UDC 633; DOI 10.18551/rjoas.2022-06.19

APPROPRIATENESS OF SUSTAINABLE SOIL MANAGEMENT TECHNOLOGIES INTRODUCED AMONG FARMERS THROUGH REFILS ACTIVITIES: IMPLICATIONS FOR THE FARMING SYSTEM RESEARCH IN NIGERIA

Adejumo Adeola Lydia*, **Adesoji Solomon Adedapo**
Obafemi Awolowo University, Nigeria
*E-mail: oadeola444@gmail.com

ABSTRACT
The study examined the perceived appropriateness of the Sustainable Soil Management Technologies practiced among farmers through the relevant actors' linkage activities in Oyo state, South-western Nigeria. A multi-stage sampling technique was used to select a total of 336 farmers across the four Agricultural Development Programme (ADP) zone in Oyo state, Nigeria. Questionnaire and structured interview Schedule were used to elicit quantitative information while Focus Group Discussion and Key Informant Interview guides were used to elicit qualitative information. Data collected were analysed using frequency, percentage, mean and standard deviation. The mean ages of all the farmers fell within the productive age of 48.02**.** 68.5% of the farmers were males while 31.5% were females. A total of 24 SSM technologies were disseminated and transferred by the REFILS and Farming System Research actors. Appropriateness of SSM technologies showed that 9, 10, 12 and 14 SSM practices respectively were beneficial to farmers on ease of application, ecological, economic and socio-cultural bases respectively. Results of the linear regression revealed that respondents' perception of appropriate technologies (b=0.06) significantly influenced their level of involvement in linkage activities for SSM development at $p \leq 0.01$. It is concluded that farmers in the study area perceived the appropriateness of SSM technologies based on their ease of application, ecological benefits, economic benefits and socio-cultural acceptability. Implementers of the Southwest Farming System Research system and the extension agents involved in SSM technology dissemination should leverage on this by creating more awareness of those technologies that are favourably perceived to be appropriate so as to influence the farmers 'eagerness to participate in linkage activities that will promote the use or application of these technologies among them.

KEY WORDS
Sustainable soil management, appropriateness, farming system research, farmers.

The valuable economic, environmental and social roles of soil cannot be over-emphasized as it is the most significant medium for agriculture, providing the opportunity to feed and nourish everyone on earth. The ever-pressing demand for food production has however mounted pressure on the use of soil, consequently affecting soil quality in Nigeria and other developing countries. Several unguided practices such as bush burning, deforestation, continuous tillage and uncontrolled grazing affects soil quality, leading to soil degradation (Amusa *et al*., 2014). The Sustainable Development Goals have identified the need to restore degraded soils and improve soil health to be able to support food production and also store and supply more clean water, maintain biodiversity and achieve carbon sequestration, thus increasing the resilience in a changing climate (FAO, 2017). This goal therefore calls for the universal implementation of Sustainable Soil Management (SSM).

The failure of farmers to adopt appropriate soil conservation practices contributes significantly to the degradation of a considerable portion of agricultural land (Genene and Abiy, 2014). This is because proper soil management has the consequential effect of adding substantial amount of biomass to the soil, thus contributing to soil organic carbon stocks. Soil management technologies thus have great potential of causing minimal soil disturbance, conserving soil and water and improving soil structure (Lal, 2004). Delaney (2011) is however of the opinion that the source of agricultural technology and the means is not as important as the appropriateness of such. An appropriate technology should be very accessible, easy to use and maintain as well as affordable. FAO (2019) therefore posited that the selection of appropriate SSM practices and approaches is an important step in ensuring the effectiveness of soil management and restoration. This is because appropriate SSM technology will be suitable to the ecological condition, applicable as well as yield the desire ecological, economical, social and cultural benefits, thus making it effective among the users. Thus, how farmers, who are the direct beneficiaries and end-users of SSM technologies perceive the appropriateness of such could go a long way in determining their level of involvement in linkage activities towards the development and upscale of SSM.

