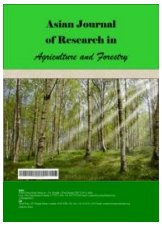

Asian Journal of Research in Agriculture and Forestry

7(3): 38-47, 2021; Article no.AJRAF.70939
ISSN: 2581-7418

Farmers' Preferences for Farming Enclaves in Forest Reserves of South-West, Nigeria: A Discrete Choice Experiment

Oluwaseun A. Otekunrin[1*], Alice T. Ademigbuji[2], Olutosin A. Otekunrin[3] and Mojisola O. Kehinde[3]

[1]Department of Statistics, Faculty of Science, University of Ibadan, Ibadan, Nigeria.
[2]Department of Forestry Technology, Federal College of Forestry, Ibadan, Nigeria.
[3]Department of Agricultural Economics and Farm Management, Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author OAO conceptualized the study, designed the study and wrote the first draft of the manuscript. Author ATA collected the data. Author OAO managed the literature searches. Author MOK performed the statistical analysis. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJRAF/2021/v7i330131
Editor(s):
(1) Dr. Hamid El Bilali, Mediterranean Agronomic Institute, Italy.
Reviewers:
(1) Eunjai Lee, National Institute of Forest Science, South Korea.
(2) Mohsen Bahmani, Sharekord University, Iran.
Complete Peer review History: https://www.sdiarticle4.com/review-history/70939

Original Research Article

Received 20 May 2021
Accepted 26 July 2021
Published 31 July 2021

ABSTRACT

Aims: Acquiring suitable land for agricultural purposes is a challenge for most prospective farmers in South-West, Nigeria. This makes them acquire lands in government-owned forest reserves with special contractual agreements. Therefore, we evaluate farmers' preferences for selected attributes of farming enclaves in four hypothetical forest reserves in South-West, Nigeria.
Study Design: An orthogonal main effects design was used to construct the choice sets used for preference elicitation.
Place and Duration of Study: The study was conducted in December, 2017 in randomly selected communities of Oluyole Local government area of Oyo State, South-West, Nigeria.
Methodology: Focus group discussions and relevant literature search were conducted to identify the relevant attributes. Four hypothetical forest reserves were considered and the selected

**Corresponding author: E-mail: oluseunoteks@gmail.com;*

attributes were size of the farmland, type of cropping system and land rent fee per hectare. Multistage sampling techniques were used to select 100 farmers and data were collected via face-to- interview. Multinomial logit model was used to analyse the data and willingness to pay for each of the selected attributes was also calculated.

Results and Conclusion: We find that farmers value intercropping system the most. The coefficient of land rent fee (per hectare) is negative and significant implying that farmers obtain higher utility from very low land rent fees. They are willing to pay an extra 12.50 US Dollars land rent fees (per hectare) to have intercropping on a particular farming enclave while avoiding other enclaves with other cropping systems. Farm size and taungya do not contribute significantly to the farmers' choice of farming enclave. These results will help forest reserve managers in formulating policies that will benefit farmers without jeopardising efficient management of forest resources.

Keywords: Farmland acquisitions; cropping systems; willingness to pay; multinomial logit model.

1. INTRODUCTION

One of the resources required for the efficient production of goods and services is land. Other resources, referred to as factors of production, are labour, capital and entrepreneurial ability [1]. Land encompasses all natural resources obtainable from fishing, agriculture and mining. It is critical to the attainment of sustainable development goals (SDGs) because of its major role in driving economic growth and serving as a source of livelihood, helping to reduce hunger and poverty for billions worldwide [2, 3, 4]. According to UN World Population Prospects [5], Nigeria has approximately 923,768 sq.km total surface area with a current estimated population of 2.1 hundred million people. About 70% of Nigerians are in the agricultural sector making land an important asset and its acquisition a major issue for many Nigerians [6, 7, 8]. Land acquisitions involve the purchase of ownership rights, acquisition of user rights over short or long period of time [9, 10]. One of the factors affecting land availability is the land tenure system. This system involves rights and institutions that governs the accessibility and usage of land [10]. The Land Use Act of 1978 gave state governors major roles in land administration activities while customary authorities have limited roles [11]. Despite this, most rural communities still practice the traditional land tenure system where land is acquired through inheritance. This leads to continuous land fragmentation making it impossible for the owners especially farmers to have a large expanse of land required for commercialized agriculture. Also, land acquisition through rent/lease especially for smallholder farmers has its limitations as most these farmers can only farm on the piece of land for a limited number of years making them prefer mostly arable crops over cash crops and discouraging agricultural commercialization [6, 10, 12]. Furthermore, available lands are in high demand for other purposes other than agriculture. This makes them to be very expensive and unaffordable for prospective farmers. Thus, these farmers move from one area to the other in search of farmlands that are fertile, bigger in size with cheaper land rent fees and possibly longer years of use [13, 14].

