



AWARENESS ON THE IMPORTANCE OF ECOSYSTEM SERVICES BY RURAL HOUSEHOLDS AROUND DANSOSHIYA FOREST AND FALGORE GAME RESERVES, KANO STATE NIGERIA

¹Haris, I.A. and ²Ibrahim, H.Y.

¹Department of Forestry and Wildlife Management, Federal University Dutsin-Ma.

²Department of Agricultural Economics, Federal University Dutsin-Ma.

ibrahimaliyuharis@gmail.com/08062473553

ABSTRACT

Forests play an important role in human existence as it offers a wide range of resources, and ecosystem services such as carbon, and oxygen production which are both vital for human existence on earth. The dependence upon these services (formally known as ecosystem services) makes human beings reliant on the immediate ecosystems for their subsistence. The study therefore assessed the level of awareness and importance of ecosystem services by rural household in Dansoshiya Forest and Falgore Game reserves in Kano State, North Western Nigeria. All households in villages within a 7km radius from the two forest reserves constituted the population for the study and a sample of 366 households was obtained as the sample size for the study. The data used for the study were collected with the aid of a well-structured questionnaire. Descriptive statistics was used to determine the awareness level and use value and fidelity level was used to determine the relative importance of ecosystem services in the two forests. The result shows that, there is a moderately high level of awareness of ecosystem services in the study area and the provisioning ecosystem services such as wild foods, livestock feed, plant-derived medicine, crops, livestock, fuel and fresh water were considered as the most important. The study concludes that, despite the high awareness level of some ecosystem services, however, with the exception of pollination that account for 60.9 percent awareness level, ecosystem services that are important for agricultural production, such as soil formation, nutrient cycling, regulation of disease and pests, are not well known to most respondents.

Keywords: Ecosystem services, game reserves, provisioning services, awareness

Introduction

Forests plays an important role in human existence as it offers a wide range of resources, and ecosystem services such as carbon storage, and oxygen production which are both vital for human existence on earth. They, help in the regulation of the water cycle, water purification, provide wildlife habitat, reduction of global warming, as well as absorbing toxic gases, conserve soil and above all connect humans with nature (Saka-razaq, 2019).

The dependence upon these services (formally known as ecosystem services)

makes human beings reliant on the immediate ecosystems for their subsistence (Gouwakinnou *et al.*, 2019). Ecosystem services (ES) are all the benefits which mankind can derive from the natural ecosystems for their physical, social, and economic well-being (Millennium Ecosystem Assessment, 2005). A well-functioning ecosystem have wide-ranging importance for human needs by providing benefits like food, building materials, medicines, climate regulation, disease prevention, provision of clean air, water,



soils, and landscape for cultural services and spiritual purpose (Vo *et al.*, 2012).

The concept of services and benefits provided by an ecosystem to human and their livestock is not novel. However, the concept is only popular and accessible to only professional (Gouwakinnou *et al.*, 2019). The benefits gained from ecosystem services are mostly ignored, misunderstood and wrongly perceived (Djossa *et al.*, 2012). On the other hand, forest resources are used in an unsustainable manner (Zhang *et al.*, 2016).

This can be attributed to inadequate understanding or awareness of the benefits of ecosystem services among the forest dependent communities. Consequently, this has led to widespread biodiversity loss, loss in forest structure, climate change, pollution, and environmental conflict which in turn lessen the ability of forest reserves to Studies on ecosystem services in Nigeria are very limited and in fact the concept has

Methodology

The Study was carried out around Dansoshiya Forest and Falgore Game Reserves, in Kano State, North Western Nigeria.

Dansoshiya Forest Reserve

Dansoshiya Forest Reserve is located at latitude 11° 32' 18" N and longitude 8° 4' 26" E in Kiru local government area; it has an estimated land area of 6870 ha and it has an annual average temperature of 25 °C . It is warmest in April up to 30°C , and the coolest at 21°C through August. The average rainfall per year is 1,203 millimeters (NEWMAP, 2019).