Suffice to note that the Farming Systems Research and Extension (FSR/E) is a participatory approach to technological improvement and has strongly influenced the direction of agricultural development over the past two decades (Fancis & Hildebrand, 1989). The concept involves farmers, change agents and researchers. In Nigeria, the Institute of Agricultural Research and Training (IAR&T) has the zonal mandate for farming systems research and extension activities and this responsibility is discharged by the Southwest Farming Systems Research and Extension Programme (SWFSR&EP). The Programme evaluates and promotes technologies that are ecologically adaptable, socio-culturally acceptable and economically viable to millions of farming households in Southwest agroecology. With this system, the technologies recommended conform with the biophysical and socioeconomic constraints that create environments within the domains, based on the philosophy that new technologies must conform with the environments where they will be used because most farmers are unable to modify their environments to meet the needs of new technologies. The system facilitates the transfer of technologies that had been previously designed and tested in experimental research centres and assess the impact of such transfer (Patrick & Sylvain, 1999).

As Farming System Research and Extension is about the inter-connectedness of the farmers, researchers and extension agents, there should be in place, an effective linkage system through the Research-Extension-Farmer-Input Linkage system (REFILS). This would facilitate the interconnectedness among the actors involved in the generation, dissemination and utilization of these technologies for meaningful result and a well-suited technology to local conditions of the end-users (Agbamu, 2000). This thus calls for a need for research and extension to collaborate with and use the available channels of information in getting new knowledge and information to farmers on appropriate SSM uptake.

Objective of the study:

- describe the socio-economic characteristics of the farmers involved in linkage activities with other actors in Oyo state, Nigeria;
- identify the Sustainable Soil Management technologies transferred and practiced among the farmers through the linkage activities with other actors (REFILS) in Oyo State, Nigeria;
- assess the perceived appropriateness of SSM technologies transferred among farmers in Oyo State, Nigeria.

Hypothesis. There is no significant relationship between the farmers' perceived appropriateness of transferred SSM technologies and their level of involvement in linkage activities with other SSM actors.

Communication process strives to maintain symmetry of a relationship among the elements by transmitting information about any change and allowing re-adjustment. Based on the identification of this main concept for this research, i.e. systems, this study was based on systems theory. The general system theory was propounded by Ludwig von Bertalanffy in 1930 and has been widely applied in many disciplines. In fact, Walonick (1993) affirmed that system theory offers an internally consistent method of scholarly inquiry that can be applied to all areas of social science. The system view was based on several fundamental ideas. First, all phenomena can be viewed as a web of relationships among elements or a system. Second, all systems have common pattern behaviour and properties that the observer can analyse and use to develop greater insights into the behaviour of complex phenomena. To explain the operation of systems, Seifu (n.d) gave the following 7 components of a system:

environment, input, through put/ process, output, feedback, goal and boundary. The system theory is applicable in explaining the inter-relationship and linkages among the identified actors of REFILS towards the achievement of Sustainable Soil Management development among the end-users. The theory is capable of providing organizations and their leaders a holistic view of the SSM system and the organizational impacts in creating an enabling environment for the stated goal to be realized.

METHODS OF RESEARCH

The study was carried out in Oyo State, Nigeria which has 33 LGAs divided into four Agricultural Development Programmes (ADPs) zones located at Saki, Ogbomoso, Oyo and Ibadan. The target population of the study consisted of ADP contact farmers and registered input dealers in Oyo state. The study population was estimated to be 2,483. Multi-stage sampling procedure was adopted for selecting the respondents. To select the farmers, a proportion of 50 percent of the blocks were selected, making 14 blocks, from which 30 percent of the contact farmers were randomly selected, making a total of 336 farmers for the study. Questionnaire and structured interview Schedule were used to collect quantitative data while Focus Group Discussion and Key Informant Interview Guides were used for the collection of qualitative data. Data collected were analysed using appropriate descriptive and inferential statistics.

