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Ecosystem-Based Forestry Land Use for Flood Risk Mitigation and Socio-Livelihood Supports in Southwest Nigeria

Abstract. Despite huge government spending on concrete infrastructure, Nigeria still faces recurrent flooding issues. Therefore, the study was conducted to assess ecosystem-based forestry land use (EFLU) for flood risk mitigation and socio-livelihood supports in South West Nigeria. A multistage procedure was applied in this research. The initial two stages involved purposive sampling of Oyo, Ogun, and Lagos States, with two local government areas (LGAs) selected from each state, followed by a third stage of random selection of 22 communities in each of the LGA, based on past incidences of flood. In the fourth stage, households listing was used to systematically select 250 households. Questionnaire administration was adopted for data collection. Data analysis utilised descriptive statistics, ranking and chi-square test at $\alpha 0.05$. Findings showed extent of awareness on discouraging refuse and waste dump into drainages and rivers ranked 1st while other government's intervention were ranked below 1.5 mean scores benchmark. In addition, for EFLU; tree planting and conservation of trees were ranked 1st and the latter ranked 2nd, respectively. This suggested that tree planting and conservation are well-promoted initiatives, but other EFLU may require more attention to increase their impacts. Furthermore, there was a significant relationship between extent of awareness and trees conservation in upland areas. Therefore, the study recommends consistent promotion and support tree planting and conservation initiatives, with effective engagement of local communities to promote environmental awareness, to curb climate change disaster.

Keywords: climate change, disaster management, awareness, environmental protection, ecosystem services, forest trees

JEL Classification: Q15, Q56

Introduction

Flooding has resulted in extensive loss of lives and destruction of property in Nigeria, compelling successive governments to allocate substantial financial resources toward infrastructural repairs and flood control measures. According to Confor (2016), significant public expenditure was directed toward the construction of flood defences in vulnerable areas in 2007; however, many of these structures failed to deliver the expected outcomes during the heavy rainfall events of December 2015. This underscores the limitations of conventional flood mitigation approaches. Carrick et al. (2018) further observed that traditional hard-

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engineering solutions such as dams, reservoirs, and embankments are capital-intensive, time-consuming, and often unsustainable over the long term.

In contrast, nature-based solutions, including vegetation cover, reforestation, improved water channelisation, and waterway diversion, have been identified as effective and sustainable flood mitigation measures (Opperman & Galloway, 2022). The inadequate adoption and limited validation of forestry land-use strategies such as tree planting and other green mitigation practices have contributed to increased vulnerability, livelihood disruption, and material losses in flood-prone communities. While structural flood control measures widely implemented across Nigerian states remain costly and unsustainable, forestry-based land use strategies are comparatively affordable, environmentally sound, and resilient.

Beyond physical interventions, awareness creation by governments at all levels particularly regarding early flood warning systems, evacuation from floodplains, and proper waste management remain critical. However, evidence from South West Nigeria suggests that reliance on structural flood mitigation measures has yielded minimal success. This situation highlights the need for forestry managers and policymakers to integrate forestry land use strategies into flood management frameworks, especially in areas that experience recurrent flood disasters. This evolving research domain is essential for strengthening forestry land-use systems for effective flood management in South West Nigeria.

Empirical studies affirm that deforestation and unsustainable land use practices significantly reduce land capacity for water absorption and retention, thereby intensifying flood risks (Ali et al., 2021). Forest ecosystems play a vital role in regulating hydrological processes, enhancing sustainability, and supporting climate adaptation and mitigation efforts (Ellison et al., 2017). Forest trees can alter surface runoff dynamics by reducing flood peaks, delaying flood occurrence, and allowing communities more time to respond to flood warnings (Confor, 2016). Riparian vegetation slows water flow, reduces sedimentation, and enhances river channel capacity, while tree buffers across hills and streams trap sediments and reduce erosion.

Consistent with this, Lopes et al. (2018) emphasised that forest vegetation both in rural and urban landscapes enhances rainwater infiltration, particularly in flood-prone ecosystems. These insights support the global shift from purely structural flood control toward integrated, non-structural floodplain management strategies (Marapara et al., 2020). Forest soils are generally porous, promoting infiltration and reducing surface runoff (Zhu et al., 2025), although the effectiveness of plantation forests depends on management practices, understory presence, and site-specific conditions (Ashrafizadeh & Yousefpour, 2025).

