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SUSTAINABLE LAND MANAGEMENT IN THE UPPER WEST REGION OF GHANA: A FORGOTTEN SOLUTION TO LAND DEGRADATION, COMMUNICATION FAILURE OR A NON-PRIORITY OPTION?

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ABSTRACT

Technology adoption in agriculture is key to improving the general well-being of small holder crop farmers, against the background of soil erosion and land degradation in most parts of Ghana. This study assessed the level of adoption of Sustainable Land Management (SLM) practices among farmers in the Upper West Region of Ghana, constraints associated with the adoption of SLM practices as well as the socio-economic factors influencing the adoption of SLM practices. The role of research and community radios in disseminating SLM practices to farmers was also investigated.

The study found low adoption of SLM practices among farmers in the Upper West region of Ghana. Land tenure, the drudgery associated with SLM practices, inadequate funds, low quantity of crop residue, bush burning and the time consuming nature of SLM practices were found to be the constraints associated with the adoption of SLM practices.

Whereas educational status of respondents was found to positively influence the number of SLM practices farmers adopted, listening to agricultural programmes on radio negatively influenced the number of SLM practices farmers adopted.

Research Institutions and Community Radio Stations were found to be involved in communicating SLM practices to farmers through field demonstrations and radio broadcasts.

The study recommends that SLM practices should be practiced with very simple farm mechanized tools. This calls for governmental support as well as that of local authorities to help farmers acquire such farm machinery in the form of high purchase and subsidies. Also,

universal primary education should be fully implemented since education is key to securing sustainable development. Research Institutions should focus on high impact-driven field demonstrations on SLM practices. The right expertise for disseminating SLM techniques via radio broadcast should also be encouraged by radio stations.

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1. INTRODUCTION AND CONTEXT

Agricultural land is one of the most important resources underpinning Ghana's economic growth. It is the main employer of the majority of Ghanaians. About 45.5 percent of the total active labour force is directly involved in agriculture, forestry and fishery sector. Agricultural production in Ghana is predominantly rural based, constituting 82.5 percent of rural households (GoG 2012; GoG 2014). However, land degradation is continuously affecting Ghana's land resources at an alarming rate, hence the livelihoods of majority of the population. Thus the future growth of Ghana's agriculture is being threatened. It is reported that 69 percent of the total land surface is susceptible to soil erosion. Land degradation is largely manifested in the form of severe or very severe soil erosion (EPA 2002).

Land degradation connotes adverse or far-reaching consequences for people and ecological systems through the exploitation of land resources. These resources include vegetation, water, soil, forestry and wildlife. The problem of land degradation is often exacerbated by human activities. Increase in land degradation is linked to population growth and increasing demand on land resources, especially agricultural lands, forestry and wildlife. Inappropriate land uses are the primary cause of land degradation. These include consistent disturbance to the natural vegetation and environment by bush fires, shifting cultivation, land clearing for crops and pastures, logging for timber, firewood and charcoal as well as mining activities (Conacher 2009). In Ghana, two thirds of the degraded land is a consequence of unsustainable agricultural practices, twice on average, than in other West African countries (FAO 2000).

The main socio-economic drivers noted to be contributing indirectly to land degradation in Ghana are population growth and poverty, land degradation is rampant in areas where the incidence of poverty is high in Ghana (Peprah 2014). This suggests a positive correlation between land degradation and poverty. The livelihood of poor people in rural communities is dependent on natural resources in the form of subsistence agriculture, firewood and charcoal burning. This is the only means through which they achieve their survival as they have no alternative livelihoods (EPA 2002). It is therefore evident that land degradation and poverty is a nexus. Efforts aimed at reducing or tackling land degradation must at the same time include poverty reduction strategies. Most often sustainable land management (SLM) is proposed as a solution to land degradation, whose benefits are linked to poverty alleviation (Peprah 2014).

Peprah (2014) noted that investment in SLM in the form of organic soil fertility management will lead to increased agricultural productivity, declining land degradation and poverty reduction. Poverty reduction because increased agricultural productivity will lead to higher incomes from the sale of farm produce. SLM is the integration of socio-economic principles with environmental concerns in land use systems, including food production through the use of technologies or a set of farming activities (FAO 1993).

SLM techniques have been applied in Ghana over the years to improve soil and water conservation on degraded lands (Diao & Sarpong 2007). These techniques are broadly classified into moisture and soil fertility management as well as run-off or erosion control methods. Moisture and soil fertility methods include cover cropping, mulching, contour vegetative barriers, zero tillage with or without weedicides and agro-forestry. The run-off or erosion control methods include contour bunds, stones lines, ridge-furrow systems and tied-ridging. These are not-expensive physical structures built on the field to control run-off. These methods have been proven to yield economic benefits to famers, apart from soil and water conservation (Diao & Sarpong 2007).

1.1 Problem statement

The Upper West Region is one of the regions in Ghana that has benefitted from projects that extended these SLM techniques to farmers. Some of these projects included the Savannah Resources Management Project (SRMP) started in 1995, the No-Till Programme implemented by Sasakawa Global 2000 and Mosanto from 1992 to 2005, as well a research component on direct planting systems and promotion of minimum tillage and cover crops under the Sedentary Farming Systems Project (SFSP) implemented between 1998 to 2004 (Boahen et al. 2007).

Some farmers in the Upper West Region also benefited from the Conservation Agricultural Production Systems (CAPS) project. This project was a component of Sustainable Agriculture and Natural Resources and Environment Management (SANREM) started in 2007 (http:www.ghananewsagency.org/details/science). These projects extended knowledge on SLM through the establishment of field demonstrations in beneficiary communities. Farmers Field Days were organized on these demonstration plots, sometimes with other farmers coming from neighboring communities. Under these projects, training on SLM techniques was also organized for farmers and agricultural extension officers in a form of Workshops.

The supply of land is fixed though population growth keeps on increasing. This has led to increasing competition for alternative uses of land, and agricultural lands are especially becoming exhausted. People now move onto cultivate marginal lands which usually produce low returns to investment from farm households. Also, forest lands, woodlands and pastures are being converted to agricultural lands. This not only affects biodiversity conservation but sustainable land management (FAO 1993).

Many stakeholders, including researchers and non-governmental organizations, are involved in the generation and dissemination of research technologies in Ghana. Unfortunately, the emphasis of most of these technologies is always on increasing agricultural productivity through the use of improved crop varieties and chemical fertilizer. The sustainability of the land is not always a priority. The fertilizer Subsidy Program (FSP) introduced by the Government of Ghana has increased fertilizer use by 40 percent from 2008 to 2013. However, this has had little impact on crop yield (GoG 2015). Against the background of soil erosion and declining crop yield in Ghana and especially, the Upper West Region, there have been reports on low or non-adoption of SLM technologies (CEA 2006). This possibly is not only because of non-priority given to issues of soil conservation, but also lack of appropriate tools or strategies born out of grass root participation for disseminating SLM technologies. Limited adoption of SLM practices could also be a result of inefficient institutional factors and poor market conditions. The institutional factors include the political and institutional frameworks at the district and community levels (Ndah et al. 2013)

1.2 Overall goal and objectives of the study

The overall goal of this study is to promote sustainable use of agricultural land by highlighting the constraints associated with the dissemination and adoption of SLM technologies among farmers.

The specific objectives of the study include:

1. Investigating the level of adoption of SLM technologies, associated constraints and factors influencing adoption of SLM
2. Assessing farmers' perceptions regarding land degradation and their proposed solutions

3. Review institutional approaches (CSIR-SARI and some selected Media Stations) to SLM dissemination

This study seeks to highlight the importance of soil and how lack of or inadequate attention on its conservation through SLM continues to make majority of farming households in the Upper West region of Ghana poorer. The study will challenge policy makers and researchers to rethink and mainstream SLM in Ghana's extension service delivery system. Furthermore, it study hopes to fill-in the gap within the adoption studies on sustainable land management practices. The study will not only consider farmers' socio-economic factors on adoption of SLM, but with emphasis on the influence of community radio on adoption, as well as whether SLM dissemination and adoption is a priority option to community radio stations, research institutions and farmers.