Falgore Game Reserve

Falgore Game Reserve is located between longitudes 8° 30' and 8° 50' East and latitudes 10° 46' and 11° 20' North, 150 km South of Kano City. It has an estimated land area of 92,000 ha is located some 110 km south of

provide the essential ecosystem services that are of benefit to human (Parrotta *et al.*, 2016).

Local communities rely and depend on forest ecosystems for several services or benefits that the forests can provide without any conscious attempt or effort on their sustainable management. In most developing countries, resources are used in an unsustainable manner (Zhang *et al.*, 2016). This situation makes a sustainable management of these forests a great challenge to forest managers and to policy makers because the community is heavily dependent on them and it is not clear how forest dependent communities who are the main players in forest dynamics and the immediate beneficiaries of ecosystem services have understood or perceive the concept of forests ecosystem services (Gouwakinnou *et al.*, 2019).

received limited research interest (Zhang *et al.*, 2016). Hence, this research.

Study Area

Kano on the Jos–Kano road. The vegetation is open Northern Guinea Savanna woodland with elements of the Sudan Savanna in the north. Tree heights reach 9–14 m. The northern boundary is formed by the artificial Lake Tiga which, when full, submerges the north-western tip of the reserve. The reserve is bisected by the Kano River which, together with its tributaries, the Maiwa, Kumbo and Randa, drains the reserve. To the south-east of Falgore lies Lame Burra Game Reserve (205,900 ha) in Bauchi State (Bird Life International, 2021).

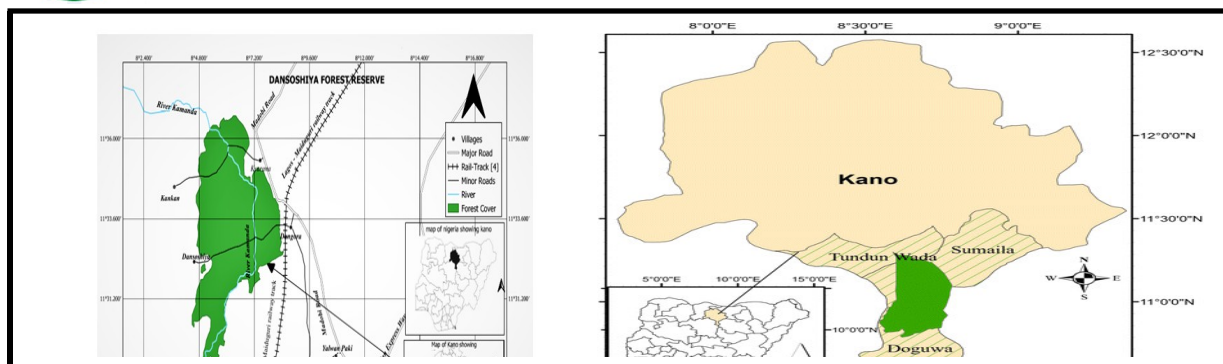


Fig. 1: Map of Dansoshiya Forest Reserve and Falgore Game Reserve

Population of the Study and Research Design

All households in villages within a 7km radius from the two forest reserves constitute the population for the study. A cross sectional sample survey design was adopted for the study.

Sampling Procedure:

A total number of 35 villages (19 from Dansoshiya Forest Reserve and 16 from Falgore Game Reserve) were obtained as the sampling frame of villages for the study. Furthermore, 50% of the number of villages around the two forest reserves were selected

randomly (10 villages from Dansoshiya Forest Reserve and 8 from Falgore Game Reserve) for the study. Using the sampling frame of all households in the 18 villages selected a sample size of 366 households was obtained as the statistically appropriate sample size for the study as recommended by the Raosoft sample size calculator (Raosoft, 2004). Proportionate sampling was used to obtain the proportion of the households to be selected per village. Finally, simple random sampling via balloting was used to select the respondents from each village.