Ecosystem-based forestry land use approaches are increasingly recognised as effective strategies for flood mitigation and livelihood sustainability, particularly in flood-prone regions. Globally and within Nigeria, sustainable forestry practices contribute significantly to environmental stability by enhancing ecosystem services such as soil conservation, watershed protection, and natural flood regulation. According to Adeoye et al. (2025), ecosystem services derived from well-managed forest landscapes help stabilise soils, reduce surface runoff and erosion, and function as natural buffers that moderate the intensity and impacts of flooding. In South West Nigeria, where seasonal rainfall and rapid urban expansion have heightened flood vulnerability, communities often adopt non-structural, ecosystem-based measures—including tree planting, riparian vegetation restoration, and streambank stabilisation—to reduce flood risks while sustaining local livelihoods. These practices reinforce the ecological capacity of landscapes to absorb excess water and protect settlements located in low-lying or flood-prone areas. Furthermore, the close relationship

between ecosystem services, food security, and economic sustainability in developing regions underscores the importance of integrating forestry-based land use strategies into flood management frameworks. As emphasised by Gupta et al. (2021), ecosystem-driven resource management provides a viable pathway for improving environmental resilience while supporting rural and peri-urban livelihoods. In this context, eco-based forestry land use systems represent a sustainable and cost-effective alternative to purely structural flood control measures.

However, despite the growing recognition of ecosystem-based forestry in flood management, empirical evidence on how communities perceive the benefits and practical impacts of such land-use systems remains limited, particularly in South West Nigeria. Existing studies have largely focused on the ecological or technical effectiveness of forestry practices, while relatively little attention has been given to local awareness of government-supported forestry interventions, community perceptions of their socio-economic benefits, and the extent to which these ecosystem-based strategies are viewed as viable tools for flood risk mitigation. This knowledge gap constrains the effective integration of ecosystem-based forestry approaches into local flood management policies and community-based adaptation strategies.

Against this background, this study evaluates the benefits and impacts of ecosystem-based forestry land use for flood mitigation in South West Nigeria, with particular emphasis on awareness of government interventions, household benefits from forestry practices, and the impact of ecosystem-based approaches on strengthening community resilience and reducing flood risks.

The general objective of this study is to assess perceived benefits of ecosystem-based forestry land use and impact for flood risk mitigation in South West Nigeria.

The specific objectives were to:

1. assess the extent of residents' awareness of government flood mitigation interventions in South West Nigeria;
2. evaluate the perceived benefits of EFLU for flooding mitigation; and
3. assess impact of ecosystem-based forestry land-use for flood risk mitigation.

The following null hypotheses were formulated and tested at an appropriate level of significance:

H₀₁: There is no significant relationship between residents' awareness of government flood intervention measures and impact of ecosystem-based forestry land-use (EFLU) strategies for flood mitigation in South West Nigeria.

Literature review

The Need for Ecosystem-Based Flood Mitigation and Socio-Livelihood Supports

Threats from incessant floods have been recurrent throughout many human civilisations, it has been an unavoidable event because residents live close to a water source (Cooper et al., 2021). The risk of fluvial flooding poses significant challenges to communities, yet it is important to recognise that flooding also plays a beneficial role by periodically rejuvenating and fertilising productive lands through the deposition of nutrient-rich sediments, an example of which is the River Nile in Egypt (Cooper et al., 2021). Traditionally, flood defence and

mitigation have relied on the construction of hard infrastructure such as dams, weirs, sluices, and barriers, or through river engineering methods like straightening and deepening channels to increase capacity (Peter & Fatuki, 2018). Similarly, levees and embankments, such as those built along the Mississippi River in the United States, have been employed to control floods (Olson & Speidel, 2021). While effective, these structural measures involve high costs for construction and maintenance, often have adverse environmental impacts, and may provoke unintended consequences. Recently, however, there has been a growing consensus that natural flood management approaches could provide more environmentally sustainable and cost-effective solutions to flood mitigation (Waylen et al., 2018).

Natural flood management (NFM) has been defined in various ways in the literature. According to Lane (2017), it involves the holistic application of general flood management and hydrological principles to develop techniques at any scale within a catchment that either replicate or enhance natural processes to reduce flood risk. The Environment Agency in England classifies several NFM techniques, including river restoration, floodplain restoration, leaky barriers, offline storage areas, catchment woodland, cross-slope woodland, floodplain woodland, riparian woodland, soil and land management, headwater management, and runoff management (Environment Agency, 2018).

