Budget of The Catchment

2.5.2.1 The Hadejia – Jama’are Strategic Catchment

- The Hadejia-Jama’are Strategic Catchment consists of two sub-watersheds, the Hadejia and Jama’are Catchments. Their hydrographs and water budgets are discussed below.
- Figures 2.14 to 2.18 illustrate the hydrograph and water budget of the Hadejia-Jama’are Catchment, highlighting seasonal patterns from January to December due to variations in precipitation and evaporation. Northern Nigeria experiences minimal rainfall from January to May, followed by peak rainfall in August. Rainfall decreases in September and October, with October and December also showing little to no precipitation.
- The graph (Fig 2.16) shows a water surplus from July to September, followed by evaporation outpacing precipitation. This results in nine months of water deficit and raises concerns about groundwater depletion, low flows, flash floods, and increased irrigation demand in the catchment.

Prospects

- The major prospect or opportunity here is water harvesting and storage for irrigation farming during the dry season.
- Groundwater exploration and management.
- Watershed restoration and protection involve revitalizing and preserving the natural functions of the watershed to maintain its ecological integrity, water quality, and biodiversity.

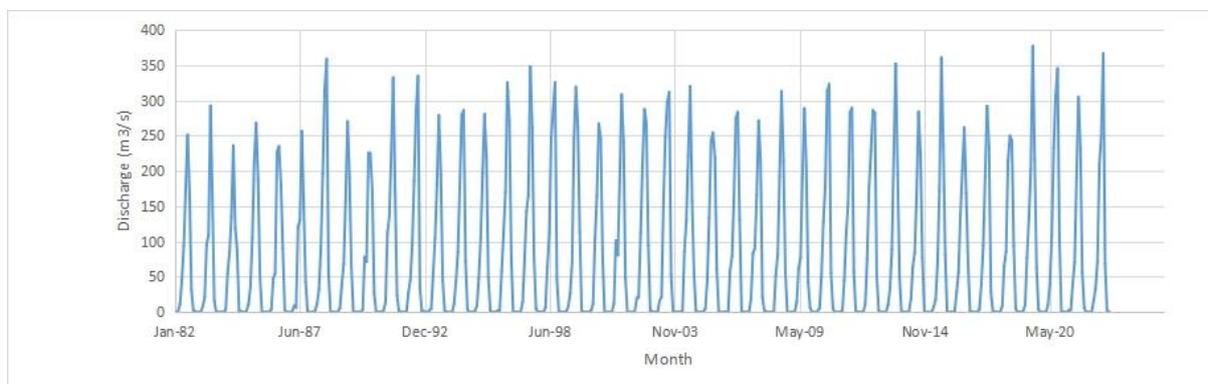


Figure 2.14: Hydrograph of Hadejia-Jamaare Catchment

Based on HEC-HMS model work on the Hadejia-Jamaare Basin.

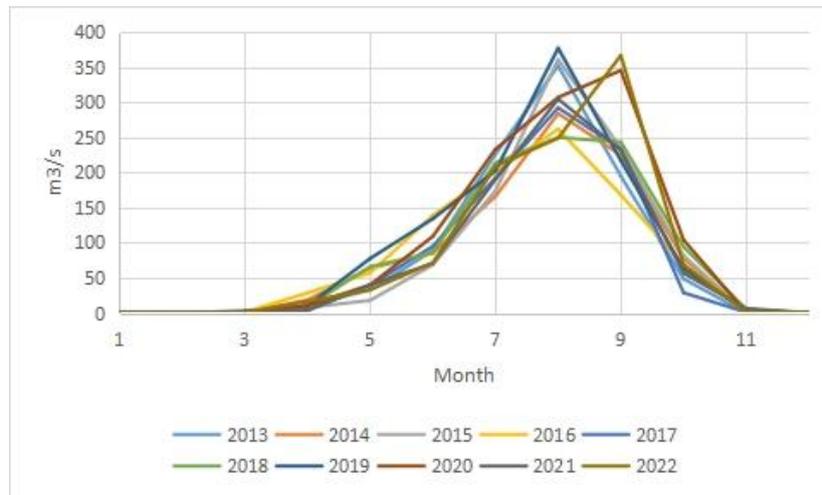


Figure 2.15: Hydrograph of Hadejia-Jamaare for specific year

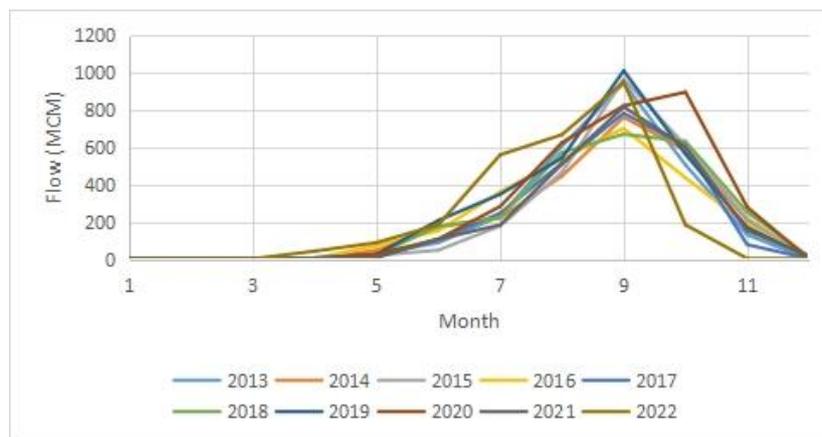


Figure 2.16: Total monthly flow of Hadejia-Jamaare Catchment

Figure 2.17 shows the inter-seasonal variation of pan evaporation in IAR, Kano, while Figure 2.18 shows the average rate.

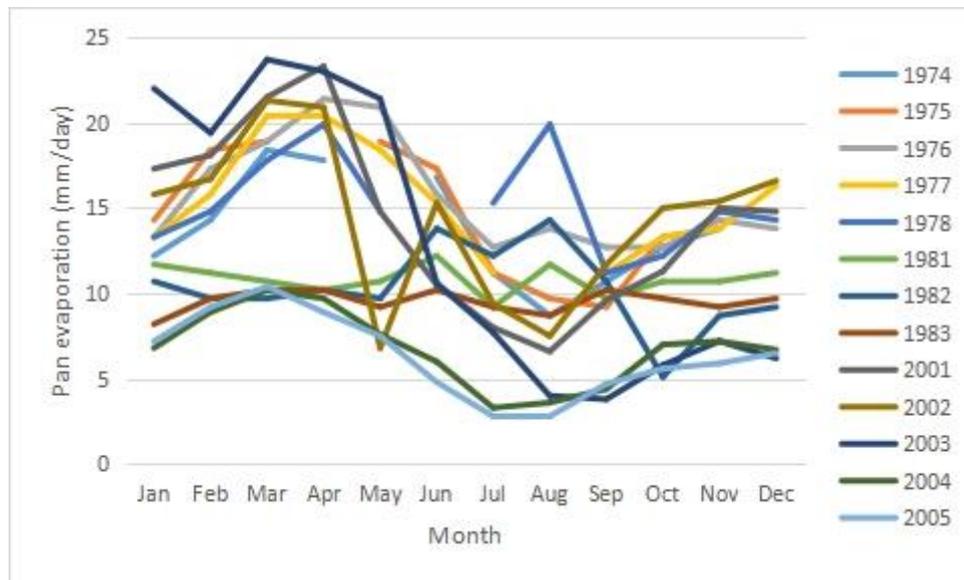


Figure 2.17: Seasonal Variation in Pan Evaporation at IAR, Kano

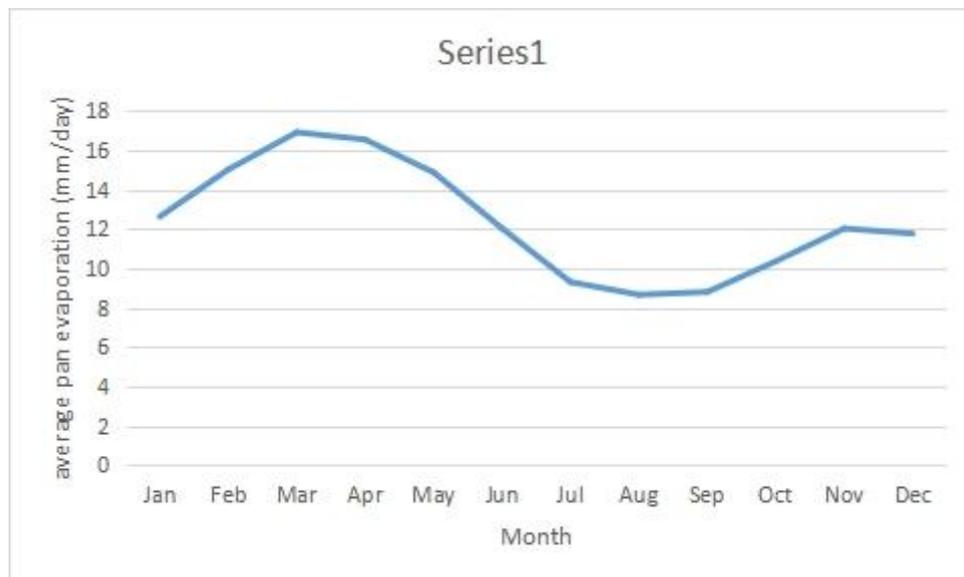


Figure 2.18: Average monthly Pan evaporation at IAR, Kano

2.5.2.2 Water Resources Assessment Concept in the Catchment

The demand for water in the catchment significantly surpasses the available supply due to factors like climate challenges, poor water management, population growth, and urbanization. Since 1998, rivers feeding Lake Chad contribute less than 1% of surface flow. Issues such as

siltation, the spread of invasive plants like typha grass, and waterlogging have worsened the situation. Additionally, the lack of an integrated water resource management strategy and increasing competition among users have led to conflicts in the basin.

2.5.2.3 Stream Flow and Seasonal Variability

The stream flow in the Hadejia Jama'are catchment is highly seasonal, corresponding closely with the rainfall patterns across the region. The flow regime is marked by significant variability, both in terms of spatial distribution across the catchment and temporal variation between the wet and dry seasons.

a) Wet Season Flow

During the wet season (May to September), the catchment receives its highest volumes of water. Rainfall, particularly in the southern portions of the catchment (Bauchi and Kano States), generates surface runoff that contributes to river flow. The streamflow peaks between **July and September**, when river levels are at their highest due to increased precipitation and subsequent runoff from the Jos Plateau and surrounding uplands.

- **Hadejia River:** The Hadejia River experiences a sharp increase in discharge during the wet season, with flow rates ranging from **50 to 200 cubic meters per second (m³/s)** depending on rainfall intensity. The river is critical for replenishing the Hadejia-Nguru wetlands and for sustaining floodplain agriculture in Jigawa and Yobe States.
- **Jama'are River:** Similarly, the Jama'are River, originating from the Jos Plateau, swells during the wet season, contributing significantly to downstream water levels and providing critical inflows to the floodplains and wetland areas. The average discharge during peak flow periods can range from **100 to 250 m³/s**.

b) Dry Season Flow

During the dry season (October to April), stream flow in the catchment decreases dramatically. Without sustained rainfall, the rivers rely primarily on baseflow contributions from groundwater reserves and residual water stored in the wetlands. Flow levels can drop to **less than 10 m³/s** in certain sections of the rivers, leading to reduced water availability for irrigation and other uses.

The **Hadejia-Nguru wetlands**, which act as natural reservoirs, play a key role during this period by storing excess floodwater from the rainy season and gradually releasing it to maintain a limited but continuous flow. However, reduced inflows due to upstream dam operations and irrigation

schemes have led to diminished water levels, impacting both wetland hydrology and downstream communities.

2.5.2.4. Discharge Measurements

Discharge, the volume of water flowing through a river channel over a specific period, is a fundamental metric for assessing water quantity in the Hadejia Jama'are catchment. Regular monitoring of river discharge is conducted by various agencies, including the **Nigeria Hydrological Services Agency (NIHSA)** and local water resource authorities, to track water availability and manage water resources effectively.

2.5.2.5 Surface Water Resource Potential

The average precipitation in Nigeria is about 1,150mm, with only 24% becoming runoff; the rest is lost to evapotranspiration and other abstractions. The total internal runoff generation is 244BCM/year, while surface water resource potential is estimated at 330BCM/year. This potential includes components that do not contribute to surface runoff. The total internal water resources potential is estimated at 286BCM/year, and when factoring in inflow from neighboring countries, it rises to 374BCM/year. Approximately 89BCM/year, or 24% of surface water resources, comes from these countries. Groundwater resources potential is estimated at 142BCM/year based on recharge rates. Figure 2.15 shows the inter-annual variation in surface water yield for the Hadejia-Jamaare catchment.

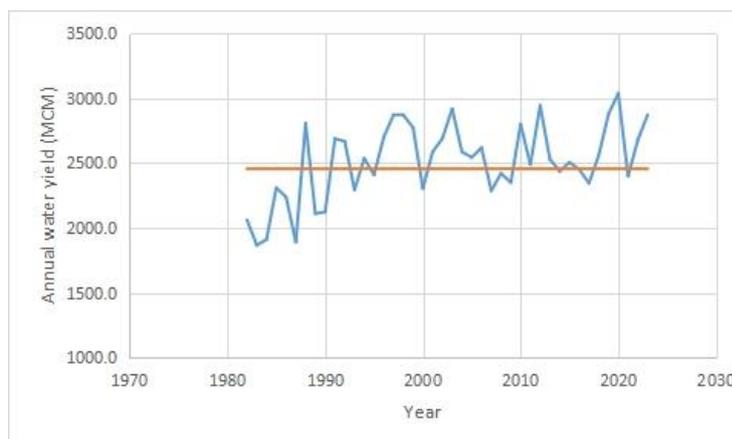


Figure 2.19: inter-annual variation in the surface water yield of Hadejia-Jama'are catchment

2.5.3 Hydrogeological Disposition of the Catchment

The hydrogeological disposition of the catchment and its hydrogeological units and aquiferous layers make up part of the water resources of the catchment, as seen and explained in Figure 2.20.

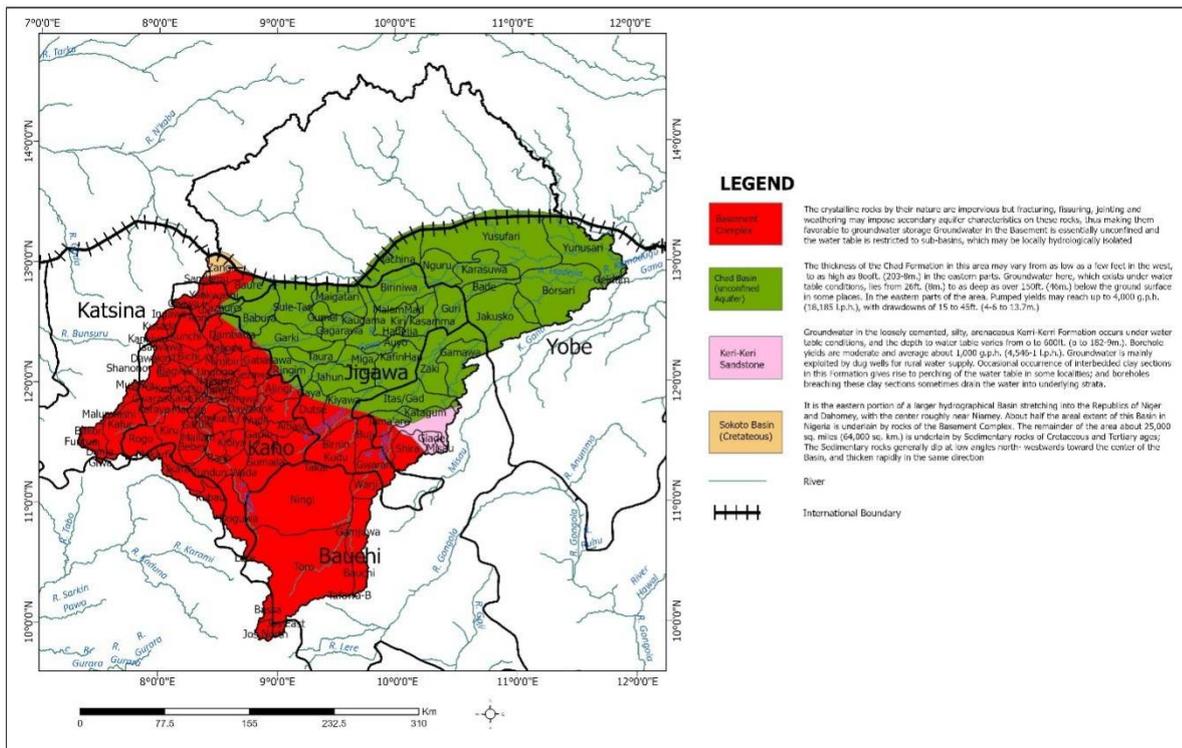


Figure 2.20. Hydrogeological Province Map of the Catchment (Source: MSL, 2024)

2.5.3.1 Groundwater Recharge

- Groundwater recharge appears to be declining as a consequence of climate change, and inordinate anthropogenic activities, with the extent of this decrease varying by region.
- It is important to recognize that areas with lower rates of groundwater recharge will experience a more significant impact than those with higher recharge rates, even when the absolute reduction in groundwater recharge is identical.
- The decline in groundwater levels due to reduced recharge will be less pronounced near rivers, as groundwater levels tend to remain relatively stable at riverbeds. Conversely, areas situated far from rivers are likely to experience a more substantial decrease in groundwater levels. Consequently, inland regions on plateaus that are distanced from river systems will be more adversely affected by the decline in groundwater recharge. As such, countermeasures to address climate change must take these regional variations into account.

2.6. Water Demand for Hadejia-Jama'are Catchment

2.6.1 Water Availability by Sub-Basin

The water resources availability (cumulative annual flow volume) under natural conditions, by sub-basin, are as follows:

Hadejia River Sub-basin: 2,274MCM/year

Jama'are River Sub-basin: 2,583MCM/year

2.6.2 Water Use and Demands

Current and future water demands were estimated for the Hadejia-Jama'are Catchment area using the methodology applied in the NWRMP (JICA, 2014 and SAP 2019 of SMEC). The demand-related data obtained were based on the State level. The States considered are part of Bauchi, Plateau, Yobe and Jigawa, Kano. The water demand projection and water capacity projection are seen in Figures 2.21 and 2.22, respectively.

The water demand is divided into the following categories:

- Municipal water demand (including domestic, commercial, and industrial).
- Irrigation water demand.
- Livestock water demand.
- Aquaculture water demand.

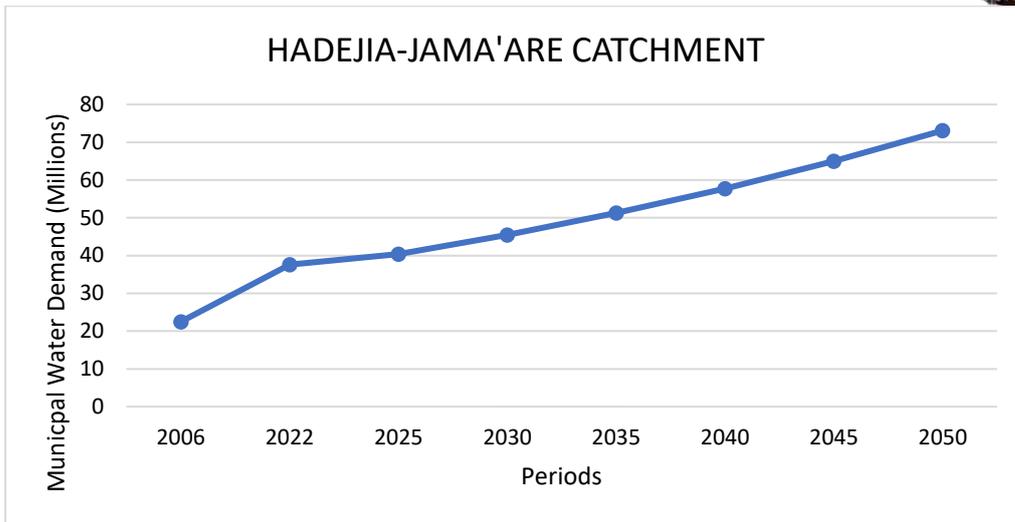


Figure 2.21 Municipal Water Demand Projection

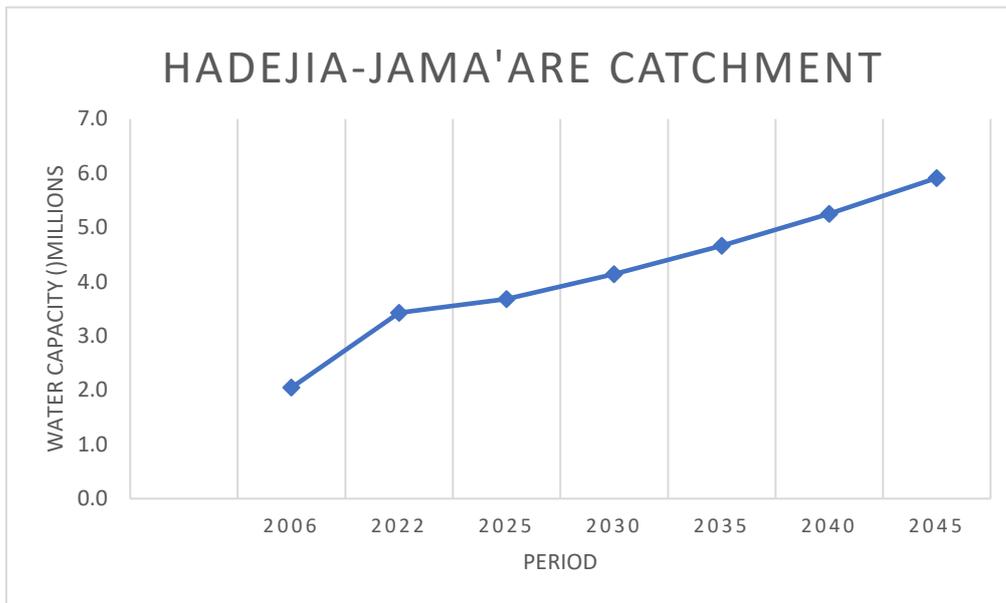


Figure 2.22. Hadejia-Jama'are Catchment Water Capacity Projection

2.6.3 Livestock Indices and Water Demand

Livestock numbers are significantly higher in northern regions than in the south, as northern communities rely heavily on livestock due to frequent droughts and limited crop farming. Water availability is low throughout the year, with insufficient surface water even during the rainy season, making livestock dependent on well water

Water Consumption: Livestock water needs depend on temperature, weight, and grazing. Grazing grass contains 80% water, and an adult cow weighing 240 kg requires 16 liters of water daily if grazing 20 kg of grass. During extreme droughts, when grass cover thins, cows may consume only 5 kg of grass, requiring at least 11 liters of water daily to survive.

Movement and Water Needs: Livestock that move require more water, approximately 25-35 liters per day, depending on weight and activity. Goats and sheep follow similar patterns, with water requirements adjusted based on grazing conditions.

2.6.4 Aquaculture water demand

Basic Data for 2030 projection: Area of farm ponds by Fishery Statistics of Nigeria, Inventory of Private and Government Fish Farm and Hatcheries (Dec. 2004) published in 2007

The annual water supply for inland fish farming is calculated at 0.03 MCM per hectare, sourced primarily from shallow wells (75-85%) and supplemented by surface runoff or stagnant water. Water quality must meet specific requirements—free from detergents and chemicals, neutral pH, and dissolved oxygen above 4 ppm, with groundwater preferred for its higher oxygen content.

- **Fish Farming Projections:** By 2030, inland fish farming is expected to supply 1.73 kg of fish per person annually, slightly higher than current consumption. The target yield of 10 t/ha surpasses rice yields, but initial investments are higher than in traditional crop farming.
- **Water Demand:** Between 2015 and 2065, aquaculture water demand is projected to increase by 72%, with significant growth in demand for aquaculture products. However, due to space limitations in areas like Kano, fish production will shift to regions like the Hadejia River basin, further increasing water demand in those areas.

2.6.5 Irrigation water demand

Several small-scale irrigation systems, either formal or informal, exist in the river basins. Local *people* take the initiative to develop the *Fadama* irrigation schemes, mostly utilizing surface water, either diverted from streams by gravity or lifted with small diesel pumps. In addition, there are comparatively large-scale irrigation systems that are normally developed by public agencies and managed jointly with users. The irrigation schemes vary in size from 40 to 16,000 ha. Most of the schemes are operational

2.6.6 Irrigation Water Demand Projection

The irrigation water demand was computed as a product of the gross irrigation water requirement multiplied by the cropped area for that particular crop. In the computation of the irrigation water demand, an irrigation efficiency of 50% is assumed. This was applied to the whole basin. Assuming that all irrigation schemes are equipped with drainage systems, then half of the water abstracted re-joins the surface water. The net and gross irrigation water requirements for each sub-basin are tabulated hereunder for the Crop Pattern 1:

2.6.7 Existing and Potential Irrigation Areas

The FMWR-TRIMING PROJECT REPORT 2016 indicates that the Hadejia Jama'are Kamadugu Yobe Basin (HJKYB) contains approximately 49 existing and proposed irrigation schemes across three sub-basins: Hadejia, Jama'are, and Yobe. The identified irrigable area is about 192,082ha, with 55,348ha developed and 31,523ha currently under irrigation. Additionally, there is an estimated 90,000ha of informal irrigation in the basin. A map detailing the status of the government's formal schemes is provided in Figure 2.23.

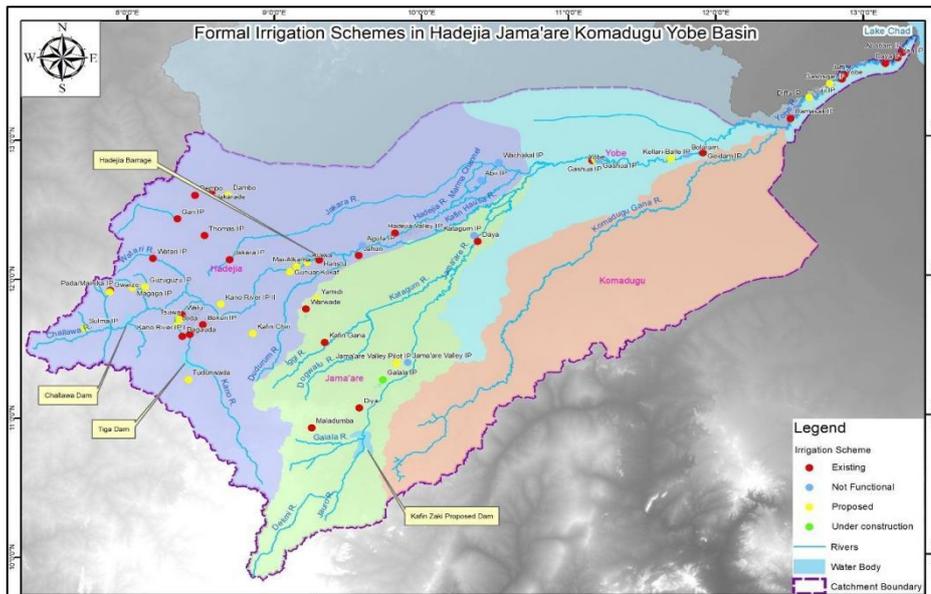


Figure 2.23. Identified Formal Irrigation Schemes in the Basin and their Status Source JICA 2014 MP

2.6.8 Total Water Demand

The municipal, livestock, and aquaculture water demand are combined to project the total water demand in the HJ-basin in time. Figure 2.24, 2.25 and 2.26 show the spatial distribution of the total water demand for the HJ-basin.