1.3 Study area

The study area is the Upper West Region, located in the northern part of Ghana, as shown in Figure 1. Upper West Region is bordered to the north by the republic of Burkina Faso. It covers a geographical area of approximately 18,878 Km^2. This constitutes about 12.7 percent of the total land area of Ghana. The region is located in the guinea savanna vegetation belt (http://www.ghanadistricts.com). The Upper West Region is the region with the least population in Ghana. It has a total population of 702, 110 people, 2.8 percent share of Ghana's total population. Female constitute 51 percent and the remaining 49 percent are male. About 73 percent of the active labour force (people who are fifteen years and older) are involved in agriculture, followed by 10 percent in trade and trade related activities (GoG 2010).
Household sizes are higher in the three northern regions of Ghana than the national average household size of 4 people. The mean household size for the Upper West Region is 5.5, the highest in the three northern regions. The Northern Region has a household size of 5.4 and that of the Upper East Region being 4.5. A higher proportion of households in Ghana are headed by males (69.5%) than females (30.5%) (GoG 2014).

2. LITERATURE AND CONCEPTUAL FRAMEWORKS

2.1 Sustainable land management (SLM)

Ghana's natural wealth consist of forests, wildlife, fisheries and land resources. These resources form the livelihood of most Ghanaians. Overexploitation of these resources over the years has accounted for serious depletion. Food crop production continues to stagnate due to soil erosion and soil fertility decline (CEA 2006). Cropland constitutes about two-third of Ghana's natural capital (64 percent) followed by timber resources (22 percent), non-timber forest resources (6 percent), sub-soil assets (5 percent), pasture land (3 percent) and protected areas constituting 1 percent (World Bank 2006).

Figure 1. Map of Ghana (Source: Wikimedia. Commons).

Land degradation occurs mainly due to the activities of man in the form of overgrazing, improper agricultural practices, deforestation, overexploitation for fuelwood and industrial pollution. Another growing form of land and soil degradation is the pollution of surface and groundwater through the application of agro-chemicals. These chemicals dissolve in soil and water causing toxication, salinization and alkalization. Unfortunately, the impact of these activities are felt at sites or places further away from the initial application sites (FAO 1993). Sustainable land management is crucial in combating land degradation.

Sustainable land management has five main objectives: 1) increased output; 2) reducing the risk associated with production; 3) protecting natural resources as well guiding against degradation of soil and water quality; 4) having an economically viable production system and; 5) the social impact of the production process should be acceptable to society. These five objectives are also known as *Pillars of Sustainable Land Management* (FAO 1993). These objectives or pillars are measured as performance indicators for sustainable agriculture. Thus, sustainability is achieved for any agricultural activity if all the objectives are met concurrently. However, in a situation where not all the objectives are met at the same time, then there is partial or conditional sustainability. The acknowledgement of partial sustainability under a farming system provides direction on the interventions necessary to enhance agricultural sustainability (Dumanski et al. 1998). Technology adoption is therefore key to realizing either sustainability or partial sustainability under any farming system.

Many socio-economic factors have been found to influence adoption of technologies by farmers. For example, age of a farmer, both farm income and off-farm income, farmers' perception about a technology and farm size have a positive influence on adoption (Jatoe et al. 2005). Thus, an increase in any of these factors will lead to an adoption of a technology by farmers. In a study on factors influencing adoption of GM crops by Fernandez-Cornejo et al. (2001) showed that farm size, price of chemical insecticides, education and the number of years

a person spent on farming positively influence decision to adopt agricultural technologies. Land ownership has also been found to influence agricultural technologies, especially sustainable land management practices (Darbekow & McBride 2003; Boahen et al. 2007). Farmers also adopt technologies only if such technologies are consistent with their objectives and superior to existing technologies (Gregg 2009).

These studies however failed to look at the influence of the mass media, especially community radio on adoption of sustainable land management techniques. In studies where the influence of community radio on adoption of SLM is prioritized like Chapman et al. (2003), there is also a failure to clearly indicate if farmers truly consider SLM practices as a priority in their farming activities. According to Chapman et al. (2003), community radio has extensively been used in extension communication in Ghana. The medium of communication is always vernacular or local language. This gives wider listening coverage and understanding of extension programmes run by these community radios. Understanding of soil conservation and management practices among farmers were found to have improved after listening to radio programmes on sustainable land management.

2.2 Performance of research institutions in research dissemination

The conceptual base for this study lies in the need to identify the priority areas of research over a six-year period. This offers an opportunity to assess if such priority areas of research cover or highlight issues of SLM in Northern Ghana, and Upper West Region in particular. The number of publications by researchers in institutions is widely used as measuring indicator for research productivity. This kind of studies has recently become a field of interest for many researchers (Helal et al. 2014). For example, Helal et al. (2014) assessed the publication productivity of researchers in the Faculty of Medicine from Mansoura University in Egypt by reviewing publications from 1969 to 2012. The means of data collection for their study was the use of the electronic data system PubMed, which according to them was the most widely used international database for medical research.

The criteria adopted for selection of published papers from the free web based literature service, PubMed, were temporal, place of study and affiliation or present job contract with the University of Mansoura. Temporal in the sense that publications in the field of medical research from the University were considered between 1969 to 2012. Place of study indicates that these publications were conducted in and published in the University, from individual scientists or international collaborative studies. Also, affiliation or present job contract with the University means that studies which were conducted in the University but, at the time of publication the author (s) was/ were working outside the University or studies which were conducted outside the University but at the time of submitting of papers and publication, the authors were working in the University (Helal et al. 2014).

In assessing the capacity and incentive factors affecting individual scientist's productivity in Ghana and Nigeria, Ragasa (2012) also used number of publications by scientists as an indicator for measuring research productivity. The scope of publications included journal articles, books and chapters from books. Another indicator used for measuring research productivity was technologies that a researcher helped to produce within a three-year period. Unlike Helal et. al (2014) who used an electronic data base system to retrieve publications of interest, Ragasa (2012) had to rely on individual surveys for scientists to report their number of publications due to non-existence of standard web based literature data system of journals produced locally in Ghana and Nigeria.

The weakness of the method of self-reported number of publications is absence of means of verification. Thus, a scientist may mis-report his/her number of publications and there exist no means of verification and validation (Northrup 1996). The use of annual reports from institutions is a more robust method. Annual reports do not only serve as means of verification, but adequately captures all scientific output of scientists during the year, including publications that might have been published in different journals by different scientists within the same institution.

2.3 The use of radio in agricultural extension

The concept of community radio has revolutionized in the extension delivery system across the globe since the past six decades. This happens particularly in the areas of agriculture and health. International Organizations such as United Nations Children's Fund (UNICEF), Food and Agriculture Organization (FAO) and United Nations Educational Scientific Cultural Organization (UNESCO) have employed the use of radio in communicating technologies to farmers since 1960 (Chapman et al. 2003). Radio transmissions have wider coverage of audience. They are also effective, efficient and very cheap per unit cost in reaching out to target listeners. Radio programmes on agriculture do not only provide useful information to rural farming communities, but also quicken the process of change. This impacts positively on livelihood improvement through increased yields and income of farmers (Mohammed et. al 2010). Radio broadcast on agricultural technologies is widely adopted by implementing agencies of research projects in the Upper West Region of Ghana. The media are usually trained on subject matter by scientists and other experts before broadcasts are made. Subject areas that farmers in the Upper West Region have benefitted in recent times from radio broadcast are soil health and crop production (CSIR-SARI 2011; CSIR-SARI 2013).