Table 1: Sampling Frame and Sample Size

Location	Village	Number of Households	Number Selected	Households
Dansoshiya Forest Reserve	Dansoshiya	180	9	
	Dangora	1055	50	
	Gabari	365	17	
	Kyarana	305	14	
	Kotoko	47	2	
	Unguwarmani	90	4	
	Bakinkamanda	79	4	
	Balbelu	123	6	
	Unguwardikko	102	5	
	Tsawa-tsawa	57	3	
	Sub-total		2403	114
Falgore Game Reserve	Falgore	2194	104	
	Yantabarmi	123	6	
	Sabuwarkaura	177	9	
	Kwandura	187	9	
	Gomo	701	33	



Ziria	515	24
Makwasa	629	30
Farunruwa	792	37
Sub-total	5318	252
Total	7721	366

Data Collection

The data used for the study was collected with the aid of a structured questionnaire administered to the respondents by trained enumerators as well as the researcher.

Data Analysis:

Descriptive statistics was used to determine the awareness level and the perception of ecosystem services trends in the two forests. Use value and fidelity level was used to determine the relative importance of ecosystem services in the two forests.

Use value (UV) is a method of expressing the relative importance of ecosystem services for the inhabitants (Phillips *et al.*, 1994):

$$UV = \frac{\sum_i U_i}{n} \dots\dots\dots 1$$

Where U_i is the number of citations for each ecosystem service and n is the total number of informants.

Fidelity Level (FL) of informants is useful for identifying the most preferred ecosystem services and will be determined using the formula described in (Kimpouniet *al.*, 2021):

$$FL = \left(\frac{N_p}{N} \right) \times 100 \dots\dots\dots 2$$

Where N_p is the number of people who cited a type of ecosystem service or use and N is the total number of people who derive some ecosystem service from it.

Awareness of cultural ecosystem services among the respondents

Majority of the respondents, in fact more than 70% are aware of cultural ecosystem

Results and Discussion

Level of ecosystem services awareness in the study area

Awareness of provisioning services among the respondents

The majority of respondents are aware of provisioning ecosystem services such as wild foods, livestock feed, plant-derived medicine, crops, and fuel (Table 2), and this shows that provisioning services are very important to them as it provide tangible resources to the forest fringe communities. This means that provisioning services were generally easier to identify to be aware as compared to the other ecosystem services. This is consistent with findings from previous studies (Zhang *et al.*, 2016; Gouwakinnou *et al.*, 2019).

Awareness of regulating and supporting ecosystem services among the respondents

The awareness of regulating and supporting services was low compared to provisioning services (Table 2). The respondents are mostly aware of regulating and supporting ecosystem services such as the regulation of air quality, erosion regulation and climate regulation which accounts for 85.5 percent, 83.6 percent and 73 percent respectively. However, except pollination that account for 60.9 percent, ecosystem services that are important for agricultural production, such as soil formation, nutrient cycling, regulation of disease and pests, are not well known to most respondents.

services such as sense of place and education and knowledge. Aesthetic value and cultural practices are the component of cultural ecosystem services that have lowest



awareness level among the respondents. This implies that, the respondents are

Awareness of ecosystem services categories among the two forest reserves

When the awareness of ecosystem services categories between the two forest reserves was compared for the respondents, the results show that, respondents around Falgore Game Reserve have a higher level of awareness of provisioning services (78.3

mostly not aware of cultural ecosystem services (Table 2).

%). this a little bit higher to the awareness level of (73.6%), for respondents, around Dansoshiya Forest Reserve. A similar pattern was also observed for cultural ecosystem services. However, the awareness level for regulating and supporting services was higher at Dansoshiya Forest Reserve compared to Falgore Game Reserve (Fig. 2).

Table 2: Awareness of provisioning ecosystem services among the respondents

Services	Frequency	Percentage
Wild foods (Game)	366	100
Livestock Feed	351	95.9
Crops	307	83.9
Fuel	325	88.8
Livestock	292	79.8
Plant-derived medicines	361	98.6
Fresh water	290	79.2
Genetic resources	120	32.8
Aqua-cultural fish	254	69.4
Ornamental resources	146	39.9
Regulation of air quality	313	85.5
Pollination	223	60.9
Erosion regulation	306	83.6
Soil formation	129	35.2
Climate regulation	267	73.0
Water purification	156	42.6
Nutrient cycling	159	43.4
Waste treatment	130	35.5
Noise buffering	102	27.9
Regulation of diseases & pest	125	34.2
Natural hazard regulation	225	61.5
Cultural practices	125	34.2
Spiritual values	152	41.5
Recreation	249	68.0
Education & knowledge	270	73.8
Aesthetic values	114	31.1
Cultural heritage	166	45.4
Ecotourism	238	65.0
Sense of place	275	75.1