Farmers practice different cropping systems including monocropping, intercropping, taungya, relay and strip cropping systems among others. Monocropping is the planting of the same crop year after year on the same field. Intercropping is a system of growing two or more crops on the same field at the same time. Relay cropping is a system whereby a crop is planted first and another crop is planted on the same farmland before harvesting the first. Strip cropping is the planting of broad strips two or more crops on the same field [15]. The taungya system is a system where farmers are allowed to cultivate food crops but only side by side forest tree seedlings in designated farming enclaves. This continues for about 3 years until the shade of the young trees becomes too dense to accommodate further growth of the food crops. The farmers then move on to a different area to repeat the process [16, 17]. This relationship enhances farmers' means of livelihood as well as contributing positively to the sustainable management of forest resources.

In this study, we examine attributes of farming enclaves in government forest reserves in south-west, Nigeria, focusing on the preferences of the farmers using a discrete choice experiment (DCE). DCEs quantitatively estimate end-user preferences for different attributes in addition to their trade-offs against one another [18]. Quantitative preference valuations are especially useful for decision-makers as this would assist

them in formulating viable decisions. Forest reserve managers are not left out, they need farmers' quantitative preference valuations to enable them to formulate good policies that will benefit prospective farmers in their farming enclaves without jeopardising efficient management of forest resources.

Studies on farmers' preferences on different subject matters using DCE abound in the literature. Farmers' preferences for high-input production systems for maize using an ICT-based extension tool were studied using a choice experiment. The results showed that maize farmers strongly preferred switching from general to ICT-enabled site-specific soil fertility management systems [19]. Farmers' preferences for the future agricultural land use given the possibility of future climate change were examined using a DCE in Austria. The results indicated that Austrian farmers would embrace opportunities for crop intensification thus making continuity of current traditional landscapes unlikely in future [20]. A choice experiment was used to examine farmers' preferences for the implementation of Biodiversity Offset (BO) contracts on arable lands in Picardy, France. The results showed that farmers did not have a preference for signing up BO contracts [21]. Assessment of farmers' preferences for soil management technologies in South Ethiopia was conducted using a DCE. From the results, secured land tenancy right significantly influenced positively farm household's decision to invest in these technologies [22]. Also, an investigation of rice farmers' preferences for Fairtrade contracting in Benin using a DCE showed that farmers preferred domestic contracts over Fairtrade contracts because of fewer requirements. Furthermore, their results implied that introducing organic requirements to Fairtrade contracts may discourage its adoption among the farmers [23].

Not much is known about farmers' preferences for farming enclaves in Nigerian forest reserves. Earlier studies have focused on land acquisition by farmers for agricultural purposes especially on methods of land acquisition, including challenges associated with each method of land acquisition and the choices farmers have made to enable them to overcome these challenges [6,13, 24, 25]. Therefore, this study contributes to existing literature by evaluating attributes of farming enclaves focusing on the preferences of the farmers. The farmers' willingness to pay for the attributes are also determined.

2. METHODOLOGY

2.1 Experimental Design, Survey and Data Collection

2.1.1 Attribute and attribute levels

Searches we first conducted relevant literature to identify attributes of forest reserves in South-West, Nigeria [26, 27, 28]. Furthermore, focus group discussions were held with representatives of farmers in selected communities in Oyo State to determine what they value before acquiring land in a particular farming enclave for agricultural purposes. Three most important factors that emerged from the group discussions are selected and these, with their levels are presented in Table 1.