3. METHODOLOGY

Data collection tools for the study were a desk top review, a check-list and a questionnaire. The data analysis tools included the use of the computer programs Excel and Statistical Package for Social scientists (SPSS). Data obtained were analyzed using both descriptive and inferential statistics.

3.1 Primary data

Primary data was obtained from farmers through the use of a questionnaire. The questionnaire was designed to obtain information on farmers' demographic background and socio-economic characteristics, such as sex, age, household size, level of education, membership to an association, land ownership, farming experience as well as access to radio broadcast. Farmers' current production practices, perceptions regarding land degradation and proposed solutions, the level of adoption of SLM technologies and associated constraints were assessed through the questionnaire.

Data collection was done by staff of Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research (CSIR-SARI) between 15th to 22nd July, 2016. The team was led by a socio-economist who trained the enumerators before data collection. There was also a pre-test of the questionnaire before actual data collection took place. The communities for the study were Nyoli, Siiriyiri and Nako in the Wa West district; Gudayiri, Naaha and Kpalinye in

the Wa East district as well as Kusiele, Nabugang and Bullenga in the Nandom district. These three districts are in the Upper West Region of Ghana. The questionnaire is contained in appendix 1.

A statistical package, SPSS, was used to analyze farmers' socio-economic factors influencing adoption of SLM practices, from an econometric model called Poisson regression. The Poisson regression is used when the response variable is in the form of a count data. This model expresses the natural logarithm of the outcome of interest (Hansen 2016), example, adoption of different number of SLM practices (Y=0,1,2,…) among farmers. Thus, the values of the response variable (counts) are all positive integers. This means that the mean from Poisson distribution is greater than zero value. This makes Poisson regression most appropriate for this study.

3.1.1 Sampling procedure and sample size

Multi-stage sampling procedure was employed for the primary data collection of this study. Purposive sampling was used to select communities in three districts in the Upper West Region. Three communities were selected from each district and ten farmers randomly selected from each community. This gave a sample size of ninety (90) respondents. Members of these communities have benefitted from projects on sustainable land management in the past. From the ten farmers interviewed in each community, there were five beneficiary farmers and five farmers who did not take part in such projects.

The sample size for the study had 60 percent men and 40 percent women, though originally 70 percent men and 30 percent women were considered for the study. The idea was to have the same percentage distribution of male and female headed households in Northern Ghana. More women were willing to grant interviews on agricultural production than previously thought. The study assessed the present socio-economic conditions of both gender. These included women's level of education, access to land, income levels and access to extension services, relative to men. Also assessed were the production practices of both gender and their role in agricultural activities such as land clearing, ploughing, planting, weeding, fertilizer application and harvesting. Also important was the assessment of non-farm income sources for both men and women. Findings on gender issues are part of the recommendations from this study.

3.2 Review of annual reports of the CSIR-Savannah Agricultural Research Institute (SARI)

A desk review of annual reports of the CSIR-Savannah Agricultural Research Institute (SARI) was undertaken. The annual reports covered a six-year period, 2009 to 2014. The annual reports contained the research activities and research outputs of CSIR-SARI under the years under review. The research activities comprised of field experiments and multi-location trials undertaken by the Institute in the areas of crop improvement, lowland and upland agronomy, soil fertility improvement, crop protection comprising field crop protection and post-harvest, and socio-economic studies. The study did not count field experiments and multi-location trials as research outputs because they do not indicate research productivity or output. These are processes of scientific investigation that produce results or output. However, following Ragasa (2012), the indicators of research output were counted as the number of publications by scientists, the number and content of technologies transferred. The technologies included demonstrations, farmer field days, farmer field schools and training organized by scientists for farmers in each year under review.

To avoid double counting, demonstrations, farmer field days, farmer field schools and training for famers were considered as one. These were then categorized into seed/crop improvement, soil fertility improvement, crop protection, post-harvest and socio-economic/ impact studies/ situation and outlook analysis. Publications and technologies that did not fall into any of these categories were classified into another category called others. Publications and technologies transferred in the reports were reviewed based on subject matter (content of publication) into these mentioned categories. Publications and technologies transferred under soil fertility improvement were sub-categorized into those that had a subject matter on SLM, Inorganic fertilizer including inoculants as well as Simulation models. Simulation models' sub-category was only specific to publications. During the review, the number of publications and transferred technologies into each category was tallied. The tallies were then transferred into frequencies. The trend in the number of publications by scientists and number of demonstrations organized over the six-year period was computed based on the frequencies using Excel 2016.

3.3 Review of radio programmes in UpperWest Region

A check-list was used to obtain information from two radio stations. The two radio stations were purposively sampled from four radio stations in the Wa Municipality of the Upper West Region of Ghana. The choice of these two radio stations was because their radio broadcast covers all the districts under the study. These two radio stations are *Radio Upper West* and *Radio Progress*. They did not have annual reports. Their programme schedules for the year 2015 were obtained. These were put into broad categories and sent back to the radio stations for validation. The following categories were agreed on as issues that were broadcast for the year 2015: 1) Music; 2) Religion; 3) News/ Current Affairs/Morning Shows; 4) Agriculture; 5) Commercial Jingles/ Announcements; 6) Sports/ Entertainment/ Jingle Plays; 7) Education/ Sciences; as well as 8) Issues of Gender & children/ Love relations. A Check List was developed based on these categories and was sent back to the radio stations for administration. They ranked the categories based on broadcast time (airtime) allocated to each category during 2015, in a group interview with selected staff of each radio station. Specific topics on agricultural broadcast were also identified. These included: 1) pest and disease control; 2) tree planting; 3) use of different fertilizers and animal husbandry as well as 4) SLM. These sub-categories under Agriculture were also ranked based on which one of them had most broadcast time.

The rationale for considering CSIR-SARI and the radio stations in this study was to examine presence of issues of SLM in their technology transfer activities as well as the level of frequency.

4. RESULTS

4.1 Farmers' cross-sectional data

4.1.1 Socio-economic characteristics of farmers

The socio-economic characteristics of the farmers can be seen in Table 1. Sixty percent of the respondents were male and 40% were female and the mean age of the farmers was 45 years. Only 22% of the respondents had formal education. On average a respondent had a household size of 10 people. This is above the average household size of 8 people for female headed

households in the study. On average, a household had spent 16 years in farming. For the 2015 cropping season, 58% of the farmers had received extension services from agricultural extension agents. Great majority of the farmers interviewed, or 76 percent, had listened to agricultural extension broadcasts on the radio.

Table 1. Farmers' socio-economic characteristics and practices in the Upper West Region of Ghana.

Characteristics of Respondents	Frequency	Percentage (%)	Statistic
Sex:			
Male	54	60	
Female	35	40	
Age:			
20-30	15	17	
31-40	29	32	Max. =76
41-50	17	19	Min. =20
51-60	18	20	Mean =45
>61	11	12	
Household Size of sample	90		Mean =10
Household size of Female headed households	36		Mean=8 Max. =19
Educational Status:			Min.=
No Formal Education	70	78	Mean=2
Formal Education	20	22	
Membership of FBO:			
Yes	58	64	
No	32	36	
			Max. =55
Farming Experience			Min. =
			Mean =16
Area of land under cultivation (acres)			Mean =2.4 Ha
Ownership of Land:			
Yes	61	68	
No	29	32	
Contact with Agric. Extension Agent:			
Yes	52	58	
No	38	42	
Listening to radio on Agriculture			
Yes			
No	68	76	
	22	24	
Farm Income			Mean =GHS1354.00 Median =GHS520.00
None-farm Income			Mean =GHS604.00 Median =GHS300.00

*1US Dollar = GHS3.95 (Ghanaian cedi) at the time of Data collection

Some 60% of the respondents owned the land that was used for cultivation. On average, a farmer cultivated 2.4 Ha of land during the last cropping season preceding this survey. A little over half of the farmers (64%) were members of farmer based organizations (FBOs). The mean income for both farm income and non-farm income were GHS1354.00 and GHS604.00, respectively.

