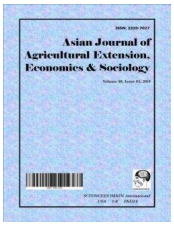

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Use of Agricultural Extension Information for Mitigation of Soil Degradation in Ondo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. The lead author O. Olalekan designed the study and wrote the first draft of the manuscript and interpreted results. Author AT analyzed the data and fine-tuned the methodology while author O. Oluwaseun supervised data collection and literature search. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This research work examined the use of agricultural extension information to mitigate soil degradation in Ondo Central senatorial district of Ondo state, Nigeria**.** The study identified significant sources of soil degradation in the study area, determine how often the farmers used the available information on soil degradation mitigation and identified observed changes that occurred on the soil in the past five years.
Methodology: A multi-stage random sampling technique was used in selecting respondents. Data were collected with the use of a structured questionnaire and interview schedule from 180 registered farmers across six communities in Ondo East and Ifedore Local Government Areas in Ondo Central senatorial district of the state.
Results: Results of the study shows that soil degradation changes observed include a great increase in water logging, soil erosion and dumping of biodegradables. The most important source of information on soil degradation is agricultural extension agents. Information on organic manuring

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and planting of cover crops were the top two information category used to mitigate soil degradation by the respondents. Test statistics showed that there was no significant relationship between changes in soil degradation and information use for mitigating soil degradation at .05 level of significance (P = .07; χ^2= 1.957).

Conclusion: Agricultural extension services served as the most significant source of information for the farmers on soil degradation mitigation. There was observed overall increase in soil degradation over the period of 5 years (2012-2017). The use of available information to mitigate soil degradation was occasional despite the availability of information.

Keywords: Soil- degradation; mitigation; environment; cover crops; flooding and erosion.

1. INTRODUCTION

One of the greatest and persistent threats to human existence is environmental degradation. It occurs in many forms, and one such form that is of particular concern, especially in agrarian communities, is soil degradation. The soil is a complex, variable and living medium that regulates the environment, it is one of the world's most significant natural resource which supports human and animal life either directly or indirectly. Mankind depends on soils to provide for food production.

Soil degradation occurs when there is a decline in the productive or functional capacity of the soil as a result of adverse changes in its biological, chemical, physical and hydrological properties. The decline can be consequent to human actions or in-actions. Soil degradation implies a decline in soil quality with an attendant reduction in ecosystem functions and services [1]. According to [2] the total land area subject to human-induced soil degradation is estimated at about two (2) billion hectares. Loss of biodiversity and human-initiated climatic change has impacts, directly and indirectly on a beneficial capability of land resources [3]. Soil degradation occurs globally, but its negative effects are most felt in regions which depend solely on agriculture for its income [4]. Several approaches have been used to halt the continuous negative impacts of soil degradation on agriculture. Notable is the use of agricultural extension services through training and education to provide appropriate information that can assist the people to make a rational decision about the management of the soil.

Agricultural Extension is the provision of assistance to farmers to help them identify and analyse their production problems and become aware of the opportunity for improvement [5]. Agricultural extension functionality revolves majorly around the provision of relevant, clear and timely information to bring about change in attitude, improve knowledge and provide new skills. The management of soil degradation requires exposure to the correct and relevant information.

Information is data that is processed for ready use in an understandable format. The farmers must be exposed to information on soil degradation and mitigation in a form ready for use if soil degradation is to be successfully mitigated. According to [6], the information available to any individual per time determines to a large extent the decision such an individual will take on issues. Access to information is a basic fundamental right. Information is not only vital for technological, scientific and economic progress as erroneously seen by some people. It is also a medium of social transformation and communication. In order for farmers to take steps to mitigate soil degradation using the information; such information must be available and also accessible to them. Mitigation of soil degradation cannot be discussed in isolation of some factors causing the degradation directly or indirectly; importantly is climate change which has brought about changes in environmental temperatures, rainfall pattern and quantity, wind pattern to mention a few.