- The municipal water demand constitutes by far the largest share of total water demand in all SHA's.
- This share is projected to increase even further in future years. In the SHA's in the western part of the basin aquaculture water demand is the second highest demand, whereas in the eastern part livestock plays a more important role.

2.6.9 Infrastructure and Assets

Table 2.1: Catchment Infrastructure and Assets

Infrastructure	Location	Importance	Risk Factor
Dams and Reservoir	Kano, Bauchi	Supports irrigation farming, Hydropower generation, water supply,	Environmental degradation, Unsustainable socioeconomic practices, Climate change effects, Unchecked population rise and density, Unregulated water use upstream and Lack of Policy implementation, enforcement and.
Irrigation Schemes	Kano, Jigawa, Bauchi, Yobe, Katsina	Enhance agriculture and animal husbandry, food production and improved trade and commerce	Unsustainable farming practices, Use of inorganic fertilizer, policy gaps and lack of funding, lack of extension services, land degradation, insecurity. Lack of agricultural trunk roads, lack of processing facilities
Hydro power station	Bauchi	Electricity generation, Boosts Industrial activity and economic growth	Environmental degradation, climate change effects, Rainfall variability, high evapotranspiration, unregulated water use upstream
Electricity grid/ Rural electrification	Bauchi, Kano, Dutse, Yobe, Jigawa	Electricity generation, Boosts Industrial activity and economic growth	Frequent collapse, Insecurity.
Grain storage Facility	Kano, Bauchi	Food storage and security, reduces post-harvest loses	Insecurity, vandalization.
Research institute	Kano, Bauchi, Yobe, Jigawa, Katsina	Support research innovation to enhance crop/soil productivity	Lack of research grants and unreliable data sources.
Local Markets and Abattoir	Kofar Wambai	Enhance trade of livestock, provide processing facilities for meat industry	Insecurity and lack of perennial produce, Source of Pollution



Tourism (National Parks and Games reserve and Ramsar site)	Yankari, Nguru,	Promotes regions cultural heritage, Tourist site, Source of forex income, Carbon sequestration sites and biodiversity conservation.	Insecurity, lack of funds for management, Lack of implementation of protective policies, overgrazing, agrarian and poaching encroachment
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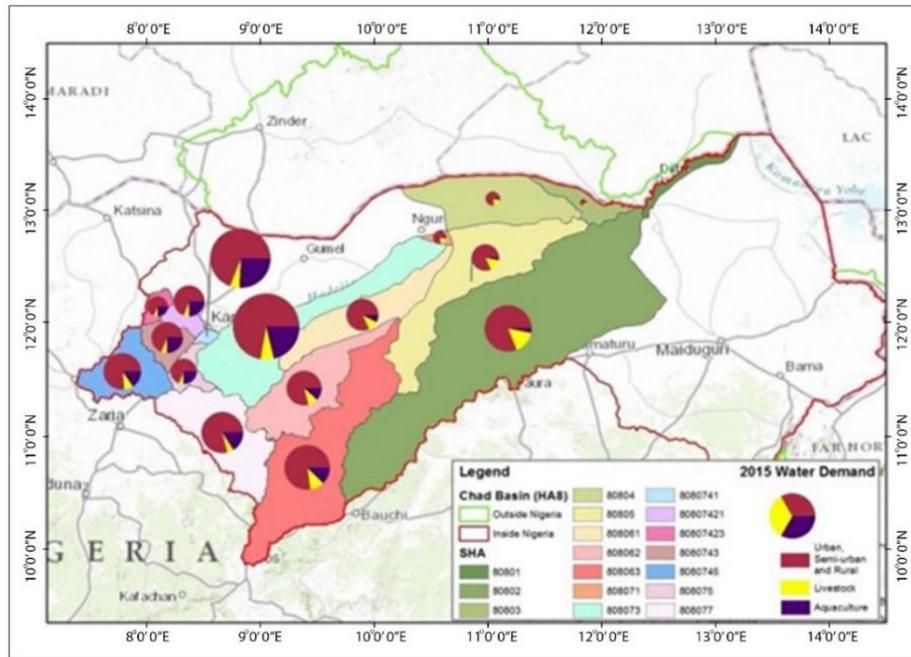


Figure 2.24. Spatial Distribution of the Estimated Water Demand in Hadejia Jama'are for the Year 2015

Source SMEC 2019

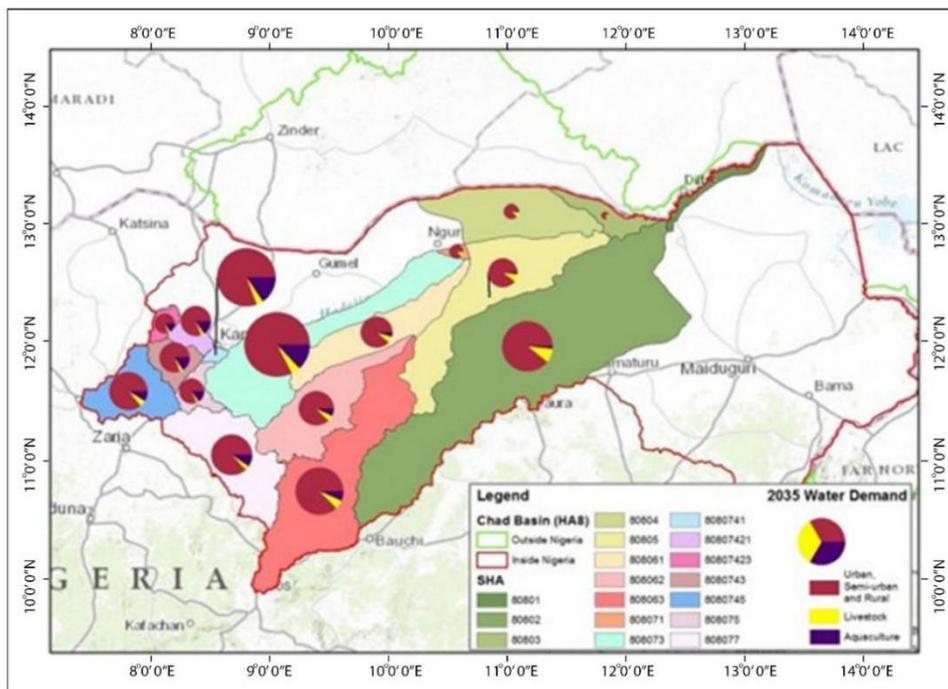


Figure 2.25. Spatial Distribution of Projected Water Demand in Hadejia Jama'are for the Year 2035

Source SMEC 2019

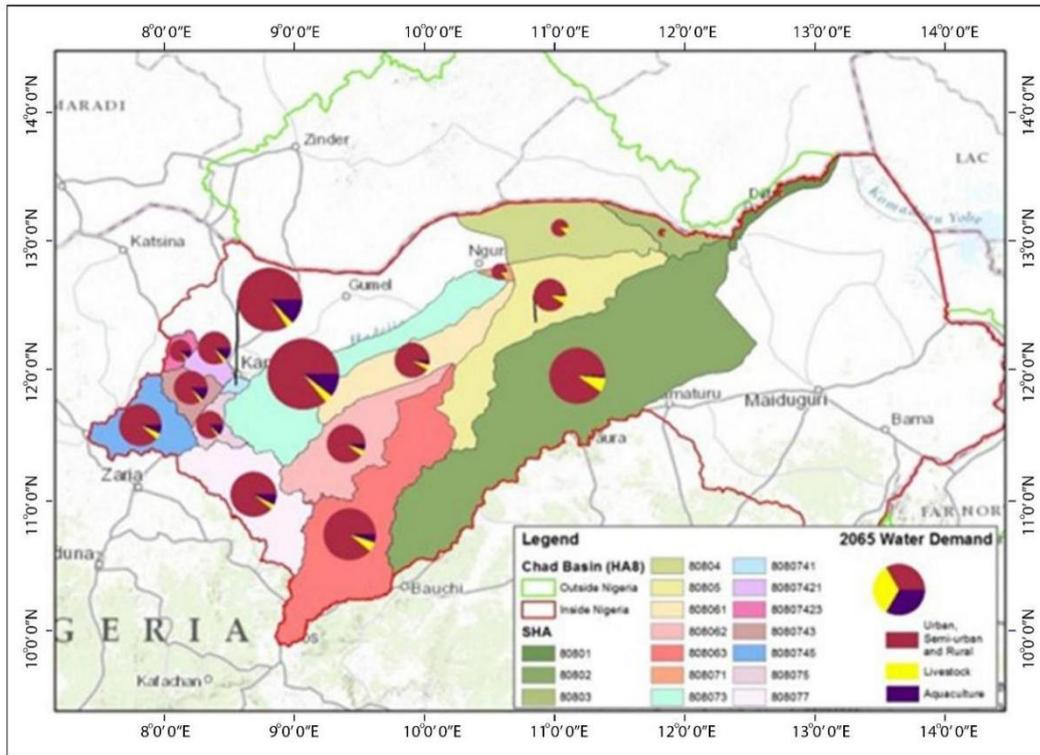


Figure 2.26. Spatial Distribution of the Projected Water Demand in Hadejia Jama'are for the Year 2065

The total water demand for irrigation has been calculated per SHA using the NNWRMP methodology. The demand for irrigation is included in the calculation for the total water demand per SHA. As shown in Table 2.2 below

Table 2.2: Water Balance Analysis for Hadejia Jama'are Catchment

WATER DEMAND		2025	2050
Municipal		1,033,003,710	1,868,963,402
Livestock		80,225,754	121,287,876
Aquaculture		140,100,000	162,800,000
Irrigation		462,800,000	1,160,400,000
Total		1,176,129,464	3,313,451,278
Available Water Resources (Cubic Meter)		5,492,460,000	5,492,460,000

Water Balance (Cubic Meter)	3,776,330,536	2,179,008,722
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Source: JICA 2014 MP and SMEC 2019 AS Analyzed

2.7 Water Quality

2.7.1 Surface Water Quality

The Hadejia Catchment represents a significant potential source of surface water pollution in the Basin, largely due to its dense population, industrial activity, and extensive areas of irrigated agriculture (IUCN, 2011). Key sources of pollution in the Basin include:

- **Drainage waters from irrigated lands**
- **Wastewater discharge from urban areas**
- **Industrial waste**

Studies have shown elevated levels of trace elements in the Hadejia River. Ahmed (1998) found concentrations of copper, cadmium, and iron higher than the permissible levels due to industrial discharge upstream. Binns et al. (2003) reported that the surface and groundwater quality near the Jakara River in Kano contained toxic waste levels far exceeding WHO limits, with cadmium (Cd up to 28.9 mg/l) and chromium (Cr up to 49 mg/l) detected in high concentrations. This suggests that the water quality of tributaries flowing into the Hadejia River, originating from Kano, may be similarly compromised.

These studies indicate that while certain areas in the Hadejia River System show relatively unpolluted conditions, there are growing concerns about the impact of agricultural chemicals and industrial waste on the region's water quality.

2.7.2 Groundwater Quality

Groundwater quality has a significant influence on groundwater availability potential. Groundwater quality was analyzed in the context of its availability by considering the following chemical characteristics.

- Groundwater Electrical conductivity (EC)
- Heavy metals
- Fluoride

➤ Nitrates

Most of the laboratory analysis that involved determination of heavy metals in ground water was done for metropolis centers with high groundwater exploitation. Table 2.3 shows the preliminary water quality status of some rivers in the catchment areas

Table 2.3. Preliminary Conclusion of Water Quality Status of Some Rivers in the Catchment area

N	State	River Name	Code	Wet Season	Dry Season	NFA
1	Kano	River Challawa at Chalawa WTP	SW/001	Good	Poor	-
2		River Challawa at Challawa George Dam	SW/004	Poor	Poor	Cu, Cd
3		River Kano at Tiga Dam	SW/003	Moderate	Moderate	-
4	Jigawa	River Ogwala at Birnin Kudu	SW/001	Good	Poor	Cu
5	Plateau	Lamingo Dam at JOS WTP	SW/001	Good	Poor	Ni, Pb, As, Cd
6	Bauchi	River Gaidan Maiwa at the Bridge	SW/001	Good	To be confirmed	As, Pb, Cd
7		Wikki spring at Yankari Game Reserve	SW/001	Poor	Moderate	Fe, As
8		Gubi Dam at intake to Bauchi WTP	SW/003	Good	Moderate	As, Cu, Ni
9	Yobe	River Komadugu-Gana at Gashua	SW/002	Moderate	Poor	Ni, As

Source: JICA 2014 MP

2.7.3 Surface Water Resources

Description of the basin

- The Hadejia-Jama'are-Komadugu-Yobe River Basin is situated in the semi-arid Northern Nigeria and is part of the larger Lake Chad Basin.
- The HJ Basin has a strongly seasonal rainfall regime. Around 80% of the rainfall occurs in just three or four months, between June and September, supporting rain-fed agriculture and extensive pastures for livestock grazing, with little or no flows occurring during the driest months. Farmers and pastoralists concentrate in the vast floodplains

and wetlands that have formed where the waters of the Hadejia and Jama'are rivers meet the ancient sand dunes, forming a complex pattern of channels and oxbows.

- The groundwater system is recharged mainly from seasonal flooding due to riverbank overtopping and to a lesser extent from concentration of rainfall in depressions. (Source: FMWR-TRIMING PROJECT REPORT 2016)
- The three main rivers in the basin are the Hadejia and Jama'are rivers which meet in the Hadejia-Nguru wetlands to become the Yobe River.
- This river flows eastward ending in Lake Chad and historically contributed only 1% of the total inflow into the lake.
- The Hadejia River system is for more than 70% controlled by the Tiga Dam (in operation since 1974) on the Kano River and the Challawa Gorge Dam (in operation since 1992) on the Challawa River.

Table 2.4 shows the average runoff yield given on a monthly and annual basis.

Table 2.4. Overview of Average Runoff Yield (Height) in Mm/Month and Mm/Year for Three Target Years

Time	J	F	M	A	M	J	J	A	S	O	N	D	Annual
2015	0.1	0.1	0	0	0.2	1.5	7.7	18.8	10.5	2.3	0.7	0.3	42.4
2035	0.1	0.1	0	0	0.1	1.3	7.8	19.4	10.1	2.2	0.7	0.3	42.2
2065	0.1	0.1	0	0	0.1	1.2	7.7	19.4	9.7	2.1	0.7	0.3	41.3

Source: FMWR-Triming Project Report 2016

2.7.3.1 River flow patterns

Measured data

Assessment of river flow patterns focuses on four key points in the basin: Wudil, Hadejia, Bunga, and Gashua. While data exists for other locations, it is often insufficient or unrealistic. There are three distinct periods: (1) before reservoir construction, (2) after Tiga reservoir construction, and (3) after Challawa reservoir construction. Data is available for all points

except Wudil, with years 1975-77 and 1992-93 omitted for Wudil and Hadejia due to significant filling effects from the Tiga and Challawa reservoirs.

The available data can be split into three periods:

1964 – 1974 – unregulated flow regimes (prior to dam construction in the Hadejia basin)

1978 – 1991 - construction and filling of the reservoirs behind the dams

1994 – 2001 - regulated flow regime (dams operational).

These periods include in the Sahel region a period with declining flows (1964-1973), a low flow period (1977-1991) and a partially restored flow period (1992-2001).

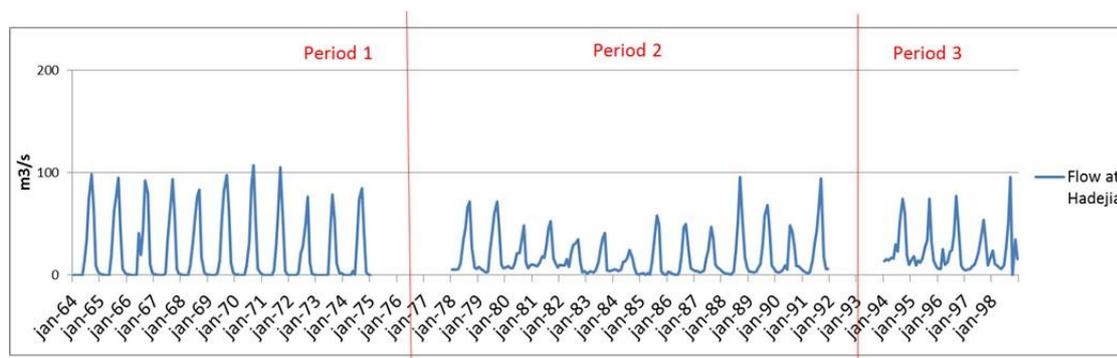


Figure 2.27. River Flow Pattern at Hadejia (WSSRP database)

Bunga is located in the upstream regions of the Jama’are River. Measurement data covers the period from 1965 to 1998. For the period 1994 to 1998 these measurements show unlikely high discharges at Bunga.

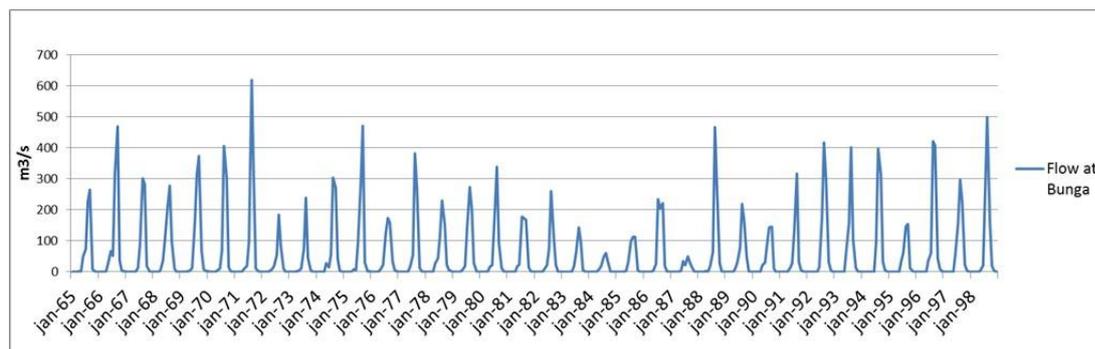


Figure 2.28. River Flow Pattern at Bunga (WSSRP database)

Source Trimming Project 2016

2.7.3.2 Relation between flows and floodplain infiltration

The floodplains in the HJ basin significantly affect flow patterns. High peak flows inundate the floodplains, leading to increased losses from infiltration and evaporation, while lower base flows remain in the riverbed, resulting in lower losses. Thus, high peak flows do not necessarily cause high downstream flows. Goes (2002) observed this phenomenon between Wudil and Hadejia, and a similar pattern occurs between Bunga and Gashua.

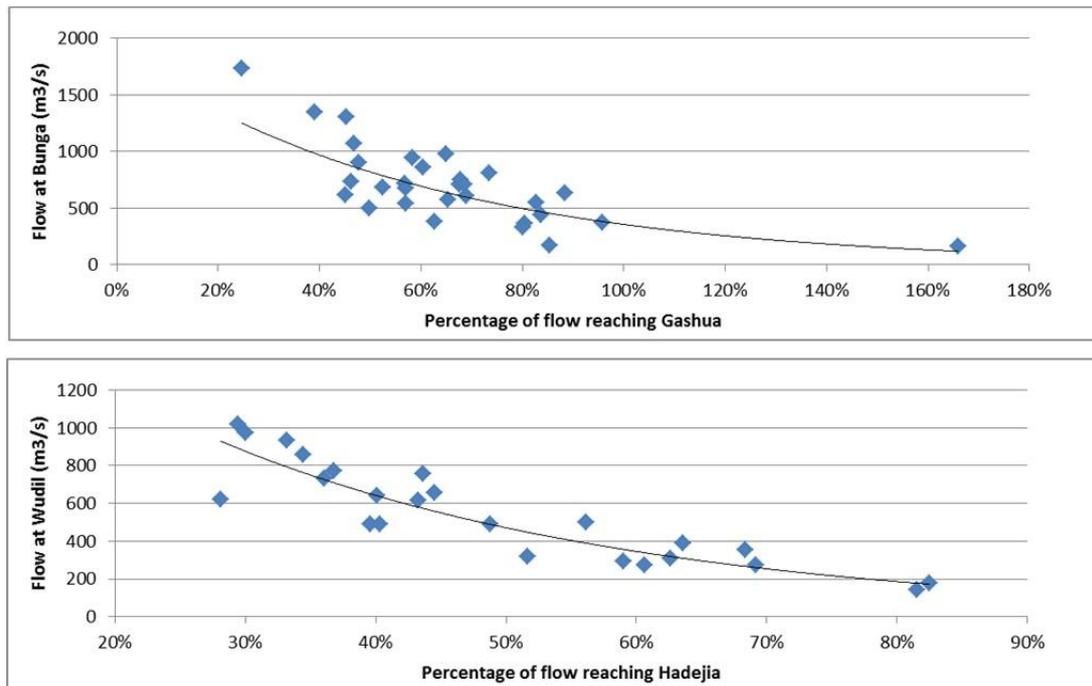


Figure 2.29. Relationship between Upstream and Downstream Flows in Hadejia and Jama'are Yobe River

2.7.3.3 Impact of changed flow patterns

The comparison of discharge data at Wudil reveals a reduction in annual discharge after dam construction, though this is not evident downstream at Hadejia. The reduced inflow to floodplains contributes to this change.

- Impacts on Flow Regime:** The constant baseflow supports the growth of *Typha* in the Hadejia-Nguru Wetland, reducing flow velocity and increasing siltation in the downstream branches of the Hadejia River. Smaller peak flows, which once cleared these branches, now lead to blockages, particularly in the Kafin Hausa, Old Hadejia, and Burum Gana branches, preventing water from reaching the Yobe River.

- **Water Loss:** The remaining flow is redirected to the Marma channel and Nguru Lake, where it stagnates and mostly evaporates. The Jama'are River, with its seasonal flow, likely faces less favorable conditions for *Typha* growth and siltation.

2.7.4 Groundwater Resources

2.7.4.1 Numbers of Boreholes in States Covering Hadejia Jama'are Catchment

Boreholes are essential aspects of groundwater resources. Several studies have been identified in the catchment based on literature. Table 2.5 shows the number of boreholes in states covering Hadejia Jama'are Catchment

Table 2.5. Numbers of Boreholes in States Covering Hadejia Jama'are Catchment

No	State	Geology	Type of borehole			Operati on rate (%)
			Motorized pump (No.)	Hand pump (No.)	Hand dug shallow Well (No.)	
1	Bauchi	B/T/S	410	721	0	54
2	Jigawa	B/T/S	1,333	15,422	3,982	89
3	Kano	Basement	1,147	2,952	0	70
4	Yobe	Sedimentary	1,189	879	2,199	52
	Total		4,079	19,974	6,181	66.25

Note) Number of shallow hand-dug well is those that were constructed by State Agencies. It does not include private wells. B: Basement rock, T: Tertiary rock. S: Sedimentary rock/layer

Source: JICA Project Team

2.7.4.2 Groundwater Recharge and Demand Balance

Table 2.6 illustrates the balance between groundwater recharge and demand.

- The national average ratio of groundwater demand to recharge is 6%, but it varies significantly by state, ranging from 1% to 72%.
- This variation is due to different levels of groundwater recharge across states. Northern Nigeria sees a higher demand/recharge ratio due to the smaller recharge associated with sedimentary rocks. Additionally, aquifers cross state boundaries, allowing for extraction from boreholes that tap into larger surrounding areas to meet demand.

Table 2.6. Groundwater Recharge and Groundwater Demand (2030)

No	State	Groundwater recharge (MCM/year)	Groundwater demand (2030) (MCM/year)					Groundwater demand/ recharge
			Water supply	Private irrigation	Live stock	Aquaculture	Total	
1	Bauchi	3,833	205	69	12	3	289	8%

2	Jigawa	568	207	70	15	9	301	53%
3	Kano	918	354	66	23	102	544	59%
4	Yobe	680	118	51	12	1	183	27%
	Total	5,999	884	256	62	115	1317	3.7%

Source: JICA Project Team

Balance of groundwater recharge and demand by effect of climate change is shown in Table

2.8

Table 2.7. Groundwater Recharge and Demand by Effect of Climate Change (2030)

		Water supply	Private irrigation	Livestock	Aquaculture	Total	
Bauchi	2,792	205	78	12	Ratio3 of groundwater /recharge	298	
Jigawa	398	207	78	15	9	309	
Kano	631	354	74	23	102	552	
Yobe	414	118	57	12	1	189	
Total	4,235	884	287	62	115	1348	55.8%

Source JICA Project team

2.8 Climate Change Impact On Water and Land Resources

2.8.1 Historical and Future Climatic Trends

- The Hadejia Jama'are catchment experiences varying climatic conditions, transitioning from semi-arid in the north to tropical wet-and-dry in the south.
- The region is characterized by distinct wet and dry seasons, with substantial spatial and temporal variations in both rainfall and temperature.

a) Rainfall Patterns

- **Wet Season:** The wet season typically spans from May to September, with the highest rainfall occurring in July and August. Rainfall distribution across the catchment is uneven, with the northern regions (Yobe and Jigawa States) receiving less precipitation compared to the southern areas (Bauchi and Kano States).
 - **Northern Catchment (Yobe, Jigawa):** Annual rainfall here ranges from 300 to 600 mm. This area lies in the semi-arid Sahelian zone, where rainfall is erratic and highly variable from year to year. Droughts are common, severely affecting agriculture and water availability.
 - **Southern Catchment (Bauchi, Kano):** In the southern parts, rainfall ranges from 800 to 1,000 mm annually. These regions fall within the Sudanian zone, where rainfall is more reliable, supporting more intensive agricultural activities.
- **Dry Season:** The dry season lasts from October to April and is influenced by the Harmattan, a dry, dusty trade wind from the Sahara. This period is marked by rising temperatures and shrinking water bodies, especially in the northern regions, which experience the highest levels of aridity. During the dry season, the region heavily depends on surface and groundwater resources for agriculture and livestock.

b) Temperature

- The catchment experiences high temperatures year-round, with average daytime temperatures ranging from 30°C to 40°C. The hottest months are from March to May, during which temperatures in the northern parts of the catchment can exceed 40°C.