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers in the study area. The ages of the farmers as shown in Table 1 mostly fell between 40-59 years. The mean ages (48.02±11.11) of all the respondents' categories is a strong indication that they are all still within their productive ages and it is in tandem with Onasanya (2009) who classified productive age of farmers to be between 20 and 55 years. This result also agrees with the findings of Adesoji and Aratunde (2012) who gave a productive age of farmers to be 41-50 years. The implication of these findings is that the farmers involved in the Farming System Research as well as the SSM actors in the study area (based on their age ranges) still have the capacity to carry out specific activities relating to the development of Sustainable Soil Management among the end users. 68.5 percent of the farmers were found to be males while the females were below average (31.5%). This implies that male sex is the dominant among the farmers which will tend to affect their level of participation in Farming System Research for SSM development. For the marital status of the farmers, majority of them (94.9%) are married with the implication that most of them will tend to embrace activities or linkage mechanisms that will promote their productivity through SSM practices. The More than average of the farmers had household sizes between 5-9, with the mean of 8.08.0±5.70 This result is in line with the findings of Adejumo (2015) where a mean moderate Household size of 7.0 was recorded for farmers in Osun state. From these findings, there is an indication that most of the farmers in the study area will tend to embrace every opportunity and innovation to support their household dependents, hence their tendency for affinity to linkage activities that will promote their productivity (SSM technologies inclusive. The results also revealed that majority of the farmers were literate, having one form of formal education or the other with a cumulative percentage of 82.1 (adult, primary, secondary, and tertiary education). Higher percentage (53%) had between 6-12 years of formal education with a mean of 7.63±2.43. This agrees with the findings of Balogun *et al (*2013) where a high percentage of the respondents in Kwara state (79.6) possessed formal education. As opined by Ogunmefun and Adule (2015), a farmer's level of acquired knowledge through education determines the ability of such farmer to make profitable decisions on investment and adopt an approach to risk management that best reduces the incidences of productivity failure. The implication of this findings is that the level of formal education of the contact farmers as one of the categories of REFILS actors will tend to have an influence their level of involvement in the linkage mechanisms and synergy with other actors towards the promotion of SSM technologies. This is because literate farmers tend to be more exposed than non- literate farmers. The findings in Table 4.3 revealed that 52.7 percent of contact farmers for the study acquired their land for production through inheritance; this was followed by 'lease' with 32.4 percent. This is simply an indication that more of the farmers had permanent access to their land as revealed in the cumulative sum of outright purchase, inheritance, gift and transfer (79.3%). This result agrees with the findings of Adejumo (2015) where there was an appreciable number of farmers owning their own farmland in a study carried out in Osun state, with a cumulative percentage of 67.2. The implication is that farmers will find it more appropriate (socio-economically) to invest in SSM technologies as a result of secured land tenureship, thus leading to improved adoption of SSM technologies, agroforestry in particular.

Table 1 – Socio economic characteristics of the farmers

Variable	Farmers n=336)
Age	
<30	8(2.4
30-39	66(19.6)
40-49	105(31.3)
50-59	109(32.4)
60+	48(14.3
	mean=48.02
	SD=11.11
Sex	
Male	230(68.5)
Female	106(31.5)
Marital status	
Single	7(2.1)
Married	319(94.9)
Divorce	3(0.9)
Separated	7(2.1)
Household size	
<5	51(15)
5.0-9.0	205(61)
10+	80(24)
	mean=8 SD=5.70

Source: Field survey, 2021.

SSM technologies transferred and practiced among the farmers. For SSM technologies, mulching and ridging across the slope had the highest responses of 72.7 percent each for transfer to farmers, mulching had the highest of those that practiced the SSM, with 77.4 percent. In the Soil Nutrient Management category, composting recorded the highest with 75.0 percent transferred while precision in organic and inorganic fertilizer recorded the highest number of farmers that practiced with 61.3 percent practiced. For minimum soil disturbance category, minimum tillage recorded a large turn-out of farmers having them being transferred to with 81.8 percent For those that practiced, minimum tillage also recorded higher percentage of 66.1 percent. For the Water Management category, majority of the farmers (90.9%) and 84.5% recorded highest figures for transfer and practice respectively. For agroforestry system, majority of the farmers (88.6%) recorded positive response for transfer of the planting of leguminous herbs as SSM technology with 78.6% having practiced it.