Table 1. Attributes and their levels

Attribute	Levels
Farm Size	1/2 hectare
	1 hectare
	3 hectares
	5 hectares
Cropping System	Monocropping
	Taungya
	Relay
	Intercropping
Land rent (per hectare)	4.86 US $
	9.72 US $
	14.58 US $
	19.44 US $

2.1.2 Experimental design and choice sets

There are different classes of experimental designs with diverse applications, including DCEs in literature [29, 30, 31, 32, 33, 34, 35]. Some of these include the use of balanced incomplete block designs, full and fractional factorial designs [36, 37]. The full factorial design gives all the possible choices that can be presented to the respondents that is, combinations of each level of each attribute with every level of the other attributes. But, as the number of attributes increases, the size of the design becomes very large making implementation difficult. In this study, the full 4^3 factorial design was obviously too large for our experiment, so we opted for an orthogonal main effects design which reduced the size of the experiment to 16 treatment combinations arranged in 4 choice sets with 4 options each. The orthogonal main effects design, therefore formed the basis of our DCE questionnaire. An example of a choice set is given in Table 2.

Table 2. Example of a choice set

Attributes of farming enclave	*A*	*B*	*C*	*D*
Size of the farmland	1/2 hectare	1 hectare	3 hectares	5 hectares
Type of cropping	Monocropping	Taungya	Relay	Intercropping
Land rent fee per hectare (Naira)	14.58 US $	19.44 US $	4.86 US $	9.72 US $
I prefer (tick one box only)	☐	☐	☐	☐

2.1.3 Survey and data collection

The study was conducted in Adebayo Idi-Ayunre multi-ethnic community of Oluyole Local government area of Oyo State. Three villages were randomly selected from the community. They were Aba Onidajo, Alata Oke and Alata Isale. Furthermore, simple random sampling technique was used to select 35, 30 and 35 farmers from the aforementioned villages respectively giving a total of 100 respondents. The sample size complied with appropriateness rule for reliable model estimation given our research budget and other constraints [38, 39]. The map of the study area is presented in *Fig.* 1.

Face-to-face interview method was used in the administration of the questionnaire so that necessary guidance especially in answering the choice questions, could be provided. The questionnaire was divided into three sections. Information about the purpose of the study, including explanation of the concepts and attributes, was provided in the first section. The second section contained the sequence of the four choice questions while anonymized demographic information of the respondents was collected in the third section.

2.2 Econometric Modelling

2.2.1 Random Utility Theory (RUT)

The RUT assumes that utility U for individual i based on choice j can be decomposed into deterministic (observable) V_{ij} and random (unobservable) component ε_{ij} giving the model

$$U_{ij} = V_{ij} + \varepsilon_{ij}, \quad (j = 1, \ldots., J; with\, J \geq 2) \qquad (1)$$