- **Northern Region:** The northern Sahelian zone experiences more extreme temperature variations, with significant diurnal temperature swings—hot days contrasted with cooler nights.
- **Southern Region:** The southern part, particularly in Bauchi and Kano States, has slightly cooler temperatures, especially during the wet season, due to the moderating effect of higher rainfall.

c) Evapotranspiration

Evapotranspiration rates are high throughout the catchment due to the hot and dry conditions, especially during the dry season. In the northern areas, annual evapotranspiration rates can reach between 2,000 and 2,500 mm, often surpassing the amount of rainfall, which exacerbates water deficits. The high evapotranspiration rates contribute to limited surface water availability and increase reliance on groundwater, especially during the dry months.

2.8.2 Annual Rainfall and Temperature for Hadejia-Jama'are Catchment

2.8.2.1 Rainfall Trends

Figure 2.30 shows:

- a clear upward trend in the annual rainy season rainfall in the Hadejia-Jama'are region over the period of 1981 to 2050.
- The graph gives an indication of a significant increase in rainfall by 2050. It is projected that rainfall will increase by about 255.71 mm compared to the 1981-2022 average.
- The increased rainfall could lead to more frequent and severe flooding events, particularly in low-lying areas. This could damage infrastructure, displace communities, and disrupt agricultural activities. It will also increase soil erosion, leading to the loss of fertile topsoil and the degradation of agricultural land. Excessive rainfall can result in waterlogging of agricultural fields, hindering crop growth reducing yields, and affecting the availability and quality of water resources in the catchment.

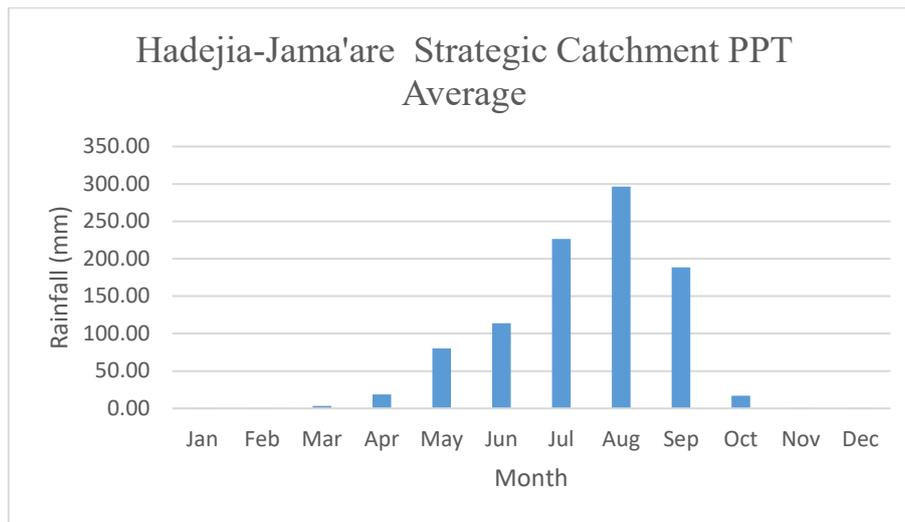


Figure 2.30. Rainfall Histogram for Hadejia-Jama'are Strategic Catchment

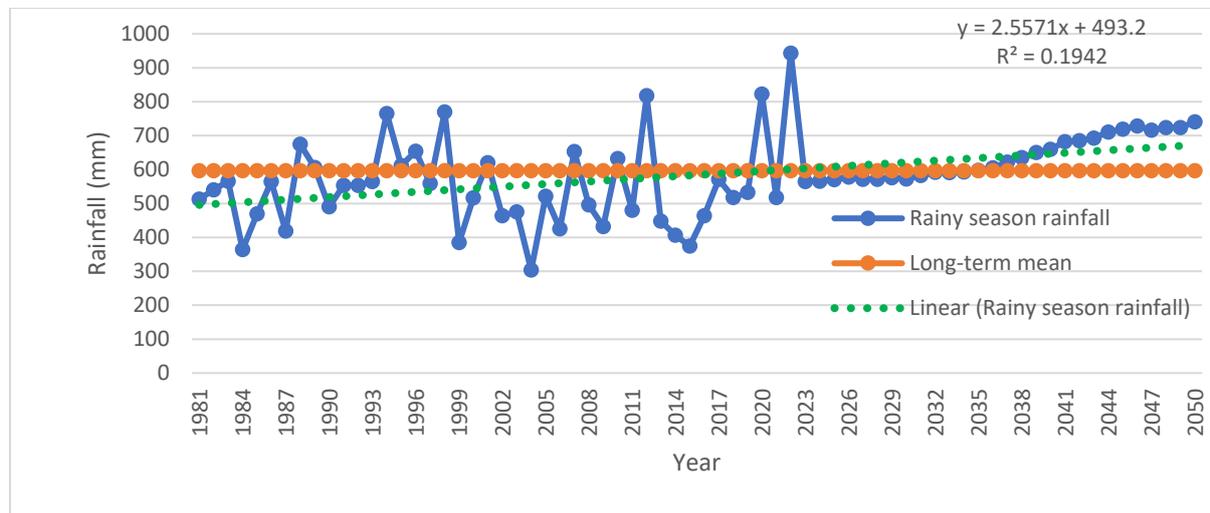


Figure 2.31. Projected Annual Rainfall Trend (1981-2050) for Hadejia-Jama'are Catchment

2.8.2.2 Temperature Trends

Temperature and rainfall trends for the Hadejia-Jama'are catchment were forecast (projected) from 2023 to 2050 based on the monthly and annual data from 1981 to 2022, deploying the growth rate schema in Excel. It is of the following specifications:

In summary, the projections indicate an overall warming pattern, especially during the hottest months, while cooler months and rainy seasons may experience more stable or slightly lower temperatures. These shifts may pose challenges for water management, agriculture, and health, as seasonal extremes intensify. The pattern of temperature is presented in Figure 2.32

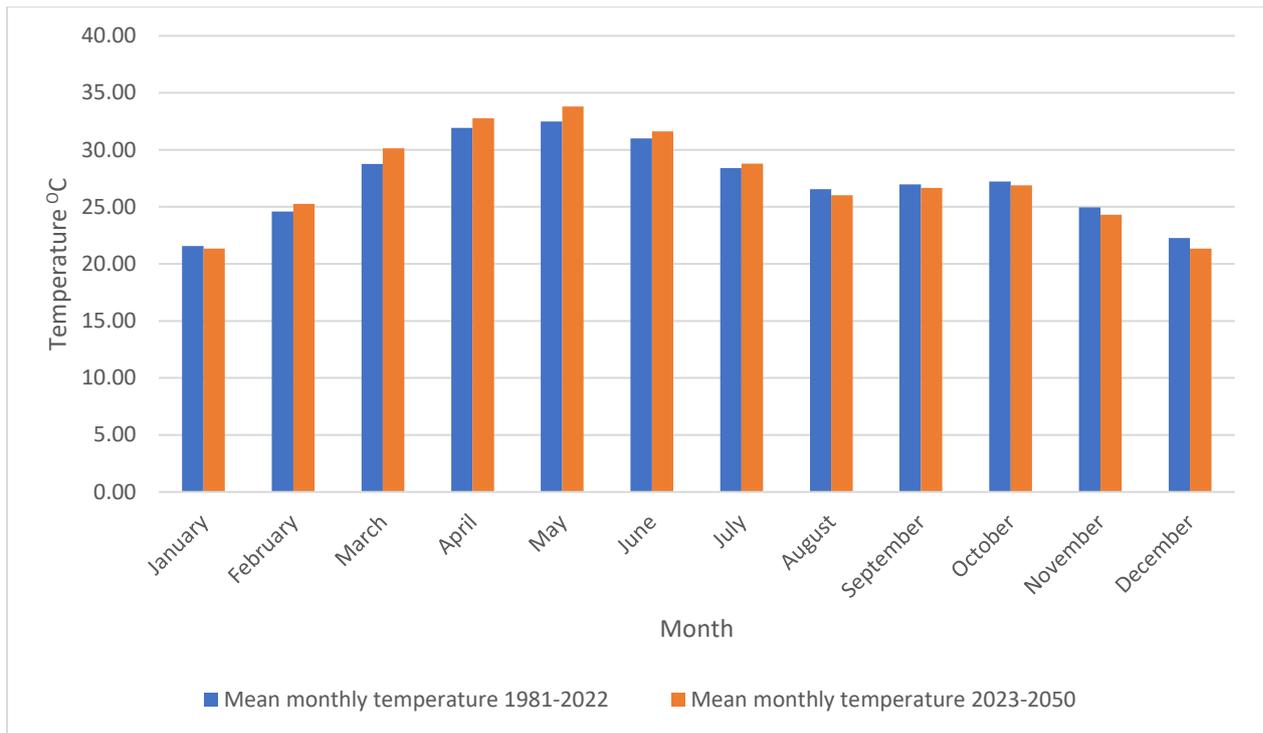


Figure 2.32. Mean Monthly Temperatures from 1981 To 2022 and 2023 to 2050 for Hadejia-Jama'are Catchment

2.8.3 Projected Mean Annual Temperature for Hadejia-Jama'are Catchment

Figure 2.33 presents the linear pattern of the catchment's projected monthly temperature. The overall trend in temperature is upward.

- From the figure, the mean annual temperature from 1981-2022 shows a gradual increase over time. This upward trend is further projected to continue. By 2050, the mean annual temperature in Hadejia-Jamare (27.37°C) is projected to increase by approximately 0.12 degrees Celsius compared to the 1981-2022 average (27.25°C).
- This 0.12°C rise by 2050 may seem minor, but it can contribute to cumulative impacts in the catchment and can amplify vulnerabilities in agriculture, health, and environmental systems, particularly when combined with other climate stressors, such as droughts, unpredictable rainfall, and extreme weather events.
- Adapting to even small temperature increases remains crucial to minimizing these impacts and building resilience in affected communities and ecosystems.

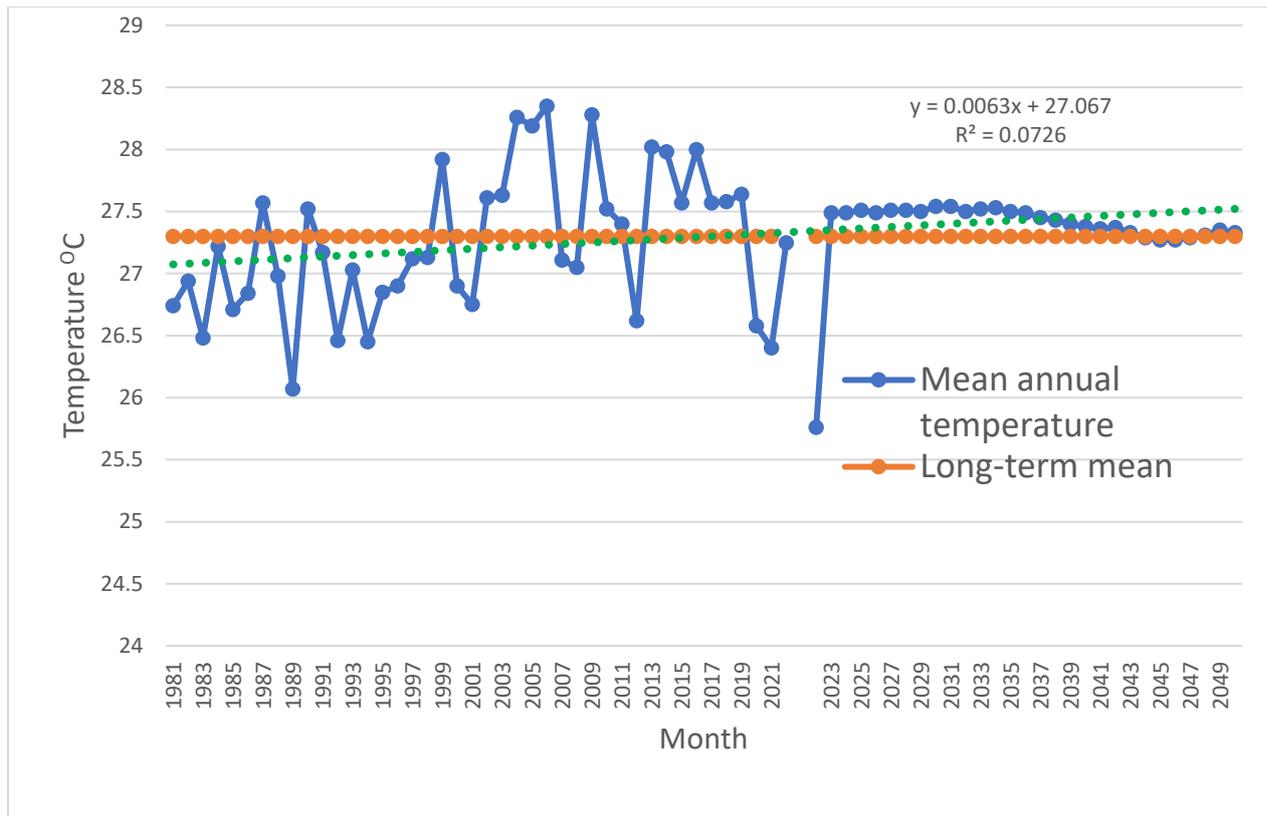


Figure 2.33. Projected Mean Annual Temperature Trend (1981-2050) for Hadejia-Jama'are

2.8.4 Analysis of Downscaled Output of GCMs

This study analyzes future climate change using statistically downscaled outputs from seven Global Climate Models (GCMs) under the A1B emission scenario, which assumes high economic growth with balanced energy sources.

- The analysis covers the average monthly precipitation and air temperature from the 2020s to the 2080s, with a focus on three-time horizons: 2035, 2065, and 2085. Results show that precipitation is expected to decrease during March-May (MAM) and increase during June-August (JJA) and September-November (SON).
- The rate of change in climate conditions gradually increases over time, amplifying initial trends.
- The study uses 30-year running averages to analyze the projected changes, with specific emphasis on changes in precipitation and annual mean temperature. The results will guide long-term planning for climate adaptation and resource management.

Table 2.8: Overview of Change Factors for the two Target Years

Parameter	Season	2035	2065
P (%)	DJF	+12.3	+17.1
	MAM	-0.5	-2.1
	JJA	+7.9	+12.0
	SON	+7.6	+11.7
T (°C)	Annual	+2.5	+3.9

Source: JICA 2014 MP

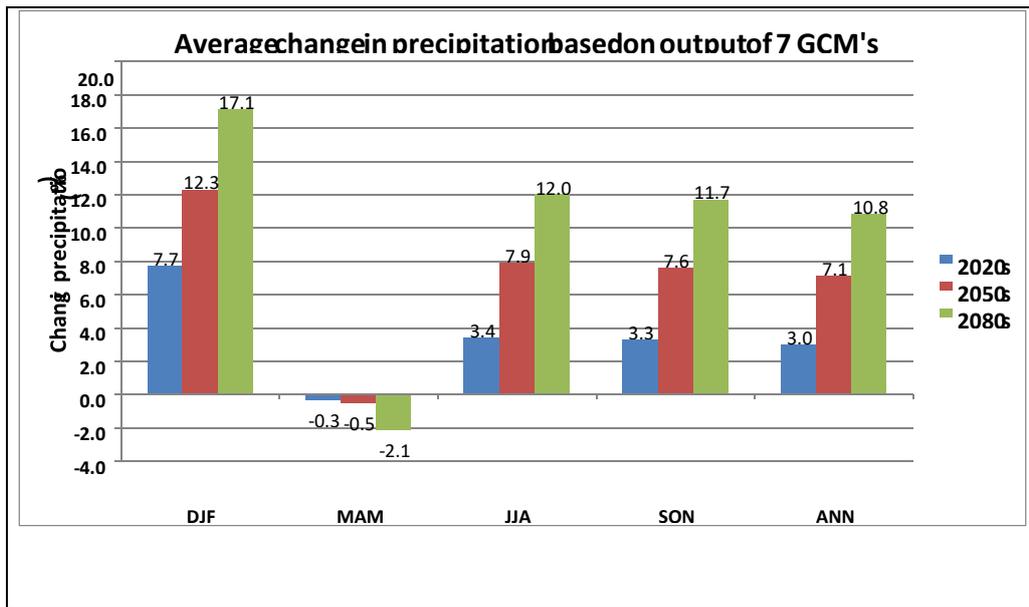


Figure 2.34: Average Changes in Precipitation Derived from Outputs of 7 GCMs (source: JICA,2014)

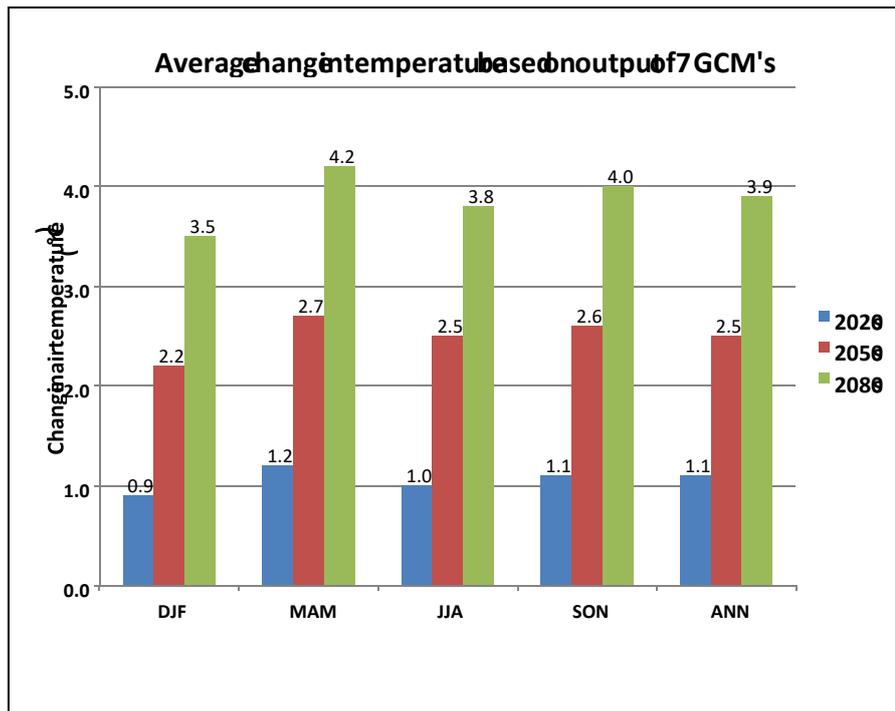


Figure 2.35. Average Changes in Temperature Derived from Outputs of 7 GCMs (source: JICA 2014)

2.8.5 Evapotranspiration

Evapotranspiration, the combined water loss through evaporation and plant transpiration, plays a crucial role in the hydrological cycle, impacting water availability, agriculture, and ecosystems.

- The analysis covers historical data (1990-2023) and projected data (2024-2050), showing fluctuations due to climatic factors and an increasing trend attributed to climate change (Fig 2.36). Rising evapotranspiration poses challenges for water management, agriculture, and energy, particularly in regions relying on reservoirs for irrigation and hydropower.
- The report stresses the need for innovative approaches, such as advanced irrigation, climate-resilient farming, and improved reservoir management, to address these challenges.
- The data was sourced from NASA's FLDAS Noah Land Surface Model and projections were made using a simple growth rate formula to estimate future trends.

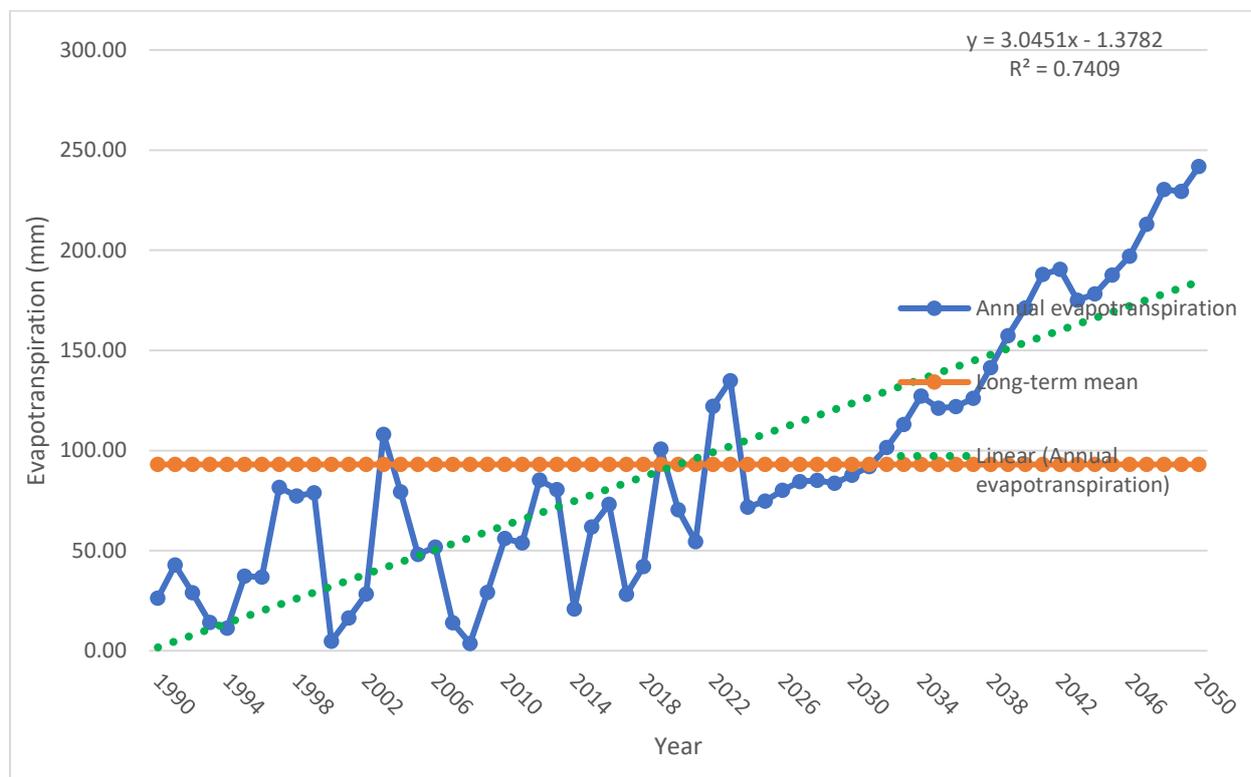


Figure 2.36. Trend in Evapotranspiration for Hadejia-Jama'are Catchment

2.8.6 Major Impacts of Climate Change

Climate change has devastating effects on several sectors of the environment, some of which include socio-economic, health, and infrastructure. Table 2.9 gives some of the details of these impacts mentioned

Table 2.9. Key Impacts of Climate Change

Impacts	Details
Economic	<ul style="list-style-type: none"> Damage to infrastructure Loss of property and assets Disruption of businesses and services Increased costs for emergency response and recovery
Social	<ul style="list-style-type: none"> Loss of life and injury Displacement and migration Psychological trauma and stress Social disruption and community cohesion

Environmental	Water pollution Soil erosion and sedimentation Loss of biodiversity Increased risk of waterborne diseases
Health	Waterborne diseases Vector-borne diseases Mental health impacts Injuries and trauma
Infrastructure and Service	Power Outage Transportation disruption Water and sanitation disruption Communication disruption

2.8.7 National and International Climate Change Frameworks/Agreements

The NWRMP (JICA,2014) investigated the climate change effects on Nigeria. The long-term trend of rainfall and air temperature in the past in Nigeria has been considered based on meteorological datasets collected from NIMET and was summarized as follows:

- ❖ There is a linear tendency of increase in air temperature in the last 50 years;
- ❖ There is a linear tendency for a decrease in rainfall in the last 50 years. However, the variation by decades is much larger than the linear decreasing rate;
- ❖ Generally, most parts of the country show evidence of long-term temperature increase;
- ❖ Annual rainfall showed a decrease of 2 to 8mm/ year across many parts of the country.

According to JICA studies 2014, it was found that the annual rainfall does not change over the coming 35 years. However, the temperature changes by 2.6°C over the time frame.

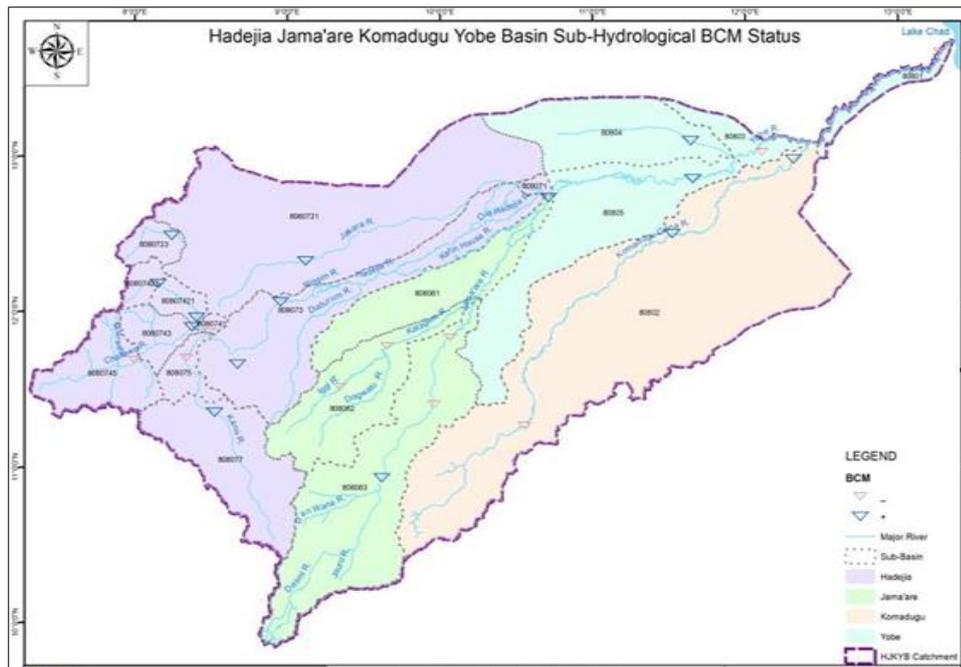


Figure 2.37. Change in Annual Rainfall in the Catchment

Source JICA 2014 MP

2.8.7.1 Climate Change Scenarios

For the possible future climate conditions, climate change scenarios in Nigeria have been discussed as shown below.