The roles extension can play in adaptation to climate change. [7] pointed that it is essential to provide farmers with information about how various options will potentially increase income and yields, provide household food security, improve soils, enhance sustainability, and generally help to alleviate the effects of climate change. They further argued that capacity development is essential in extension; to improve outcomes in rural development, farmers and extension agents need new skills that will require agricultural education and extension curriculums to include valuing and understanding the knowledge and experiences of rural people and co-learning (that is, farmers and extension agents learning together rather than extension

agents training farmers in a one-way information transfer). Extension agents may also play a role in assisting farmers in implementing policies and programs that deal with climate change adaptation [7]. Agricultural extension has forged ahead to be a pivotal promoter to attain food security and to diminish poverty of rural population in developing countries [8]. However, Land degradation is increasing in severity and extent in many parts of the world. Success in arresting land degradation entails an improved understanding of its causes, process, indicators and impacts [9]. For a country like Nigeria whose, population dramatically rose from 116 million in 1991 to 140million in 2006 [10]. Human-induced soil degradation has intensified, due mainly to the expansion of agricultural lands into marginal areas.

A significant challenge on the issue of soil degradation is the ignorance of the people. Correct, appropriate, logical, transparent and timely information if given to the farmers would enlighten them and allow them to make informed decisions that would help them mitigate any form of soil degradation in their environment. The use of information from various sources in mitigating soil degradation is essential if agriculture in Nigeria would be sustainable. Hardly any study exists on the availability of information and how often such information is used to combat soil degradation, especially in the rural areas. Thus, the study identified the forms of soil degradation experienced in the study area, the sources of information available to the farmers on soil degradation, observed changes on the soil and ascertained how often the farmers use the available information to mitigate soil degradation.

2. METHODOLOGY

The study was carried out in Ondo State, Nigeria (Fig. 1). It is one of the six states that made up the South West Geopolitical Zone of Nigeria. Ondo State is bounded in the North by Ekiti and Kogi States, in the East by Edo State, in the West by Osun and Ogun States, and in the South by the Atlantic Ocean [11]. Ondo State covers a land area of 14,793 km^2. According to [12], the State has a population of 3,441,024 comprising 1,761,263 males and 1,679,761 females; it has a population density of 218 people per square kilometer. The longitude of the state is 5.0ºE and latitude of 7.1ºN.

The ethnic composition of Ondo state is largely from the Yoruba subgroups of the Akure, Akoko, Ikale, Ilaje, Ondo and Owo people. Ijaw minority and Ilaje populations inhabit the coastal areas; while a sizable number of Ondo State people who speak a variant of the Yoruba language similar to Ife dialect reside in Oke-Igbo. The ethnic groups are spread over eighteen Local Government Areas. Agriculture constitutes the primary occupation of the people of the state. Ondo State is leading cocoa producing state in Nigeria. Other agricultural products produced in the state include yams, cassava, cocoyam, vegetables, plantain, cocoa, palm tree and kola nut. The vegetation of the study area is rainforest where rainfall is heavy for an average of 8 months in a year with an average volume of 1500 mm annually. Politically the state is divided into three senatorial districts namely North, Central and South.

The population of the study consists of all farmers in Ondo State. A multistage sampling technique was employed for the study. The first stage involved the random selection of one (1) Senatorial District (Ondo Central Senatorial District) out of the three (3) Senatorial Districts in the State. In the second stage, two (2) Local Government Areas (Ondo East and Ifedore Local Government Areas) were randomly selected out of the six (6) Local Government Areas in Ondo Central Senatorial District. The third stage involved random selection of three (3) communities each from Ondo East and Ifedore Local Government Areas; this gives a total of six communities. In the fourth and final stage, a random selection of 30 farmers was done from the Agricultural Development Programme (ADP) farmers' list in each of the selected communities. This gave a total sample size of 180 respondents across six (6) communities from two (2) Local Government Areas. Data were collected from the respondents through a carefully designed and pretested interview schedule.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Respondents

The socio-economic characteristics of the respondents considered in the study are; age, sex, marital status, level of education attained and farming experience. Results as presented in Table 1 shows that a total of 76% of the respondents fell between the ages of 31-60 years with the mean age of 46 years. This suggests the respondents were in the middle age class and can be considered

energetic enough to be productive in their farming business.