The main source of labour for farming activities from the study was family labour. The farming activities included land preparation, transplanting and/or sowing, weeding, fertilizer application, harvesting, threshing and/ processing as well as marketing of farm produce. As shown in Table 2, more women were involved in transplanting and/or sowing, fertilizer application and marketing, relative to men. Men had a lead role in land preparation and weeding. Women were found to have access to farm lands as equally as men. However, they do not own farmlands.

Table 2. Farming activities by gender and participation, in percentages (%) among farmers in the Upper West Region of Ghana. The farming activities were land preparation, transplanting/ sowing, weeding, fertilizer application, harvesting, threshing and/ processing as well as marketing/ selling.

Farming Activities	Gender	Percentage (%)
Land Preparation	Men	75
	Women	4
	Both	21
	Total	**100**
Transplanting/ sowing	Men	3
	Women	32
	Both	65
	Total	**100**
Weeding	Men	70
	Women	3
	Both	27
	Total	**100**
Fertilizer Application	Men	5
	Women	12
	Both	83
	Total	**100**
Harvesting	Women	17
	Both	83
	Total	**100**
Threshing and/ processing	Women	8
	Both	92
	Total	**100**
Marketing/ selling	Men	2
	Women	79
	Both	19
	Total	**100**

The study also revealed additional gender dimensions on household size, total land area under cultivation, total farm income and total non-farm income of respondents. The average size for female headed household was 8 people as against 11 people for male headed households. Female respondents had lesser land area under cultivation (1.2 Ha) than their male counterparts (3.2 Ha), on average. Consequently, male farmers had higher farm income (GHS1,877.00) than female farmers (GHS570.00). Also, male farmers had higher non-farm income than female farmers, GHS700.00 and GHS459.00, respectively.

4.1.2 Adoption of sustainable land management (SLM) practices

There was generally low adoption of SLM practices among farmers. Table 3 shows that adoption of Zero tillage with weedicide application was the highest (38%) among respondents followed by mulching (22%). There was zero adoption for agro-forestry, zero-tillage without weedicide application as well as contour vegetative barriers.

In terms of the number of SLM practices adopted by farmers, 9% of the farmers did not adopt any of the SLM practices, as indicated in Table 4. Some 28% of farmers adopted one SLM practice and 45% of the farmers adopted two SLM practices.

The mean quantities of NPK fertilizer, Sulphate of Ammonia and Inorganic fertilizer applied on crop fields by respondents during the 2015 cropping season were 140 Kg, 74 Kg and 97 Kg, respectively. The average land area that had fertilizer application was 0.8 Ha. The farmers also identified a number of constraints militating against the adoption of SLM practices. These were land tenure, the drudgery associated with SLM practices (labour intensive), inadequate funds, low quantity of crop residue, bush burning and the time-consuming nature of SLM practices. The highest constraint to farmers was inadequate funds (35%) followed by labour intensity of SLM (23%), as shown in Figure 2.

4.1.3 Factors influencing adoption of sustainable land management (SLM) practices

Objective 1 of the study sought to investigate the socio-economic factors of farmers that influenced adoption of SLM practices. The Poisson regression was used as the model for estimating the coefficients for farmers' socio-economic factors affecting adoption of SLM practices, as outlined in Table 5. The farmers' socio-economic factors were educational status of the farmers, whether he/ she was listening to agricultural programmes on the radio, ownership of land under cultivation, land area under cultivation and total amount of money realized from non-farm income sources. The Likelihood Ratio Chi-square was significant at 1% with a value of 22.276 in the Omnibus test. This suggests that all the predictor variables (the farmers' socio-economic factors) jointly explained the dependent variable (thus adoption of SLM practices). Educational status of respondents had a significant positive influence on adoption of SLM practices. However, listening to agricultural programmes by farmers was found to have a significant negative influence on adoption of all the SLM practices. Ownership of land under cultivation, land area under cultivation as well as non-farm income were found to have positive influence on adoption of SLM practices, though statistically not significant.

Table 3. Adoption of SLM practices by farmers in the Upper West Region of Ghana indicated by Frequency and Percentage. Yes, indicates that farmers adopted a particular SLM practice whereas No indicates that farmers did not adopt a particular SLM practice.

SLM Practices	Frequency	Percent (%)
Zero-tillage with weedicide application		
Yes	34	38
No	56	62
Total	**90**	**100**
Mulching		
Yes	20	22
No	70	78
Total	**90**	**100**
Tied ridges		
Yes	10	11
No	80	89
Total	**90**	**100**
Contour bunds		
Yes	6	7
No	84	93
Total	**90**	**100**
Cover Cropping		
Yes	1	1
No	89	99
Total	**90**	**100**
Contour vegetative barriers		
Yes	0	0
No	90	100
Total	**90**	**100**
Zero-tillage without weedicide application		
Yes	0	0
No	90	100
Total	**90**	**100**
Agro-forestry		
Yes	0	0
No	90	100
Total	**90**	**100**

Table 4. The number of SLM practices adopted by farmers from a total of 8 SLM practices assessed. These SLM practices were Zero-tillage with weedicide application, mulching, tied ridges, Contour bunding, cover cropping, agro-forestry, zero-tillage without weedicide application and contour vegetative barriers.

Number of SLM practices adopted by farmers	Frequency	Percentage (%)
0	8	9
1	25	28
2	41	45
3	14	16
4	2	2
Total	**90**	**100**

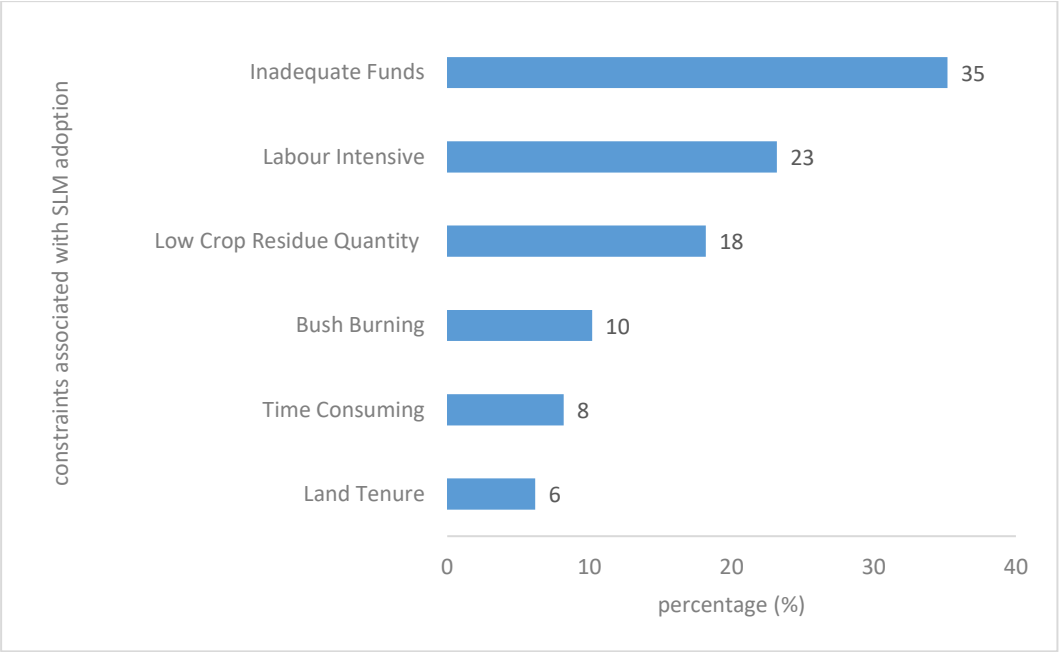

Figure 2. Constraints facing adoption of SLM practices as indicated by farmers in the Upper West Region of Ghana based on their first priority constraint.