Notwithstanding, forest ecosystem services showcase an imminent role in supporting livelihoods by providing essential resources such as food, fuelwood, and medicine (Ahhammad et al., 2019), which hinges on SDG 2 focusing on zero hunger, and they further regulate water cycles and climate, preventing soil erosion and offer income and employment opportunities, particularly for the rural poor communities. More so, the ecosystem free services are critical for both subsistence and economic development, yet they are often undervalued (Thammanu et al., 2021), but aggregately, successful community forest management enhances the provision of ecosystem benefits and contributes to sustainable agricultural production through effective regulation and stewardship of forest resources, and livelihood activities that engender economic prosperity in the rural setting. This underscores the importance of effective forest management policies to ensure the sustainability of these benefits and to support vulnerable populations.

Forest Trees and Water Control

Forest trees have long been recognised for their role in water regulation, dating back to the time of Pliny the Elder (Vaquero et al., 2025). Historical awareness of this relationship is evident in mediaeval France, where a decree issued in 1219 acknowledged the connection between forests and water systems (Cooper et al., 2021). According to Vaquero et al. (2025), the earliest recorded hydrological monitoring occurred in France during the mid to late 1800s. As scientific understanding of the global hydrological cycle has advanced, forests have increasingly been seen as critical components in maintaining this cycle. This recognition has led to the establishment of numerous monitoring and experimental initiatives worldwide, including the Long-Term Ecological Research (LTER) network in the United States and the Coalburn catchment studies (Gupta et al., 2021). Trees possess unique characteristics that distinguish them from other vegetation types, particularly in terms of water usage, due to their size, longevity, and structure. Hu et al. (2025) identify three main categories of factors influencing tree water use: (1) climatic factors, including solar radiation, air temperature, humidity, and wind; (2) water availability, such as rainfall, irrigation, soil water, and groundwater; and (3) tree-specific factors, including leaf area, rooting depth, maturity, and

overall size. The age, species composition, and spatial distribution of trees in a forest significantly affect the hydrological fluxes within that ecosystem.

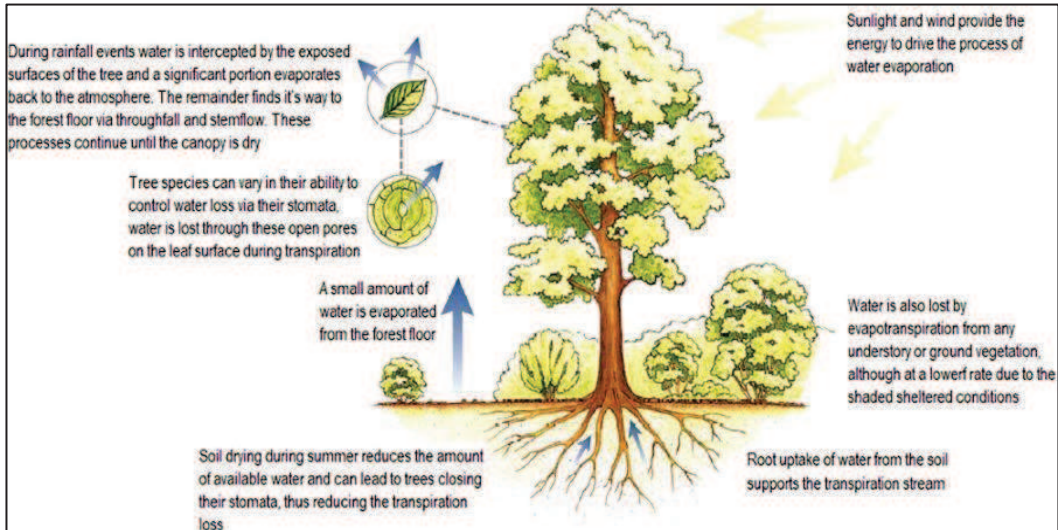


Fig. 1. How forest trees use water

Source: Adapted from an original illustration published in *Forestry and Natural Resources*, Purdue University (2021).

Beyond their direct impact on water uptake and evapotranspiration, trees also influence hydrological processes indirectly. They alter soil properties enhancing infiltration and water storage—modify surface roughness, which affects overland flow during flooding, and reduce erosion and downstream sedimentation (Firoozi & Firoozi, 2024). These functions collectively underscore the essential role forests play in managing water resources and mitigating flood risks. Figure 1 illustrates the processes through which trees influence the hydrological balance in forested landscapes.

Methodology

The study was conducted in South West Nigeria, focusing on residents in flood-prone communities. The South-West is one of Nigeria's six geopolitical zones and is predominantly inhabited by the Yoruba ethnic group. The population of South West Nigeria is 41,192,000 according to demographic statistics (2022). The region covers a land area of approximately 114,271 km² and comprises six states: Oyo, Osun, Ogun, Lagos, Ondo, and Ekiti. A four-stage sampling procedure was employed to select the households for the study.