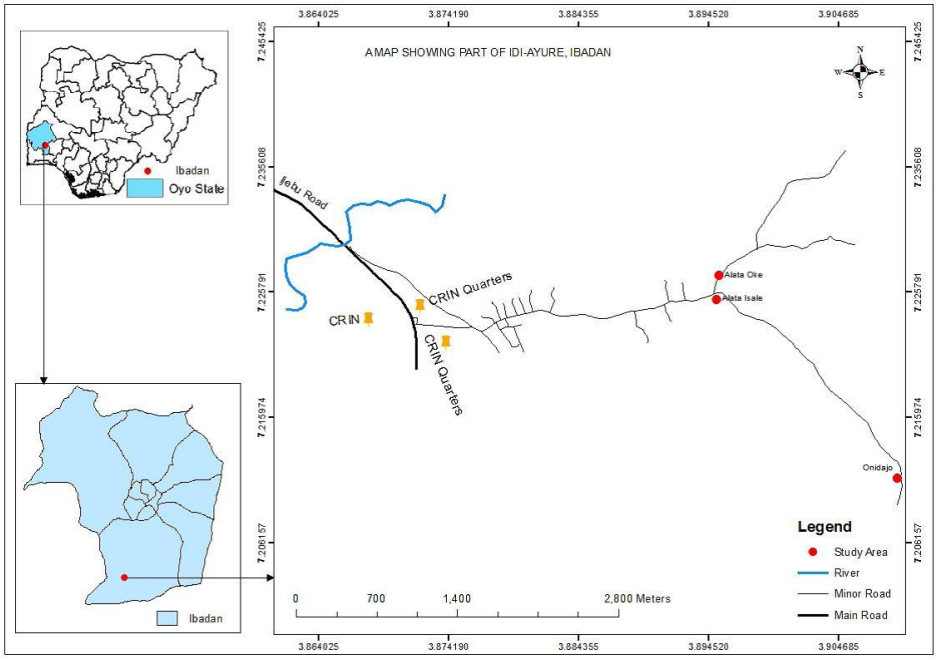

Fig. 1. Map of the study area

The deterministic component is, most times, assumed to be a linear function of the attributes of the good/service and characteristics of individual choosers often represented as

$$V_{ij} = X_{ij}^{'}\beta + Z_i^{'}\gamma \quad (2)$$

where $X_{ij}^{'}$ is the vector of attributes of good j as viewed by individual i, $Z_i^{'}$ is a vector of characteristics of individual i while β and γ are vectors of coefficients to be estimated [34, 35, 38, 40, 41, 42].

2.2.2 Multinomial Logit model

In this study, the respondent has to choose from $j = 1, \ldots, J$ alternatives where our $J = 4$. The respondent will evaluate the utility to be derived from each alternative and select the one with the highest utility. Assuming that a respondent chooses alternative 1 if and only if its utility is the highest among all other alternatives. So, the probability that utility is maximized by choosing alternative 1 is given by

$$\begin{aligned} P(Y_i = 1) &= P\left(U_{i1} > U_{ij}\right) \\ &= P\left(V_{i1} + \varepsilon_{i1} > V_{ij} + \varepsilon_{ij}\right) \\ &= P\left(V_{i1} - V_{ij} > \varepsilon_{ij} - \varepsilon_{i1}\right) \forall\, j \neq 1 \end{aligned} \quad (3)$$

where Y_i is a random variable denoting the choice outcome. If the errors are assumed to be independently and identically distributed (iid) extreme value type 1 random variates, then

$$P(Y_i = 1) = \frac{exp(\lambda V_{i1})}{\sum_{j=1}^{J} exp(\lambda V_{ij})},\ j = 1, \ldots, 4 \quad (4)$$

where λ represents a scale parameter usually normalized to 1 for any data set.

Equation (4) can be rewritten as

$$P(Y_i = 1) = \frac{exp\lambda(X_{i1}^{'}\beta + Z_i^{'}\gamma)}{\sum_{j=1}^{J} exp\lambda(X_{ij}^{'}\beta + Z_i^{'}\gamma)}, j = 1, \ldots, 4 \quad (5)$$

(using equation (2)).

Equation (5) is known as the multinomial logit model (MNL) [34, 41, 38, 43].

2.2.3 Marginal Willingness to pay (MWTP)

The MWTP is the marginal rate of substitution between the non-monetary attribute and the price attribute with the assumption that only one product is available and that it is chosen with 100% certainty. In this study, we compute $\widehat{MWTP}$ for a single non-monetary attribute using $-1\left(\frac{\hat{\beta}_{attribute}}{\hat{\beta}_{price}}\right)$ [18, 43, 44]. The confidence intervals are computed using the Fieller's method [45, 46].

3. RESULTS AND DISCUSSION

Socio-demographic characteristics of the respondents are presented in Table 3. Forty-five percent (45%) of the respondents have basic (primary) education while five percent (5%) of the respondents do not have any form of formal education. Almost half of the respondents (47%) are aged fifty (50) years and above. Majority (80%) of the farmers are males while 50% of the respondents have household size ranging between 6 and 10.