Table 5. Poisson regression indicating socio-economic factors influencing adoption of SLM practices among farmers in the Upper West Region of Ghana

Parameter	Coefficient
Educational Status of Respondent	0.553 (0.1610) ***
Listening to agricultural programmes on radio	-0.546 (0.2425) **
Ownership of land under cultivation	0.062 (0.2016)
Land area under cultivation (in Ha)	0.14 (0.0175)
Non-farm Income	1.110E-5 (5.6916E-5)

, *, represent 5% and 1% levels of significance respectively
Source: Poisson Regression Results from computation based on field data (2016)

The mean crop yield obtained by farmers from their harvest was also compared over a three-year period, from 2013 to 2015. The crops under consideration were cowpea, maize (corn) and Soya. From Figure 3, the yield for cowpea was highest in 2015 (468 Kg). The year with the least mean yield for cowpea was 2014 (349 Kg). The highest yield obtained for maize was also in 2015 and that for Soya was in 2013.

Objective 2 of the study was to assess farmers' perceptions regarding land degradation and their proposed solutions. Some 79% of respondents perceived soil erosion to be a problem both on their farms and in their community. Also, 61 % of respondents reported having problems of annual bushfires on their crop fields. The main causes of bushfires identified in the study were charcoal burning, hunting, cigarette litters from smokers, farmers, herdsmen, children setting fires to bushes for rodents and for pleasure as well as wildfires, as indicated in Figure 4. The leading cause of bushfires from the study was charcoal burning.

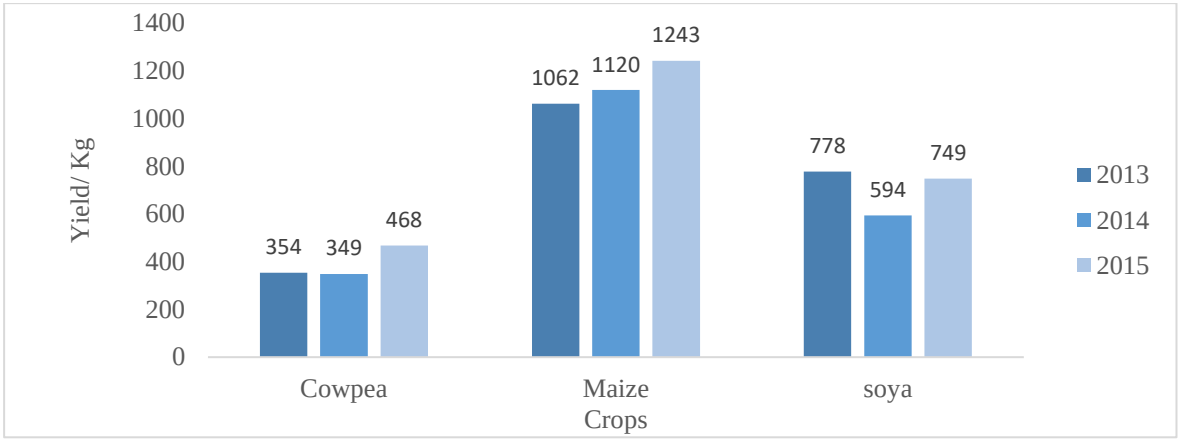

Figure 3. Crop yield of farmers in the Upper West Region of Ghana for cowpea, maize and soya from 2013 to 2015.

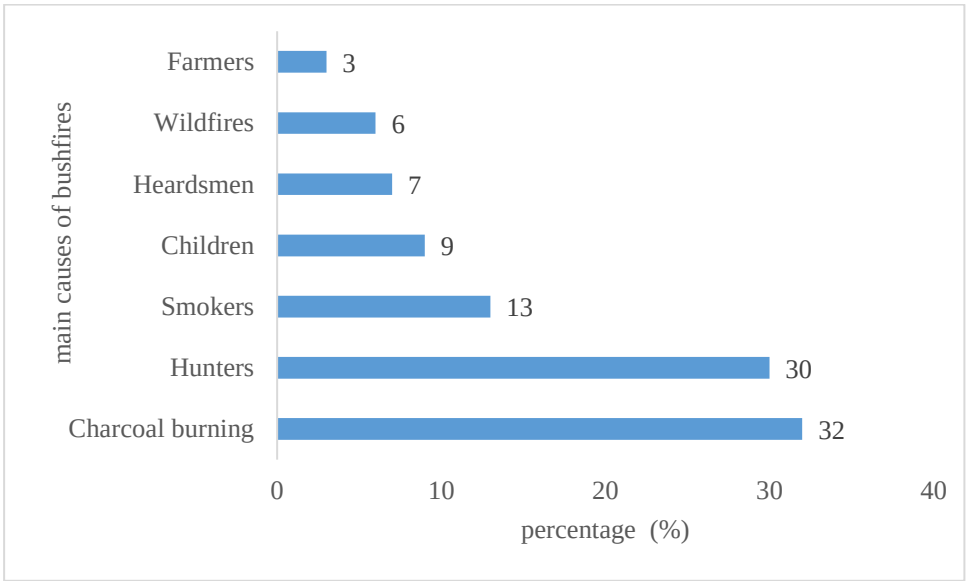

Figure 4. The main causes of bushfires in farming communities in the Upper West Region of Ghana as identified in the study by percentage (%).

A great majority of farmers (74%) revealed that agricultural extension, research and NGOs had interacted with them on issues of soil erosion and land degradation. The remaining 26% of the farmers indicated otherwise. This they blamed on inadequate staffing and lack of priority on issues of SLM practices. Some 88% of respondents agreed that it was their responsibility to conserve soil and water for the use of future generations, whilst the remaining 12% of respondents held a contrary view. The farmers proposed a number of measures that could control soil erosion on their crop fields. Some of these measures included crop residue retention, diversion of run-offs as well as use of stones and grasses to control water run-offs. Percentages of responses for each of the control measure proposed by the farmers are shown in Figure 5. Majority of farmers (19%) proposed diversion of run-offs as an efficient measure for controlling soil erosion. However, great majority of respondents (28%) did not propose any soil erosion control measure.

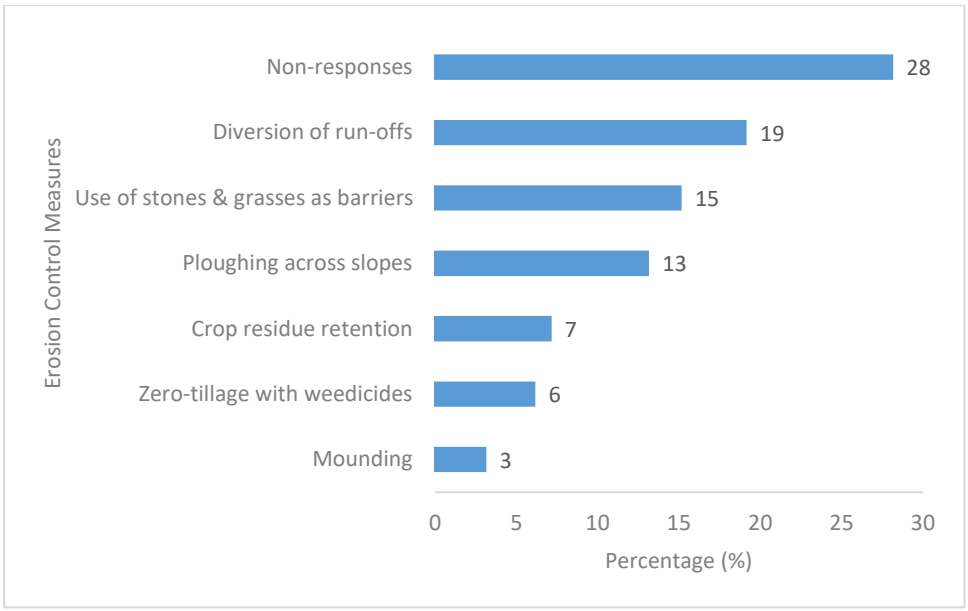

Figure 5. Proposed measures by farmers in the Upper West Region of Ghana for controlling soil erosion on crop fields by percentage (%). The Figure is based on the first ranking of erosion control measure from each respondent.