Stage 1: Three states of Oyo, Ogun, and Lagos were purposively selected based on their history of frequent and severe flood events (Nnodim, 2023; Cirella et al., 2018).

Stage 2: Within the selected states, Local Government Areas (LGAs) and wards with the presence of water bodies and recurrent flooding were also purposively chosen. In Oyo

State, Ido and Oluyole LGAs were selected; in Ogun State, Obafemi Owode and Abeokuta South LGAs were chosen; and in Lagos State, Alimosho and Ikorodu LGAs were selected. The number of wards in each LGA is as follows: Ido – 10 wards, Oluyole – 10 wards, Obafemi Owode – 12 wards, Abeokuta South – 15 wards, Alimosho – 11 wards, and Ikorodu – 19 wards.

Stage 3: A total of 22 highly flood-prone communities were randomly selected from the wards. These include: Ido LGA (Oyo State): Apete/Awotan, Omi-Adio, Idi-Iya; Oluyole LGA (Oyo State): Odo-Ona Elewe/Ikereku, Odo-Ona Kekere, Odo-Ona Nla; Obafemi Owode LGA (Ogun State): Ofada/Mokoloki, Mowe, Ibafo, Asese; Abeokuta South LGA (Ogun State): Obantoko, Igbore/Itori/Ago-Oba, Ago-Ijesha/Ijeun Titun; Alimosho LGA (Lagos State): Shasha/Akowonjo, Egbe/Agodo, Ikotun/Ijegun; Ikorodu LGA (Lagos State): Ijede II, Ibeshe, Odogunyan, Agura/Iponmi, Isiu, Ipakodo

Stage 4: A household listing was conducted in each selected community to create a sampling frame. From this list, households were systematically sampled by selecting every 5th household. A total of 250 respondents were ultimately selected across the 22 communities as sample size. The test instrument used for collection of information from the respondents was a well-structured questionnaire and interview section. Data analyses were carried out with frequencies, simple percentages, chi-square and ranking of mean scores.

Analytical Tools

- i. Chi-square Analysis

$$\chi^2 = \sum \left[\frac{(f_o - f_e)^2}{f_e} \right] \dots \dots \dots (1)$$

Where:

- χ^2 = Chi-Square statistic;
- Σ = Summation symbol, indicating the total sum;
- f_o = Observed frequencies of the qualitative variables in the study;
- f_e = Expected frequencies of occurrence, derived from the distribution of response categories.

Ranking of Mean Scores

Residents were asked to indicate their extent of awareness, as well as perceived benefits, and the categorisation of the impact of ecosystem-based forestry land-use in flood-prone communities of South West Nigeria using a 4-point Likert scale of larger extent=3, lesser extent=2, rare extent=1, and not aware=0. Also, for perceived benefits, effectiveness was measured using a four-point rating scale as follows: very effective = 3; effective = 2; mildly effective = 1; not effective = 0. The benchmark was obtained as 3+2+1+0=6 divided by 4 =1.5. Hence, any point below 1.5 is low, and any point equal to and above 1.5 is high. These were used to rank the mean scores of extents of awareness and socio-livelihood support. Further, the same benchmark of 1.5 was used to operationalise impact of ecosystem-based forestry land-use (EFLU).

Results and Discussion

Extent of Awareness of Government Intervention

The results in Table 1 on the extent of government intervention among residents reveal that the extent of awareness on discouraging refuse and waste dumping into drainages and rivers (mean = 1.6) was the most popular level of awareness among residents and was ranked 1st. This infers that this information was the most accessible among residents and it suggests that the more informed residents are on refuse and waste dump management, the less flood overflow.

Table 1. Extent of Awareness of Government Intervention (N= 250)