Table 3. Socio-demographic characteristics of the respondents

Variables	Frequency
Education	
No Education	5
Primary	45
Secondary	40
Tertiary	10
Total	100
Age	
Less or equal to 30	11
31-40	20
41-50	22
50 and above	47
Total	100
Gender	
Male	80
Female	20
Total	100
Religion	
Christianity	67
Islam	28
Others	5
Total	100
Marital Status	
Married	88
Single	10
Others	2
Total	100
Household Size	
Less than 3	12
3-5	26
6-10	50
Above 10	12
Total	100

Table 4. Results of the multinomial Logit model estimation

Choice	β-Coefficient	Standard Error	Z	P > |z|	(95% Confidence Interval)	
Farm size	-0.138	0.121	-1.14	0.254	-0.375	0.099
Monocropping	-1.315	0.256	-5.14	0.000	-1.817	-0.813
Taungya	-0.661	0.831	-0.8	0.426	-2.290	0.968
Intercropping	1.904	0.842	2.26	0.024	0.253	3.555
Land rent	-0.0004	0.0002	-2.03	0.042	-0.0007	-1.4E-05
Wald chi^2(47) = 1159.86						
Log pseudolikelihood = -372.013						
Prob > chi^2 = 0						

Table 5. Marginal Willingness to Pay (MWTP) Estimates

Variables	MWTP (US$)	95% Confidence Interval
Farm size	-0.91	(-1.10, -0.73)*
Monocropping	-8.64	(-9.63, -7.81)*
Taungya	-4.34	(-5.55, -3.22)*
Intercropping	12.50	(10.98, 14.27)*

** confidence interval does not include zero*

The results of the multinomial logit model estimation are presented in Table 4.

The attribute, "type of cropping system" is a qualitative variable with 4 levels (L). Dummy variables were used to represent $L-1$ of the levels to avoid perfect linear dependence. The omitted level, relay cropping, is set as the base (coefficient in the model is set at zero) so that the other parameters estimated display differences in choice probabilities between the base level and specific attribute levels. The coefficient of intercropping is positive and significant indicating that farmers prefer intercropping to relay cropping. Negative coefficients for both monocropping and taungya systems show that farmers prefer relay cropping to both systems. Therefore, the more intercropping is allowed on a particular farming enclave, the higher the probability that it will be chosen. This corroborates the result of [47] which identified intercropping system as the commonest cropping system in south-west Nigeria. The β coefficient for land rent (per hectare) is negative and significant indicating that farmers obtain higher utility from very low land rent fees. This is in line with the result of [6] which identified financial constraints as one of the factors affecting land acquisition among farmers in south-west, Nigeria.

The coefficient of monocropping is negative and significant implying that farmers have a strong aversion for this cropping system. Furthermore, the coefficients of farm size and taungya are negative but not significant; each of their 95% confidence intervals contains zero. This indicates that farm size and taungya system of farming do not contribute significantly to farmers' choice of farming enclave. From the focus group discussions conducted, the farmers identified inability to engage in any agricultural endeavour of their choice, incessant conflicts between them and forest reserves managers among others as reasons for not favouring the taungya system. Most of the farmers preferred personal lands they can claim ownership of, having freedom to engage in any agricultural endeavour at any time as opposed to taungya where they are constrained to plant agricultural crops for about 1 – 3 years along with tree crops (usually specified) and are forced to move to another area when the shades of the trees become too dense to repeat the process. This result corroborates the findings of [48] which showed that only 6% of sampled farmers embraced taungya. The authors opined that majority of the farmers were discouraged by land availability problems in the study area and their inability to plant tree species of their choice in the forest estates. Furthermore, [17] highlighted some of the sources of conflict between farmers and forest reserve managers. These included forest land encroachment, over-pruning of trees and destruction of tree seedlings by farmers in a bid to have more land for cultivation and also stay on the land for longer periods of time.

The MWTP estimates for the attributes and their 95% confidence intervals are presented in Table

5. Farmers are willing to pay an extra 12.50 US $ land rent fees (per hectare) to have intercropping on a particular farming enclave. Furthermore, the MWTP estimates for farm size, monocropping and taungya are negative and significant indicating that farmers would substantially avoid farming enclaves where monocropping and taungya systems are being practised. These results further corroborate results presented in Table 4 above and the findings of [17, 48].

4. CONCLUSION

In this study, we investigated farmers' preferences for farming enclaves in government-owned forest reserves in south-west, Nigeria using selected attributes in a discrete choice experiment. Farmers prefer farming enclaves where intercropping is allowed over other identified cropping systems. Furthermore, they are willing to pay an extra 12.50 US $ land rent fees (per hectare) to have intercropping on a particular farming enclave while avoiding other enclaves with other cropping systems. These results will help forest reserve managers in formulating policies that will benefit farmers without jeopardising efficient management of forest resources.