The study also revealed the importance farmers attach to radio broadcasts and how they interpret such broadcasts to suit their farming needs. Some 52% of the respondents perceived agricultural broadcast for 2015 to have centered mainly on Good Agronomic Practices (GAP), including the use of improved seed, as shown in Figure 6. There was little coverage under agricultural broadcasts on SLM practices such as avoidance of bushfires, use of organic manure, crop rotation as well as crop residue retention.

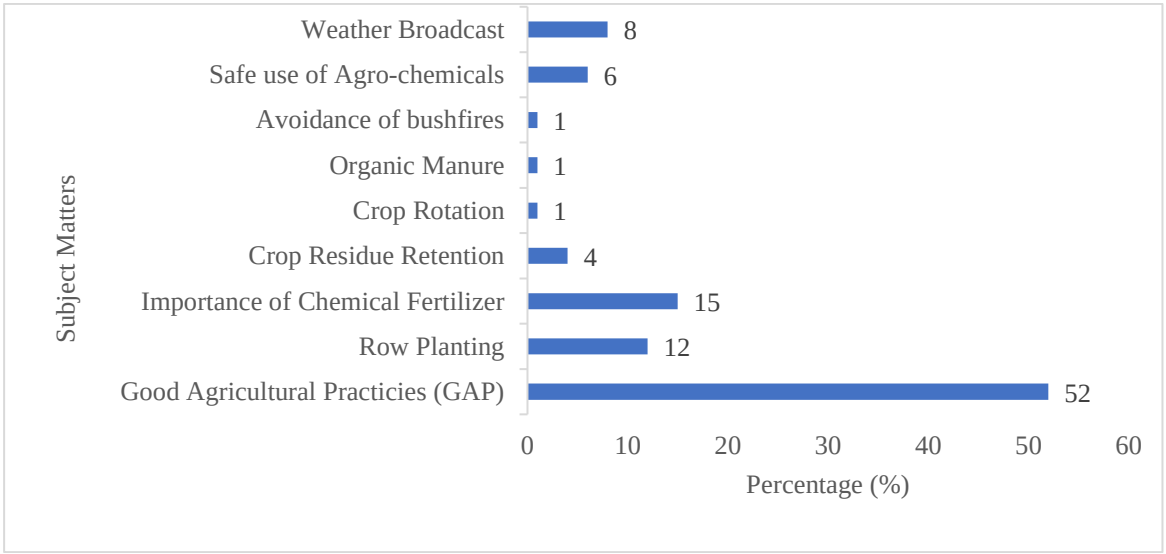

Figure 6. Farmers' perception on coverage of subject matter under agricultural radio broadcasts in the Upper West Region of Ghana.

4.2 CSIR-SARI SLM dissemination

Objective 3 of the study was to review institutional approaches (CSIR-SARI and some selected radio stations) to SLM dissemination. The number of publications from CSIR-SARI as well number of demonstrations organized were used to measure the Institute's approach towards SLM dissemination.

There was a total of 123 publications from scientists over the period 2009 to 2014. The year with the highest number of publications was 2013, which recorded 53 publications followed by 2014 with 19 publications. The year with the least number of publications from scientists was 2010 which had 5 publications, followed by 2011 with 7 publications. In 2013, publications in the category of socio-economics, impact, outlook and situation analysis studies was the highest (16 publications) followed by publications on Sustainable Land Management (SLM). The category with the least number of publications for 2013 was simulation models followed by publications on post-harvest technologies. There were no publications on SLM, simulation models, crop protection and post-harvest technologies for 2010. However, there were two publications each on Inorganic fertilizer use as well as on studies on socio-economics, impact, situation and outlook analysis. As shown in Figure 7, publications on all the categories except simulation models, peaked in 2013.

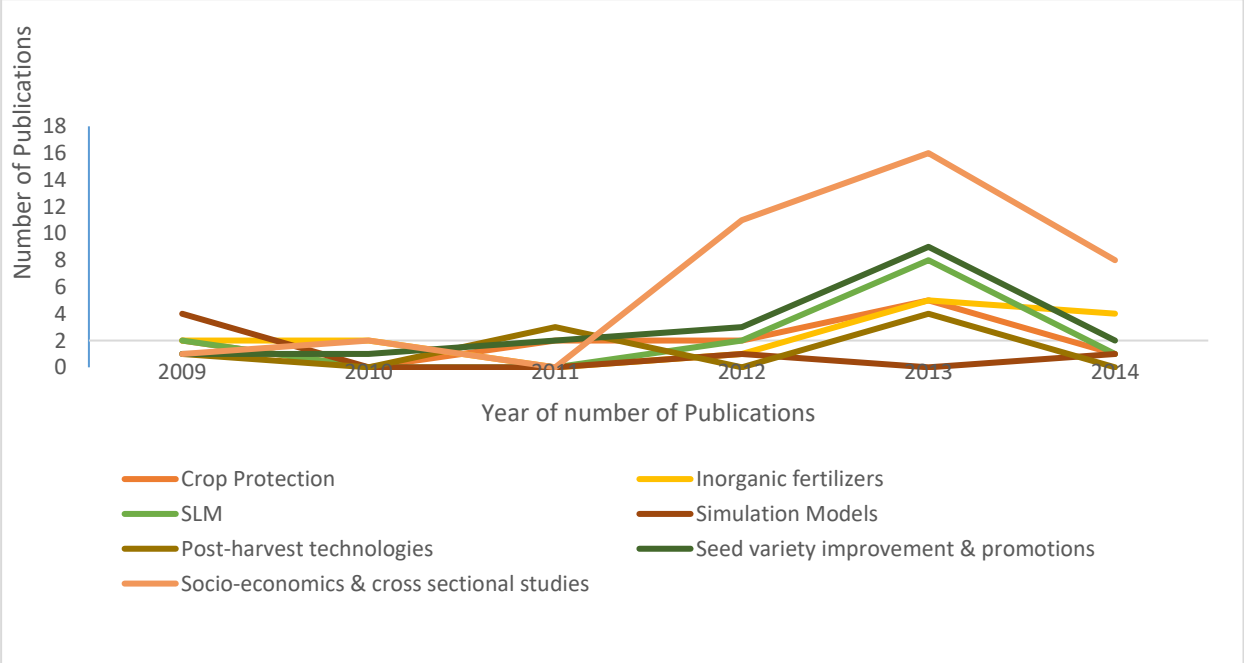

Figure 7. Trend of Number of Publications from Scientists in the CSIR-Savanna Agricultural Research Institute (SARI), Ghana from 2009 to 2014. The Legend indicates areas of publications.

A total of 944 demonstrations, training of farmers and field days was held over the six-year period. Sustainable Land Management (SLM) received the highest number of technology transferred to farmers over the period. Six hundred and eighty demonstrations, training for farmers and field days were organized from 2009 to 2014. The least number of technology transferred to farmers was post-harvest technologies. There was irregular trend in the number of demonstrations/ trainings organized over the period, as shown in Figure 8.