According to Table 1, 74.4% of the respondents were males while about 26% were females; the male domination might be as a result of the drudgery associated with farming which males can cope with more easily than female. The married respondents were 92% while 6% were separated none of the respondents was single. African culture holds marriage in high esteem as such, adults not married at a certain age are regarded as a deviant from the norm of the society. Only 10% of the respondents had a tertiary education while 32.0% had no formal education. A total of about 8% of the respondents had an adult education. Hence, a good number of them were literate, and extension information on soil degradation would be understood and appreciated. In Table 1, 68% of the respondents completed one level of education or the other from primary to tertiary level. This portends hope for the appropriate use of information at their disposal.

The respondents' faming experience as presented in Table 1 reveals 61.1% of the respondents had over 10 years of experience in farming while 38.9% had less 10 years of experience. They are thus expected to be knowledgeable about soil degradation. The mean farming experience is 15 years

3.2 Forms of Soil Degradation and Changes in Occurrence level in the Past Five Years

Forms of soil degradation and changes in occurrences as observed by the respondents presented in Table 2 reveals that water logging ($\bar{x}$ = 1.97), water erosion ($\bar{x}$ = 1.93) and dumping of non-biodegradables ($\bar{x}$ = 1.74) were the top three forms of soil degradation observable in the study area; and had ''increased greatly'' over the past 5 years. While dumping of mining waste, gravity erosion and wind erosion had the least three mean scores. This could be attributed to the fact that mining is not a popular activity going on in the study area compared to lumbering which had resulted in soil compaction. In addition the zone is in the rain forest zone where there is large amount of canopy covering for the soil; as such wind erosion is not a threat to the quality of the soil. The top six indicators of soil degradation (Water logging, water erosion, dumping of non-biodegradables, flooding, leaching and soil compaction through logging activities) in the study area shows that there is "great increase" in their observable occurrence in the past five years.

3.3 Sources of Information on Soil Degradation and Mitigation

In Table 3, the farmers revealed agricultural extension agents as their greatest source of information on soil degradation as 72.2% of them claimed that they relied on extension agents for information on soil degradation. Television & Radio similarly followed as the main source of information after extension agents, as 68.9% of the respondents indicated it to be source of information for them. This further portrays the importance of extension agents and the dissemination of information through Television & Radio. However, despite the widespread of technology advancement across the globe, the internet has the lowest percentage (1.11%) of respondents indicating it as the source of information on soil degradation and its mitigation.

3.4 Access, Quality and Frequency of Information from Extension Agents

Access, quality, relevance and frequency of use of information on soil degradation by the respondents are presented in Table 4. All the respondents (100%) indicated they had access to information on soil degradation. Furthermore, 40% of the respondents indicated they received information on a quarterly basis while 31% and 17.8%receieved theirs on a monthly and fortnightly basis respectively. Majority of the respondents (70%) claimed that the method of an extension was 'very good' while another 26.7% agreed it was 'good'.

The quality of interaction between agricultural extension and farmers will influence the farmers' knowledge, skill and attitude and as such could result in better farming experiences. On the quality of the information disseminated, 83.3% of the farmers opined that the information was of high quality as another 15.6% considered it to be of moderate quality. Also, 53.3% of the respondents rated the information to be very relevant, this is similar to the findings of Ighoro, 2016(Federal University of Technology, Akure. Unpublished PhD thesis) who reported that farmers in the Niger Delta area found extension visits satisfactory and relevant.