According to the 4th IPCC report (2007), it is expected that the increase of air temperature in West Africa area in 2100 would be about 3-5 degree Celsius in the case of A1B scenario, which is about 1.5 times higher than the average in the world. As for the precipitation, the predictions of precipitation by different GCM models vary very much. It is difficult to conclude the general tendency for the change in precipitation.

2.8.7.2 Nigeria's First National Communication on Climate Change

In the Nigeria's First National Communication (2003), the climate change scenarios in Nigeria have been discussed based on several GCM model output. The following findings were noted.

- ✚ The most significant changes are with respect to temperature and temperature-related parameters.
- ✚ There has been an observed trend towards aridity in Sub-Saharan West Africa. This trend will be put on hold or reversed as the century progresses. There are possibilities,

however, that the additional water need created by higher temperatures may not be met by the increases in precipitation.

- ✚ The difference in climate conditions from coastal areas to the northern part of the country could become more significant.

2.8.7.3 Nigeria's Second National Communication on Climate Change

Nigeria's Second National Communication on Climate Change is a key step in evaluating and addressing climate change impacts nationally, in line with the Paris Agreement and UNFCCC requirements. It provides a comprehensive analysis of greenhouse gas emissions, climate vulnerability, and tailored adaptation and mitigation strategies for Nigeria's specific socio-economic and environmental conditions.

The findings of the SNC highlight the escalating risks posed by climate change to Nigeria's ecosystems, economy, and communities, particularly vulnerable populations. Some of the key findings are listed below;

- i. Greenhouse Gas (GHG) Inventory and Emissions Trends
- ii. Vulnerability and Impacts of Climate Change
- iii. Adaptation Measures and Challenges
- iv. Mitigation Strategies and Potential
- v. Barriers to Climate Action
- vi. International Cooperation and Support Needs

Some of the outcomes and Future Steps are also presented below;

- i. Strengthening Policy Frameworks
- ii. Public Awareness and Community Engagement
- iii. Focus on Renewable Energy Expansion
- iv. Capacity Building and Research Development

2.8.7.4 Nigeria's Third National Communication on Climate Change

To build on the insights and successes from the previous communications and to provide an updated assessment of the country's Greenhouse Gas (GHG) emissions, climate vulnerabilities, and strategies for adaptation and mitigation, the Third National Communication on climate

change was held to also reflects Nigeria's ongoing commitment to climate action and sustainable development, presenting a comprehensive review of its climate policies, measures undertaken, and future directions for a climate-resilient and low-carbon economy. Emissions in Nigeria are mainly from the Agriculture, Forestry, and Other Land Use (AFOLU) sector, accounting for 60.1%, followed by the energy sector at 33.9%. Without intervention, emissions could rise over 58% by 2035. The country also faces serious climate vulnerabilities, including drought, desertification, flooding, water scarcity, and reduced agricultural productivity.

Key findings and outcomes were similar to the second National Communication with some improvement such as;

- i. Capacity Building, Technology Transfer, and Financial Needs
- ii. Enhanced Policy Framework and Institutional Coordination
- iii. Scaling Up Renewable Energy and Green Economy Initiatives
- iv. Strengthening Community Engagement and Resilience Building
- v. Research, Innovation, and Monitoring Systems

2.8.7.5 The Paris Agreement

Since joining the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, Nigeria ratified the Kyoto Protocol in 2004 and the Paris Agreement in 2007. The Paris Agreement, a legally binding treaty adopted by 196 Parties at COP21 in Paris on December 12, 2015, aims to limit the global temperature increase to well below 2°C above pre-industrial levels, with efforts to limit it to 1.5°C. It took effect on November 4, 2016.

2.9 Flood and Drought Vulnerability

- The study used a weighted overlay analysis to assess flood vulnerabilities across the catchment by combining datasets such as elevation, proximity to rivers, precipitation, slope, and land use.
- Each layer was categorized, weighted, and scored on a 1–9 scale. Proximity to rivers received the highest weight.
- The resulting flood risk map identified five flood vulnerability levels: Highly not vulnerable, Not Vulnerable, Moderate, Vulnerable, and Highly Vulnerable. The study area covers 123,365 km², with a critical vulnerability area of 261.3 ha.
- Low vulnerability zones are found in high-elevation regions, while high-risk areas are concentrated in lower elevation zones near the highlands.

Proximity to streams is also a very important variable to consider in flood vulnerability analysis because nearness to streams/rivers means high probability to the risk of flooding. This depicts uniform distances away from the river and for this study about 0-7km shows areas closest to the river while about 39-47km depicts areas far away from the river.

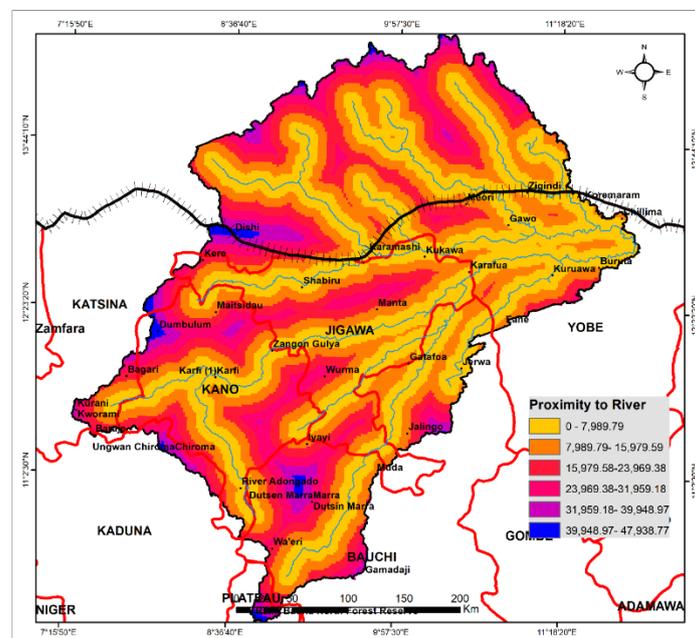


Figure 2.38. Proximity to River Map of the Catchment (Source: MSL, 2024)

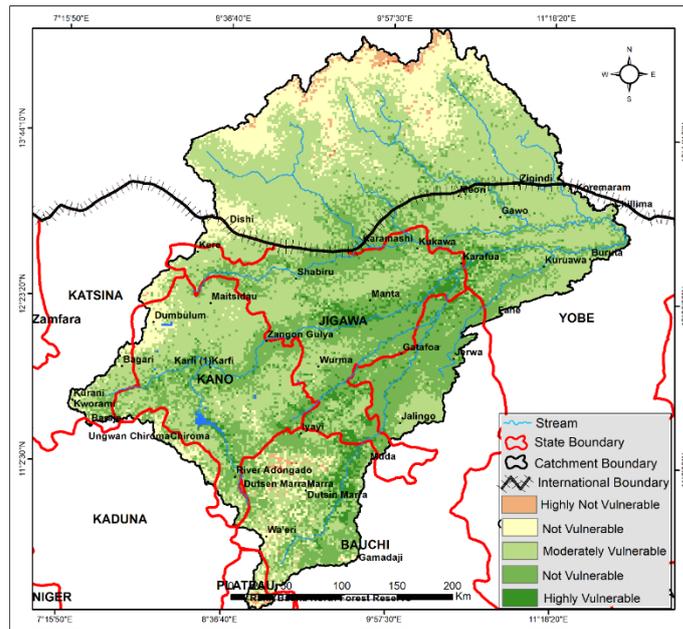


Figure 2.39. Flood Vulnerability Map of the Catchment (Source: MSL, 2024)

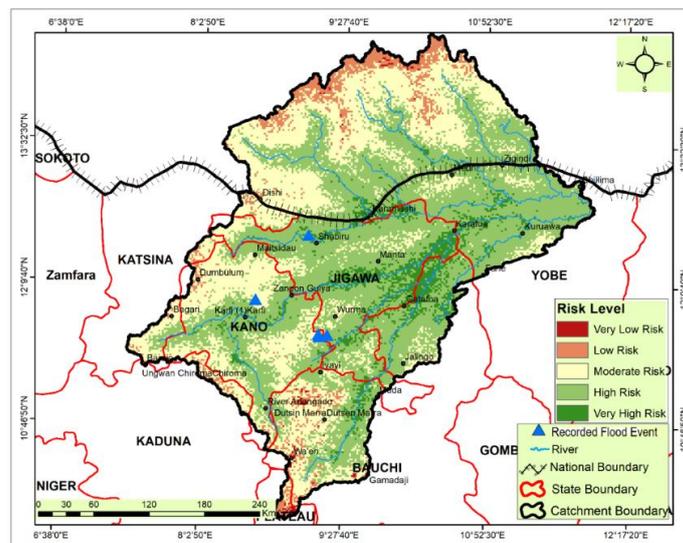


Figure 2.40. Flood Risk Map of the Catchment (Source: MSL, 2024)

The Hadejia-Jama catchment has experienced frequent flooding, with several recent events causing significant damage and displacement.

- In September 2014, heavy rainfall led to widespread flooding in Kano State, impacting communities such as Kano City, Dawakin Kudu, and Bichi.

- The flooding caused infrastructure damage and displaced families, triggering urgent relief efforts. Similarly, in early September 2018, heavy rainfall in Dutse and surrounding areas in Jigawa State caused severe devastation, displacing residents and disrupting livelihoods.
- Flash floods in Kano City in August 2018 led to fatalities, home damage, and road blockages. In October 2020, severe flooding from river overflows displaced thousands and disrupted essential services.
- The following year, in August 2021, flooding in Guri Local Government Area of Jigawa State damaged over 120 homes, prompting evacuations and highlighting the need for better drainage. Later that year, Kano City also experienced significant flooding, damaging property and disrupting economic activities.
- The September 2022 flooding affected over 60,000 people in Kano, submerging homes and washing away farmlands. The 2023 event impacted communities like Tarauni, Dala, and Nassarawa, with similar effects. In September 2024, heavy rainfall overwhelmed drainage systems in areas like Tarauni, Fagge, and Nassarawa, posing health risks from waterborne diseases.
- The flood risk analysis indicates that 415.8 hectares of farmland (77%) and 12.33 hectares of built-up areas (2%) are at high risk of flooding in the catchment.

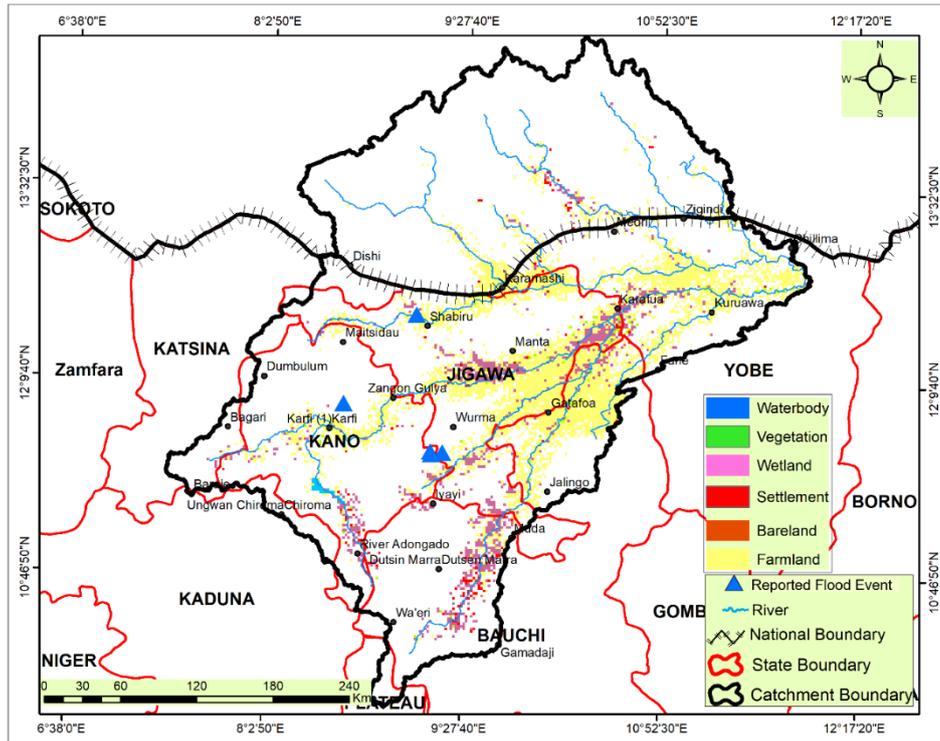


Figure 2.41. Flood Recorded Event Map of the Catchment (Source: MSL, 2024)

2.10 Socio-Economic Dynamics

2.10.1 Population Distribution and Growth

The current population in the catchment is approximately 40 million people (Fig 2.42). It is expected to grow to 73 million by the year 2050. More detailed tables with population by state and Local Government Area (LGA) is shown in Annex 1.

2006	2022	2025	2030	2035	2040	2045	2050
22.5	37.6	40.4	45.5	51.3	57.7	65.0	73.1

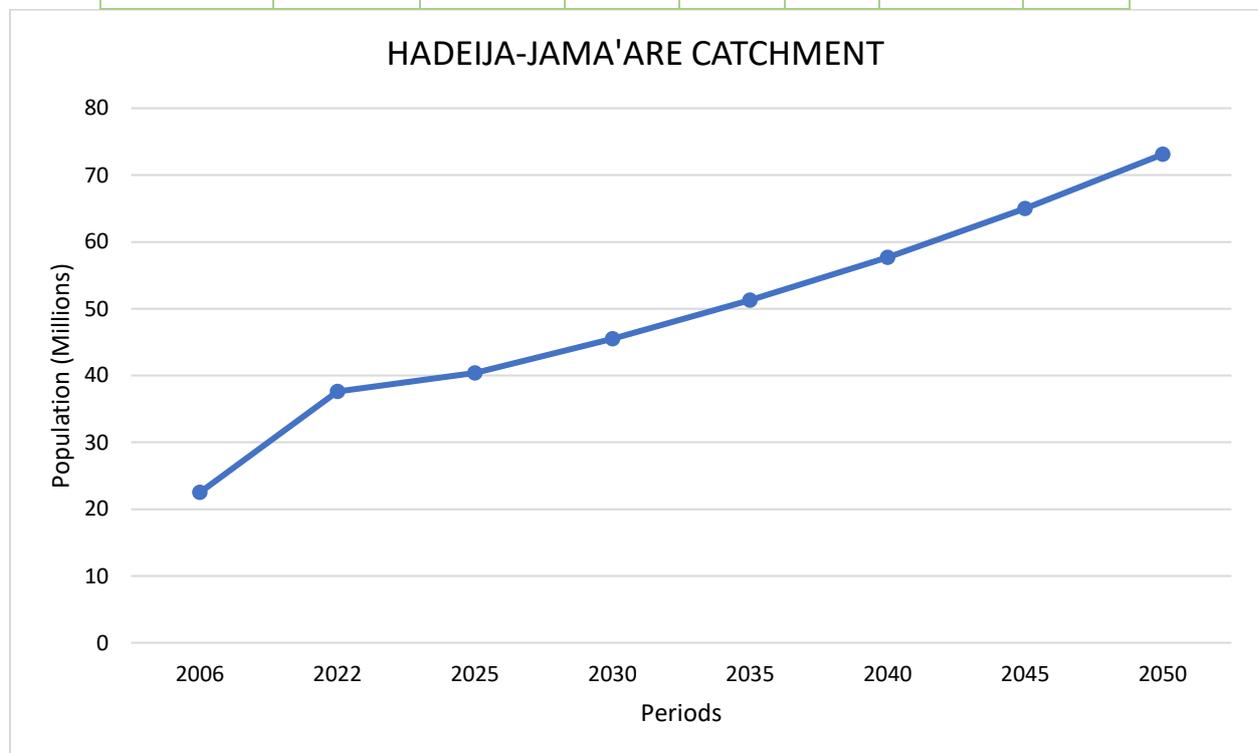


Figure 2.42. Population Projection for Hadeija-Jama'are Catchment (Source: MSL, 2024)

Table 2.10. Summary of the characteristics of Hadejia Jama'are Catchment

NAME	STATES	POPULATION	GEOGRAPHY	GEOLOGY	HYDROLOGY - HYDROGEOLOGY	VEGETATION	SOCIO- ECONOMICS
Hadejia Catchment	Kano, Yobe, Jigawa, Bauchi	<p><i>Estimated population within the catchment:</i> Varies depending on source, but likely around 40 million people.</p> <p><i>Major cities:</i> Kano (partial area), Hadejia, Dutse (Nigeria) Predominantly rural settlements with Kano City on the fringes of the catchment</p>	<p><i>Location:</i> Northern Nigeria, covering parts of Kano, Yobe, Jigawa and Bauchi</p> <p><i>Size:</i> Approximately 12.34 million hectares (larger than Rima River catchment)</p> <p><i>Topography:</i> Primarily flat plains with some scattered hills and inselbergs (isolated rocky outcrops)</p>	<p><i>Underlying rock formations:</i> Primarily consist of sedimentary rocks like sandstones and shales.</p> <p><i>Geologic vulnerability:</i> Certain areas might be susceptible to erosion due to the type of underlying rock and soil composition</p>	<p><i>Drainage system:</i> The Hadejia River is a major tributary of the Komadugu Yobe River, which feeds into Lake Chad.</p> <p><i>Groundwater resources:</i> Similar to the Rima catchment, aquifers provide essential water, but face pressure due to increasing demand and potential salinization</p>	<p><i>Predominant vegetation:</i> Sudanian savanna with transitions towards Sahel vegetation in the northern parts of the catchment.</p> <p><i>Vegetation degradation:</i> Overgrazing, deforestation, and desertification threaten the natural vegetation cover, impacting soil quality and water retention</p>	<p><i>Livelihoods:</i> Predominantly rain-fed agriculture, with some irrigation projects in specific areas. Livestock rearing, fishing (along the river), and some trade and commerce are also important economic activities.</p> <p><i>Water dependence:</i> Communities heavily rely on the Hadejia River and groundwater resources for survival and economic activities.</p> <p><i>Challenges:</i> Poverty, water scarcity (seasonal and exacerbated by upstream water</p>

							usage), environmental degradation, and limited infrastructure development in some rural areas
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2.10.2 Demographics and Poverty

Table 2.11. Catchment Demographics and Poverty

State	Demographics and Poverty
Kano	<ul style="list-style-type: none"> • Population of over 15 million people (National Population Commission, 2023) • Population density of about 745 people/Km² • Has a youthful population. Approximately 60% of the population is below the age of 25, while about 40% is under the age of 15. • Population growth of 5.6 million in 1991 to over 15 million by 2023 (National Population Commission, 2023) • Gender ratio in Kano is relatively balanced, with a slight male predominance. The male to female ratio is approximately 1.03:1 (National Bureau of Statistics, 2022) • There is rapid urbanization, particularly in the metropolitan area of Kano city. There is significant rural-urban migration driven by factors such as employment opportunity, access to better services, and economic activities concentrated in urban areas. • There is high fertility rate in Kano which is a significant driver of population growth. Total Fertility Rate (TFR) is estimated at 5.8 children per woman, higher than the national average of 5.3 (Nigeria Demographic and Health Survey, 2018) • Kano has attracted migrants from neighbouring states and countries, due to its economic opportunities, trade, and commerce. Additionally, conflicts and insecurity in some parts of Northern Nigeria has led to an influx of Internally Displaced Persons (IDPs) into Kano, further contributing to population growth. • Kano's population is projected to continue to increase over the coming decades. By 2035, the population is expected to reach approximately 20 million if the current growth rate persists (United Nations, 2022). • Kano is known as the commercial and industrial hub of Northern Nigeria, with a diverse economy characterized by Agriculture, trade, manufacturing, and services. • The backbone of Kano state is Agriculture, employing over 70% of the population (National Bureau of Statistics, 2022). Kano is the leading producer of several crops, including millet, sorghum, maize, rice, groundnuts, cowpeas, and vegetables. • Kano has a long history as a centre of trade and commerce. It hosts the famous Kurmi market, as well as Textile and Leather industries. It also is a hub for manufacturing, such as food processing, plastics, chemicals, and pharmaceuticals. • Kano is a centre for education in Northern Nigeria, with numerous primaries, secondary, and tertiary institutions. The healthcare sector has also seen improvements with the establishment of new hospitals and clinics to cater to the growing population. • Kano's strategic location makes it a major transportation hub, with an extensive road network, a railway terminus, and the Mallam Aminu Kano International Airport. • Majority of the population of Kano is Muslim, following Sunni Islam, particularly the Maliki school of thought, which significantly influences the state's cultural practices, social norms, and legal system.

	<ul style="list-style-type: none"> • The people of Kano place a high value on family and community. The extended family system is prevalent, with strong kinship ties and a sense of collective responsibility.
Jigawa	<ul style="list-style-type: none"> • Jigawa state has an estimated population of approximately 5.5 million people (national Population Commission, 2023) • The population is relatively young, with about 45% under the age of 15. The working-age population (15-64 years) constitutes around 50%, while the elderly (65 years and above) makes up approximately 5%. • The population is fairly evenly split, with a gender ratio of approximately 1.02 males to 1 female. • Jigawa State has experienced a population growth rate of approximately 3.2% per annum over the past decade. This reflects both natural growth and migration patterns. • Majority of the population resides in rural areas (about 80%), with urban areas experiencing moderate growth. Urbanization trends show a gradual increase in urban population, especially in cities like Dutse, the state capital. • Jigawa State’s economy is predominantly based on agriculture, contributing approximately 70% to the state’s Gross Domestic Product (GDP). Other sectors include trade and services. • The poverty rate in Jigawa State is relatively high, with estimates indicating that about 60% of the population lives below the national poverty line. • Agriculture dominates Jigawa State’s economy, employing approximately 70% of the population. Key crops include millet, sorghum, maize, rice, and groundnuts. The state has a significant livestock sector, with cattle, goats, and sheep being major contributors to local trade and economy. • There are major markets in Dutse, Hadejia, and Gumel facilitate the exchange of agricultural produce and consumer goods. These markets are central to the state’s trade dynamics. • There is significant infrastructure development, including roads, and energy supply. • The extended family system is predominant in Jigawa State, where multiple generations often live together. This structure plays a crucial role in social support and communal living. • Traditional crafts such as pottery, weaving, and embroidery are integral to local culture. These crafts are often showcased during festivals and markets • The predominant religion in Jigawa State is Islam, with the majority of the population adhering to Islamic practices. Religious practices influence daily life, including dietary restrictions, prayer times, and social interactions
Bauchi	<ul style="list-style-type: none"> • Bauchi state has an estimated population of approximately 6 million as at the 2016 census. • Bauchi State has experienced steady population growth over the years, driven by both natural increase and migration. The state's population growth rate is estimated at around 2.8% per annum, which is consistent with the national average. • The state has seen an influx of people from neighboring states and regions, particularly due to conflict and insecurity in other parts of northern Nigeria,

	<p>which has led to an increase in the internally displaced population in Bauchi State (National Population Commission, 2019).</p> <ul style="list-style-type: none"> • Agriculture is the backbone of Bauchi State's economy, employing over 70% of the population. The state is predominantly agrarian, with a focus on subsistence farming. Major crops grown include maize, millet, sorghum, rice, groundnuts, and cotton. The state is also known for livestock rearing, particularly cattle, goats, and sheep, which are central to the livelihoods of the rural population (Musa, 2020). • In addition to agriculture, Bauchi State has a growing industrial sector, though it remains underdeveloped compared to other parts of the country. Key industries include food processing, textiles, and leather production. The state is also rich in mineral resources, including limestone, tin, and kaolin, which have the potential to drive industrial growth if properly harnessed • The social structure of Bauchi State is deeply rooted in its traditional and religious institutions. The Emirate system, led by traditional rulers, plays a significant role in governance, conflict resolution, and the preservation of cultural heritage. • Religion plays a pivotal role in the lives of the people of Bauchi State. Islam is the dominant religion, and it influences various aspects of life, including education, law, and social interactions. The state has a significant number of Islamic schools (madradas), which provide religious and secular education. Christian communities, though a minority, also have a strong presence in the state, particularly in the southern regions. Religious tolerance and coexistence are generally maintained, although there have been occasional conflicts between different religious groups.
<p>Yobe</p>	<ul style="list-style-type: none"> • As of the 2006 National Census, Yobe State had a population of approximately 2.3 million people. According to the National Population Commission (NPC) in 2022, the population of Yobe State is estimated to have grown to around 3.6 million people, reflecting an annual growth rate of about 2.6%. • The population is predominantly rural, with a youthful demographic profile—about 60% of the population is under the age of 30 (NPC, 2006 and NPC 2022). • Agriculture is the backbone of Yobe State's economy, employing over 70% of the population. The state is known for the cultivation of millet, sorghum, groundnuts, beans, and maize. Livestock farming, particularly cattle, sheep, and goats, is also significant. Major markets include those in Damaturu, Potiskum, and Nguru, where agricultural products and livestock are traded • Yobe State is home to diverse ethnic groups, including the Kanuri, Fulani, and Hausa, each with distinct cultural practices, languages, and traditions. Major cultural events include the Durbar festival, celebrated during Eid, and the annual Yobe Cultural Festival, which showcases traditional music, dance, and crafts. • Islam is the predominant religion, influencing social practices, festivals, and community life.

2.10.2.1 Unsustainable Livelihoods

Many communities in the Hadejia Jama'are catchment rely on natural resources for their livelihoods, including farming, fishing, and livestock rearing. However, high levels of poverty and limited access to alternative livelihoods have led to unsustainable resource use.

- **Overexploitation of Resources:** Due to poverty, local communities often resort to overharvesting resources, such as overfishing, deforestation for firewood, and overgrazing, leading to long-term environmental degradation.
- **Lack of Alternative Livelihoods:** In many rural areas, there are limited opportunities for alternative income sources. This forces people to rely on agriculture and natural resources, making it difficult to implement sustainable practices.

2.10.3 Gender Issues

Challenges

Gender inequality in the catchment is driven by cultural, social, and economic factors that disadvantage women and vulnerable groups. Limited access to education, skills, and financial services restricts their economic opportunities and participation in leadership and decision-making.

Socio-economic challenges like poverty, conflict, and weak governance exacerbate issues related to climate change. Women face increased vulnerability to its impacts, including natural disasters and migration, which elevate their risk of gender-based violence (GBV) and hinder their ability to adapt. Although policies such as the Gender Policy and Violence Against Persons Prohibition (VAPP) Law are in place, their implementation is hindered by language barriers, lack of community engagement, and insufficient enforcement.

Opportunities

Despite challenges, the catchment presents opportunities for advancing gender equality. The presence of government, civil society, and development actors—spurred by insurgency-related interventions—has increased funding and programs targeting gender and social inclusion. These efforts provide a foundation for integrating gender considerations into resource management and development initiatives.