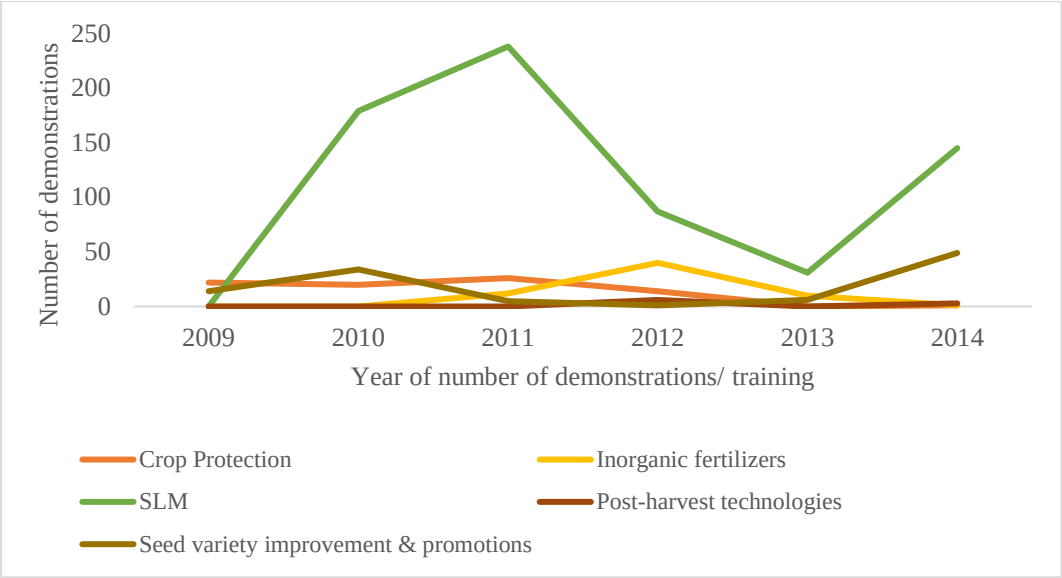

Figure 8. Number of demonstrations, training and farmer field days organized as technology transfer to farmers by Scientists of CSIR-SARI from 2009 to 2014.

4.3 SLM radio programmes

The approach to disseminating SLM practices by two radio stations was also assessed through the use of a check list for each radio station. The programmes broadcast by the radio stations were ranked based on the amount of air time given to each Programme. News broadcast had the most broadcast time followed by religious preaching, entertainment, then agriculture. The Programme that had the least air-time was issues on gender and children. Table 6 shows the various programmes and their respective rankings based on allocation of broadcast time in the two radio stations. Rankings were in ascending order of importance.

Table 6. Ranking of Radio Programmes based on air-time allocation for broadcast by two radio Stations in the Upper West Region of Ghana. Radio Programme with a rank of 1 means it had more broadcast time relative to the other programmes.

Radio Programmes	Rankings based on air-time allocation 1= most ranked, 7= least ranked
News broadcast (local & national)	1
Religious preaching	2
Entertainment	3
Agriculture	4
Health	5
Issues on Gender & Children	6
Education	7

Subject matter covered under agricultural broadcasts were also ranked. Broadcast on crop varieties had the most airtime followed by pest and disease control, as outlined in Table 7. Animal husbandry had the least air-time followed by SLM practices. Sponsorship for programmes, mandatory on radio stations to broadcast national and local news and the availability of human resource determined the allocation of air time to radio programmes. On average, out of the 18 hours' operational broadcast for the two radio stations, news broadcast alone takes 5 hours and, the remaining 13 hours for all other programmes. Respondents in the

group interviews revealed that such programmes receive less air-time, less priority and are broadcast at the discretion of radio producers. These programmes do not also receive sponsorship coupled with inadequate human resource. These reasons accounted for the low rankings received by programmes on issues of gender and children, health and education. Agricultural broadcasts had more air-time than health and education. Respondents attributed this to mainly sponsorship from the Ministry of Food and Agriculture (MoFA), Savanna Agricultural Research Institute (SARI) and Farm Radio International, an NGO.

Table 7. Ranking of Subject Matter on agricultural programmes by broadcast through radio based on air-time allocation by two radio Stations in the Upper West Region of Ghana. Subject Matter with a rank of 1 means it had more broadcast time relative to the other subject matters under agricultural broadcasts.

Subject Matter on agricultural programmes through radio broadcast	**Rankings based on air-time allocation 1= most ranked, 6= least ranked**
Crop varieties/ Good Agricultural practices (GAP)	1
Pest & Disease Control	2
Inorganic Fertilizers	3
Post-harvest techniques	4
SLM Practices	5
Animal Husbandry	6

5. DISCUSSIONS

Technology adoption is key to improving societal welfare, especially, the welfare of small-holder farmers. Agricultural technologies such as Sustainable Land Management (SLM) practices have been found to improve incomes of small farm households due to increased yield, in addition to improving soil conditions (Diao & Sarpong 2007). The overall goal of this study is to promote the sustainable use of agricultural land by highlighting the constraints associated with the adoption of SLM technologies among farmers in the Upper West Region of Ghana.

Objective 1 of the study was to investigate the level of adoption of SLM techniques, associated constraints and factors influencing adoption of SLM among farmers in the Upper West Region of Ghana. The study revealed low level of adoption of SLM practices among farmers in the Upper West Region. This confirms the findings of CEA (2006) that there was low level of adoption of SLM practices across the various agro-ecological zones of Ghana. Also, Ndah et al. (2013) found limited adoption of SLM practices in Sub-Saharan Africa. They contended that though there are benefits associated with SLM, its up-scaling and adoption have always been limited. Among the various practices of SLM, the highest adoption practice was Zero-tillage with weedicide application. This is probably because of the increasing availability and use of agrochemicals in the Upper West Region. Zero-tillage with weedicide application is increasingly being considered by farmers as an alternative to tractor plough, which most of the time is not accessible due to limited number of tractors.

The study revealed non-adoption for agro-forestry, zero-tillage without weedicide application and contour vegetative barriers. This is possibly because crop cultivation is not practiced on forest lands in the study areas due to availability of arable lands, mostly grasslands. The vegetation of Northern Ghana, and the Upper west region, for that matter, is woody and grasslands (Oppong-Anane 2006). The Ghana Country Environmental Analysis (CEA 2016) attributed low adoption of SLM techniques to the drudgery associated with their practices.

Beyond that, this study found additional constraints to SLM adoption in the Upper West Region. These are land tenure, inadequate funds, low quantity of crop residue, bush burning and the time consuming nature of SLM practices. These constraints need to be addressed if SLM adoption is to be improved.

Research has shown that the socio-economic factors most likely to influence adoption of SLM are: the educational status of farmers (Fernandez-Cornejo et al. 2001); listening to agricultural programmes on radio by farmers (Chapman et al. 2003); ownership of land under cultivation (Darbekow & McBride 2003; Boahen et al. 2007); land area under cultivation as well as non-farm income of the farmers (Jatoe et al. 2005). In the present study the educational status of farmers was found to have a positive influence on the number of SLM practices a farmer adopts, at 1% significance level (see Table 4). This means that, *ceteris paribus*, a farmer who has formal education is more likely to increase the number of SLM practices he adopts, relative to a farmer who has no formal education. Formal education increases the understanding and appreciation of issues by individuals. It also helps one to cooperate with others on issues (Enete & Igbokwe 2009).

The statistical analysis showed a negative relationship between listening to agricultural programmes on radio and the number of SLM practices adopted by farmers, at 5% significance level. This result is somewhat intriguing as it (literally) means that listening to agricultural programmes by respondents will reduce the probability of adopting all the SLM practices. This negative relationship goes against our prior expectation, and surely calls for further data analysis and investigations. Yet, one possible reason for this finding could be that listening farmers may consider adopting all the SLM practices cumbersome, labour intensive and time-consuming. This calls for capable resource persons for disseminating SLM practices through radio broadcast. Farmers will also like to adopt those practices that have trialability. Thus those that they can easily practice on small scale. This confirms the findings of Rogers (2003) that innovations that are perceived simple, can be tried easily and on small scale are easily adopted.