Government's Interventions	Extent of Awareness				Mean	Rank
	Not Aware	RrE	LsE	LgE		
Dumping of refuse and waste into drainages and rivers is discouraged in our community.	39 (15.6)	89 (35.6)	67 (26.8)	55 (22.0)	1.6	1 st
Government has warned many residents living in the floodplain to relocate	53 (21.2)	154 (61.6)	18 (7.2)	25 (10.0)	1.1	2 nd
Upland area of floodplain must be restricted to cattle grazing to avoid soil compactness	229 (91.6)	17 (6.8)	3 (1.2)	1 (0.4)	1.0	3 rd
Sensitisation and early warning systems are essential components of effective flood management.	65 (26.0)	135 (54.0)	26 (10.4)	24 (9.6)	1.0	3 rd
Both government and non-governmental organisations (NGOs) have critical roles to play in mitigating flood risks and enhancing community preparedness.	86 (34.4)	124 (49.6)	26 (10.4)	14 (5.6)	0.9	4 th
Prohibition of building construction on the floodplain is enforced.	118 (47.2)	74 (29.6)	32 (12.8)	26 (10.4)	0.9	4 th
De-silting of the river must be carried out frequently to allow free flow of water.	145 (58.0)	52 (20.8)	34 (13.6)	19 (7.6)	0.7	5 th
Upland area must be engaged with reforestation where deforestation has occurred.	189 (75.6)	22 (8.8)	36 (14.4)	3 (1.2)	0.4	6 th
Adequate sensitisation on land-use strategies is environmental best natural practice to control flood.	183(73.2)	49 (19.6)	2 (0.8)	16 (6.4)	0.4	6 th
The importance of conservation of existing trees and shrubs in flood management.	182 (72.8)	45 (18.0)	17 (6.8)	6 (2.4)	0.4	6 th
Tree planting (reforestation) and agroforestry as effective flood management.	179 (71.6)	46 (18.4)	22 (8.8)	3 (1.2)	0.4	6 th
Adequacy of tree planting as means of preventing flood.	198 (79.2)	26 (10.4)	16 (6.4)	10 (4.0)	0.4	6 th

NB* Figures in parentheses are percentages; RrE = Rare Extent; LsE = Lesser Extent; LgE = Larger Extent

Source: Field survey.

Government's warning to many residents living in the floodplain or flood-prone areas to relocate (mean = 1.1) was ranked 2nd most level of awareness of government intervention. Sensitisation and early warnings about flooding being useful in flood management (mean = 1.0) was ranked 3rd most popular level of awareness of government intervention among residents for flood risk mitigation. This corroborates with Vaquero et al. (2025) and Cooper et al. (2021) that it is an awareness of forest trees which plays a role in water regulation, and awareness of this relationship is evident in mediaeval France, where a decree issued in 1219 acknowledged the connection between forests and water systems. However, awareness on government and non-government organisation's roles in combating flood (mean = 0.9), the necessity for regular desilting of the river to ensure the free flow of water (mean = 0.7), and agroforestry as effective flood risk mitigation practices, adequacy of tree planting as a means of preventing flood, conservation of existing trees and shrubs for flood management and adequate sensitisation on land-use strategies being environmental best natural practices to control flood and vulnerability of people (mean = 0.4) were ranked 4th, 5th, and 6th, respectively, most popular level of awareness of government intervention among residents. This implies that the higher the extent of awareness among residents on government intervention, the more flood risk is averted. This corroborates Ellison et al., (2017) that forest ecosystems play a vital role in regulating hydrological processes, enhancing sustainability, and supporting climate adaptation and mitigation efforts. Furthermore, extent of awareness on government interventions about ecosystem services was ranked 6th. This suggests residents showed limited awareness of ecosystem services, ranking knowledge of these practices like reforestation, conservation, and agroforestry as low, indicating a significant knowledge gap.

Perceived Benefits of Ecosystem-based Land Use

Table 2 shows the distribution of benefits of ecosystem-based forestry land use (EFLU) in the study area. The results reveal EFLU enhances carbon sequestration which contributes to global efforts on reduction of greenhouse gas emission supporting sustainable development ranked 1st. This indicates that EFLU has a positive impact on the environment by enhancing carbon dioxide from the atmosphere, mitigating climate change and enforcing sustainable development and a healthier environment. This aligns with Sustainable Development Goal (SDG) 13 on Climate Action, as it directly contributes to combating climate change by facilitating the removal of greenhouse gases from the atmosphere (Dagnachew et al., 2021). The findings also show that environmental benefits from EFLU support agriculture, fisheries and other livelihoods enhancing food security and nutrition ranked 2nd. This implies that EFLU has a positive impact on food availability and nutrition by supporting key sectors like production of arable crops, permanent crops, animals and fish as more important socio-livelihoods activities. This concurs with Sustainable Development Goal (SDG) 2 on Zero Hunger, as forest ecosystem services directly support food security, enhance nutrition, and promote sustainable agriculture by providing essential resources and maintaining the health of ecosystems critical for food production (Food and Agriculture Organization of the United Nations, 2015). In addition, findings reveal increased resilience by EFLU in reducing vulnerability to floods, droughts, and other climate-related shocks ranked 3rd. This indicates that EFLU approach enhances community resilience, enabling them to better withstand and adapt to climate-related challenges. This corroborates SDG 15 on life on land which focuses on protecting, restoring, and sustainably using terrestrial ecosystems, including forests which align with SDG 13 on climate action entrench on

strengthening resilience and adaptive capacity on climate-related hazards as forests are crucial for mitigating climate change and building resilience (Bowyer et al., 2018). To sum-up, EFLU has positive impacts generally on sustainable development for ensuring a healthier environment, lands, soils, and water supply for agricultural and fisheries production, overall livelihood supports, total food safety net combating hunger, and enforcing resilience to floods, droughts, and climate-related hazards.