CONSENT

As per international standard or university standard, Participants' written consents have been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Papava V. On Production Factors. Bull. Georg. Natl. Acad. Sci. 2017;11(4):145-49.
2. UN Convention to Combat Desertification (UNCCD). Land and Sustainable Development Goals; 2018. Accessed 23 October 2020. Available:https://www.unccd.int/issues/land-and-sustainable-development-goals.
3. Otekunrin OA, Otekunrin OA, Momoh S, Ayinde IA. How far has Africa gone in achieving the Zero Hunger Target? Evidence from Nigeria. Glob. Food Sec. 2019a;22:1-12. DOI:https://doi.org/10.1016/j.gfs.2019.08.001
4. Otekunrin OA, Momoh S, Ayinde IA, Otekunrin OA. How far has Africa gone in achieving the Sustainable Development Goals? Exploring the African dataset. Data Br. 2019b;27(104647). DOI:https://doi.org/10.1016/j.dib.2019.104647
5. UN World Population Prospects. Nigeria Population; 2020 (Live). Accessed 23 October 2020. Available:https://worldpopulationreview.com
6. Adamu CO. Land acquisition and types of crops cultivated by farmers in Ayedaade Local Government Area, Osun State, Nigeria. AJAEES 2014;3(6):738-45. Accessed 4 November 2020. Available:https://www.journalajaees.com/index.php/AJAEES/article/download/28295/53177.
7. Obayelu AE, Arowolo AO, Osinowo OH. Land tenure, governance and accountability in Nigeria:The implications on food production to feed the present and the future. JADE 2017;6(1). Accessed 30 October 2020. Available:http://digitalcommons.unl.edu/jade/33.
8. Otekunrin OA, Otekunrin OA, Oni LO. Attitude and academic success in practical agriculture:Evidence from public single-sex high school students in Ibadan, Nigeria. AJARR 2019c;4(3):1-18. https://doi.org/10.9734/ajarr/2019/v4i330111
9. De Zoysa R. The implications of large scale land acquisition on small landholder's food security. The Bartlett Development Planning Unit (DPU) Working Paper 2013;156. Accessed 4 November 2020. Available:https://www.ucl.ac.uk/bartlett/development/sites/bartlett/files/migrated-files/WP156_0.pdf.
10. Oluwatayo IB, Timothy O, Ojo AO. Land acquisition and use in Nigeria:implications for sustainable food and livelihood security. In:Land Use - Assessing the Past, Envisioning the Future. IntechOpen. 2019. http://dx.doi.org/10.5772/intechopen.79997
11. Birner R, Okumo A. Challenges of land governance in Nigeria:Insights from a case study in Ondo State. NSSP Working Paper 22. Washington, D.C.:International Food Policy Research Institute (IFPRI). 2011.

Accessed 25 October 2020. Available:http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/126875. 25.10.2020