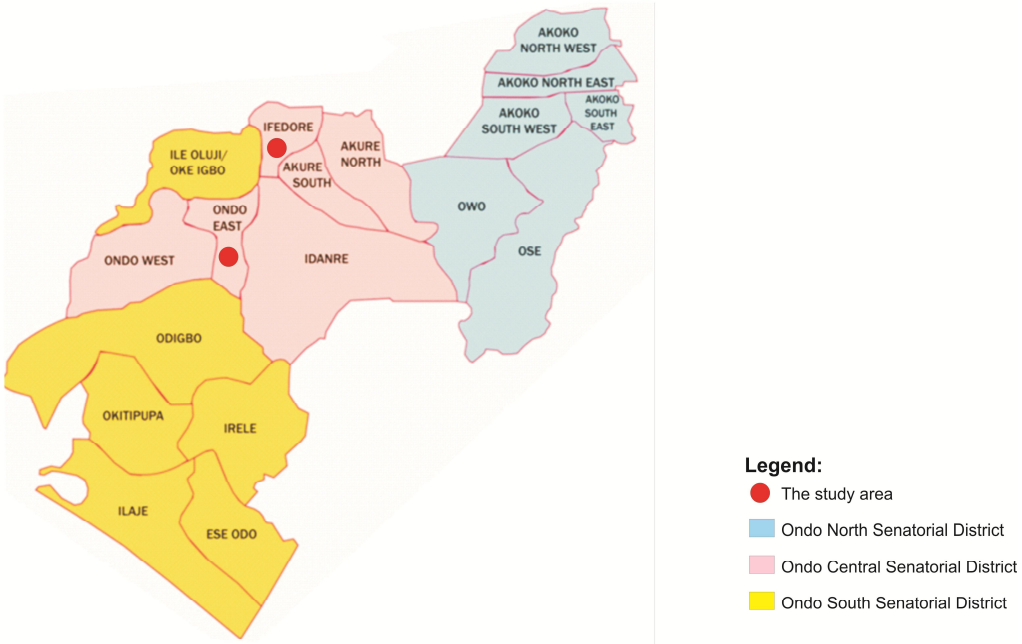

Figure 1: Map of Ondo state showing the three senatorial districts and the study area

Source: Adapted from https://umar-yusuf.blogspot.com/2017/10/map-of-Nigeria-senatorial-districts-by.html

Table 1. Socio-economic characteristics of the respondents

Variable	Frequency	Percentage (%)
Age		
≤ 30	20	11.1
31-40	46	25.6
41-50	56	31.1
51-60	34	18.9
> 60	24	13.3 **Mean = 46 years**
Sex		
Male	134	74.4
Female	46	25.6
Marital status		
Married	166	92.0
Single	0	0.0
Separated	11	6.0
Divorced	3	2.0
Highest level of education		
No formal education	58	32.0
Completed Tertiary education	18	10.0
Adult education	14	8.0
Attempted primary school	12	6.6
Completed primary school	26	14.5
Attempted secondary school	18	10.0
Completed secondary school	34	18.9
Farming experience		
1-10	70	38.9
11-20	60	33.3
21-30	26	14.4
> 30	24	13.4 **Mean= 15years**

Source: Field data, 2017

Table 2. Soil degradation experienced and observed changes in occurrence level in the past five years

Forms of degradation	Increased greatly		Increased slightly		Unchanged		Mean	Ranking
	Freq.	%	Freq.	%	Freq.	%		
Water logging	178	98.9	0	0.0	2	1.7	1.97	1
Water Erosion	164	91.1	16	8.9	0	0	1.93	2
Dumping of non-biodegradables	140	77.8	20	11.1	20	11.1	1.74	3
Flooding	121	67.2	40	22.2	19	10.6	1.68	4
Leaching	121	67.2	21	11.7	38	21.1	1.67	5
Soil compaction through logging activities	116	64.4	25	13.9	39	21.7	1.61	6
Removal of top soil during construction	84	46.6	60	33.3	36	20	1.32	7
Acidification	58	32.2	54	30.0	68	37.8	1.24	8
Salinization	24	13.3	58	32.2	6	3.3	0.62	9
Dumping of Mining waste	18	10	73	40.6	89	49.4	0.48	10
Mechanical/Gravity Erosion	8	4.4	60	33.3	112	62.2	0.42	11
Wind Erosion	0	0	58	32.2	122	67.8	0.4	12

Source: Field data, 2017

0.4-0.9 (No change); 1.0-1.5 (Slight increase); 1.6 and above (Great increase)

Table 3. Respondents' sources of information on soil degradation

Source of information	Frequency (N= 180)	Percentage
Agricultural extension agent	65	72.2
Market	3	3.3
Family member	13	14.4
TV/Radio	62	68.9
Social Organizations	14	15.6
Experience	8	8.9
Bulletin/Newspaper	5	5.6
Friends/Neighbours	50	55.6
Internet	1	1.11

*Source: Field data, 2017; * Multiple responses*

3.5 Information Use to Mitigate Soil Degradation

The availability and accessibility of information does not necessarily translate to its use. This section examines various mitigation strategies on which information is available and determined which of them are often used based on ranking of mean scores; which was re arranged after analysis in descending order for logical presentation.