Table 2. Perceived Benefits of Ecosystem-based Forestry Land Use (N= 250)

Ecosystem-Based Forestry Land Use	Highly Effective	Effective	Mildly Effective	Not Effective	Mean Scores	Rank
Flood mitigation from ecosystem-based forestry land-use (EFLU) protects home, agricultural lands and infrastructure enhancing food safety and stable income	35 (14.0)	115 (46.0)	75 (30.0)	25 (10.0)	1.6	5 th
Sustainable livelihoods from EFLU generate income and employment opportunities improving overall well-being	30 (12.0)	125 (50.0)	68 (27.2)	27 (10.8)	1.6	5 th
Environmental benefits from EFLU support agriculture, fisheries and other livelihoods enhancing food security and nutrition	50 (20.0)	130 (52.0)	70 (28.0)	0 (0.0)	1.9	2 nd
Increased restoration reduces vulnerability to floods, droughts, and other climate-related shocks	45 (18.0)	132 (52.8)	65 (26.0)	8 (3.2)	1.8	3 rd
EFLU improves food security which increases access to nutrition, better health, and well-being	32 (12.8)	141 (56.4)	60 (24.0)	17 (6.8)	1.7	4 th
EFLU enforces carbon sequestration which contributes to global efforts to reduce greenhouse gas emission supporting sustainable development	75 (30.0)	120 (48.0)	41 (16.4)	14 (5.6)	2.0	1 st
EFLU supports community empowerment which enhances community capacity to manage natural resources	28 (11.2)	117 (46.8)	85 (34.0)	20 (8.0)	1.6	5 th

NB* Figures in parentheses are percentages

Source: Field survey.

Impact of Ecosystem-based Forestry Land Use for Flood Risk Mitigation

Table 3 presents the ecosystem-based forestry land-use (EFLU) practices employed in the study area for flood risk mitigation. Tree planting, with a mean score of 1.8, was the most extensively utilised EFLU and ranked first. It was partially practiced by most residents (98.4%) in Lagos, Oyo, and Ogun States, respectively. Following this, the conservation of trees and shrubs in upland areas (mean = 1.6) ranked as the second most prominent EFLU, with partial use among majority of residents (78.0%). Similarly, stream bank stabilisation through re-vegetation, also with a mean of 1.6, shared the second rank, with partial utilisation among majority of residents (77.6%) in South West Nigeria. Additionally, de-silting of streams and rivers, with a mean score of 1.0, ranked third, with partial use reported by 49.2% residents who never used EFLU and about 50.4% of residents who partially used EFLU in

South West Nigeria. This corroborates with Hu et al. (2025) and Firoozi & Firoozi, (2024) that forest trees have significant use for mitigating flooding by influencing hydrological processes indirectly and altering soil properties to enhance infiltration of running waters. Furthermore, sustenance of the natural environment (mean = 0.7) ranked as the fourth most popular EFLU, with partial adoption rates of EFLU never used by residents (64.8%) and partially used by residents (35.2%). Similarly, landscaping, planning, and beautification of the environment (mean = 0.7) attracted residents who never used EFLU(65.6%) and residents who partially used EFLU (34.4%), respectively. These findings indicate that tree planting, tree conservation, and streambank stabilisation were the most practiced forest land-use strategies with relatively high utilisation. This corroborates Ellison et al., (2017) that forest ecosystems play a vital role in regulating hydrological processes, enhancing sustainability, and supporting climate adaptation and mitigation efforts. In contrast, other approaches such as desilting of streams, sustenance of the natural environment, and environmental landscaping exhibited lower levels of use in South West Nigeria. Overall, this suggests that ecosystem-based forestry land-use (EFLU) practices are generally underutilised in the region.