12. Eze CC, Konkwo SO, Orebiyi JS, Kadiri FA. Land tenure system, farm size, innovation and agricultural productivity in South-East Nigeria. In:Contributed Paper for the 85th Annual Conference of the Agricultural Economics Society, held at Warwick University, Coventry, UK 2011. DOI:10.22004/ag.econ.108934.
13. Nmadu JN, Inalegwu WO, Sallawu H. Acquisition and management of land resources for agricultural production in Benue State, Nigeria. AJAEES 2014;3(1):63-75. https://doi.org/10.9734/AJAEES/2014/7707
14. Ogundare BA. A comparative analysis of agricultural land use in Ikere-Ekiti, Nigeria. JRDM 2016;27. Accessed 4 November 2020. Available:https://iiste.org/Journals/index.php/JRDM/article/view/34761/35742.
15. Nafziger E. Cropping systems In:Illinois Agronomy Handbook. 2009. Accessed 25 October 2020. Available:http://extension.cropsciences.illinois.edu/handbook/pdfs/chapter05.pdf
16. Chamshama SAO, Monela GC, Sekiete KEA, Persson A. Suitability of the taungya system at North Kilimanjaro Forest Plantation, Tanzania. Agroforestry Systems 1992;17:1-11. https://doi.org/10.1007/BF00122924
17. Ndomba OA, Bakengesa S, Petro R, Maguzu J, Chamshama, SAO., Kiimu, HR et al. Perils of taungya to the productivity of forest plantations and need for modification:Case study of Meru Forest Plantation in Tanzania. International Journal of Agriculture and Forestry. 2015;5(5):267-75.10.5923/j.ijaf.20150505.01
18. Tetteh EK, Morris S, Titcheneker-Hooker N. Discrete-choice modelling of patient preferences for modes of drug administration. Health Econ. Rev. 2017;7:26. 10.1186/s13561-017-0162-6
19. Oyinbo O, Chamberlin J, Vanlauwe B, Vrankena L, Kamarad YA, Craufurd P. et al. Farmers' preferences for high-input agriculture supported by site-specific extension services:Evidence from a choice experiment in Nigeria. Agric. Syst. 2019;173:12-26. DOI:https://doi.org/10.1016/j.agsy.2019.02.003
20. Probstl-Haider U, Mostegl NM, Kelemen-Finan J, Haider W, Formayer H, Kantelhardt J. et al. Farmers' preferences for future agricultural land use under the consideration of climate change. Environmental Management 2016;58:446–64. 10.1007/s00267-016-0720-4
21. Vaissière AC, Tardieu L, Quetier F, Roussel S. Preferences for biodiversity offset contracts on arable land:A choice experiment study with farmers. ERAE 2018;45(4):553-82. DOI:https://doi.org/10.1093/erae/jby006
22. Tarfasa S, Balana BB, Tefera T, Woldeamanuel T, Moges A, Dinato M. et al. Modeling smallholder farmers' preferences for soil management measures:A case study from South Ethiopia. Ecol. Econ. 2018;145:410-19. DOI:https://doi.org/10.1016/j.ecolecon.2017.11.027
23. Van den Broeck G, Vlaeminck P, Raymaekers K, Velde KV, Vranken L, Maertens M. Rice farmers' preferences for fairtrade contracting in Benin:Evidence from a discrete choice experiment. J. Clean. Prod. 2017;165:846-54. http://dx.doi.org/10.1016/j.jclepro.2017.07.128
24. Ojo SO. Effects of land acquisition for large scale farming on the performance of small scale farming in Nigeria. J. Hum. Ecol. 2008;24(1):35-40. DOI:https://doi.org/10.1080/09709274.2008.11906096
25. Okezie CA, Ahuchuogu CU, Jamalludin S. Exploring the link between land fragmentation and agricultural productivity. Int. J. Agric. For. 2012;2(1):30-34. 10.5923/j.ijaf.20120201.05
26. Ajayi SS. In situ conservation of wildlife in West Africa. In:Wildlife Conservation in Africa:A Scientific Approach. Elsevier, London, UK. 2019. 141-72. https://doi.org/10.1016/B978-0-12-816962-9.00015-6
27. Larinde SL, Olasupo OO. Socio-economic importance of fuelwood production in Gambari Forest Reserve Area, Oyo State, Nigeria. Journal of Agriculture and Social Research 2011;11(1):201-10. Accessed 4 November 2020. Available:https://www.ajol.info/index.php/jasr/article/view/73703.
28. Ikemeh RA. Sustainable forest management in a human dominated landscape and its implications for

biodiversity conservation:A Nigerian lowland forest perspective. Research and Reports in Biodiversity Studies. 2013;3:9-23. DOI:http://dx.doi.org/10.2147/RRBS.S35442