Information on organic manuring ($\bar{x}$ = 1.99) as revealed in Table 5 ranked number one among forms of information used for the mitigation of soil degradation by the respondents, information on planting of cover crops ($\bar{x}$ = 1.86) ranked second, while information on crop rotation was in the third position with mean score of 1.81. The farmers pointed out that these three measures were cheap and easy to practice.

The use of conservative tillage and controlled ploughing by farmers helps to reduce organic matter loss and controls erosion of farmland. However, information on controlled ploughing ($\bar{x}$ = 0.61) and irrigation ranked as the least used by the respondents. This might largely be due to the fact that these measures are expensive and require a considerable level of technical know-how as most of the respondents were small scale farmers with modest financial status. Grand mean of the respondents' responses was 1.38, implying they generally used the information provided occasionally.

Table 4. Access, frequency, quality and relevance of information from extension agents to mitigate soil degradation

	Frequency (N=180)	Percentage (%)
Access to information		
Yes	180	100.0
No	0	0.0
Frequency of receiving information (N=180)		
Fortnightly	32	17.8
Monthly	56	31.1
Quarterly	72	40.0
Yearly	20	11.1
Perception on method of information delivery		
Very good	126	70.0
Good	48	26.7
Average	6	3.3
Perceived quality of the information		
High	150	83.3
Moderate	28	15.6
Low	2	1.1
Relevance of information		
Very relevant	96	53.3
Relevant	84	46.7

Source: Field data, 2017

Table 5. Information used by respondents to mitigate soil degradation

Information on mitigation measures	Rarely		Occasionally		Always		Mean	Ranking
	Freq.	%	Freq.	%	Freq.	%		
Organic manuring	94	53.3	80	44.4	6	3.3	1.99	1
Planting cover crops	10	5.56	100	55.6	70	38.9	1.86	2
Crop Rotation	24	13.3	102	56.6	54	30	1.81	3
Shifting Cultivation	28	15.6	92	51.1	60	33.3	1.49	4
Afforestation and Reforestation	4	2.2	70	38.9	106	58.9	1.48	5
Use of Terraces	0	0	2	1.1	178	98.9	1.48	5
Conservation tillage	82	45.6	40	22.2	58	32.2	1.46	7
Gardening or Hydroponics	42	23.3	94	52.2	44	24.4	1.42	8
Construction of windbreakers	0	0	60	33.3	120	66.7	1.40	9
Responsible waste management	96	53.3	80	44.4	6	3.3	1.39	10
Planting improved varieties of crops	20	11.1	90	50.0	70	38.9	1.30	11
Controlled Grazing	56	31.1	124	68.9	0	0	0.99	12
Controlled ploughing	32	17.8	100	55.6	48	26.7	0.61	13
Irrigation	20	11.1	138	76.7	22	12.2	0.61	13
Grand Mean							**1.38**	

Source: Field Data, 2017

Key: 0.61-1.07 Rarely; 1.08-1.54 Occasionally; 1.55-2.01 Always

3.6 Relationship between the Use of Extension Information and Changes in Soil Degradation

Chi-Square analysis presented in Table 6 indicated that there is no significant relationship between use of information (χ^2 = 1.96, P=.07) and changes observed in soil degradation at .05 level of significance. This could be due to the fact that the use of information from the sources identified by the respondents has a grand mean that revealed an overall "occasional" use of these information. This shows that the use of mitigating information does not have effect on the changes observed on soil degradation in the study area.