Recommendations

- **Social and Behavioral Change Communication:** Promote rights-based social norms through sensitization campaigns, emphasizing equitable resource management and gender inclusion. Utilize local knowledge and innovative approaches to address cultural beliefs and foster gender equity.
- **Economic Empowerment:** Enable women to access credit, land ownership, and entrepreneurial opportunities. Encourage government initiatives that support women-led businesses, enforce equal pay, and create policies for career advancement.
- **Policy Implementation:** Translate existing policies into local languages and engage communities to ensure effective implementation. Develop costed workplans and budgets for translating policy into action.
- **Addressing GBV:** Make GBV prevention and response integral to all programs. Establish confidential reporting systems, grievance redress mechanisms, and referral directories to support survivors. Promote cultural shifts that redefine masculinity and challenge GBV norms.
- **Multi-Sectoral Collaboration:** Integrate gender and social inclusion across sectors such as education, agriculture, water resources, and economic development to strengthen the impact and sustainability of programs like ACRoSAL.

By addressing these challenges and leveraging opportunities, sustainable resource management and socio-economic development can be achieved with equitable gender representation and participation.

CHAPTER 3 : STAKEHOLDER ENGAGEMENT AND GOVERNANCE

3.1 Methodology

Considering that the strategic catchment management plan study was conducted on a macro level, stakeholder mapping for participants was done mainly on an institutional level. The institutions sent in representatives at a central location. Information was gathered through interviews, focus group discussions and outright enquires. The details from the respondents are as outlined in Annex 2 table A-2-3.

3.2 Key Stakeholders Engaged

For the purpose of this study, the stakeholder engagement concepts that have been employed are as follows:

- Natural Resources (Land, water, vegetation, wildlife, minerals etc.)
- Threats and Challenges
- Socio-economics
- Policies

To develop the strategic catchment management plan at a macro level, the study entailed the engagement of institutional stakeholders.

Kano State:

- i. Hadejia-Jama'are River Basin Development Authority, Kano-kano
- ii. Center for Animal Rights Protection-Kano
- iii. Women Farmers Advancement network-WOFAN, Kano
- iv. Center for Dryland Agriculture, BUK Kano-Kano
- v. Center for Environment, Education and Development (CEED), Kano
- vi. Hadejia- Nguru Wetland Conservation Project-Kano/Jigawa
- vii. Farmer's association/ pastoralists of the State
- viii. Rural Water Supply and Sanitation Agency (RUWASA)
- ix. State Ministries of Environment,
- x. State Ministry of Agriculture and food security
- xi. State Ministry of Water Resources,
- xii. State Ministry of Min of Lands,

Mecon Geology & Engineering Services Ltd

- xiii. State Ministry of Women Affairs,
- xiv. State Ministry of Solid Mineral Development
- xv. State Miners Association

Jigawa State:

- i. Hadejia- Nguru Wetland Conservation Project-Kano/Jigawa
- ii. Nigeria Integrated Water Resources Management Commission Dutse
- iii. Farmer's association/ pastoralists of the State
- iv. Rural Water Supply and Sanitation Agency (RUWASA)
- v. State Ministries of Environment,
- vi. State Ministry of Agriculture and food security
- vii. State Ministry of Water Resources,
- viii. State Ministry of Min of Lands,
- ix. State Ministry of Women Affairs,
- x. State Ministry of Solid Mineral Development
- xi. State Miners Association

Yobe State:

- i. Hadejia Jama'are Komadugu Yobe Basin Trust Fund, Damaturu-Yobe
- ii. Komadugu Yobe Basin Wetlands Development Initiative-Yobe
- iii. Kumadugu Yobe Basin Development Initiatives Hadejia-Yobe
- iv. Farmer's association/ pastoralists of the State
- v. Rural Water Supply and Sanitation Agency (RUWASA)
- vi. State Ministries of Environment,
- vii. State Ministry of Agriculture and food security
- viii. State Ministry of Water Resources,
- ix. State Ministry of Min of Lands,
- x. State Ministry of Women Affairs,
- xi. State Ministry of Solid Mineral Development
- xii. State Miners Association

Bauchi State:

- i. Yankari Game Reserve, Bauchi-Bauchi (Gali Lamurde Strategic catchment)
- ii. Farmer's association/ pastoralists of the State
- iii. Rural Water Supply and Sanitation Agency (RUWASA)
- iv. State Ministries of Environment,
- v. State Ministry of Agriculture and food security
- vi. State Ministry of Water Resources,
- vii. State Ministry of Min of Lands,
- viii. State Ministry of Women Affairs,
- ix. State Ministry of Solid Mineral Development
- x. State Miners Association

3.2 Major Topics for Stakeholder Discussions

The above stakeholders were considered as the institutions that could influence and impact development of the strategic catchment management plan.

Stakeholders were engaged in group settings in each State to discuss key issues affecting development of catchment and opportunities for addressing these issues. The FPMU team first presented the results of the catchment analysis, focusing on the biophysical and socio-economic aspects. The meetings then tried to develop a consensus around a long-term vision, strategic goals for catchment development, and finally, priority actions.

The discussions covered issues and potential best practices around:

- Water management
- Land-Use
- Environmental protection
- Community benefits
- Economic development
- Climate change resilience
- Monitoring and evaluation alignment of policies governing the catchment

More specific topics included:

- Water supply
- Agriculture
- Industrial use
- Making rivers more navigable
- Implementing the water charter of the Basin
- Creating and maintaining a decision support system/databank for the catchment
- Dam and reservoir operating guidelines
- River training
- Flow proportioning structures
- Restoration and expansion of the hydromet monitoring network

3.3 Key Points from the Stakeholder Engagement

Based on the stakeholder engagement information from Annex 2 on strategic issues and opportunities, the following detailed points were developed around the key topics of interest identified in the previous section above:

1. **Water Management and Access:**

- Stakeholders emphasized the importance of sustainable water resource management, particularly addressing overuse and pollution from upstream activities.
- A significant focus was on implementing and enforcing operational guidelines for dams and reservoirs, alongside river training to manage sedimentation and flow distribution effectively.
- Enhancing climate resilience through rainwater harvesting and expanding hydromet monitoring networks were considered critical.

2. **Land Use and Degradation:**

- Concerns were raised about unsustainable farming practices, leading to soil degradation and reduced productivity.
- Encroachment into forest reserves for agriculture was identified as a pressing issue, impacting biodiversity and contributing to deforestation.

3. **Environmental Protection:**

- Restoration of degraded wetlands and afforestation initiatives were highlighted to improve ecosystem services and carbon sequestration.
- Stakeholders emphasized the need for protecting riparian corridors and ensuring the sustainable use of natural resources.

4. **Community and Livelihoods:**

- There was widespread acknowledgment of the socio-economic challenges linked to water resource access, including poverty and food insecurity.
- Livelihood support through initiatives like providing farming equipment, credit facilities, and skills training was noted as a vital intervention.
- Issues of insecurity in certain regions hinder the effective implementation of initiatives.

5. Institutional Gaps and Policy Alignment:

- Weak coordination among agencies and gaps in policy implementation were recurring themes.
- Suggestions included harmonizing existing policies on land tenure, mining, and water resources, alongside developing costed action plans and budgets.

6. Strengthening Coordination Mechanisms:

- Create a multi-stakeholder platform to improve collaborative decision-making.
- Encourage capacity building for local institutions to enhance governance structures.

7. Promoting Sustainable Practices:

- Roll out community-driven sustainable agricultural practices and integrated land management approaches.
- Incentivize the use of organic farming methods to reduce chemical runoff into water systems.

8. Enhancing Data and Monitoring Systems:

- Regularly collect and share water quality and hydrological data to inform planning and mitigate risks.
- Utilize modern tools like GIS and remote sensing for better resource management.

9. Engaging Communities:

- Strengthen community engagement through awareness campaigns about sustainable practices.
- Include gender-sensitive approaches to empower marginalized groups, particularly women, in resource management activities.

In consideration of a clear understanding of the outcome of the valuable inputs from the stakeholders, as indicated above and listed in the components of the plan (Fig 5.1-5.9), interventions were suggested:

Most in concurrence with the stakeholder output,

- While others were slightly modified in line with existing data on related factors, as deduced from the study, the idea is to develop the most practicable intervention projects.
- By addressing these identified challenges and leveraging the opportunities highlighted, the catchment management plan can achieve sustainable development outcomes that balance ecological health with socio-economic goals.

It is pertinent to note that there were very few areas of none concurrence.

- An example is the area of typha grass elimination. While a majority insisted on elimination, others preferred management, considering some had discovered some commercial use of the Typha grass as a building material.
- Also, participants preferred that the management of the catchment should be under the purview of the North East Development Commission (NEDC).

3.4 Coordination Mechanisms

The roles of federal, state, and local stakeholders in catchment plan Management and implementation are:

Federal Stakeholders

1. Federal Ministry of Environment: Provides overall guidance and coordination for catchment management in Nigeria. Supports the implementation of environmental aspects of the catchment plan, including conservation and sustainable use of natural resources (through the ACREsAL project)
2. Federal Ministry of Water Resources and Sanitation: Provides support in implementation and guidance.
3. Federal Ministry of Agriculture and Food Security
4. National Space Research and Development Agency (NARSDA): Provided Satellite data
5. National Centre for Remote Sensing (NCRS): Provided geospatial support
6. Nigerian Meteorological Agency (NIMET): Provides climate and weather data to support catchment planning and management.
7. National Emergency Management Agency (NEMA): Supports disaster risk reduction and management efforts in the catchment.

State Stakeholders

8. State Ministry of Water Resources: Implements state-level policies and programs for catchment management.
9. State Ministry of Environment: Supports the implementation of the catchment plan's environmental aspects at the state level.
10. State Ministry of Agriculture: Supports sustainable agriculture practices and water management in the catchment.

11. State Emergency Management Agency (SEMA): This agency supports disaster risk reduction and management efforts in the catchment.

Local Government Stakeholders

12. Local Government Councils: Implement catchment management plans at the local level, including waste management and environmental conservation.

Community Oriented Stakeholders

13. Community-Based Organizations (CBOs): Support community-led initiatives for catchment management, including water conservation and sustainable land use practices.

14. Traditional Rulers: Provide leadership and support for catchment management efforts at the local level.

15. Farmers and Water Users Associations: Support sustainable water management practices and conservation of natural resources in the catchment.

16. Civil Society Organizations (CSOs): Support advocacy and awareness-raising efforts for catchment management and conservation.

Private Sector Stakeholders

17. Private Sector: Supports the implementation of catchment management plans through corporate social responsibility initiatives and investments in sustainable water management practices.

Research Institutions

18. Research Institutions: Provide technical support and research expertise for catchment management and conservation efforts.

International Stakeholders

19. International Development Partners: Support catchment management efforts through funding, technical assistance, and capacity-building programs.

CHAPTER 4 : STRATEGIC VISION AND GOALS

Based on the biophysical and socio-economic assessment and comprehensive stakeholder engagement, the consensus for a strategic vision for the Hadejia-Jama'are catchment is:

To ensure the sustainable management of the Hadejia-Jama'are catchment's natural resources, promote ecosystem services, and improve the livelihoods of local

The consensus for long-term and short-term strategic goals and expected outcomes are shown in Table 4.1 below:

Table 4.1: Strategic Goals of the Catchment

LONG-TERM STRATEGIC GOALS (2030)	KEY PERFORMANCE INDICATORS (KPIs)	SHORT TERM STRATEGIC GOALS (2025)	KEY PERFORMANCE INDICATORS (KPIs)	TARGETS (EXPECTED OUTCOMES)
1. Improved Water Resources and Flood Risk Management: Ensure the sustainable management of water resources, including the protection of water sources, efficient use of	<ul style="list-style-type: none"> Percentage increase in year-round water availability for domestic, agricultural and industrial use. Reduction in the frequency and severity of flood events. 	1. Conduct a Comprehensive Assessment of the Catchment's Natural Resources, Ecosystem Services, and Livelihoods	<ul style="list-style-type: none"> Completion of the comprehensive assessment report within the defined timeframe. Number of natural resources, ecosystem services, and 	Improved Water quality and quantity

<p>water, and mitigation of flood and drought risks.</p>	<ul style="list-style-type: none"> • Number of water sources protected and rehabilitated (e.g., springs, boreholes, rivers). • Reduction in drought-related water shortages. • Percentage of water users adopting efficient water use practices (e.g rainwater harvesting, drip irrigation). 		<p>livelihood indicators assessed.</p> <ul style="list-style-type: none"> • Percentage of stakeholders consulted during the assessment process. • Number of maps and datasets produced. • Identification of key challenges and opportunities documented in the assessment report. 	
<p>2. Preserve and restore critical Ecosystem and Services: Protect and restore ecosystems, including forests, wetlands, and wildlife habitats, to maintain biodiversity, support ecosystem services, and promote ecological resilience.</p>	<ul style="list-style-type: none"> • Improvement in biodiversity indicators (e.g., number of species observed) • Area of critical ecosystems (forests, wetlands, wildlife habitats) protected and restored. • Increase in eco-system services (e.g., water regulation, soil fertility, carbon sequestration). • Reduction in deforestation and land degradation rates • Number of community-led conservation initiatives 	<p>2. Establish a Multi-Stakeholder Platform for Coordinated Management of the Catchment</p>	<ul style="list-style-type: none"> • Increase in number of stakeholders represented in the multi-stakeholder platform. • Frequency of platform meetings (e.g., quarterly or biannually). • Increase in the percentage of platform members actively participating in meetings and activities. • Development of a terms of reference (TOR) or governance 	<p>Increase in forest cover and biodiversity</p>

<p>3. Promote Sustainable Agriculture and Livestock Practices: Promote sustainable agriculture and livestock practices, including conservation agriculture, agroforestry, and integrated water management, to reduce environmental degradation and improve livelihoods.</p>	<ul style="list-style-type: none"> • Percentage increase in farmers adopting sustainable agricultural practices. • Reduction in soil erosion and land degradation rates • Increase in agricultural productivity • Number of integrated water management systems implemented • Percentage reduction in the use of harmful agrochemicals 	<p>3. Develop and Implement a Water Resources Management Plan</p>	<p>framework for the platform.</p> <ul style="list-style-type: none"> • Completion and approval of the water resources management plan within the defined timeframe • Number of water resource management interventions implemented • Increase in the percentage of water users adopting efficient water use practices. • Reduction in water-related conflicts • Improvement in water quality indicators 	
<p>4. Enhance Climate Resilience: Implement climate-resilient practices, including climate-smart agriculture, disaster risk reduction, and ecosystem-based adaptation, to enhance the catchment's resilience to climate change.</p>	<ul style="list-style-type: none"> • Percentage of households and farms adopting climate-smart agricultural practices. • Reduction in crop failure rates due to climate variability. • Number of disaster risk reduction 	<p>4. Launch a Sustainable Agriculture and Livestock Program</p>	<ul style="list-style-type: none"> • Increase in number of farmers trained in sustainable agriculture and livestock practices • Area of land (in hectares) under sustainable agricultural practices. • Increase in crop yield pr livestock productivity. 	<p>Reduced greenhouse gas emissions</p>

	<p>measures implemented (e.g., early warning systems, flood barriers)</p> <ul style="list-style-type: none"> • Increase in the use of ecosystem-based adaptation practices (e.g., reforestation, wetland restoration). • Percentage of communities with access to climate-resilient infrastructure (e.g., flood-resistant housing, drought-resistant water systems). 		<ul style="list-style-type: none"> • Reduction in soil erosion and land degradation rates 	
<p>5. Improved Livelihoods and Well-Being of the various stakeholders in the catchment: Enhance the livelihoods of local communities, including women and youth, through improved access to education, healthcare, and economic opportunities.</p>	<ul style="list-style-type: none"> • Percentage increase in household income among local communities. • Improvement in access to education and healthcare services. • Percentage increase in women and youth engaged in income-generating activities. 	<p>5. Establish a Climate Change Mitigation and Adaptation Program</p>	<ul style="list-style-type: none"> • Number of climate change mitigation and adaptation measures implemented • Increase in percentage of households adopting climate-resilient practices • Reduction in vulnerability to climate-related disasters 	<p>Enhanced livelihoods and human well-being</p>

	<ul style="list-style-type: none"> • Reduction in poverty rates within the catchment 		<ul style="list-style-type: none"> • Number of community awareness campaigns conducted on climate change mitigation and adaption • Improvement in climate resilience indicators (e.g., reduced crop failure rates, increased water availability during droughts) 	
<p>6. Strengthen inclusive governance and Stakeholder Partnerships: Strengthen governance and stakeholder engagement, including the involvement of local communities, civil society organizations, and private sector entities, to ensure inclusive decision-making and coordinated management of the catchment.</p>	<ul style="list-style-type: none"> • Increase in number of stakeholder engagement platforms established and functional • Increase in local communities actively participating in decision-making processes. • Percentage increase in environmental regulations and policies enforced effectively. • Reduction in land-use conflicts 			Improved governance and stakeholder engagement

CHAPTER 5 : STRATEGIC CHALLENGES AND PRIORITY INTERVENTIONS

5.1 Key Issues

Based on biophysical assessments and stakeholder engagement, the Hadejia-Jama'are Catchment faces several interconnected environmental and socio-economic challenges:

1. **Water Resource Management:** Seasonal variability, floods, and inadequate infrastructure undermine efficient water use and distribution. Groundwater recharge rates are declining, and surface water availability is limited by siltation and upstream diversions. With physical infrastructure, aging or poorly maintained dams and reservoirs reduces their effectiveness, and unregulated water usage impacts reservoir capacities and downstream flow. Communities in lower-lying areas face significant risks from seasonal flooding, which damages infrastructure, displaces populations, and disrupts livelihoods.
2. **Environmental Degradation:** Deforestation, desertification, and the encroachment of invasive species into wetland areas have degraded ecosystems critical for biodiversity and livelihoods. Siltation in rivers is leading to flooding incidents. Encroachment of invasive species like Typha grass, which hinders water flow.
3. **Unsustainable Agriculture and Livestock Practices:** There is an over-reliance on irrigation for agriculture that is depleting water resources. The use of inorganic fertilizers leads to soil degradation and groundwater pollution. Poor water use practices upstream result in imbalances in water distribution.
4. **Climate Change:** Increasing temperatures, erratic rainfall, and more frequent droughts threaten agricultural productivity and water security. The lack of adaptive measures exacerbates vulnerabilities in the region. Increased temperatures, erratic rainfall, and high evapotranspiration rates reduce water availability and impact agricultural productivity.
5. **Socio-Economic Disparities and Unsustainable Livelihood Practices:** High poverty rates, weak governance, and limited access to infrastructure hinder sustainable development. Over 70% of local government areas (LGAs) in the catchment are

experiencing very rapid population growth with consequent high or very high poverty levels.

6. **Weak Governance:** More sustainable resource management is hindered by: weak institutional frameworks and lack of coordinated water management; ineffective enforcement of existing policies and lack of funding for infrastructure maintenance; and limited stakeholder engagement and the neglect of traditional governance structures.

5.2 Strategic Interventions

To achieve the outlined goals, the Hadejia-Jama'are Catchment Management Plan recommends the following strategic interventions:

1. **Improve Water Resource and Flood Risk Management:**

- Rehabilitate existing dams and reservoirs to improve water retention and release.
- Construct small-scale water storage facilities and enhance rainwater harvesting techniques.
- Establish water allocation plans that balance upstream and downstream needs.
- Construct embankments and improve drainage systems in high-risk areas.
- Develop early warning systems and conduct flood risk assessments regularly.
- Strengthen network of groundwater monitoring systems and hydromet stations
- Enhance public awareness and preparedness for flood events.

2. **Preserve and Restore Critical Ecosystems and Services**

- Restoration of 30% to 40% degraded land through afforestation
- Restore 25% and improve agricultural degraded land
- Restore and maintain wetlands to stabilize hydrological cycles and support biodiversity.
- Enforce the protective boundaries of national parks and valuable reserves such as Nguru

3. **Promote Sustainable Agricultural and Livestock Practices**

- Increase agricultural productivity by 40% through climate smart agriculture, capacity building and data gathering
Improve soil fertility management, and apply soil and water conservation to reduce erosion
- Support smallholder farmers through training and access to improved technologies

- Encourage use of micro-irrigation facilities

4. Enhance Climate Resilience:

- Support the adoption of drought-resistant crop varieties and efficient irrigation technologies.
- Promote afforestation programs to combat desertification and stabilize soils.
- Implement community-based initiatives for floodplain management and watershed protection.

5. Improve Livelihoods and Human Well-Being:

- Provide training programs for sustainable farming, fishing, and aquaculture practices.
- Facilitate access to credit and market opportunities for smallholder farmers and fisherfolk.
- Develop community-based tourism and eco-friendly economic activities.
- Improve access to sustainable natural resources, low-cost energy, better sanitation and hygiene practices

6. Strengthen Governance and Stakeholder Collaboration:

- Establish a regulatory framework for integrated water resource management at the catchment level.
- Strengthen coordination among federal, state, and local agencies.
- Ensure community representation in decision-making processes and management committees.

These strategic interventions (in components) are as outlined in figures 5.1 to 5.9

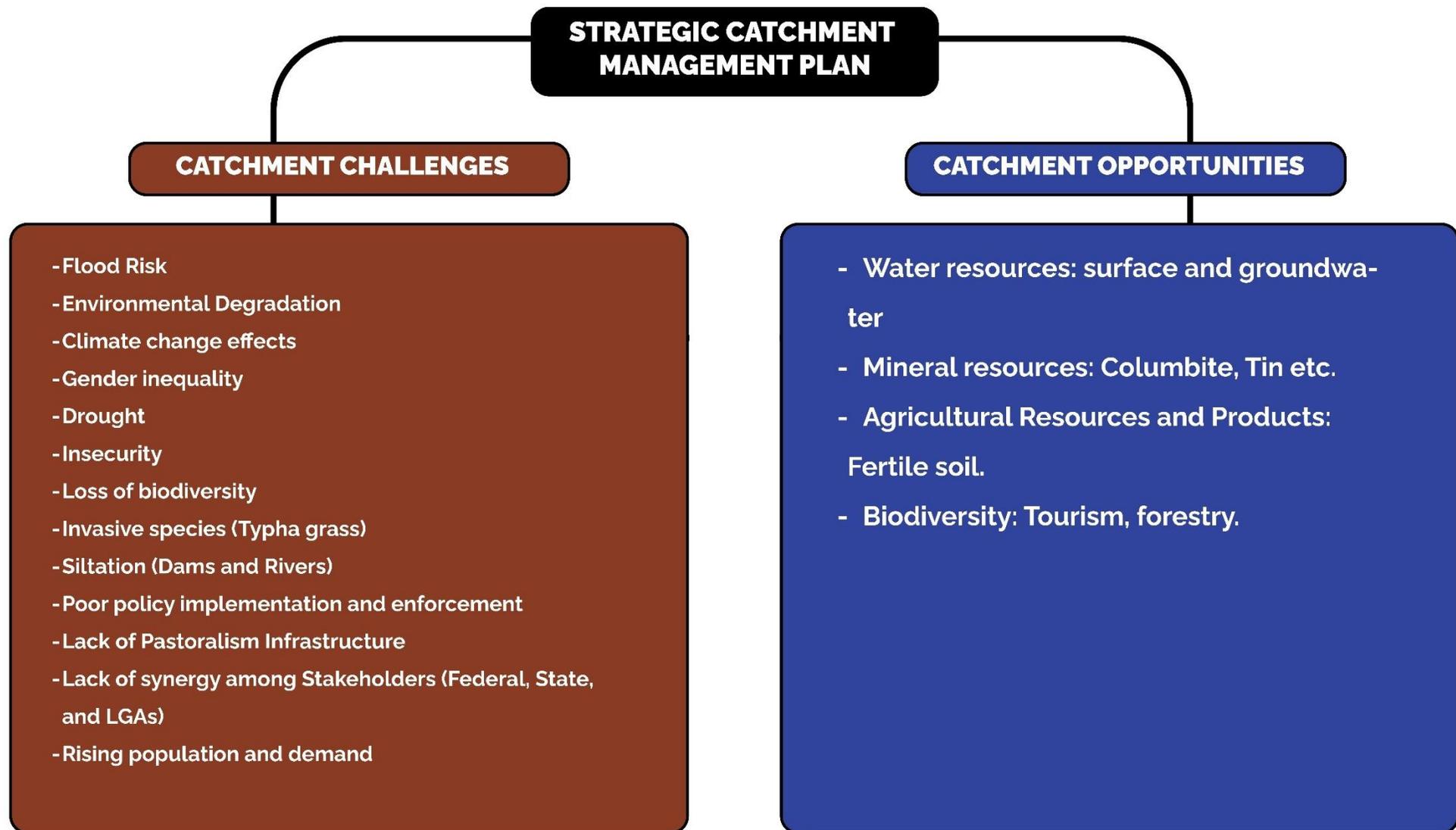


Figure 5.1: Strategic Catchment Management Plan

INTERVENTIONS FOR COMPONENT 1

Sustainable conservation management and use of water resources.