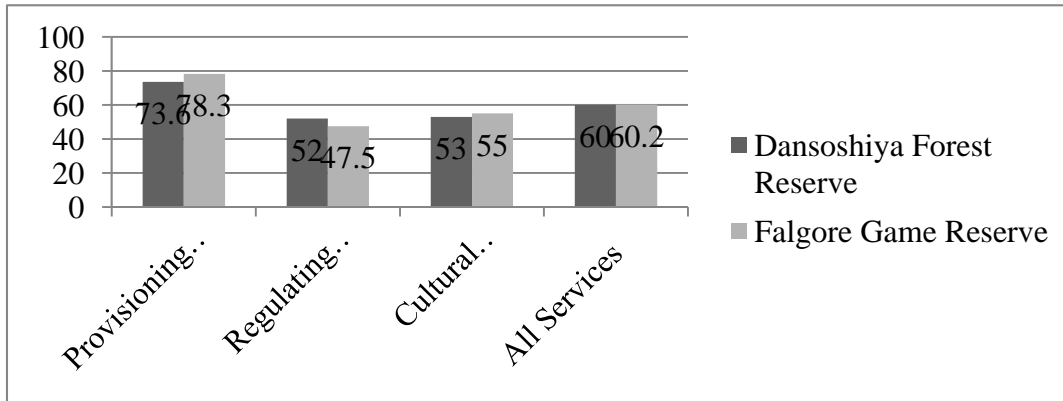


Fig. 2: Awareness level categories by forest reserves

Relative importance of ecosystem services in the study area

Use value and fidelity level of ecosystem services categories around Dansoshiya Forest Reserve

The use value of ecosystem services around Dansoshiya Forest Reserve as a whole range from 4.38 to 7.40. For functions, each ecosystem services values range from 0.26 to 1.0. The total use value (UVt) for Dansoshiya Forest Reserve is 17.43 (Table 3). The high values of this parameter are indicative of forest resource exploitation by the respondents. Given the increase in the population and the benefit associated with tangible goods, in particular, this shows that, the ecosystem services satisfy the duality of provisioning and demand (Kimpouni *et al.*, 2021).

The most prominent ecosystem service is provisioning services and it is associated with services such as, wild foods, livestock feed, crops, fuel, and plant-derived medicine (Table 3). Considered individually, majority of the 10 provisioning services among the

29 ecosystem services receives more than 3.4% of fidelity level with the exception of genetic resources, aqua-cultural fish and ornamental resources (Table 3). In general, provisioning services account for 42.4 percent, this shows that, this service is important and useful to the communities.

For regulating and supporting service, erosion regulation and regulation of air quality are the only services that receive more than 3.4 percent fidelity level (5.0 %) and (4.6%) respectively, this service receive a total of 32.4 percent lower than provisioning services, this shows that, it relevance is not much (Table 3). cultural services which include education and knowledge, recreation and sense of place were the most significant (4.3, 4.0 and 3.9 %) fidelity level. Based on categories of ecosystem services, cultural services represent 25.2 percent lower than both provisioning and regulating and supporting services. This shows that, cultural services were not much relevant to the forest dependent communities compared to others services.