29. Dinitz JH, Froncek D, Lamken ER, Wallis WD. Scheduling a Tournament. In:Colbourn CJ, Dinitz JH, editors. Handbook of Combinatorial Designs. Boca Raton:CRC Press;2007.
30. Alawode OA, Amahia GN. Training schedules for sixteen Ayo players using some Balanced Incomplete Block Designs. Science Focus. 2008;13(2):56-69. Accessed 4 November 2020. Available:https://www.researchgate.net/publication/318722019_Training_Schedules_for_Sixteen_Ayo_Players_Using_some_Balanced_Incomplete_Block_Designs#fullTextFileContent.
31. Johnson FR, Lancsar E, Marshall D, Kilambi V, Mühlbacher A, Regier DA et al. Constructing experimental designs for discrete-choice experiments:Report of the ISPOR conjoint analysis experimental design good research practices task force. Value Health 2013;16:3–13. 10.1016/j.jval.2012.08.2223
32. Otekunrin OA. Result Processing Scheme for University of Ibadan Statistics Department using Anonymous Threshold Scheme. Annals. Computer Science Series 2016;14(2):59-62. Accessed 4 November 2020. Available:http://anale-informatica.tibiscus.ro/download/lucrari/14-2-09-Otekunrin.pdf.
33. Jaynes J, Wong WK, Xu H. Using blocked fractional factorial designs to construct discrete choice experiments for healthcare studies. Stat. Med. 2016;35:2543-60. DOI:10.1002/sim.6882
34. Elshiewy O, Guhl D, Boztuğ Y. Multinomial logit models in marketing – from fundamentals to state-of-the-art. ZFP Journal of Research and Management. 2017;39(3):32-49. DOI:10.15358/0344-1369-2017-3-32
35. Otekunrin OA, Oliobi, CE. Modelling students' preferences for mobile telecommunication plans:A discrete choice experiment. ACRI 2021;21(3):1-10. DOI:10.9734/ACRI/2021/v21i330234
36. Green PE. On the design of choice experiments involving multifactor alternatives. J. Consum. Res. 1974;1(2):61–68. DOI:https://doi.org/10.1086/208592
37. Demirkale F, Donovan D, Street DJ. Constructing D-optimal symmetric stated preference discrete choice experiments. J. Stat. Plan. Inference 2013;143:1380–91. DOI:http://dx.doi.org/10.1016/j.jspi.2013.02.004
38. Lancsar E, Louviere J. Conducting discrete choice experiments to inform healthcare decision making. A User's Guide. Pharmacoeconomics. 2008;26(8):661-77. DOI:10.2165/00019053-200826080-00004
39. Bridges JFP, Hauber AB, Marshall D, Lloyd A, Prosser LA, Regier DA et al. Conjoint analysis applications in health—a checklist: A report of the ISPOR good research practices for conjoint analysis task force. Value Health 2011;14(4):403-413. DOI:https://doi.org/10.1016/j.jval.2010.11.013
40. Thurstone L. A law of comparative judgement. Psychol. Rev. 1927;34(4):273-86. DOI:https://doi.org/10.1037/h0070288
41. McFadden D. Conditional logit analysis of qualitative choice behaviour, In:Zarembka P. editor. Frontiers in Econometrics. New York:Academic Press;1974.
42. Train K. Discrete choice methods with simulation. 2nd ed. Cambridge:Cambridge University Press; 2009. DOI:10.1017/CBO9780511805271
43. Rolfe J, Bennett J, Louviere J. Choice modelling and its potential application to tropical rainforest preservation. Ecol. Econ. 2000;35(2):289–302. DOI:10.1016/S0921-8009(00)00201-9
44. Ranasingha RGSM, Edirisinghe JC, Ratnayake RHMK. Willingness to pay for fruit attributes:a conjoint analysis. JAS 2019;14(2):102-10. DOI:http://dx.doi.org/10.4038/jas.v14i2.8512
45. Hirschberg J, Lye J. A geometric comparison of the Delta and Fieller Confidence Intervals. Am. Stat. 2010;64(3):234-41. https://doi.org/10.1198/tast.2010.08130
46. Beyene J, Moineddin R. Methods for confidence interval estimation of a ratio parameter with application to location quotients. BMC Med. Res. Methodol. 2005;5:32. DOI:10.1186/1471-2288-5-32
47. Saka JO. Productivity and income potentials of intercrop combinations among food crop farmers in Southwestern Nigeria.

African Journal of Agricultural Research. 2015;10(52):4730-37. Accessed 4 November 2020. Available:http://academicjournals.org/journal/AJAR/article-full-text-pdf/E7ECE6D56468.

48. Agera SIN, Adegeye AO, Jimoh SO. Appraisal of Taungya Farming as a sustainable land-use option in Vandeikya local government of Benue State, Nigeria. Journal of Research in Forestry, Wildlife and Environment 2010;2(1):32-43.
Accessed 4 November 2020.
Available:https://www.ajol.info/index.php/jrfwe/article/view/82360/72515

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/70939