Activities	Timelines	Key Indicators	Responsibilities	Stakeholders' View	Recommendations
<p>Rehabilitate existing dams and reservoirs (including the extensive removal of typha grass to improve water retention and release).</p> <p>Construct small-scale water storage facilities and enhance rainwater harvesting techniques</p> <p>Establish water allocation plans that balance upstream and downstream needs.</p> <p>Construct embankments and improve drainage systems in high-risk areas.</p> <p>Develop early warning systems and conduct flood risk assessment regularly.</p> <p>Strengthen network of groundwater monitoring systems and hydrometeorological stations.</p> <p>Enhance public awareness and preparedness for flood events and conservation (Sensitization and capacity building of the inhabitants of the flood prone areas within the catchment)</p> <p>Implement integrated water management practices that address seasonal variability, optimize groundwater recharge, and enhance surface water distribution to meet agricultural, domestic, and industrial demands.</p>	<p>S M L</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>	<p>Reports, Implementation, and Supervision.</p> <p>Report on a comprehensive study, Policy enactment, implementation, and enforcement.</p> <p>Reduction in environmental risk and disaster</p> <p>Better Socioeconomic engagement.</p> <p>Routine Reports</p> <p>Reports</p>	<p>The three tiers of government encompassing the RBDAs, FMWR, and allied agencies.</p> <p>The three tiers of government encompassing the RBDAs, FMWR, allied agencies, NIWRMC.</p> <p>NIHSA, NIMET, NIWRMC</p> <p>NIHSA, NIWRMC</p> <p>The three tiers of government encompassing the RBDAs, FMWR, allied agencies, NIWRMC.</p> <p>NIMET, NIHSA</p> <p>Local Governments, River Basin Authorities</p> <p>NIHSA, The three tiers of government encompassing the RBDAs, FMWR, and allied agencies.</p> <p>NIHSA, NIMET, MOA, CBOS.</p>	<p>IN CONCURRENCE</p>	<p>Conduct a comprehensive study on the status of the dams and rivers.</p> <p>- Strengthen institutional capacity to implement and enforce agreements.</p> <p>- Develop watershed management policies.</p> <p>In Concurrence</p> <p>Small water conservatory reservoirs.</p> <p>Continuous data generation to improve catchment management plan.</p> <p>In Concurrence</p>

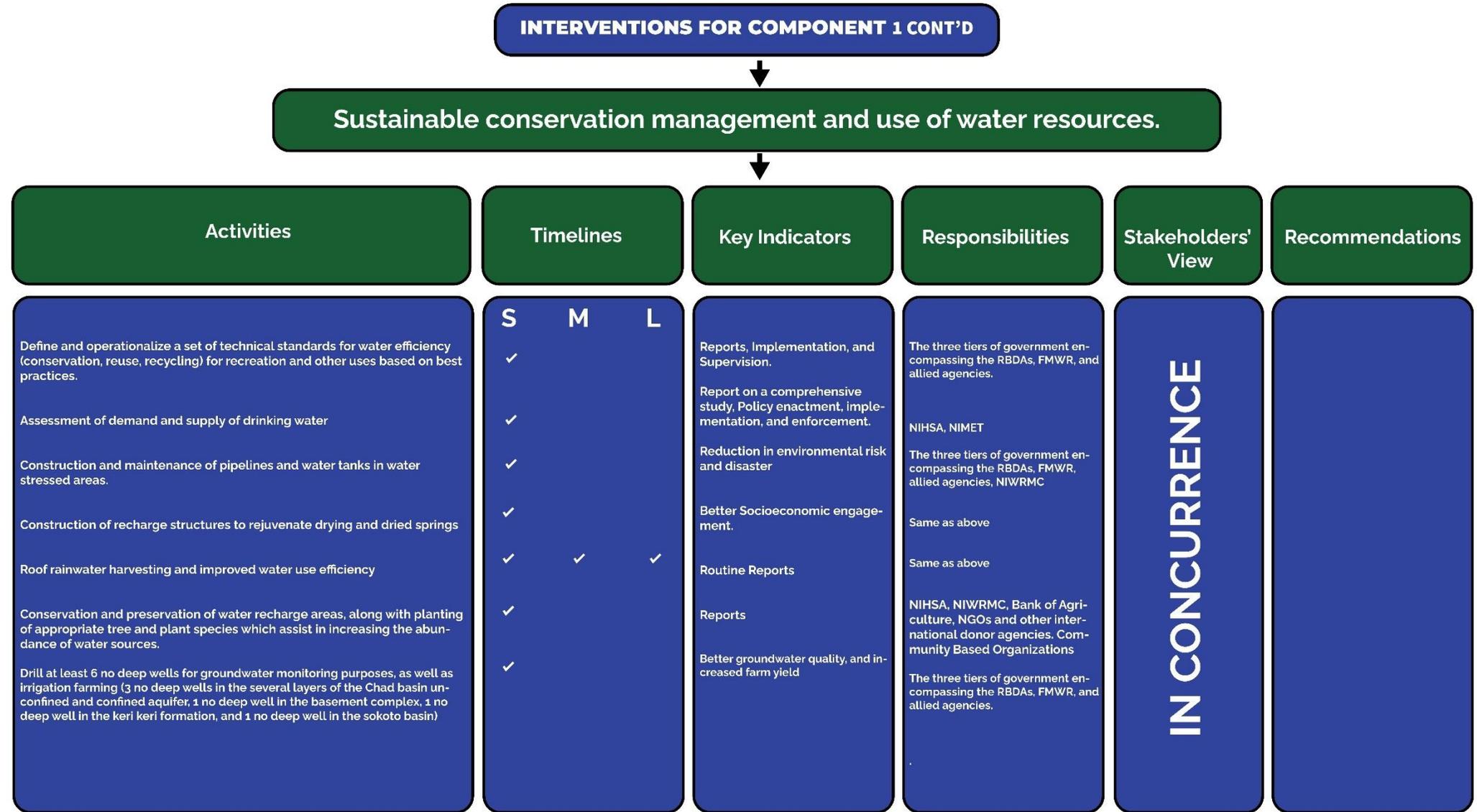


Figure 5.2: Component 1 (Sustainable Conservation Management and Use of Water Resources)

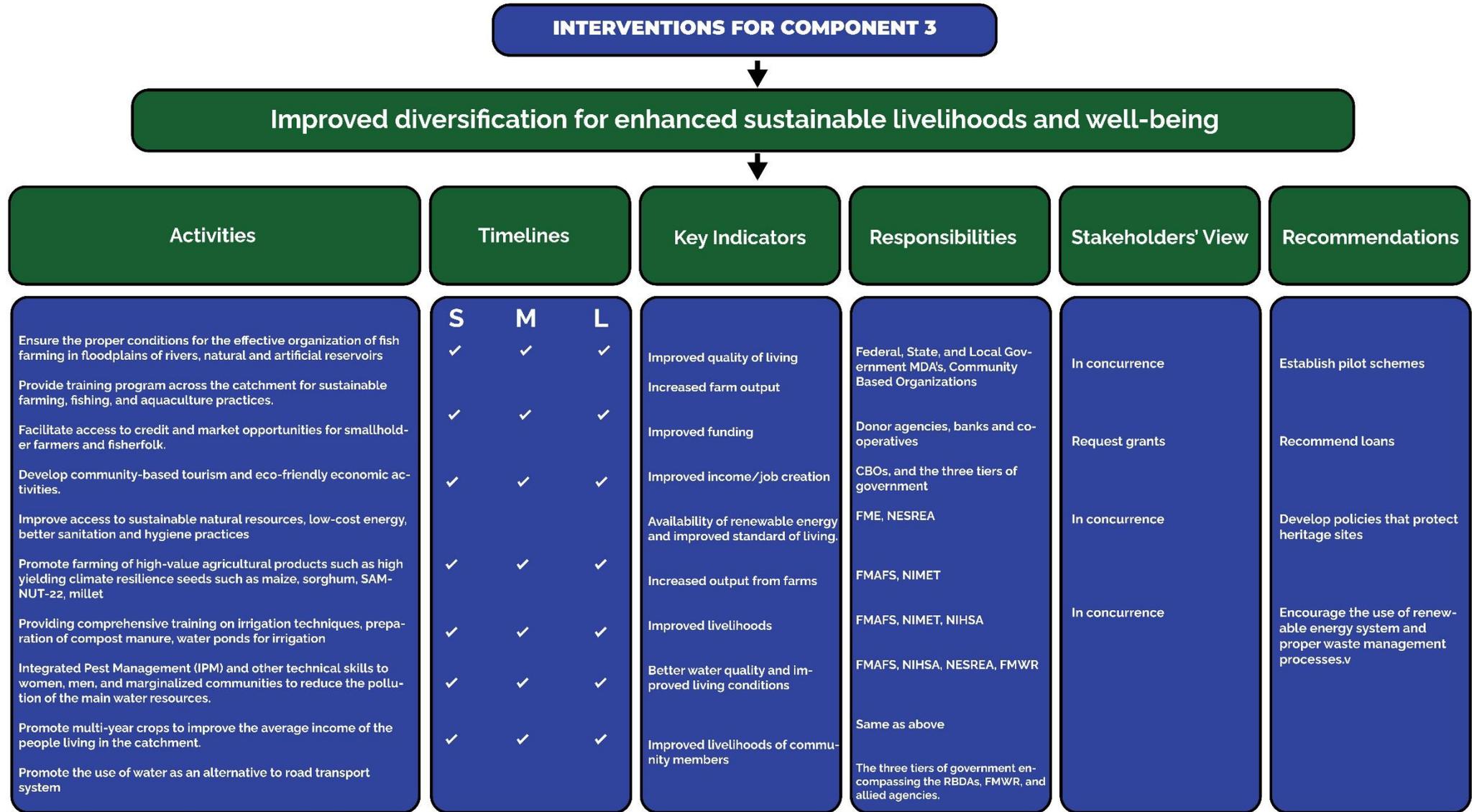
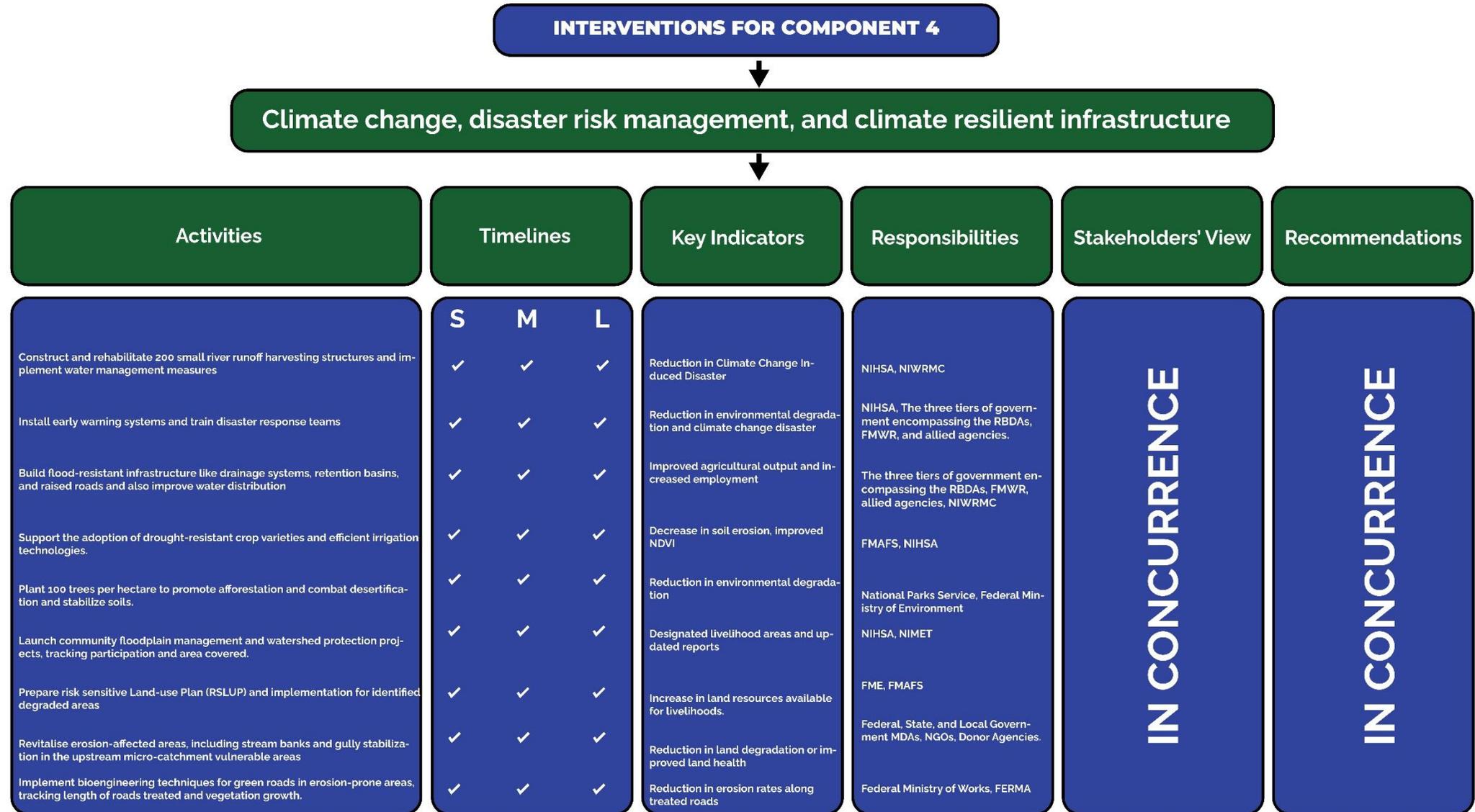


Figure 5.4: Component 3(Improved Diversification for Enhanced Sustainable Livelihoods and Well-Being)



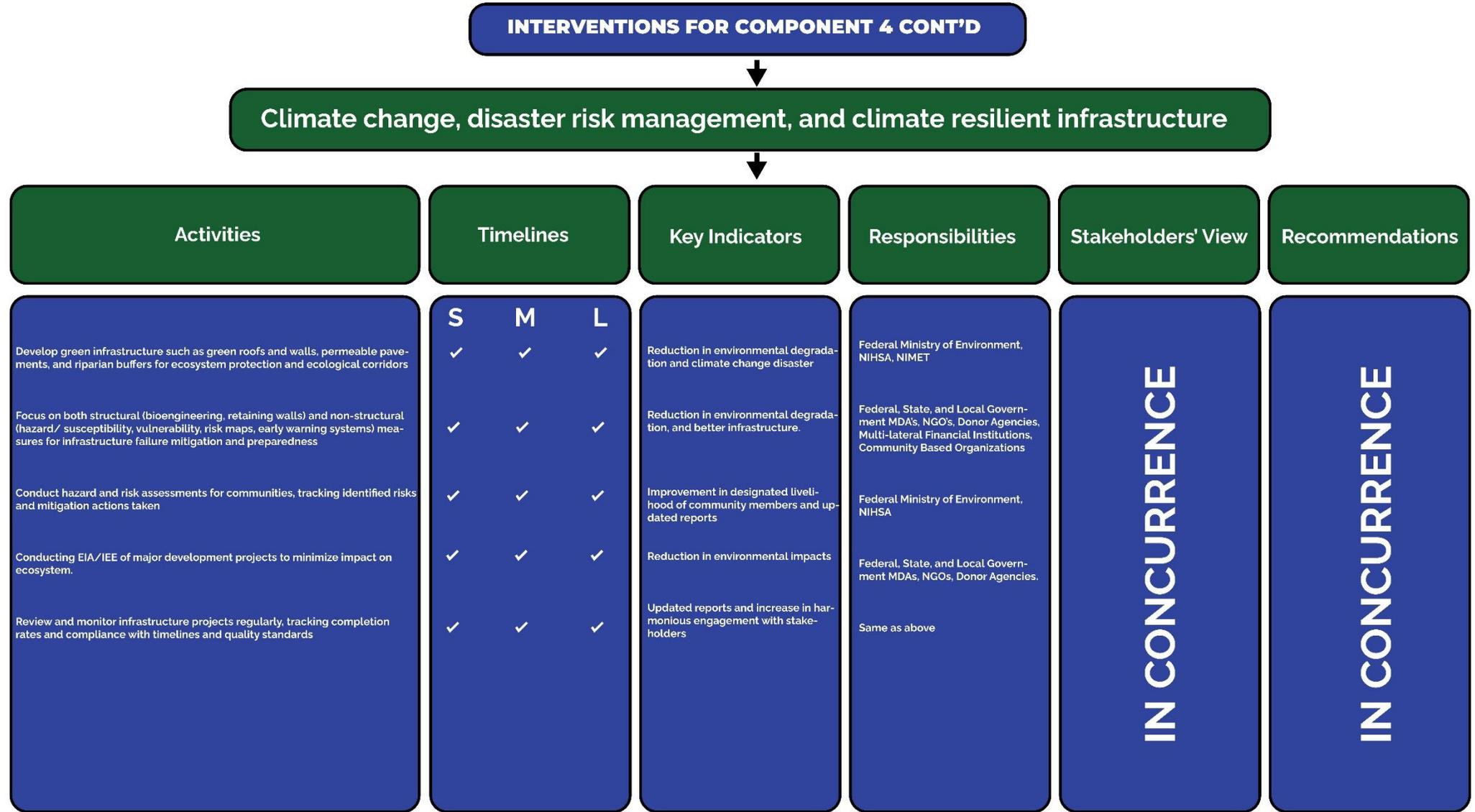


Figure 5.5: Component 4 (Climate Change, Disaster Risk Management, and Climate Resilient Infrastructure)

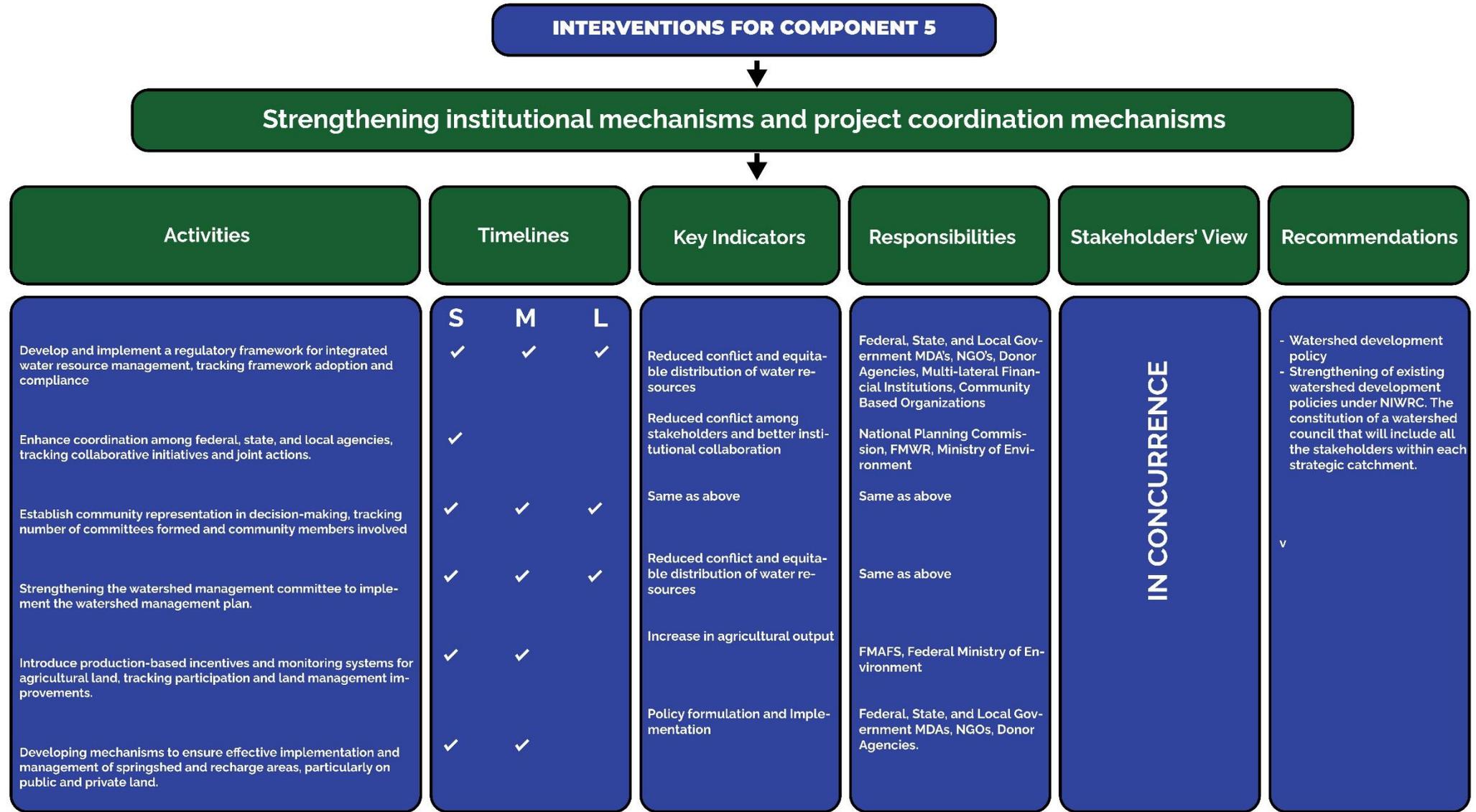


Figure 5.6: Component 5 (Strengthening Institutional Mechanisms and Project Coordination Mechanisms)

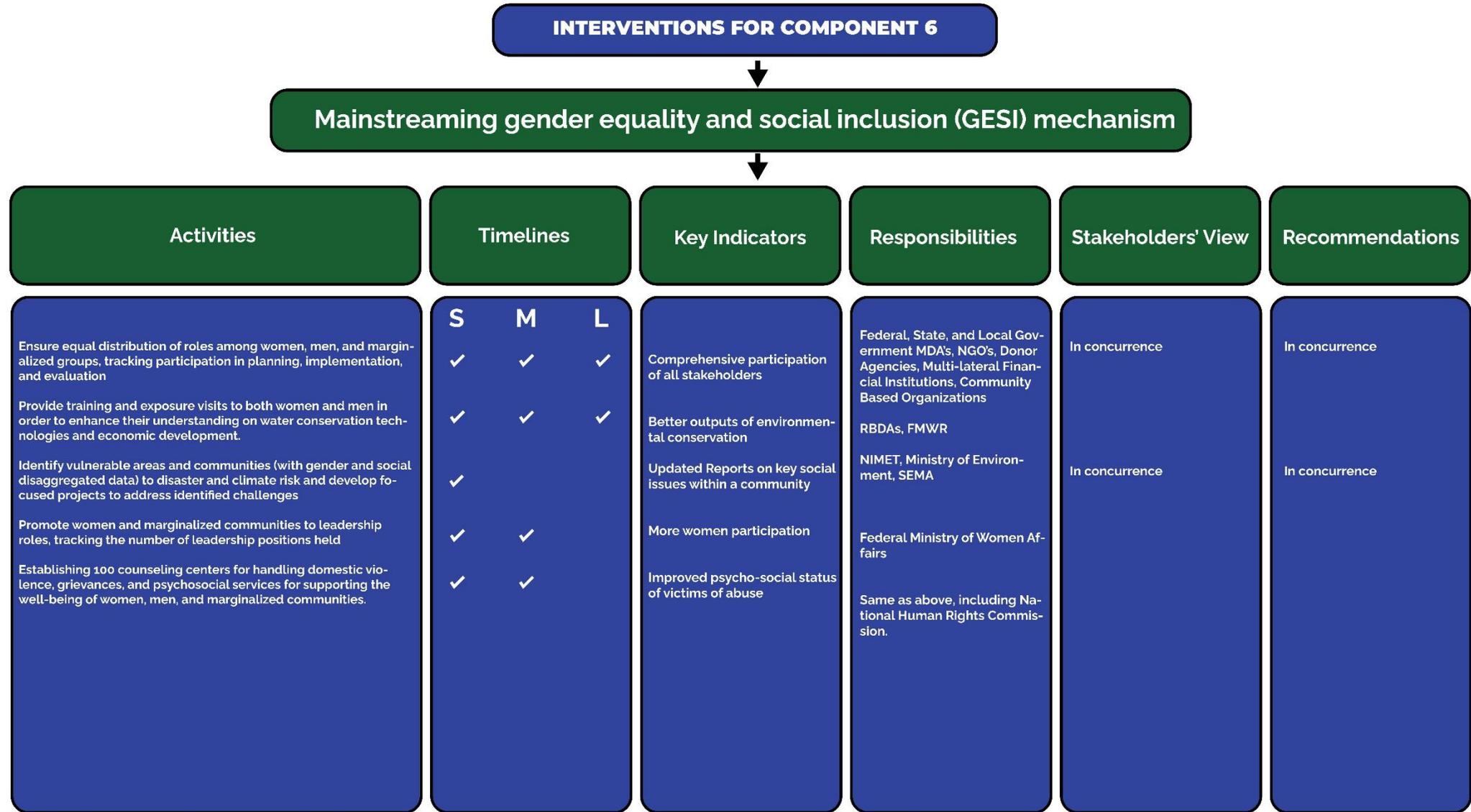


Figure 5.7: Component 6 (Mainstreaming gender equality and social inclusion (GESI) mechanism)

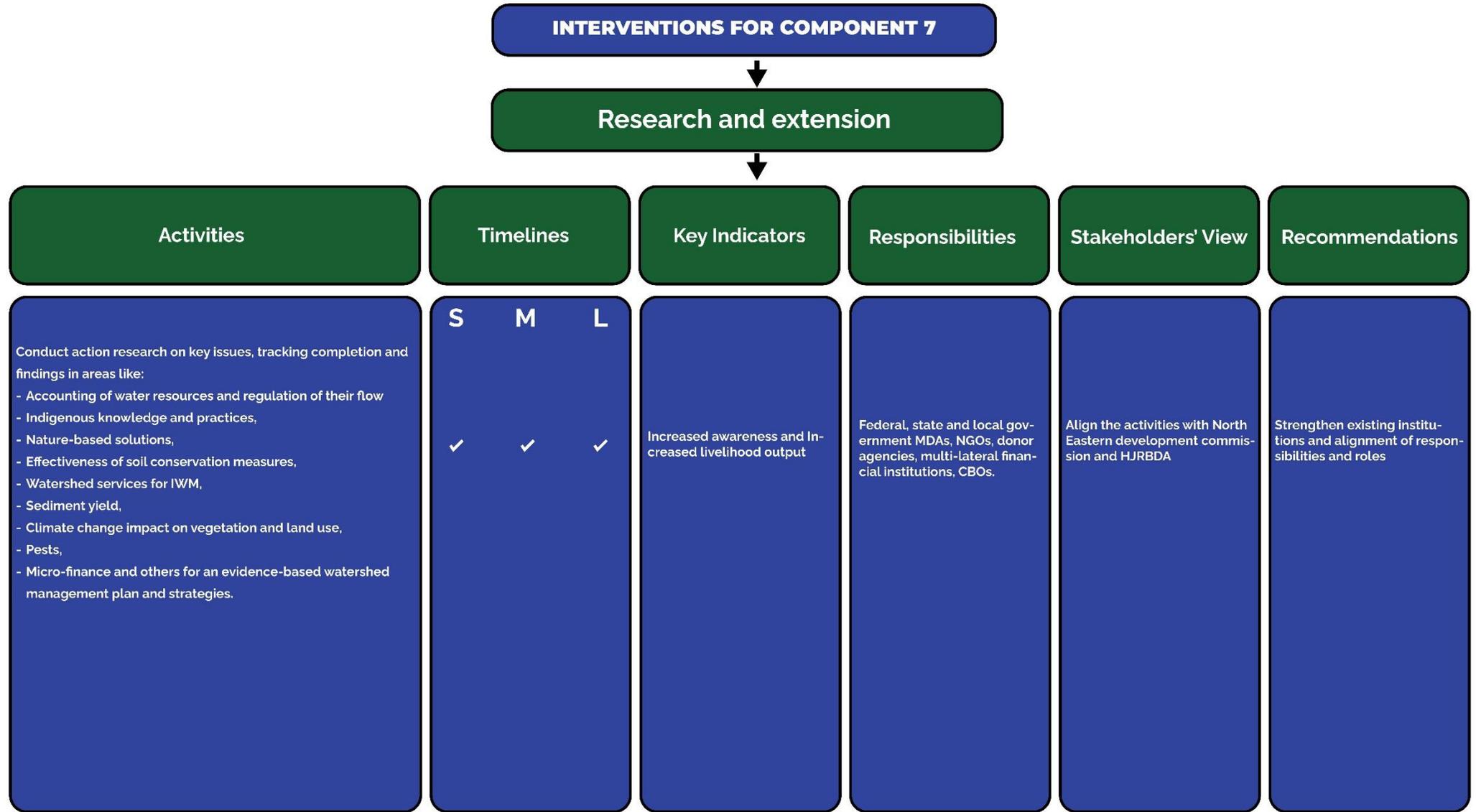


Figure 5.8: Component 7 (Research and Extension)