Table 3: Use value and fidelity level of ecosystem services categories around Dansoshiya Forest Reserve

Categories	Ecosystem Services	U_i	UV	FL	U_i	UVt	FL
Provisioning	Wild foods (Game)	114	1.00	5.7			
	Livestock feed	110	0.96	5.5			
	Crops	104	0.91	5.2			



	Fuel	98	0.86	4.9			
	Livestock	95	0.83	4.8			
	Plant-derived medicines	114	1.00	5.7	845	7.40	42.4
	Fresh water	81	0.71	4.1			
	Genetic resources	34	0.30	1.7			
	Aqua-cultural fish	65	0.57	3.3			
	Ornamental resources	30	0.26	1.5			
Regulating and Supporting Services	Regulation of air quality	91	0.81	4.6			
	Pollination	57	0.50	2.9			
	Erosion regulation	99	0.87	5.0			
	Soil formation	41	0.36	2.1			
	Climate regulation	91	0.81	4.6			
	Water purification	49	0.43	2.5	641	5.65	32.4
	Nutrient cycling	50	0.44	2.5			
	Waste treatment	36	0.32	1.8			
	Noise buffering	30	0.26	1.5			
	Regulation of diseases & pest	32	0.28	1.6			
	Natural hazard regulation	65	0.57	3.3			
Cultural Services	Cultural practices	52	0.46	2.6			
	Spiritual values	65	0.57	3.3			
	Recreation	79	0.70	4.0			
	Education & knowledge	86	0.75	4.3			
	Aesthetic values	31	0.27	1.6	499	4.38	25.2
	Cultural heritage	47	0.41	2.4			
	Ecotourism	62	0.54	3.1			
	Sense of place	77	0.68	3.9			
Total		1985	17.43	100	1985	17.43	100

Use value and fidelity level of ecosystem services categories around Falgore Game Reserve

The use value of ecosystem services around Falgore Game Reserve as a whole ranges from 5.41 to 7.47. For functions, each ecosystem services values range from 0.27 to 0.97. The total use value (UVt) for Falgore Game Reserve is 17.09 (Table 4). The high values of this parameter are indicative of forest resource exploitation by the respondents. Given the increase in the population and the benefit associated with tangible goods, in particular, this shows that, the ecosystem services satisfy the

duality of provisioning and demand (Kimpouni *et al.*, 2021).

The most prominent ecosystem service is provisioning services and it is associated with services such as, wild foods, plant-derived medicine, livestock feed, fresh water, fuel, and livestock (Table 4). Considered individually, majority of the 10 provisioning services among the 29 ecosystem services receives more than 3.4% of fidelity level with the exception of genetic resources, and ornamental resources (Table 4). In general, provisioning services account for 43.6 percent a little bit higher than provisioning services in Dansoshiya



Forest Reserve, this shows that, this service is important and useful to the communities.

For regulating and supporting service, regulation of air quality, erosion regulation and climate regulation were the only services that receive more than 3.4 percent fidelity level (5.2 %), (4.1%) and (3.9%) respectively, this service receive a total of 31.7 percent lower than provisioning services, this shows that, it service is not much useful to the respondents or they are not aware of it essentiality (Table 4).

cultural services which include sense of place, education and knowledge, recreation and ecotourism were the most significant (4.5, 4.3, 4.2 and 4.2 %) fidelity level. Based on categories of ecosystem services, cultural services represent 24.7 percent lower than both provisioning and regulating and supporting services. This shows that, cultural services were not much relevant to the forest dependent communities compared to others services.

Table 4: use value and fidelity level of ecosystem services categories in Falgore Game Reserve

Categories	Ecosystem Services	U_i	UV	FL	U_i	UVt	FL
Provisioning Services	Wild foods (Game)	244	0.97	5.6			
	Livestock feed	234	0.93	5.4			
	Crops	176	0.70	4.1			
	Fuel	209	0.83	4.8			
	Livestock	196	0.77	4.5			
	Plant-derived medicines	241	0.96	5.6	1885	7.47	43.6
	Fresh water	210	0.83	4.9			
	Genetic resources	86	0.34	2.0			
	Aqua-cultural fish	185	0.73	4.3			
Ornamental resources	104	0.41	2.4				
Regulating and Supporting Services	Regulation of air quality	222	0.88	5.2			
	Pollination	144	0.57	3.3			
	Erosion regulation	179	0.71	4.1			
	Soil formation	88	0.35	2.0			
	Climate regulation	165	0.65	3.9			
	Water purification	107	0.42	2.6	1365	5.41	31.7
	Nutrient cycling	86	0.34	2.0			
	Waste treatment	96	0.38	2.2			
	Noise buffering	78	0.31	1.8			
	Regulation of diseases & pest	75	0.30	1.7			
Natural hazard regulation	125	0.50	2.9				
Cultural Services	Cultural practices	82	0.32	1.9			
	Spiritual values	70	0.27	1.6			
	Recreation	180	0.71	4.2			
	Education & knowledge	185	0.73	4.3			
	Aesthetic values	67	0.27	1.5	1070	4.21	24.7
	Cultural heritage	110	0.43	2.5			
Ecotourism	180	0.71	4.2				