The perceived appropriateness of SSM technologies transferred among farmers through the REFILS activities in Oyo State, Nigeria. Results in Table 3, 4, 5 and 6 revealed the perceived appropriateness of the transferred technologies among the farmers in the study area, based on 'Ease of Application', 'Ecological benefit', 'Economic benefit' and 'Socio-cultural benefit'. These results were in line with Delaney (2010), that an appropriate technology should be accessible, affordable, easy to use and maintain, effective and serves the real need.

Table 2 – Technologies transferred and practiced

SSM Technologies	Transferred	Practised	Rank

	percentage	Rank	percentage	
Soil Erosion Control				
Erosion chambers	54.5	4th	32.1	4th
Use of vetiver grass and sweet potato strips	34.1	5th	30.7	5th
Semi-Circular bonds (for slopy areas)	56.8	3rd	40.2	3rd
Ridge tying and (or) ridging across the slope	72.7	1st	65.5	2nd
Mulching	72.7	1st	77.4	1st
Soil Nutrient Management				
Production and Application of organic fertilizer (Cassava-based and vetiver-based compost)	65.9	2nd	52.1	2nd
Production & use of bio-char	54.5	5th	26.5	5th
Use of bio-fertilizer (Noodles in the roots of plants, Rhizomes)	63.6	3rd	27.4	4th
Precision in organic & inorganic fertilizer use (application rate, type and timing)	61.4	4th	61.3	1st
Composting	75	1st	33	3rd
Minimum Soil disturbance				
Minimum Tillage	81.8	1st	66.1	1st
No-till	59.1	2nd	18.8	2nd
Water Management				
Water harvesting from concentrated run-offs(for irrigation)	56.8	1st	11	2nd
Micro-check dams (for irrigation)	34.1	4th	7.4	4th
Tube wells	45.5	2nd	12.8	1st
Low-cost PVC-based sprinkler irrigation	45.5	2nd	10.4	3rd
Vegetation Management				
Choice plant species/ use of improved hybrids	88.6	2nd	59.5	4th
Crop rotation	72.7	4th	81.8	2nd
Short term fallow with planting of legumes (to be ploughed back into the soil as manure)	50	5th	44	5th
Multiple cropping, inter-cropping	90.9	1st	84.5	1st
Shifting cultivation	84.1	3rd	64	3rd
Agroforestry systems				
Planting of leguminous herbs (Moringa, Leucaena, glyricidia, etc)	88.6	1st	78.6	1st
Planting tree crops on croplands	84.1	2nd	50.3	2nd
Trees for bio-drainage (Live fences and hedge rows)	50	3rd	47.9	3rd

Source: Field survey, 2020.

Ease of Application of SSM technologies. Evidence in Table 3 showed that eight (8) SSM technologies were perceived to be appropriate by the farmers, on the basis of their ease of application. With the mean >2.5, Crop rotation and multiple cropping/ inter-cropping was perceived by most of the farmers as appropriate with the mean of 3.20±0.86 and 3.13±0.90 respectively. These 2 SSM technologies are under the Vegetation Management category. Planting of leguminous herbs and minimum tillage were perceived to be appropriate with the mean of 2.98±0.97 each. Table 2 further revealed that mulching, use of improved hybrids, precision fertilizer use, and use of vetiver grass and sweet potatoe strips recorded the mean of 2.96±1.05, 2.84±1.06, 2.63±1.10, and 2.51±1.32 respectively. The result of this finding implies that farmers tend to adopt or practice these 8 SSM technologies more, based on their ease of application.