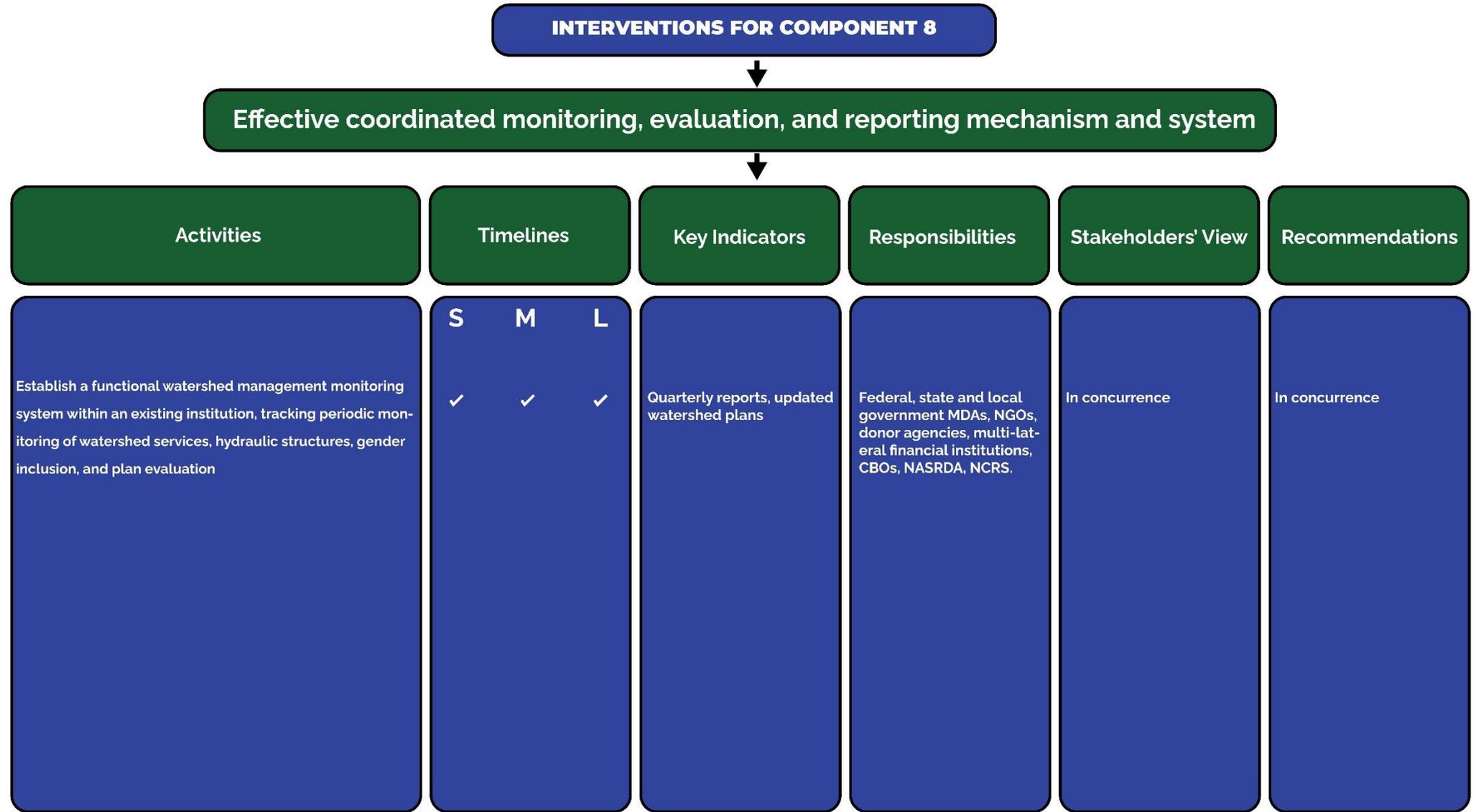


Figure 5.9: Component 8 (Effective Coordinated monitoring, and reporting mechanism and system)

5.3 Expected Outcomes

The successful implementation of these interventions will result in:

- Improved water availability and reduced seasonal scarcity.
- Enhanced resilience of agricultural systems to climate variability.
- Restoration of critical ecosystems and enhanced biodiversity.
- Strengthened governance structures and stakeholder engagement.
- Reduced flood vulnerability and minimized socio-economic disruptions from extreme weather events.

CHAPTER 6 : MONITORING, EVALUATION AND LEARNING

It is imperative to conduct ongoing monitoring and evaluation of strategic catchment plans to ensure their effectiveness and to implement necessary adjustments as required. A comprehensive monitoring and evaluation framework should capture insights, challenges, and milestones, facilitating systematic progress reviews. These reviews will encompass, but are not limited to, the following elements:

- Activities undertaken and milestones achieved
- Results from water quality monitoring
- Challenges faced and lessons learned
- Financial data
- Amendments to the governance structure, if applicable
- Significant modifications to the Implementation Plan

As this document serves as a dynamic operational guide, it is anticipated that actions will be modified to reflect evolving priorities. Any amendments shall be documented in the appendix of the original management plan. For the monitoring process, appropriate indicators will be identified to assess catchment management activities and their impacts, encompassing both biophysical and social dimensions. When relevant, these indicators will integrate multimedia elements, such as images, videos, and documents, and will capture both qualitative and quantitative data. The Monitoring and Evaluation Plan is shown in Table 6.1

Data Collection Methods

- i. **Water Quality Monitoring:** Regular sampling of water quality parameters such as pH, turbidity, and nutrient levels at designated monitoring sites.
- ii. **Field Observations:** Regular field visits to monitor changes in vegetation cover, erosion, and other environmental indicators.
- iii. **Remote Sensing:** Use of satellite or aerial imagery to monitor changes in land use, vegetation cover, and water quality.

- iv. Stakeholder Surveys: Regular surveys of stakeholders, including landholders, community groups, and government agencies, to gather information on their perceptions, attitudes, and experiences related to catchment management.
- v. Community-Based Monitoring: Engagement of local communities in monitoring and reporting on environmental indicators, such as water quality and vegetation cover.
- vi. Automated Sensors: Installation of automated sensors to monitor water quality, flow, and other environmental parameters in real-time.

Feedback Mechanisms

- i. Regular Progress Reports: Preparation and dissemination of regular progress reports to stakeholders, highlighting achievements, challenges, and future directions.
- ii. Stakeholder Meetings: Regular meetings with stakeholders to provide updates, gather feedback, and discuss emerging issues.
- iii. Community Engagement Forums: Hosting of community engagement forums to provide information, gather feedback, and build support for catchment management initiatives.
- iv. Social Media: Utilization of social media platforms to share information, gather feedback, and engage with stakeholders.
- v. Online Feedback Mechanisms: Establishment of online feedback mechanisms, such as surveys or comment boxes, to gather feedback from stakeholders.
- vi. Independent Review Panels: Establishment of independent review panels to provide objective feedback and assessment of catchment management initiatives.

Data Management and Analysis

- i. Data Storage: Establishment of a secure and accessible data storage system to store and manage data.
- ii. Data Analysis: Regular analysis of data to identify trends, patterns, and insights that inform catchment management decisions.
- iii. Data Visualization: Use of data visualization tools to present complex data in a clear and concise manner.
- iv. Reporting and Dissemination: Preparation and dissemination of reports and other communication materials to stakeholders, highlighting key findings and insights.

Table 6.1: Monitoring and Evaluation Plan for Hadejia Jama'are Catchment

S/NO	Monitoring Tools and Techniques	Target/Output	Monitoring	Evaluation	Responsibility
1	Geographical Information Systems Tools: software, ArcGIS, QGIS, Mapbox etc	Analyze and visualize spatial data use, water quality, and hydrological data.	Establish Key Performance Indicators to track progress. Analyse data and come out with outputs. Update visuals and maps on progress or otherwise.	Mid-Term and End Term: Conduct comprehensive evaluations at the midterm and end of implementations	WB/SPMU
2.	Remote Sensing/Drone technology. Tools: Multispectral and thermal imageries. Unmanned ariel vehicles and complimenting softwares.	Using remote sensing technology, such as satellite imagery to monitor land use and environmental changes	Water Quality Monitoring: Regularly collect and analyze water samples to assess changes. Analysis of past and present images, e.g., NDVI, the perimeter of water bodies, and degraded lands.	Stakeholder Feedback and Participation: Engaging Stakeholders within the local communities.	Consultant, NASRDA, NCRS SPMU, FoNGO, community.
3	Statistical Analysis	To analyze new data and monitor trends, patterns and correlations.	Hydrological Monitoring: monitor precipitation, stream flow and ground water levels to understand hydrological trends.	Cost -Benefit analysis: an assessment of the economic and social costs.	SPMU/Consultant
4	Participatory Rural Appraisal (PRA)	Engage local communities in the evaluation of the process, E.g., FGD, surveys and	Land use and land cover monitoring are used to track changes.	Environmental impact assessment.	Consultant, NASRDA, NCRS

		stakeholder workshops			
5	Ground truthing of intervention sites periodically	Entire catchment	Socio-Economic Monitoring through data collection to assess the impact of the plan on local communities	Institutional and governance assessment.	Consultant, SPMU, Ministry of Environment, FoNGO, community.
6	Video Documentary	Entire catchment		A movie documentary on the socio-economic and biophysical impact of environmental issues. It will also capture the progress of the implementation of BMPs	Consultant, SPMU, Ministry of Environment, FoNGO, community.

Specific Indicators for Success and Potential Reporting Framework

A typical measurable success story that can be used to monitor and evaluate a strategic catchment management plan will be indicated in the following:

Environmental Indicators

- i. **Water Quality Index:** Measures the overall health of the waterway based on parameters such as pH, turbidity, and nutrient levels.
- ii. **Sediment Load Reduction:** Tracks the reduction in sediment loads entering the waterway.
- iii. **Vegetation Cover:** Monitors the increase in vegetation cover along the waterway and its tributaries.
- iv. **Biodiversity Index:** Measures the health and diversity of aquatic and terrestrial ecosystems.

Social Indicators

- i. **Community Engagement:** Tracks the number of community events, meetings, and activities related to catchment management.
- ii. **Stakeholder Satisfaction:** Measures the satisfaction of stakeholders, including landholders, community groups, and government agencies, with the catchment management plan.
- iii. **Education and Awareness:** Monitors the increase in knowledge and awareness of catchment management issues among the community.

Economic Indicators

- i. **Cost-Benefit Analysis:** Evaluates the economic benefits of catchment management activities, such as reduced sedimentation and improved water quality.
- ii. **Job Creation:** Tracks the number of jobs created in industries related to catchment management, such as conservation and restoration.
- iii. **Agricultural Productivity:** Monitors the impact of catchment management activities on agricultural productivity and profitability.

Annual Report Template

It is important that monitoring and evaluation is reported either quarterly or annually based on a framework. The reporting framework provides a structure for presenting progress against objectives, highlighting key achievements and challenges, and identifying areas for future improvement. This plan will report monitoring and evaluation in the following manner:

1 Executive Summary

- Brief overview of progress against objectives
- Key achievements and challenges

2 Environmental Performance

- Water Quality Index
- Sediment Load Reduction
- Vegetation Cover
- Biodiversity Index

3 Social Performance

- Community Engagement
- Stakeholder Satisfaction
- Education and Awareness

4 Economic Performance

- Cost-Benefit Analysis
- Job Creation
- Agricultural Productivity

5 Case Studies and Success Stories

- Examples of successful catchment management projects
- Lessons learned and best practices

6 Challenges and Future Directions

- Identification of challenges and areas for improvement
- Outline of future directions and strategies for addressing challenges

7 Conclusion

- Recap of progress and achievements
- Commitment to ongoing improvement and accountability.

CHAPTER 7 : CONCLUSION AND MOVING FORWARD

7.1 Summary of Strategic Issues and Priorities

The Hadejia Jama'are catchment encompassing Kano, Jigawa, Yobe, and Bauchi States, is replete with diverse ecosystems and significant socio-economic potential.

The Hadejia-Jama'are Catchment Management Plan offers a comprehensive approach to addressing the multifaceted challenges facing the region. The strategic interventions outlined in this plan prioritize sustainable management of natural resources, enhancement of livelihoods, and resilience to climate change, ensuring a balanced approach to socio-economic development and ecological conservation.

To improve water resource management and mitigate flood risks, the plan emphasizes the rehabilitation of critical water infrastructure, such as dams and reservoirs, and the development of small-scale water storage systems. These measures, coupled with enhanced drainage systems, flood risk assessments, and public awareness campaigns, aim to safeguard communities against water-related hazards while promoting equitable water allocation across the catchment. Strengthening groundwater monitoring networks and advancing rainwater harvesting further enhance the region's capacity to manage its water resources sustainably.

Restoration of critical ecosystems is another cornerstone of the plan, with ambitious goals to afforest up to 40% of degraded lands and restore wetlands. These efforts will stabilize hydrological cycles, bolster biodiversity, and reinforce the ecological integrity of the catchment. Protecting national parks and reserves also ensures the preservation of key habitats and natural resources for future generations.

Sustainable agricultural and livestock practices are at the heart of the strategy to enhance food security and economic resilience. By increasing agricultural productivity through climate-smart approaches, improving soil fertility, and supporting smallholder farmers with training and technology, the plan aims to transform the agricultural landscape. Initiatives such as micro-irrigation adoption and erosion control further underline the commitment to sustainability.

Building climate resilience is a critical priority. Community-based initiatives, afforestation programs, and the promotion of drought-resistant crop varieties are pivotal in addressing desertification and climate-induced vulnerabilities. Simultaneously, enhancing livelihoods through sustainable practices, access to credit, and eco-friendly economic activities will empower local communities, particularly smallholder farmers and fisherfolk.

Achieving these ambitious objectives requires robust financial and institutional frameworks. The plan advocates for increased public-sector funding, urging state and federal governments to allocate dedicated budgets for water, agriculture, and environmental projects. Establishing catchment development funds will pool resources across agencies and stakeholders. International donor support from development partners like the World Bank and the African Development Bank is essential, with efforts to align projects with global funding mechanisms such as the Green Climate Fund. The private sector also plays a critical role through public-private partnerships to develop key infrastructure and renewable energy projects, while community contributions via cooperatives, savings schemes, and microfinance opportunities can support localized interventions.

Finally, robust governance and stakeholder collaboration underpin the success of these interventions. Establishing integrated water resource management frameworks, improving inter-agency coordination, and ensuring inclusive community representation in decision-making processes will strengthen the institutional foundation for long-term success.

In sum, the strategic interventions and funding strategies provide a roadmap for fostering resilience, sustainability, and prosperity in the Hadejia-Jama'are catchment, ensuring its natural and human systems thrive in the face of future challenges.

7.2 Recommendations for Aligning with Broader National and Regional Programs

The catchment management plan should integrate with existing national and regional frameworks to maximize impact and ensure sustainability. Key recommendations include:

1. Alignment with National Policies:

- Incorporate strategies into Nigeria's National Water Resources Policy and Agricultural Transformation Agenda.

- Coordinate with the Great Green Wall Initiative to address desertification and land degradation.

2. Regional Collaboration:

- Leverage partnerships with neighboring states to manage shared resources, such as water systems and wetlands, more effectively.
- Align with regional development programs, such as ECOWAS agricultural and environmental initiatives, to foster cross-border cooperation.

3. Community-Driven Development:

- Strengthen partnerships with local governments, traditional institutions, and civil society organizations to enhance grassroots participation.
- Integrate gender-responsive approaches to empower women and youth in natural resource management.

7.3 Catchment Policy for Interstate River Systems

Several river basins in Nigeria are not only inter-state watercourses but also sub-basins of transboundary or shared watercourses. Examples are the Hadeija Jama'are, sub-basin of Lake Chad, Sokoto Rima River Basin, sub-basin of Niger River Basin and Benue River Basin, sub-basin of Niger River Basin. The implication is that uses and activities in the catchments affect the transboundary watercourse and so are subject of international water treaties that apply to the particular transboundary watercourse. Nigeria is member of the Niger Basin Authority with other eight other riparian states, Niger, Cameroun, Burkina Faso, Republic of Benin, Mali and Guinea, Chad and Cote d'Ivoire. Nigeria is also member of the Lake Chad Basin Commission with five other riparian states, Chad, Central Africa Republic, Cameroun, Niger, and Libya. Nigeria is party to the 2008 Niger Basin Water Charter, 2012 Lake Chad Basin Water Charter, 1997 UN Watercourses Convention and 1992 UNECE Water Convention. Accordingly, obligation to comply with provisions of the treaties under international law within Article 26 of Vienna Convention on the Law of treaties applies to Nigeria as a country that ratified the treaties.

Apart from the principles of international water law, other relevant instruments are the National Water Resources Act, policies on water resources, environment and climate change. Other policies are international soft laws adopted under auspices of United Nations and ECOWAS Water Resources Policy.

Five Principles of International Water Law Enunciated in The Water Treaties

- i. Scope of application of the treaty: Does it address surface water, ground water or both?
Is it applicable to non-navigational uses only or for all purposes?
- ii. Substantive Principles:
 - a. Principle of equitable and reasonable utilization
 - b. Obligation not to cause significant harm (no harm rule)
 - c. Protection of the Ecosystems
- iii. Procedural Principles
 - a. Principle of cooperation
 - b. Notification of any planned project
 - c. Exchange of data and information
- iv. Institutional Framework (river basin organization)
- v. Dispute Resolution Provisions

The Niger Basin Water Charter, Lake Chad Water Charter and UN water treaties reflect the five principles generously. Relevant treaties for transboundary watercourse management in Nigeria are:

- Vienna Convention on the Law of Treaties on principle of binding nature of treaty once signed, ratified and in force (*pacta sunt servanda*),
- UN Watercourses Convention on non-navigational use of shared watercourses, application to surface water and connected groundwater,
- UNECE Water Convention on relevance to both surface and ground water as well as application to all uses of the shared watercourse,
- Niger Basin Water Charter as principal treaty of the Niger River Basin,
- Lake Chad Water Charter as principal treaty of the Lake Chad Basin.

International Policies That Affect Shared Water Resources

They are soft laws not treaties but they provide direction. However, they lack legal significance and not binding.

- I. 1971 Stockholm Declaration on Human Environment that states the principle of ‘no harm rule’ (Principle 21)
- II. 1992 Dublin principles on water and sustainable Development, which heralded integrated water resources management

- III. 1992 Rio Declaration on Environment and Development and Agenda 21 that expounded on the Stockholm Declaration and also codifies other principles of sustainable environment, applicable to management of transboundary watercourse, which were absent in the Stockholm Declaration. They are Principle 15 (Precautionary Principle), Principle 16 (Polluter Pays Principle), Principle 17 (Environmental Impact Assessment) and Principles 18 and 19 (Principle of prior and timely notification of transboundary harm.)
- IV. 2008 ECOWAS Water Resources Policy is not a regional water treaty but policy statements to guide ECOWAS member states in managing their water resources. According to the Policy, a river basin organization is paramount for cooperation and equitable sharing of water resources that affects transboundary watercourses. Article 2.3 of the ECOWAS Water Policy reflects guiding principles of equitable sharing or water resources and other principles of shared watercourse protection such as precaution, prevention and polluter-pays principles as well as principles exchange of information, subsidiarity and cooperation. Other enunciated principles are user pays, notification or information, effective governance in water resources management, gender equality, solidarity, progressiveness, partnership, and hydrographic basins or aquifers systems management.
- V. Draft Articles on the Law of Transboundary Aquifer currently guides riparian states in negotiating groundwater treaties.

National Water Law and Policies on Water Resources

- a) National Water Resources Act vests the use and control of all surface and ground water affecting more than one state on the Federal Government. Schedule to the Act lists the affected water resources to include River Niger, Sokoto/Rima River from the border, Hadeija Jama'are Basin, all the tributaries of River Niger crossing the border of Benin Republic and the Sokoto sedimentary (Western) hydro-geological area.
- b) National Water Resources Policy recommends coordinating committee for interstate river basins. It also states that international water resources shall be managed in a manner that optimizes the benefits for all parties in a spirit of mutual co-operation ... Accordingly "transboundary or shared water resources shall be protected, developed, conserved, used and managed in accordance with the existing national or international riparian Laws/conventions/Guidelines and shared equitably, while maintaining the ecosystem.

- c) National Policy on Environment reflects guiding principles of sustainable environment and water resources such as polluter pays, user pays, precautionary principle, subsidiarity principle, pollution prevention principle, principle of inter-generational equity, principle of intra-generational equity, principle of participation, international cooperation, good environmental governance, and integrated ecosystem approach. It recommends domestication of transboundary water treaties and establishing river basin institutions for managing shared watercourse
- d) National Climate Change Policy for Nigeria

7.4 High-Level Funding Strategies and Partnership Opportunities

Achieving the goals outlined in this plan requires sustainable financing and strategic partnerships. Key strategies include:

1. **Public Sector Funding:**

- Advocate for increased budgetary allocation from state and federal governments for water, agriculture, and environmental projects.
- Establish dedicated catchment development funds to pool resources from government agencies and stakeholders.

2. **International Donor Support:**

- Engage development partners, such as the World Bank, African Development Bank, and UNDP, to secure grants and technical assistance.
- Align projects with global funding mechanisms, such as the Green Climate Fund, for climate resilience initiatives.

3. **Private Sector Investment:**

- Promote public-private partnerships (PPPs) to develop critical infrastructure, such as irrigation systems and agro-processing facilities.
- Encourage investment in renewable energy projects, such as solar irrigation pumps and mini-hydropower plants.

4. **Community Contributions:**

- Mobilize community-based financing through cooperatives and savings schemes to fund localized interventions.
- Explore microfinance opportunities to support smallholder farmers and rural entrepreneurs.

7.5 Moving Forward with the Catchment Plan

The CMP is a living document that needs to be reviewed and updated regularly as part of an ongoing management process. It signifies the conclusion of the planning phase and the start of the actual catchment management implementation process. The FPMU and the national consultants should also have access to the plan and knowledge base so they can update it and turn it into an online ePlan.

The following tasks are necessary to maintain the catchment management plan as a living document: Table 7.1 indicates next steps and key actions points moving forward.

Table 7.1: Next steps and key actions points

Next Steps	Key Action Points	Responsibilities	Timeline
Review and Update Plan	Review progress against objectives	Catchment Management Committee	Quarterly
	Update plan to reflect changes in policy, legislation, or catchment condition	Catchment Management Committee	Annually
Monitor and Evaluate Progress	Establish monitoring and evaluation framework	Catchment Management Committee	Ongoing
	Collect and analyze data on key indicators	Catchment Management Committee	Quarterly
	Report on progress against objectives	Catchment Management Committee	Annually
Engage Stakeholders	Identify and engage key stakeholders	Stakeholder Engagement Team	Ongoing
	Develop stakeholder engagement strategy	Stakeholder Engagement Team	Quarterly
	Report on stakeholder engagement activities	Stakeholder Engagement Team	Annually
Build Capacity and Skills	Identify capacity and skills gaps	Capacity Building Team	Ongoing
	Develop capacity building plan	Capacity Building Team	Quarterly
	Report on capacity building activities	Capacity Building Team	Annually
Secure Funding and Resources	Identify funding and resource needs	Funding and Resources Team	Ongoing
	Develop funding and resource mobilization plan	Funding and Resources Team	Quarterly
	Report on funding and resource mobilization activities	Funding and Resources Team	Annually

A committee comprising representatives from key stakeholders, including government agencies, local communities, and NGOs.

Other actions could include

- Educating people on the importance of the natural environment and what we can all do to restore and protect it.
- Work closely with the government to continue to improve and where required strengthen the regulatory framework to achieve greater protection for the environment.
- More joined-up thinking and enforcement from the different government agencies. The agencies should be funded to undertake their enforcement roles when the natural environment is damaged. Those groups with the biggest impact on the water environment should be focused on to gain the greatest benefits.
- Monitoring and sharing data with others to improve this evidence and make it more widely available.
- Acknowledging that biodiversity, environmental health, and water and soil quality are all closely interrelated. Policies need to link up well and be catchment-wide and long-term.
- Working in partnership with a wide range of organizations set at the appropriate scale for example catchment or coastal scales.
- Committed to an integrated and partnership approach that will attract funding from a wider range of sources including private funding and ensure that the benefits can be spread more widely, across sectors and the landscape.
- Ensuring that resources and environmental legislation should be simpler and enabling.
- Working towards tighter regulation and increased punishments, supported with funding for the Environment Agency to deliver this.
- Moving away from or reducing the use of pesticides by adopting organic, an integrated pest management system, genetic crop manipulation, and the use of highly targeted application of agrochemicals.
- Greater efforts should be made to educate and raise awareness of the issues, to understand how physical modifications impact the environment, how they can be managed, and what benefits they offer society.
- Providing strong support for nature-based solutions and their role in flood risk and coastal erosion management.

- Acknowledging the importance of broader landscape management and the value of looking at catchments as an entire system – all elements working together.
- The overwhelming majority of respondents recognize that well-designed drainage and green infrastructure provide multiple benefits for people and the environment, including better integration and connections across towns and cities.
- Identify appropriate riparian corridors for designation to protect the primary drainage paths and provide for riparian cover.
- Identifying floodplain areas and putting in place rules to avoid inappropriate development in those floodplains
- provide as far as possible for enhancement of groundwater and interflow to assist in maintaining stream base flows
- Protecting the important habitat qualities of streams including provision for fish passage
- Planning for appropriate measures for both primary (on-site control) and secondary (off-site backup) management of erosion and sediment runoff during the development phases
- Providing for both targeted source control of contaminants and general catchment-wide removal of contaminants in stormwater.
- Sustaining public support and stakeholder engagement under the CMP through open and honest communication about progress.
- Being prepared to revise strategies in response to new scientific findings or changes in socio-economic conditions affecting the catchment area.

In order to guarantee that a catchment management plan not only addresses current issues but also fosters the long-term sustainability of natural resources within the catchment area, these steps should be followed methodically while maintaining the flexibility to adjust as necessary.

7.6 Conclusion

The Hadejia Jama'are catchment is a critical resource for the socio-economic and environmental well-being of the region. The Strategic Catchment Management Plan has been developed through a collaborative and inclusive process, with valuable inputs and contributions from stakeholders. This plan provides a framework for managing the catchment in a sustainable

and equitable manner, balancing the needs of different stakeholders and ensuring the long-term health and resilience of the catchment.