Table 3. Impact of Ecosystem-Based Forestry Land Use for Flood Risk Mitigation (N= 250)

Ecosystem-Based Forestry Land Use	Category of Utilisation				Mean	Rank
	NU	US	PU	FU		
Planting of trees	4 (1.6)	-	246 (98.4)	-	1.8	1 st
Conservation of trees	55 (22.0)	-	195 (78.0)	-	1.6	2 nd
Streambanks stability by revegetation	56 (22.4)	-	194 (77.6)	-	1.6	2 nd
Desilting of rivers and culverts in vulnerable communities	123 (49.2)	-	126 (50.4)	1 (0.4)	1.0	3 rd
Sustenance of the natural environment	162 (64.8)	-	88 (35.2)	-	0.7	4 th
Landscaping and beautification planning of the environment	164 (65.6)	-	86 (34.4)	-	0.7	4 th
Agroforestry practices	250 (100.0)	-	-	-	0.0	5 th
Green fencing with trees and shrubs in the floodplain	250 (100.0)	-	-	-	0.0	5 th

Note: Never used: NU; Used but stopped: US; Partially in use: PU; Fully in use: FU

Figures in parentheses are percentages

Source: Field survey.

Hypothesis testing for a relationship between extent of awareness and impact of EFLU

Ho1: There is no significant relationship between extent of awareness of government interventions and impact of ecosystem-based forestry land use (EFLU)

The study (Table 4) revealed no significant relationship between the extent of residents’ awareness of government and non-governmental organisations’ roles in flood combat and several specific interventions, including desilting of rivers ($\chi^2 = 1.09$, $p = 0.777$), prohibition of construction on floodplains ($\chi^2 = 4.54$, $p = 0.208$), sensitisation and early warning of flooding ($\chi^2 = 1.72$, $p = 0.631$), government warnings on relocation from floodplains ($\chi^2 = 2.37$, $p = 0.498$), refuse prohibition into drainage and rivers ($\chi^2 = 2.06$,

$p = 0.558$), and tree planting as an ecosystem-based forestry land use (EFLU). This suggests that these government interventions may not be effectively enforced, making it difficult to assess their influence on tree planting as an EFLU strategy. This concurs with Lopes et al. (2018) who emphasised that forest vegetation both in rural and urban landscapes enhances rainwater infiltration, particularly in flood-prone ecosystems.

Table 4. Chi-square Analyses of Extent of Awareness of Government's Interventions and Impact of Ecosystem-based Forestry Land Use

Extent of Awareness of Government's Interventions	Ecosystem-Based Forestry Land Use [df=(6-1) (6-1)]					
	Tree planting	Conservation of trees	Sustenance of natural environment	Stream bank stabilisation	Desilting of streams and rivers	Landscaping and environment
Government and non-government organisation role in combating flood	0.93 (0.816) ^{ns}	18.31 (1×10 ⁻⁴)*	20.28 (1.2×10 ⁻⁴)*	19.19 (1×10 ⁻⁴)*	5.01 (0.542) ^{ns}	22.66 (1.1×10 ⁻⁴)*
Desilting of river frequently	1.09 (0.777) ^{ns}	22.07 (1×10 ⁻⁴)*	11.88 (0.01)*	22.85 (1×10 ⁻⁴)*	18.40 (0.01)*	12.43 (0.01)*
Prohibition of building construction on floodplain	4.54 (0.208) ^{ns}	52.19 (1×10 ⁻⁴)*	10.40 (0.02)*	51.67 (1.1×10 ⁻⁴)*	71.84 (1×10 ⁻⁴)*	10.07 (0.02)*
Sensitisation and early warning of flooding	1.72 (0.631) ^{ns}	18.92 (1×10 ⁻⁴)*	27.88 (1.1×10 ⁻⁴)*	19.06 (1.3×10 ⁻⁴)*	21.81 (1×10 ⁻³)*	28.12 (1×10 ⁻⁴)*
Government warning on relocation from flood-prone areas	2.37 (0.498) ^{ns}	14.64 (2×10 ⁻³)*	33.42 (1×10 ⁻⁴)*	15.05 (1×10 ⁻⁴)*	29.85 (1.2×10 ⁻⁴)*	36.53 (1×10 ⁻⁴)*
Prohibiting Dumping of refuse into drainages and rivers	2.06 (0.558) ^{ns}	27.89 (1×10 ⁻⁴)*	20.37 (1.2×10 ⁻⁴)*	27.24 (1×10 ⁻⁴)*	6.31 (0.389) ^{ns}	23.05 (1.1×10 ⁻⁴)*

Note: χ^2 - values outside parentheses, p-values are in parentheses, Degree of Freedom (df) = 25, ns - not significant and *Significant $p \leq 0.05$

Source: Field survey.