Ecological benefit of SSM technologies. Evidence in Table 4 revealed that of all the identified SSM technologies, planting of leguminous herbs (agroforestry practice) had the highest mean of 2.98±0.84 of the farmers with high perceived appropriateness, followed by mulching, 2.91±1.08. Multiple cropping and short-term fallow had 2.85±0.94 and 2.84±1.10 respectively. The use of improved hybrid had the mean of 2.81±1.03 and shifting cultivation also recorded the mean of 2.81±1.08 each. Minimum tillage also recorded appreciable number of farmers with high perception of appropriateness (2.56±1.00). The use of vetiver grass had 2.50±1.31, precision in fertilizer, 2.50±2.00, and use and planting of tree crops on cropland recorded 2.50±0.90. For appropriateness of technology based on ecological benefit, ten (10) SSM technologies were perceived appropriate by the farmers. This is an indication that the farmers will tend to practice or adopt these technologies for their ecological benefits.

Economic benefit of SSM technologies. Results from this finding indicated that 12 of the SSM technologies had the farmers' favourable perception of them as being appropriate on the basis of economic benefit. As indicated in Table 4, crop rotation and planting of leguminous herbs had the mean of 3.20±1.05 and 3.16±0.92 respectively. The use of improved hybrids, multiple cropping/ inter-cropping, minimum tillage and shifting cultivation recorded the mean of 2.93±1.20, 2.91±0.87, 2.85±1.16 and 2.74±1.06 respectively. For short term fallow, planting of trees on cropland, ridging across slope and erosion chambers, their perception mean recorded are 2.70±1.09, 2.64±1.07, 2.53±1.12 and 2.51±1.26 respectively. Composting and production of organic fertilizer also recorded a mean of 2.50±1.23 each. Findings from FGD sessions with the farmers however revealed that most of the SSM technologies perceived to most appropriate based on their economic benefit are also associated with high cost of implementation or adoption thus limiting their rate of adoption by the end-users.

Table 3 – Perceived appropriateness of SSM technologies (ease of application)

SSM Technologies	Perceived Appropriateness (ease of application)	
	Mean	Std. Dev
Soil Erosion Control		
Erosion Chambers	2.17	1.07
Use of vetiver grass and sweet potato strips	2.51*	1.32
Semi-Circular bonds (for slopy areas)	1.59	0.89
Ridge tying and (or) ridging across the slope	1.85	1.12
Mulching	2.96*	1.05
Soil Nutrient Management		
Production and Application of organic fertilizer (Cassava-based and vetiver-based compost)	1.84	1.08
Production & use of biochar	1.37	0.86
Use of bio-fertilizer (Noodles in the roots of plants, Rhizomes)	1.76	0.96
Precision in organic & inorganic fertilizer use (application rate, type and timing)	2.63*	1.10
Composting (Partially Aerated Composting Technique and Accelerated Composting Technique to reduce the period of composting)	1.76	1.06
Minimum Soil disturbance		
Minimum Tillage	2.98	0.97
No-till	2.00	1.19
Water Management		
Water harvesting from concentrated run-offs (for irrigation)	1.75	1.10
Micro-check dams (for irrigation)	1.43	0.79
Tube wells	1.50	0.70
Low-cost PVC-based sprinkler irrigation	1.47	0.84
Vegetation Management		
Choice plant species/ use of improved hybrids	2.84	1.06
Crop rotation	3.20*	0.84
Short term fallow with planting of legumes (to be ploughed back into the soil as manure)	2.18	1.11
Multiple cropping, inter-cropping	3.13*	0.90
Shifting cultivation	2.42	1.08
Agroforestry systems		
Planting of leguminous herbs (Moringa, Leucaena, glyricidia, e.t.c	2.98*	0.98
Planting tree crops on croplands	2.84	1.04
Trees for bio-drainage (Live fences and hedge rows)	1.81	1.02

Source: Field Survey, 2021.
Mean > 2.5 = Appropriate.