	Sense of place	196	0.77	4.5			
Total		4320	17.09	100	4320	17.09	100

Discussion

Awareness of ecosystem services

The awareness of ecosystem services varies within the local community. This suggests the complexity of the relationship between local perceptions and ecosystem services (Boafo *et al.*, 2014). Provisioning services were more widely perceived, followed by regulating, and supporting services, and lastly cultural services. This result is explained by the tangible nature of provisioning services, unlike regulating and supporting services and cultural services (Zhang *et al.*, 2016).

Besides, provisioning services are directly involved in community well-being. This result corroborates those of Zhang *et al.*, (2016), Gouwakinnou *et al.*, (2019); Ahononga *et al.*, (2020); and Nyangoko *et al.*, (2021) and suggests that tangible services directly affect the community, unlike indirect services (Ouko *et al.*, 2018). The most cited provisioning services in the study areas being the supply of wild food (game), livestock feed, plant-derived medicine, fuel (wood energy), and crops, this result shows the dependence of the local community to close-ecosystem which provide services for their well-being, because they are important to them and satisfy the majority of the population. This support the findings that rural community prioritizes substantial ecosystem benefits (Martín-López *et al.*, 2012) whereas the urban community values only the more abstract services (Kroll *et al.*, 2012).

On the other hand, the local perception of regulating and supporting services was low compared to provisioning services. And supporting services are the main basis for the production of provisioning services

(Ahononga *et al.*, 2020). The respondents are mostly aware of regulating and supporting ecosystem services such as the regulation of air quality, erosion regulation and climate regulation

However, except pollination, ecosystem services that are important for agricultural production, such as soil formation, nutrient cycling, regulation of disease and pests, are not well known to most respondents. This result confirms the findings of previous studies those of Zhang *et al.*, (2016), Gouwakinnou *et al.*, (2019) and Ahononga *et al.*, (2020). The inability of forest dependent communities to be aware of those services such as soil formation constitutes the reasons for land use without any sustainable land management initiative (Ahononga *et al.*, 2020). This is disturbing for sustainable land management because the population of the two forest reserves is mainly constituted of farmers. This result shows the importance of integrating a policy to sensitize people to strengthen the local perception of ecosystem services. This also confirms the relationship between the development level and the perception of indirect services. The under-developed localities, is concerned more with the improvement of its livelihood rather than with the factors of which depend on this livelihood. The low level of satisfaction with these services also shows the decline in forests, which modifies the ecological function of forest ecosystems.

Cultural services, although intangible, contribute to the protection of biodiversity and therefore to the maintaining of ecosystem service. The services cited by the community related sense of place, and education and knowledge systems. The perception of these services depends on



education rate of the communities (Gouwakinnou *et al.*, 2019). The local community also expressed the importance of cultural services. This result also shows the community's link to their forest. This cultural importance of forests should reflect the positive attitudes of the community towards the conservation of the natural forests of each region. The study by Fritz-Vietta, (2016) in Madagascar is a case where populations protect some of forests and trees for spiritual beliefs aimed at increasing well-being. Nowadays, we notice in the two study areas an uncontrolled exploitation of ecosystems as well as community forests dedicated to conservation. The regressive trend of these cultural services suggests the forests are losing their sacred aspect (Ryan *et al.*, 2016) what impact conservation practices.