However, there was a significant relationship between the extent of residents' awareness of the roles of government and non-governmental organisations in combating flooding and the utilisation of tree conservation in upland areas ($\chi^2 = 18.31$, $p = 1 \times 10^{-4}$); sustenance of natural environment ($\chi^2 = 20.28$, $p = 1.2 \times 10^{-4}$); stream bank stabilisation by vegetation ($\chi^2 = 19.19$, $p = 1 \times 10^{-4}$); and landscaping of environment ($\chi^2 = 22.66$, $p = 1 \times 10^{-4}$). This indicates that that government's efforts to combat flooding are closely linked to tree conservation which helps absorb excess rainwater and reduce flood risk; sustaining natural environment which preserves natural habitats and mitigates flood impacts; streambank stabilisation reduces sedimentation and flood risk; while well-designed landscaping could absorb rainwater, reduce runoff and flood risk, thereby promoting ecosystem health. This corroborates Zhu et al., (2025) that forest soils are generally porous, promoting infiltration and reducing surface runoff. It also aligns with Adeoye et al. (2025) that ecosystem services derived from well-managed forest landscapes help stabilise soils, reduce surface runoff and erosion, and function as natural buffers that moderate the intensity and impacts of flooding.

Furthermore, there was a significant relationship between extent of residents' awareness of river desilting and utilisation of tree conservation practices in upland areas ($\chi^2 = 22.07$, $p = 1 \times 10^{-4}$); sustenance of natural environment ($\chi^2 = 11.88$, $p = 0.01$); streambank stabilisation ($\chi^2 = 22.85$, $p = 1 \times 10^{-4}$); and landscaping of environment ($\chi^2 = 12.43$, $p = 0.01$). This suggests that when river desilting is combined with these ecosystem-based forestry land-use practices, it helps reduce sediment load, improve water quality, and enhance ecosystem health through preservation of natural habitats and promoting biodiversity.

In addition, the study found a significant relationship between the extent of residents' awareness of the prohibition on building in flood-prone areas and several ecosystem-based forestry land-use (EFLU) practices: tree conservation in upland areas ($\chi^2 = 52.19$, $p = 1 \times 10^{-4}$), sustenance of the natural environment ($\chi^2 = 10.40$, $p = 0.02$), stream bank stabilisation ($\chi^2 = 51.67$, $p = 1.1 \times 10^{-4}$), desilting of streams and rivers ($\chi^2 = 71.84$, $p = 1 \times 10^{-4}$), and landscaping of the environment ($\chi^2 = 10.07$, $p = 0.02$). This suggests that effective flood risk management in the study area requires a holistic approach that integrates environmental conservation with sustainable land-use practices.

By enforcing the prohibition of construction on flood-prone areas, the risk of flooding can be mitigated while simultaneously protecting the natural environment. In conclusion, the significant relationships observed between residents' awareness of institutional interventions by government agencies and the adoption of EFLU practices indicate a positive impact on flood risk mitigation in flood-prone communities of South West Nigeria.

Conclusions and Recommendations

The findings of this study demonstrate that residents in flood-prone communities of South West Nigeria possess varying levels of awareness regarding government interventions for flood risk mitigation. The highest level was awareness regarding the discouragement of refuse dumping into drainages and rivers, followed by relocation warnings from flood-prone areas and sensitisation on early flood warnings. However, awareness of broader ecosystem-based forestry land-use (EFLU) strategies such as agroforestry, tree conservation, and reforestation remained relatively low, indicating a substantial knowledge gap in understanding nature-based approaches to flood mitigation. Despite this limited awareness, residents perceived significant environmental and socio-economic benefits from EFLU practices, particularly in terms of carbon sequestration, support for agriculture and livelihoods, and enhancement of resilience to climate-related hazards such as floods and droughts. These perceived benefits highlight the potential contribution of ecosystem-based land use to sustainable development and climate adaptation within the region. Furthermore, the results reveal that tree planting, conservation of trees and shrubs, and stream bank stabilisation were the most practiced EFLU strategies, although overall adoption levels remain moderate to low. A further analysis showed that while some government interventions had no significant relationship with certain ecosystem-based forestry land-use (EFLU) practices, institutional awareness was significantly associated with practices such as tree conservation, natural environmental sustenance, stream bank stabilisation, and environmental landscaping.

Based on the findings of this study, the following policy measures are recommended:

1. Enhance public awareness of the flood-mitigation benefits of ecosystem-based forestry practices.
2. Encourage community participation in tree planting and riparian vegetation restoration.
3. Integrate forestry land use into land-use planning for natural flood regulation.
4. Highlight livelihood benefits such as improved ecosystem services and local resource security.
5. Promote reforestation in flood-prone areas to strengthen natural flood buffers.
6. Provide capacity building on ecosystem-based flood management practices.
7. Offer incentives to encourage adoption of forestry land use strategies.
8. Monitor community perceptions of the effectiveness of ecosystem-based forestry for flood risk reduction.

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