Table 4 – Perceived appropriateness of SSM technologies (ecological benefit)

SSM Technologies	Perceived Appropriateness (ecological benefit)	
	Mean	Std. Dev
Soil Erosion Control		
Erosion Chambers	2.27	1.33
Use of vetiver grass and sweet potato strips	2.50*	1.31
Semi-Circular bonds (for slopy areas)	2.08	1.03
Ridge tying and (or) ridging across the slope	2.26	1.08
Mulching	2.91*	1.08
Soil Nutrient Management		
Production and Application of organic fertilizer (Cassava-based and vetiver-based compost)	1.60	0.77
Production & use of biochar	2.20	1.24
Use of bio-fertilizer (Noodles in the roots of plants, Rhizomes)	2.50*	2.00
Precision in organic & inorganic fertilizer use (Application rate, type and timing)	2.06	0.98
Composting (Partially Aerated Composting Technique and Accelerated Composting Technique to reduce the period of composting)	2.56*	1.00
Minimum Soil disturbance		
Minimum Tillage	2.58	1.00
No-till	1.66	0.88
Water Management		
Water harvesting from concentrated run-offs (for irrigation)1.85	1.07	
Micro-check dams (for irrigation)	1.5	0.88
Tube wells	1.4	0.78
Low-cost PVC-based sprinkler irrigation	1.83	0.94
Vegetation Management		
Choice plant species/ use of improved hybrids	2.81*	1.03
Crop rotation	3.1	0.90
Short term fallow with planting of legumes (to be ploughed back into the soil as manure)	2.84*	1.10
Multiple cropping, inter-cropping	2.85*	0.94
Shifting cultivation	2.81*	1.08
Agroforestry systems		
Planting of leguminous herbs (Moringa, Leucaena, glyricidia, etc.	2.98*	0.84
Planting tree crops on croplands	2.50*	0.90
Trees for bio-drainage (Live fences and hedge rows)	2.08	0.87

Source: Field Survey, 2021.
Mean > 2.5 = Appropriate.

Socio-cultural benefit. For the socio-cultural benefits' category, mulching had the highest mean of 3.22±1.15, followed by crop rotation of 3.13±0.82. Planting of leguminous herbs and shifting cultivation had 3.07±0.88 and 3.06±1.08 respectively. As stated by the respondents, the afore-mentioned SSM technologies had their histories in their indigenous ways/ practices of soil improvement. From the result of this findings, as shown in Table 5 and as captured in one of the FGD sessions, some of the SSM technologies utilized by the farmers were indigenous practices which could just be regarded as 're-introduction' by the extension agents to the farmers. Other technologies identified to have most socio-cultural appropriateness include multiple cropping/ inter-cropping, short term fallow, tree crops on crop lands, minimum tillage and use of improved hybrids with mean of 3.00±0.91, 2.88±1.15, 2.82±0.89, 2.73±1.05 and 2.70±1.07 respectively. Precision fertilizer application, use of vetiver grass or potato strips, erosion chambers and ridging across the slope had the mean of 2.69±1.07, 2.65±1.38, 2.57±1.31 and 2.53±1.21 respectively. The implication of this results is that farmers who are the end-users of the SSM technologies tend to adopt and promote technologies that have antecedents in their socio-cultural practices and beliefs as the research scientists and EAs are supposed to build on this.

Table 5 – Perceived appropriateness of SSM technologies (economic benefit)