According to Mama *et al.*, (2013) as cited by Ahononga *et al.*, (2020), the socioeconomic changes of human societies through the non-respect of ancestral nature conservation practices based on the development of myths and fear by the younger generation is the cause of the deterioration of forest ecosystems and therefore cultural services. Taking into account the diversity of advantages offered by forest ecosystems and participatory decision-making can facilitate integrated forest management in types of land use (Ahammad *et al.*, 2019). Forest policy, focus on increasing of number of forest species, should take into account the aspirations and satisfaction of ES to increase the interest of populations in adapting to land use planning.

Relative importance of ecosystem services

Ecosystem services were seen as quite important in both Dansoshiya Forest and Falgore Game Reserves. Provisioning services were considered the most important by the studied villages, which demonstrated the dependence of households on

provisioning services (Boafo, *et al.*, 2014). The most prominent ecosystem service is provisioning services and it is associated with services such as, wild foods, plant-derived medicine, livestock feed, fresh water, fuel, and livestock. Given the increase in the population and the benefit associated with tangible goods, in particular, this shows that, the ecosystem services satisfy the duality of provisioning and demand (Kimpouni *et al.*, 2021). The importance of forests as a genetic resource provider was not identified, suggesting a lack of community involvement in the conservation of genetic material of some species. Similar observations were made by Zhang *et al.*, (2016).

In addition, services such as soil formation and nutrient cycling, which are a fundamental support for agricultural production, were not very important to the studied villages despite the predominance of farmers. Only air quality, erosion regulation and climate regulation were perceived as important. This finding is similar to that of Gouwakinnou *et al.*, (2019). The results show that the communities appreciated the value of forest providing regulating services in terms of air quality, protection of erosion and climate regulation.

Furthermore, local communities in the study area relied more on the forests for cheap fuel wood compared to use of liquefied natural gas, as alternative sources for cooking energy. This finding aligns with observations by Makonese *et al.*, (2018), that rural people in nearby forests often use firewood to meet their basic cooking requirements due to its easier access and affordability. Cultural services, such as spiritual beliefs, and cultural heritage, aesthetic values, received lower scores than provisioning and regulating services. As such, local communities tend to live by the word of God and hence discourage issues of rituals and spiritual beliefs Nyangoko *et al.*,



(2021). On the other hand, cultural ecosystem services, such as education and knowledge, sense of place and recreation, had high scores, this implies its impact on the communities.

Conclusion

There is a moderately high level of awareness of ecosystem services in the study area and the provisioning ecosystem services were considered as the most important. The education and sensitization of forest dependent communities, poverty alleviation programmes and community participation on forest resource management and conservation can help to reduce the misuse of forest ecosystem services.