Table 6. Relationship between extension information and soil degradation

	χ^2 value	Df.	*P*-value	Remark
Information vs. Changes in Soil Degradation.	1.957	2	.07	Not Significant

Source: Field survey, 2017

3.7 Discussion

In the study, a majority of the respondents (92%) are married, and male-dominated the respondents (74.4%). The category of age that has the highest respondents of 31.1% is the 41-50 year age category. The mean age value was 46 years which is a reflection of the respondents still being in the active age bracket. The farming in the study area is dominated by male farmers who exert a lot of physical energy to cultivate their farms. The females are not always given an equal opportunity like their male counterparts as such they have limited access to productive resources; therefore men are more prominent as farmers. The women may farm, but they are often seen as supporting their husbands while the husbands are seen as the 'real' farmers. [12] opined that women in the study area are mostly not opportune to own farms due to cultural biases and low resources. The respondents have one form of education or the other except 32.0% that had no formal education. Being educated will influence their use of information to mitigate soil degradation. Several factors are facilitating the adoption of technologies for sustainable farming systems; the trend towards better education and training of farmers is an important factor [13]. The respondents had an average of 15 years of farming experience which would have given them a high level of knowledge about soil degradation and its management. [14] reported that the adoption of land management technology of farmer is significantly related to their farming experience. Whatever the farmer experiences in the past will definitely modify their orientation and action.

The increased waterlogging, erosion and dumping of non-biodegradables as observed by the respondents could be attributed to increasing in human activities like farming where several agrochemical plastic containers are dumped carelessly on the land. Several food items now come in plastic containers as well. The climate change has caused increased precipitation which has led to flooding and increased erosion. [15] indicated that flooding is one of the obvious impacts of climate change on communities in Nigeria. The increased flooding noticed in this study could bring about colossal loss of farmland which eventually can increase food shortages across the country. This threat to the over 180 million estimated Nigerians, needs attention. Flooding of farmlands in Benue state (food basket of Nigeria) has been in the increase in the last three years (2014-2017) The River Niger annually overflows its banks. Similar scenarios have been noticed in the study area where buildings have collapsed, farmlands flooded and roads cut off. Erosion in towns and cities have been increasing in addition to the ones noticed on the farms. Erosion of different forms is inimical to agricultural production. Whether it is sheet, rill or gully. The impact on human and the economy could be grave. Erosion control could significantly improve the productivity of the soil in some locations without any other soil improvement technologies like fertiliser application. In the Eastern part of Nigeria, a significant challenge to the agricultural productivity is erosion where all forms of erosion are noticeable and are at different stages. Roads have been destroyed; communities cut off after a heavy downpour of rainfall to the extent that emergency agencies were called upon to rescue the residents of some communities in the year 2016.

The degradation of the soil and mitigation could be a difficult task without exposure of the farmers to timely and relevant information. Different sources of information used by the respondents revealed that, mostly, information on soil degradation and mitigation were received from agricultural extension agents as indicated by 72.2% of the respondents. Television and radio ranked second as a mostly used source of information. [16] reported that personal contact and radio were the most effective channels of information from farmers' perspective.

The mainly used information to combat soil degradation was information on organic manuring while information on the planting of cover crops ranked second mostly used information to mitigate soil degradation. The array of advantage from the use of organic

manuring includes a supply of nutrients into the soil, conservation of the natural nutrients of the soil. [17] asserted that organic manure adopted by farmers not only sustainably increases soil fertility but also increase the moisture content of the soil. These two technologies were topmost. According to the respondents, these two technologies are easy to use and incur a minimum financial cost. The respondents also claimed that there were no technical complications in the use of these top two technologies (organic manuring and planting cover crops). Farmers easily adopt any technology that is not complicated while they do not readily adopt expensive and complicated technologies. [18] suggested five characteristics of an innovation that affect the rate at which it is diffused and adopted, these are relative advantage, compatibility, complexity, triability and observability. The non-complexity of the top two mitigating strategies could be said to encourage their use.

4. CONCLUSION

Findings from this study revealed that extension services served as the most significant source of information for the farmers on soil degradation. There is observed an overall increase in soil degradation over a period of 5 years (2012-2017). Based on the grand mean, the use of available information to mitigate soil degradation was classified as occasional.

5. RECOMMENDATION

It is therefore recommended that extension services and programs should be further intensified in the study area through training and re-training of farmers. Measures like organic manuring, planting of cover crops were primarily used by the farmers to mitigate soil degradation. However, more technical measures like controlled ploughing, conservative tillage were rarely used. The study recommends technical training and provision of incentives for the farmers to enable them to embrace other effective though slightly technical and cost demanding measures. Aggressively follow up on information disseminated to the farmers on mitigation of soil degradation is very necessary to ensure the use of the information.

CONSENT

As per international standard or university standard written participants' consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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