SSM Technologies (economic benefits)	Perceived Appropriateness	
	Mean	Std. Dev
Soil Erosion Control		
Erosion Chambers	2.51*	1.26
Use of vetiver grass and sweet potato strips	2.42	1.26
Semi-Circular bonds (for slopy areas)	2.26	1.08
Ridge tying and (or) ridging across the slope	2.53*	1.12
Mulching	3.18	1.05
Soil Nutrient Management		
Production and Application of organic fertilizer (Cassava-based and vetiver-based compost)	2.50*	1.23
Production & use of biochar	1.80	0.98
Use of bio-fertilizer (Noodles in the roots of plants, Rhizomes)	1.94	1.10
Precision in organic & inorganic fertilizer use (application rate, type and timing)	2.71	1.22
Composting (Partially Aerated Composting Technique and Accelerated Composting Technique to reduce the period of composting)	2.50*	1.23
Minimum Soil disturbance		
Minimum Tillage	2.85	1.16
No-till	1.72	0.98
Water Management		
Water harvesting from concentrated run-offs (for irrigation)	2.08	1.16
Micro-check dams (for irrigation)	1.74	1.03
Tube wells	1.68	0.93
Low-cost PVC-based sprinkler irrigation	1.94	1.09
Vegetation Management		
Choice plant species/ use of improved hybrids	2.93*	1.20
Crop rotation	3.20*	1.05
Short term fallow with planting of legumes (to be ploughed back into the soil as manure)	2.70*	1.09
Multiple cropping, inter-cropping	2.91*	0.87
Shifting cultivation	2.74*	1.06
Agroforestry systems		
Planting of leguminous herbs (Moringa, Leucaena, glyricidia, etc.	3.16*	0.92
Planting tree crops on croplands	2.64*	1.07
Trees for bio-drainage (Live fences and hedge rows)	2.34	1.34

Source: Field Survey, 2021.
**Mean > 2.5 = Appropriate.*

The influence of perceived appropriateness of SSM technologies on farmers' involvement in FSR/ SSM linkage activities. Results in Table 7 revealed that respondents' perception (B=0.34) significantly influenced their level of involvement in linkage activities at 0.01 level of significance. This indicates that the higher the perceived appropriateness of SSM technologies available for use by the farmers, the more involved they are in linkage activities to access the knowledge of the technologies. This indicates the respondents tend to get more involved in Farming System Research linkage activities for SSM technologies if they are favorably disposed to the SSM technologies. The implication is that Extension agents and FSR implementers involved in SSM technology dissemination should create more awareness of those technologies that are favorably perceived to be appropriate so as to influence the farmers 'eagerness to participate in linkage activities that will promote the use or application of these technologies among the farmers.

Table 6 – Perceived appropriateness of SSM technologies (socio-cultural benefit)

SSM Technologies (socio-cultural benefit)	Perceived Appropriateness	
	Mean	Std. Dev
Soil Erosion Control		
Erosion Chambers	2.57*	1.31
Use of vetiver grass and sweet potato strips	2.65*	1.38
Semi-Circular bonds (for slopy areas)	2.25	1.10
Ridge tying and (or) ridging across the slope	2.53*	1.21
Mulching	3.22*	1.15
Soil Nutrient Management		
Production and Application of organic fertilizer (Cassava-based and vetiver-based compost)	2.19	1.13
Production & use of biochar	2.12	1.13
Use of bio-fertilizer (Noodles in the roots of plants, Rhizomes)	1.84	0.84
Precision in organic & inorganic fertilizer use (application rate, type and timing)	2.69*	1.07
Composting (Partially Aerated Composting Technique and Accelerated Composting Technique to reduce the period of composting)	2.39	1.17
Minimum Soil disturbance		
Minimum Tillage	2.73*	1.05
No-till	1.55	0.85
Water Management		
Water harvesting from concentrated run-offs (for irrigation)	1.70	0.91
Micro-check dams (for irrigation)	1.55	0.75
Tube wells	1.69	0.96
Low-cost PVC-based sprinkler irrigation	1.86	1.95
Vegetation Management		
Choice plant species/ use of improved hybrids	2.70*	1.07
Crop rotation	3.13*	0.82
Short term fallow with planting of legumes (to be ploughed back into the soil as manure)	2.88*	1.15
Multiple cropping, inter-cropping	3.00*	0.91
Shifting cultivation	3.06*	1.08
Agroforestry systems		
Planting of leguminous herbs (Moringa, Leucaena, glyricidia, etc.	3.07*	0.88
Planting tree crops on croplands	2.82*	0.89
Trees for bio-drainage (Live fences and hedge rows)	2.40	1.04

Source: Field Survey, 2021.
** Mean > 2.5 = Appropriate.*

Furthermore, overall regression model summary show that R^2 value of 0.117 and adjusted R^2 value of 0.115 were obtained at $p<0.00$ significant level. This indicates that 11.7% variation in the dependent variable (involvement in linkage activities) was accounted for by the independent variable included in the regression analysis. The remaining percentage was due to other variables not included in the analysis.