References

- Ahammad R, Stacey N, and Sunderland T.C.H. (2019): Use and perceived importance of forest ecosystem services in rural livelihoods of Chittagong Hill Tracts, Bangladesh. *Ecosystem Services*, 35, 87–98.
- Ahononga F.C, Gouwakinnou G.N, Biaou S.S.H, 1, Biaou S, and Sonounameto RC.(2020):Socioeconomic factors determining ecosystem services local perceptions in two ecological zones in Benin (West Africa). *International journal of biological and chemical sciences*, 14(5): 1716-1733.
- BirdLife International (2021): Important Bird Areas factsheet: Falgore and Lame Burra Game Reserves. Downloaded from <http://www.birdlife.org> on 22/09/2021.
- Boafo Y, Osamu S, and Takeuchi K. (2014): Provisioning ecosystem services in rural savannah landscapes of Northern Ghana: an assessment of supply, utilization and drivers of change. *Journal of Disaster Research*.9, 501–15.
- Djossa BA, Toni H, Dossa K,Azonanhoun P, and Sinsin B. (2012): Local perception ofecosystems services provided by bats and bees their conservation in Benin, West Africa. *International Journal of Biological and Chemical Sciences*, 6(5): 2034–2042.
- Fritz-Vietta N. (2016): What can forest values tell us about human well-being? Insights from two biosphere reserves in Madagascar.*Landscape Urban Planning*, 147, 28–37.
- Gouwakinnou G.N, BiaouSeverin, Vodouhe F.G, Tovihessi M.S, Awessou B.K. and Biaou H.S.S (2019): Local perceptions and factors determining ecosystem services identification around two forest reserves in Northern Benin.*Journal of ethnobiology and medicine* 15(61): 1-12.
- Kimpouni V., Nzila J. D. D., Wathandoudy N., Madzella-Mbiemo M. I., MouhamedYalloS. , and Kampe J.-P. (2021): Exploring Local People’s Perception of Ecosystem Services in Djoumouna Periurban Forest, Brazzaville, Congo, *International Journal of Forestry Research*, 2021, 1-17.
- Kroll F, Müller F, Haase D, and Fohrer N. (2012): Rural–urban gradient analysis of ecosystemservices supply and demand dynamics. *Land Use Policy*, 29, 521–535.
- Makonese, T.; Ifegbesan, A.P.; and Rampedi, I.T. (2018):Household cooking fuel use patterns and determinants across southern Africa: Evidence from the demographic and health survey data. *Energy Environ*, 29, 29–48.
- Martin-Lopez B, Iniesta-Arandia I, Garcia-Llorente M, Palomo I, Casado-Arzuaga I, Amo D, Gomez-Baggethun E, Oteros-Rozas E, Palacios-Agundez I, Willaarts B, Gonzalez J, Santos-Martin F, Onaindia M, Lopez-Santiago C, and Montes C. (2012): Uncovering ecosystem service bundles through social preferences. *PLoS One*, 7: e38970.
- Millenium Ecosystems Assesment (2005): Ecosystems and human well-being: biodiversity synthesis. Word Resources Institute Washington, DC.



- NEWMAP Kano (2019): The geography of Dansoshiya 'afforestation and land degradation sites' Nigerian Erosion and Watershed Management Project. From <https://www.kanonewmap.org/afforestation-and-land-degradation-sites/> on 20/09/2021.
- Nyangoko Baraka P., Berg Håkan, Mangora Mwita M., Gullström Martin and Shalli Mwanahija S. (2021): Community Perceptions of Mangrove Ecosystem Services and Their Determinants in the Rufiji Delta, Tanzania. *Sustainability*, 13, 63.
- Ouko C, Mulwa R, Kibugi R, Owuor M, Zaehringer J, and Oguge N. (2018): Community Perceptions of Ecosystem Services and the Management of Mt. Marsabit Forest in Northern Kenya. *Environments*, 5: 121.
- Parrotta John, Yeo-Chang Y, and Camacho L.D (2016): Traditional Knowledge for sustainable forest management and provision of ecosystem services, *International Journal of Biodiversity Science, Ecosystem Services & Management*, 12:1-2, 1-4.
- Phillips O., A. H. Gentry, C. Reynel, P. Galvez-Durand, and C. B. Gavez-Durand, (1994): Quantitative ethnobotany and Amazonian conservation, *Conservation Biology*, 8 (1): 225–248.
- Raosoftware Corporation (2004): Raosoftware Sample Size Online Calculator. Available from: <http://www.raosoftware.com/samplesize> assessed on 16/02/2023.
- Ryan CM, Pritchard R, Mcnicol I, Owen M, Fisher JA, Lehmann C, and Ryan CM. (2016): Ecosystem services from southern African woodlands and their future under global change. *Philosophical Transactions of the Royal Society B*, 371, 1-16.
- Saka-razaq Owolabi (2019): Forest Loss in Nigeria, the Impact on Climate and People from the Perspectives of illegal Forest activities and Government Negligence, Degree thesis for Bachelor of Natural Resources in Sustainable Coastal Management, Raseborg.
- Vo Q.T, Kuenzer C, Vo Q.M, Moder F, and Oppelt N. (2012): Review of valuation methods for mangrove ecosystem services. *Ecological Indicators* 23, 431–446.
- Zhang W., Kato E., Bhandary P., Nkonya E.M., Ibrahim H. I., Agbonlahor M. U., Ibrahim H.Y. and Cox C. (2016): Awareness and perception of ecosystem services in relation to land use types: Evidence from rural communities in Nigeria. *Ecosystem Services* 12(A): 150-160.