Through strategic prioritization, alignment with broader programs, and robust funding mechanisms, the plan sets a clear roadmap for sustainable development. Implementing these recommendations will enhance resource management, empower communities, and build resilience against environmental and socio-economic challenges, ensuring the catchment's long-term vitality and prosperity

Call to Action for Stakeholders

We call on all stakeholders to join us in implementing this plan and working towards a sustainable and prosperous future for our catchment. Specifically, we ask that:

Government agencies: Provide support and resources for the implementation of this plan, and work with us to develop and implement policies and regulations that support sustainable catchment management.

Local communities: Take an active role in implementing this plan, and work with us to develop and implement community-led initiatives that support sustainable catchment management.

Landholders and farmers: Adopt sustainable land management practices, and work with us to develop and implement initiatives that support sustainable agriculture and conservation.

NGOs and community groups: Provide support and resources for the implementation of this plan, and work with us to develop and implement initiatives that support sustainable catchment management.

Private sector: Invest in sustainable initiatives and practices that support the implementation of this plan, and work with us to develop and implement initiatives that support sustainable catchment management.

Together, we can achieve a sustainable and prosperous future for our catchment. Let us work together to implement this plan and make a positive impact on our environment, our communities, and our economy.

Annexes

ANNEX 1. DETAILED POPULATION STATISTICS FOR THE CATCHMENT

Table A-1-1: Population Projection for Hadejia Jama'are Catchment

State	LGA	2006	2022	2025	2030	2035	2040	2045	2050
Bauchi	Bauchi	493,730	881,600	946611	1065789	1199972	1351048	1521145	1712657
Bauchi	Gamawa	284,411	507,900	545353	614013	691318	778354	876349	986682
Bauchi	Gamjuwa	278,471	497,300	533972	601199	676890	762110	858060	966089
Bauchi	Giade	156,022	278,600	299144	336807	379211	426953	480707	541228
Bauchi	Itas/Gad	228,527	408,100	438194	493363	555477	625411	704151	792803
Bauchi	Jama'are	117,482	209,800	225271	253633	285565	321518	361997	407572
Bauchi	Katagum	293,020	523,200	561782	632510	712143	801802	902748	1016404
Bauchi	Misau	261,410	466,800	501223	564327	635375	715369	805434	906838
Bauchi	Ningi	385,997	689,300	740130	833313	938227	1056349	1189343	1339082
Bauchi	Shira	233,999	417,800	448609	505089	568680	640277	720887	811647
Bauchi	Tafawa-B	221,310	395,200	424343	477767	537918	605642	681893	767743
Bauchi	Toro	346,000	617,800	663358	746874	840906	946776	1065975	1200181
Bauchi	Warji	114,983	205,300	220439	248192	279440	314621	354232	398830
Bauchi	Zaki	189,703	338,700	363676	409463	461015	519056	584405	657982
Jigawa	Auyo	132,268	227,400	244169	274910	309521	348489	392364	441763
Jigawa	Babura	212,955	366,200	393204	442709	498446	561200	631855	711405
Jigawa	Biriniwa	142,015	244,200	262208	295220	332388	374235	421352	474400
Jigawa	Birnin Kudu	314,108	540,100	579928	652941	735146	827701	931908	1049235
Jigawa	Buji	97,284	167,300	179637	202253	227717	256387	288666	325009

Jigawa	Dutse	251,135	431,800	463642	522014	587736	661732	745044	838844
Jigawa	Gagarawa	82,153	141,300	151720	170821	192328	216542	243804	274499
Jigawa	Garki	150,261	258,400	277455	312386	351716	395997	445853	501986
Jigawa	Gumel	106,371	182,900	196387	221113	248951	280293	315582	355314
Jigawa	Guri	113,363	194,900	209272	235620	265284	298683	336288	378626
Jigawa	Gwaram	271,368	466,600	501008	564085	635103	715062	805089	906449
Jigawa	Gwiwa	128,730	221,400	237726	267656	301354	339295	382012	430107
Jigawa	Hadejia	104,286	179,300	192522	216760	244051	274776	309371	348321
Jigawa	Jahun	229,882	395,300	424450	477888	538054	605795	682065	767937
Jigawa	KafinHau	267,284	459,600	493492	555622	625575	704335	793011	892851
Jigawa	Kaugama	128,981	221,800	238156	268140	301899	339908	382702	430884
Jigawa	Kazaure	161,161	277,100	297534	334993	377169	424655	478118	538314
Jigawa	Kiri Kasamma	192,583	331,200	355623	400396	450806	507563	571465	643412
Jigawa	Kiyawa	172,952	297,400	319331	359535	404800	455764	513145	577750
Jigawa	Maigatari	177,057	304,500	326954	368118	414464	466645	525395	591543
Jigawa	MalamMad	164,791	283,400	304298	342610	385744	434309	488989	550552
Jigawa	Miga	127,876	219,900	236116	265843	299312	336996	379424	427193
Jigawa	Ringim	192,407	330,900	355301	400034	450398	507103	570947	642829
Jigawa	Roni	77,414	133,100	142915	160908	181166	203975	229656	258569
Jigawa	Sule-Tan	134,813	231,800	248893	280229	315510	355232	399956	450311
Jigawa	Taura	131,861	226,700	243417	274063	308568	347417	391156	440403
Jigawa	Yankwashi	95,643	164,500	176631	198868	223906	252096	283834	319569
Kaduna	Giwa	292,384	432,000	463856	522256	588008	662038	745389	839233

Kaduna	Ikara	194,723	230,400	247390	278537	313604	353087	397541	447591
Kaduna	Kubau	280,704	414,700	445281	501342	564460	635526	715539	805625
Kaduna	Lere	339,740	501,900	538911	606760	683151	769160	865997	975026
Kaduna	Makarfi	146,574	216,600	232572	261853	294821	331939	373730	420782
Kano	Ajingi	172,610	283,900	304835	343214	386425	435075	489851	551524
Kano	Albasu	187,639	308,600	331357	373075	420045	472928	532470	599508
Kano	Bagwai	161,533	265,700	285293	321212	361652	407184	458449	516167
Kano	Bebeji	191,916	315,600	338873	381537	429572	483656	544548	613106
Kano	Bichi	278,309	457,799	491558	553445	623124	701575	789903	889352
Kano	Bunkure	174,467	286,900	308057	346841	390508	439673	495028	557352
Kano	Dala	418,759	688,700	739486	832587	937410	1055430	1188308	1337916
Kano	Dambatta	210,474	346,200	371729	418530	471223	530550	597346	672552
Kano	DawakinK	225,497	370,900	398251	448391	504843	568403	639964	720536
Kano	DawakinT	246,197	404,900	434758	489494	551121	620507	698629	786587
Kano	Doguwa	150,645	247,800	266073	299572	337288	379752	427563	481393
Kano	Fagge	200,095	329,100	353368	397857	447948	504344	567841	639332
Kano	Gabasawa	211,204	347,400	373018	419981	472856	532389	599417	674883
Kano	Garko	161,966	266,400	286045	322058	362605	408257	459656	517527
Kano	Garum Mallam	118,622	195,100	209487	235861	265556	298990	336633	379015
Kano	Gaya	207,419	341,100	366253	412365	464281	522734	588546	662644
Kano	Gezawa	281,328	464,300	498538	561304	631972	711538	801120	901981
Kano	Gwale	357,827	588,500	631897	711453	801025	901874	1015419	1143261
Kano	Gwarzo	183,624	302,000	324270	365096	411061	462814	521082	586686

Kano	Kabo	153,158	251,900	270476	304528	342869	386036	434637	489358
Kano	Kano	371,243	610,600	655627	738170	831106	935742	1053552	1186194
Kano	Karaye	144,045	236,900	254369	286395	322452	363048	408756	460218
Kano	Kibiya	138,618	228,000	244813	275635	310338	349409	393400	442929
Kano	Kiru	267,168	439,400	471802	531202	598080	673379	758157	853609
Kano	Kumbotso	294,391	484,200	519906	585362	659059	742034	835456	940640
Kano	Kunchi	110,170	181,200	194562	219057	246637	277688	312649	352012
Kano	Kura	143,094	235,300	252651	284460	320274	360596	405995	457110
Kano	Madobi	137,685	226,400	243095	273701	308160	346957	390639	439820
Kano	Makoda	220,094	362,000	388695	437631	492729	554763	624608	703246
Kano	Minjibir	219,611	361,200	387836	436664	491640	553537	623228	701692
Kano	Nassaraw	596,411	980,900	1053233	1185835	1335132	1503225	1692481	1905564
Kano	Rano	148,276	243,900	261886	294857	331979	373776	420834	473817
Kano	RiminGad	103,371	170,000	182536	205517	231392	260524	293324	330254
Kano	Rogo	227,607	374,300	401902	452501	509471	573613	645831	727141
Kano	Shanono	139,128	228,800	245672	276602	311426	350635	394780	444483
Kano	Sumaila	250,379	411,800	442167	497836	560513	631082	710535	799991
Kano	Takai	202,639	333,300	357878	402935	453664	510781	575088	647492
Kano	Tarauni	221,844	364,900	391808	441137	496676	559208	629612	708880
Kano	Tofa	98,603	162,200	174161	196088	220775	248571	279866	315101
Kano	Tsanyawa	157,730	259,400	278529	313595	353077	397529	447578	503928
Kano	Tundun Wada	228,658	376,100	403834	454677	511921	576372	648937	730638
Kano	Ungogo	365,737	601,500	645856	727169	818719	921796	1037850	1168515

Kano	Warawa	131,858	216,900	232895	262216	295229	332398	374247	421365
Kano	Wudil	188,639	310,300	333182	375130	422358	475533	535403	602810
Katsina	Bakori	149,516	267,200	286904	323025	363694	409483	461037	519081
Katsina	Baure	202,941	362,700	389446	438477	493682	555836	625816	704606
Katsina	Danja	125,481	224,300	240840	271162	305301	343739	387015	435741
Katsina	Funtua	225,156	402,400	432074	486472	547718	616676	694316	781730
Katsina	Ingawa	169,148	302,300	324592	365458	411469	463273	521599	587269
Katsina	Kafur	209,360	374,200	401794	452380	509335	573460	645658	726947
Katsina	Kankiya	151,395	270,600	290555	327135	368322	414693	466903	525686
Katsina	Kusada	98,348	175,800	188764	212529	239287	269413	303332	341521
Katsina	Malumfashi	182,891	326,900	351006	395198	444953	500973	564045	635058
Katsina	Musawa	170,006	303,800	326203	367272	413511	465572	524188	590183
Katsina	Sandamu	136,944	244,700	262745	295824	333068	375002	422214	475371
Katsina	Zango	156,052	278,900	299467	337169	379619	427413	481224	541810
Plateau	Bassa	189,834	279,300	299896	337653	380163	428026	481914	542587
Plateau	Jos East	88,301	129,900	139479	157039	176811	199071	224134	252353
Plateau	Jos North	437,217	643,200	690631	777581	875478	985701	1109801	1249525
Yobe	Bade	139,804	219,800	236008	265722	299176	336843	379251	426999
Yobe	Borsari	109,692	172,500	185220	208540	234795	264355	297638	335110
Yobe	Geidam	155,740	244,900	262959	296066	333341	375308	422559	475760
Yobe	Jakusko	232,458	365,500	392453	441862	497493	560127	630647	710045
Yobe	Karasuwa	105,514	165,900	178134	200561	225811	254241	286250	322289
Yobe	Machina	60,994	95,900	102972	115936	130532	146966	165469	186302

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Yobe	Nguru	150,699	236,900	254369	286395	322452	363048	408756	460218
Yobe	Yunusari	125,940	198,000	212601	239367	269504	303434	341636	384648
Yobe	Yusufari	110,739	174,100	186938	210474	236973	266807	300399	338219
TOTAL		22,504,650	37,653,999	40,430,674	45,520,892	51,251,968	57,704,586	64,969,588	73,149,253

ANNEX 2. THREATS, CHALLENGES, SOCIO-ECONOMICS AND POLICIES LINKED TO WATER INFRASTRUCTURE IN THE CATCHMENT AS INDICATED BY THE STAKEHOLDERS

Table A-2-3. Threats, Challenges, Socio-Economics and Policies Linked to Water Infrastructure in the Catchment from Stakeholders

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Tiga Dam in Bebeji LGA	Tin Ore: Gwaram	Tamarind	Over 25 species of mammals	1,754,200 hectares of arable land	There is a lot of siltation in the rivers, resulting in incidences of flooding	There are very widespread irrigation projects in Dutse, Birnin Kudu, Gwaram, Miga, Tsagaiwa, Jahun, kazaure, Yankwashi and Guri LGAs.	(The Nigeria Integrated Water Resources Management Commission) NIWRMC has a policy on water source protection
Challawa Dam in	Gold:	Doum palm	15 species of reptiles	86,500 hectares of	There is imbalance in water	There are efforts across the catchment especially in the	There is the Agricultural Policy (2024-2028)

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Karaje LGA	Kazaure, Roni, Yankwashi			Low land (<i>Fadama</i>)	distribution within the catchment	Kano region to generate power from industrial waste to power over 35,000 homes	operating within the entire Kano state to improve Agriculture.
Ruwan Kanya in Bebeji	Gemstone: Gwaram, Dutse and Kazaure	Crist thorn	2 species of amphibians	75,000 hectares comprises of forest and grazing land.	The role of traditional rulers is neglected when it comes to policy making	There are irrigation schemes in Gashuwa	A challenge on mining policies is the way the federal laws are made. The extractive industry is in the exclusion list, hence states have very little to do in this regard.
Thomas Dam in	Columbite: Gwaram	Baobab (<i>Adansonia digitata</i>)	More than 89 species of fish	Livestock farming, including	In some areas of the catchment, locals have to walk	In Tudun Wada, there are training schemes for women	There is a need to cascade these policies and laws to

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Makoda LGA				cattle, sheep, goats, and poultry	over 2km to get water.	on sustainable livelihood, as well as training schemes for farmers, with distribution of improved seedlings. This has ensured food security and improved living conditions.	the states and local government levels.
Magaga Dam	Iron Ore: Kazaure (Nanimawa)	Acacia Albida	Over 377 species of birds in the wetlands.	Horticultural products such as tomatoes, onions, peppers, and leafy vegetables.	There is illiteracy spread across the catchment in rural areas.	School conservation clubs have been engaged on world conservation days and similar events across the catchment.	There are policies to switch to clean energy by converting boreholes across the catchment to use solar power.

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Kafin Chiri Dam in Garko LGA	Ilmanite: Birnin Kudu, Gwaram, Kazaure, Roni, Yankwashi	Shea tree (Vitellaria paradoxa)		Key crops include millet, sorghum, maize, rice, cotton, and groundnuts.	Bad mining practices across the catchment results in significant harm to local ecosystems and environments such as air and water pollution.	Within the Nguru wetlands, about 32 schools have been educated and taken on excursions concerning environmental conservation.	It is important to make policy formulation to follow bottom – top approach.
Gari Dam in Kunchi LGA	Copper: Roni, Gwaram	Neem tree (Azadirachta indica)			Increased deforestation across the catchment has made downstream areas very prone to erosion.	Also, nurseries of economic trees have been raised within the Nguru wetlands.	It is a general consensus among stakeholders that Policies need to be reviewed more often (3 – 5 years) to keep up with trends that keep changing.

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Jakara Dam in Minjir	Granite: Dutse, Birnin Kudu, Gwaram	Locust bean (Parkia biglobosa)			Rivers and lands are polluted excessively from very poor agricultural activities and waste management.	WASH programmes have been provided to schools and also hygiene kits were supplied to schools across the catchment.	There are: <ul style="list-style-type: none"> • Forestry Laws • Grazing Policies
Tudun Wada Dam in Tudun Wada	Soda Ash: Hadejia, Kiri-Kasamma, Birniwa, Buji				There is erratic rainfall, as well as desertification in parts of Karsuwa, Ynusari, Nguru.	Support is given to farmers in areas infested with Typha grass to help them in controlling these grasses, such as weed clearing materials.	Land Use Act for the state which aligns with the Federal Land Use Act.
Bagauda Dam in	Kaolin: Gwaram				Poor implementation of	There are efforts by the Government	However, some of these policies are

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Bebeji LGA					water sharing policies between the upstream and downstream.	across the catchment to provide solar powered boreholes to help in clean water supply.	obsolete, others require reviews and updates, and in some cases, there might be need for new policies/laws.
Kussalla Dam in Karaye	Potash: Hadejia, Auyo, Guri, Kiri-Kasamma				Typha grass infestation in places like Hadejia, Kiri Kasamma, Auyo, Nguru, Bade, Gashua, Warawara.	Grazing routes are being redefined and demarcated to reduce farmer herder crises within the catchment.	There is lack of synergy between federal and state laws, hence, the need for more collaboration on implementation. Some of these policies and laws at best are weakly implemented with political

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
							interference, low political will, and lack of enforcement
Watari Dam in Bagwai LGA	Talc: Jahun				There is conflict of interest across the catchment on the exploitation of natural resources.	22 consultant clubs were established within the Yobe wetland areas to educate locals on the need to appreciate nature.	
Pada Dam in Gwarzo	Glass Sand: Kazaure, Babura, Sule-Tankarkar, Ringim, Kiyawa,				Pastoralists across the catchment are neglected with no empowerment, education or awareness.	There are general habitat restoration and income generation activities in the Nguru wetlands.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
	Jahun, Miga, Kafin						
Guzu-Guzu Dam in Kabo LGA	Clay Mineral: Hadejia, Kaugama, Auyo, Guri, Kiri-Kasamma, Mallam Madori, Buji				Vandalization of power and water infrastructure across the catchment	18 IDP camps across the catchment were provided with hygiene kits.	
Yansabo Dam in Tofa LGA	Calcareous Limestone: Kaugama,				Contaminated groundwater in areas of the catchment. Bade	CIBs were provided with interest free loans with due monitoring.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
	Mallam Madori				has a lot of reported kidney disease which has been scientifically attributed to groundwater contamination. Very poor drilling practices by quacks are also a factor.		
Dams in Giade and Jama'are LGAs in Bauchi					Reports of very widespread illegal mining practices across the catchment.	Yobe ministry of environment, in conjunction with The World Bank, has provided tree seedlings to be planted so as to	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
						address climate change.	
Gauging stations at: Dabi, Sintilmawa, Majiyawa, Nahu ce, Dudduru in Ringim LGA; and Hadejia: Marke, Hantsu, Hadin, Kafin Hausa,					Little to no information on gender-based violence especially on boys and men.	Also, a nursery with the capacity to produce 500,000 seedlings annually has been established in Garko LGA.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
Hadejia, Marma, Likori in Hadejia LGA							
					Cases of farmer – herder conflict across the catchment especially in rural areas. This is despite the presence of committees for dispute settlements.	Schools have been constructed in some remote areas in Kano around herder settlements to educate their children.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
					General lack of infrastructure spread across majority of areas in the catchment	The Chad basin Authority has distributed grinding machines and fertilizers to communities around their areas of influence.	
					Very little synergy between stakeholders so growth and progress are very slow.	Boreholes have been drilled in Machina LGA which has a very difficult geology.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
					Insecurity on the Northern parts of the catchment, affecting intervention programs.	There has been widespread awareness on open defecation across the catchment to reduce it to the barest minimum.	
					There is gross misuse of infrastructure for purposes they were not designed for, causing degradation of these infrastructures.	NIWRMC collaborated with ICICN to construct a dyke for river embankment in Hadin Village, Kaugama LGA. This collaboration also desilted a river channel at Dabi	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
						village in Ringim LGA	
					Forest reserves are being encroached into and converted into farmlands by locals. This is causing degradation of the forest reserves.	NIWRMC collaborated with ACREsAL in CMP to develop an action plan for promotion sustainable utilization of water resources.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
					There is very poor tourism development across the catchment, which could be a major source of economic activity.	Individual Orchards have been established for 1,140 farmers as a source of livelihood in Leni, Shanono, Gudan, Tuwo etc.	
					There is indiscriminate use of chemicals in the lowlands (<i>Fadama</i>) resulting in the loss of precious fauna and flora, as well as causing diseases in some cases.	Same was established for 100 farmers in Makoda and 100 farmers in Takai.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
					There are reported cases of Wrong fishing practices such as using the wrong dragnet sizes which is wiping out fingerlings.	The CRF (Community Revolving Fund) along with ACREsAL Jigawa provides interest free loans to farmers within the Hadejia – Ringim area.	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
					There is serious degradation in the Nguru lake which is part of the Nguru – Marma channel.	Jigawa ACREsAL provided Livelihood support for farmers. 50 Rice Threshers, 50 Rice Millers, and 50 Rice Destoners, including seedlings, fertilizers, and pesticides were distributed to about 1,250 beneficiaries.	
					There are reports on the occurrence of child labour across the catchment	Tanneries: Great Northern Tannery Gashash Tannery Nakudu Tannery	

Natural Resources					Threats and Challenges	Socioeconomics	Policies
Water reservoirs	Minerals	Flora	Fauna	Agriculture			
						Mahona Tannery GB Tannery Godlittle Tannery Salcon Tannery Multo Tannery Rana Tannery Bompari Tannery	
					There are reports of river channels getting blocked due to human activities.		

Annex 3

Shared Strategic Vision and Goals

HADEJIA JAMAARE CATCHMENT AREA.

1. GOALS AND OBJECTIVES

GOALS

- 1) Sustainable management and utilization of resources in Hadejia-Jama'are catchment area
- 2) Equitable desilting of river channels and reservoirs within the catchment area

OBJECTIVE:

- 1) To allow free flow of clean water across the catchment
- 2) To streamline/ harmonise policies in states within the catchment
- 3) To strengthen early warning systems and hydrological/meteorological network
- 4) Capacity building to relevant stakeholders

2. STAKEHOLDERS ENGAGEMENT:

- 1) Ensure regular engagement of stakeholders (quarterly) except on emergency situation
- 2) Awareness and community engagement on environmental and economic impact of the river

3. WATER MANAGEMENT

- 1) Harmonising existing policies and update obsolete policies along the catchment
- 2) Enforcement of laws and policies within the catchment
- 3) Establishment of regulatory body in the catchment

4. LAND USE

- 1) Plan for sustainable land use and management practices
- 2) Restoration of 30-40 % of the degraded land through afforestation and sand-dunes stabilisation.
- 3) Regulating all illegal mining activities in the catchment
- 4) Increase agricultural productivity by 40% through climate smart agriculture

5. ENVIRONMENTAL PROTECTION

- 1) Restore 25-30% of wetlands, sand dunes
- 2) Restore 25% and improve agricultural degraded land
- 3) Restore forest holdings, improve protection and wildlife
- 4) Environmental and social standard (ess)

6. COMMUNITY BENEFITS

- 1) Livelihood need assessment
- 2) Access to use of non-timber forest products in sustainable manner
- 3) Creation of community orchard
- 4) Access to sanitation and hygiene practice
- 5) Good agronomic practices
- 6) Access to low cost energy
- 7) Mentoring of youth on emerging technologies for sustainable resource use

7. ECONOMIC DEVELOPMENT

- 1) Access to community revolving funds
- 2) Promote gender mainstreaming in resource allocation
- 3) Encourage the emergence community entrepreneurship hubs
- 4) Empower traditional institutions for
- 5) Encourage water harvesting infrastructure for flood waters
- 6) encourage green house and drip irrigation

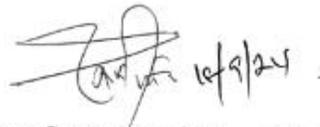
8. CLIMATE CHANGE RESILENCE

1. Encourage use of micro-irrigation facilities
2. Solar powered pumps
3. Use of improve seedlings
4. Investment in agro/hydrometric monitoring devices to support early warning

9. MONITORING AND EVALUTION /ALIGNMENT OF POLICIES

1. Develop KPI's for the above including sources of information and responsible agency
2. Data-driven decision support tool

Zakari Sulaiman



18/9/24

Hadejia Jamaara River Basin Development Authority, Kano,
Chairman.

Bello Adamu Takai

Director Hydrogeology,
Ministry Of Water Resources, Kano.
Co-Chairman



18/9/24

Zainab Baba

Social And Livlihood Officer,
ACReSAL, Jigawa
Secretary.



18/09/2024

HADEJIA-JAMA'ARE CATCHMENT MANAGEMENT PLAN

Focus Group Discussion

18th September, 2024

1. GOALS AND OBJECTIVES

Goal

- Equitable, sustainable and efficient use of the water resources.

Objectives

Through sustainable best practices concerning the following:

- Water supply.
- Agriculture.
- Industrial use.
- Make our rivers navigable.
- Implementation of the water charter of the Basin.
- To create and maintain decision support system/ databank (DSS) for the catchment.
- Dam and reservoir operation guidelines.
- River training.
- Flo proportioning structure.
- Restoration and expansion of the hydrometeorological monitoring network.

2. STAKEHOLDER ENGAGEMENT

- Agencies and institutions.
- The riparian community.
- Industries (private or public).

2. STAKEHOLDER ENGAGEMENT

- Agencies and institutions.
- The riparian community.
- Industries (private or public).

3. WATER MANAGEMENT

- Implementation of the Integrated Water Resource Management (IWRM) strategy.

4. LAND USE

- Agriculture.
- Mining.
- Conservation.
- Residential.
- Infrastructural Development.

5. ENVIRONMENTAL PROTECTION

- Identification of vulnerable areas.
- Pollution control.
- Sustainable use of natural resources.
- Making it compulsory for every project to undergo Environmental and Social Impact Assessment.

6. COMMUNITY BENEFITS

- Livelihood enhancement.
- Food security.
- Improved health.
- Provision of basic amenities.
- Awareness.

7. ECONOMIC DEVELOPMENT

- Infrastructure.
- Basic amenities (portable drinking water, schools and markets).
- Boosting of agricultural activities in the catchment.
- Gender and social inclusion.

8. CLIMATE CHANGE RESILIENCE

- Mitigation measures (Planting of trees and sustainable agricultural practice).
- Adaptation (climate smart and precision agricultural and practices, use of alternative energy sources and use of efficient energy cookstoves and use of renewable energy).
- Awareness and education (sensitization on impact, causes and effect of climate change).

9. MONITORING AND EVALUATION/ ALIGNMENT OF POLICIES ON THE CATCMENT BASES

Develop strategy and policy for the following:

- Data gathering, data analysis and interpretation to inform policy decisions.
- Enforcement of already existing policies on the catchment.
- Tracking of targets.
- Impact evaluation of interventions in the catchment.
- Establishment of early warning systems.
- Establishment of Key Performance Indicators for tracking activities/ project implementation.



Engr. Muhammad Galadima Magaji

(Sarkin Azare)

Chairman

19/9/2024



Mu'azu Aminu Aliyu

Secretary

19/07/2024

STAKEHOLDER ENGAGEMENT PHOTOGRAPHS