Table 7 – Results of linear regression showing the influence of perceived appropriateness SSM and farmers' involvement

n/n	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	0.49	1.95		0.25	0.80
Perceived appropriateness scores	0.06	0.01	0.34	6.63	0.00

Source: Field survey, 2020.
F-value = 43.936; p<0.00.
R = 0.343, R –square = 0.117, Adjusted R- square = 0.115.

CONCLUSION

Some SSM technologies have been perceived to be more appropriate in terms of their 'ease of application, economic, ecological and socio-cultural benefits. Implementers of the Southwest Farming System Research (FSR) system (including the REFILS actors) and the extension agents involved in SSM technology dissemination should leverage on this by creating more awareness of those technologies that are favorably perceived to be appropriate so as to influence the farmers 'eagerness to participate in linkage activities that will promote the use or application of these technologies among the farmers. Research institutes and Extension Personnel in ADP that are stakeholders / actors in FSR system in the southwest to synergize efforts towards the promotion of SSM technologies that are perceived to be appropriate by the farmers, especially in terms of 'ease of application and socio-cultural suitability

REFERENCES

1. Adejumo A. L (2015). Adoption of Sustainable Land Management (SLM) Practices among Fadama III Farmers in Osun State. Unpublished MSc. Thesis. Obafemi Awolowo University, Ile-Ife.
2. Adesoji S. A. and Arantunde T (2012). Evaluation of the linkage system of Research-Extension-Farmers in Oyo State, Nigeria. Lessons for Agricultural Extension and Rural Development, 4(20),561-568. https://www.academic journals.org.
3. Agbamu J. U (2000). Agricultural Research–Extension Linkage Systems: An International Perspective. Agricultural Research & Extension Network. Network Paper No.106. https://www.agris fao.org.
4. Amusa T. A., Enete A. A. and Okon U. E (2014). Willingness-to-Pay for Agronomic Soil Conservation Practices among Crop-based Farmers in Ekiti State, Nigeria. A Paper Presented at the 28th Annual Conference of Farm Management Association of Nigeria (FAMAN), 750 Seater Auditorium, Site III, Delta State University, Abraka, Tuesday 14th – Thursday 16th October, 2014.
5. Balogun O.S., Aliyu T. H and Musa A. K (2013). Perception of Fadama III participating farmers on pest and diseases and the use of integrated pest management control strategy in Kwara state, Nigeria. Ethiopian Journal of Environment Studies and Management. Vol 6 (6). https://www.ajol.infol.
6. Delaney M. R (2011). An analysis of Biochar's appropriateness and strategic action plan for its adoption and diffusion in a poverty context: the case of central Haiti. A MSc. Thesis, Arizona State University. https://www.asu.edu.
7. Food and Agriculture Organization (2017). Voluntary Guidelines for Sustainable Soil Management Food and Agriculture Organization of the United Nations Rome, Italy.
8. Genene T. M and Abiy G (2014). Review on Overall Status of Soil and Water Conservation System and Its Constraints in Different Agro Ecology of Southern, Ethiopia. Journal of Natural Sciences Research, 4 (7): 59 – 69.
9. Ogunmefun S.O and Achike A.I (2015). Socioeconomic Characteristics of Rural Farmers and Problems Associated with the Use of Informal Insurance Measures in Odogbolu Local Government Area, Ogun State, Nigeria. RJOAS, 2 (38).
10. Onasanya A. S (2007). Crop Farmers Use of Environmentally Sustainable Agricultural Practices in Ogun State, Nigeria. Journal of Environmental Extension, 6(1):75-78.
11. Walonick (1993). General System Theory. https://www.ststpac.org.