The study did not find any significant yield difference between a farmer who has adopted at least one SLM practice and a farmer who did not adopt any of the SLM practices. Also, there was no significant mean yield difference between farmers who benefited from SLM projects in the past and farmers who did not take part in such SLM projects. This indicates that the projects on SLM did not impact on yields among beneficiary farmers. The mean yields obtained by farmers from 2013 to 2015 for cowpea, maize and soybean were far below the national average actual yields that farmers obtain for the same crops. For example, from Figure 5, for maize, the mean yields for 2015, 2014 and 2013 were 1.2 MT, 1.1 MT and 1 MT. These are below the reported national average yield of 1.7 MT (MoFA 2010). The national average yield/ MT for cowpea and soybean are 1.3 MT and 1.5 MT, respectively. The potential yields for maize, cowpea and soybean are 6 MT, 2.6 MT and 2.3 MT, respectively (MoFA 2010).

Soil erosion in the study areas is also not being addressed due to low adoption of SLM practices. Some 79% of respondents still perceived soil erosion to be a problem both on their farms and in their communities. Maintaining a vegetation cover on crop fields all year-round will also be a challenge because of annual bushfires. SLM practices aimed at controlling soil erosion and improving soil fertility were considered as solutions to the problem of soil erosion and land degradation. It is possible that some farmers in the Upper West Region do not still appreciate SLM practices as control measures for soil erosion and land degradation. This might have accounted for the non-responses from 28% of respondents on measures of controlling soil

erosion and land degradation, as indicated in Figure 6. This is against the background of majority of respondents (74%) having benefited from agricultural extension on SLM practices. Objective 3 of the study reviewed institutional approaches by CSIR-SARI and two radio stations to SLM dissemination. For CSIR-SARI, the number of publications by scientists and number of technologies transferred in the form of demonstrations, training and field days from 2009 to 2014 were assessed.

On number of publications, though there were considerable studies that looked at issues of SLM (13 publications from 2009 to 2015, from Fig. 7), it was still less as compared to studies on seed variety improvement & promotions (18 publications) as well as studies on the use of inorganic fertilizers (14 publications). This is an indication that over the period under study, there has been some focus on issues of SLM in the research activities of SCIR-SARI. Publications are integral part of research communication to the general public and other agencies that are directly involved in research, extension and development. There could be farmers who have not benefitted directly from such publications, hence the need to consider another form of research output; direct technology transfer to farmers in the form of demonstrations, training and field days.

From a total of 944 demonstrations, training of farmers and field days organized over the six-year period, 72% were components of SLM extended to farmers. This indicates a very high level of performance on issues of SLM by CSIR-SARI. The type of SLM promoted by CSIR-SARI was largely Integrated Soil Fertility Management (ISFM) practices. These include the use of both organic and inorganic fertilizers at the same time, crop rotation coupled with the use of improved crop varieties (CSIR-SARI 2010). For example, field demonstrations on ISFM practices were on: 1. Soil fertility in maize with mineral fertilizer and rotation with cowpea or soybean, 2. Soil fertility in maize with organic and inorganic fertilizers, 3. Evaluation of different drought tolerant varieties under fertilized conditions as well as 4. Evaluation of hybrid and open-pollinated maize varieties under fertilized conditions (CSIR-SARI 2010).

Maize is the staple crop for Ghana (MoFA 2010), and the Upper West Region for that matter. ISFM practices have mainly centered on improving soil conditions for its increased productivity. It is reported that maize productivity can be increased substantially through ISFM adoption (CSIR-SARI 2011). Without fertilizer application, maize production is not viable in Northern Ghana. Use of organic fertilizers and crop rotation are important for increased maize yield (CSIR-SARI 2011). There were also demonstrations on intercropping maize with legumes, cowpea and pigeon pea. This is because the intercropping has agronomic advantage over sole cropping of maize. The intercrops (mucuna, cowpea and pigeon pea) fix nitrogen into the soil. This improves soil fertility in the cropping systems (CSIR-SARI 2013). There were also demonstrations on the construction of bunds on slopes to store water from rain and improve water infiltration (CSIR-SARI 2012). According to Diao & Sarpong (2007), SLM techniques are classified into soil fertility improvement, run-off or erosion control as well as soil moisture conservation methods. The ISFM practices also have the same characteristics as SLM.

On the approaches of the two radio stations to SLM dissemination, the study revealed that they were involved in agricultural broadcasts, driven by sponsorships from agricultural based organizations. Issues on SLM was ranked 5th by the radio stations in terms of air-time allocation on agricultural issues. A little over half of the farmers interviewed (52%) perceived agricultural broadcasts to have centered mainly on Good Agronomic Practices (GAP), including use of improved crop seed varieties. This is confirmed by the radio stations that broadcast on crop varieties had the most air time, followed by pest and disease control, as indicated in Table 7.

The priority on SLM dissemination by radio stations in agricultural broadcasts is less relative to crop varieties, pest and disease control as well as the use of inorganic fertilizers.

6. CONCLUSION AND RECOMMENDATIONS

There was low adoption of SLM practices among farmers. Land tenure, the drudgery associated with SLM practices, inadequate funds, low quantity of crop residues, bush burning and the time consuming nature of SLM practices were identified by farmers as constraints associated with SLM adoption. The educational status of respondents was found to positively influence the number of SLM practices adopted by farmers. However, listening to agricultural programmes on radio by respondents negatively influenced the number of SLM practices adopted.

Research activities on SLM and disseminating SLM practices to the general public and farmers were evident in researchers' number of publications and number of demonstrations organized over the six-year period. There was great performance by CSIR-SARI in communicating SLM techniques to farmers, especially through demonstrations. Radio stations were also involved in communicating SLM practices to farmers, however with limited allocation of air-time.

CSIR-SARI, the Ministry of Food and Agriculture (MoFA) and Radio stations have been involved in disseminating SLM practices to farmers, yet low adoption of SLM exists among farmers. This means that the success of SLM adoption among farmers will be dependent on removing or reducing the constraints associated with SLM practices, at the same time improving on socio-economic factors influencing adoption of SLM.

This study therefore recommends the local manufacturing of simple farm tools by local artisans. This could be sold to farmers at subsidized prices to reduce the drudgery associated with SLM practices. The CSIR-Savanna Agricultural Research Institute (SARI), the Ministry of Food and Agriculture (MoFA), the Ghana Regional Appropriate Technology Industrial Service (GRATIS), the District Assemblies and Farmer Based Organizations could collaborate to make this a reality. The District Assemblies should also enforce existing laws on the prevention of bushfires.

The study's findings that education has a strong influence on adoption of SLM practices among farmers in the Upper West Region of Ghana highlights that basic education is one of the fundamental factors in securing sustainable development. These findings should encourage the Government of Ghana to prioritize universal primary education as well as to invest in non-formal educational/literacy programmes for adults. Radio broadcasts on SLM should be carried out with the right expertise, since listening to agricultural programmes on radio was found to have a negative influence on the number of SLM practices adopted by farmers.

6.1 Suggestions for future research

This study looks at SLM adoption only in the Upper West Region. Future studies could consider SLM adoption in the other two regions of Northern Ghana: Upper East and northern Region, which are part of the mandate zone of CSIR-Savanna Agricultural Research Institute (SARI). The negative relationship between the variables listening *to agricultural programmes on radio* and *adoption of number of SLM practices* did not meet our *a priori* expectation. This calls for further investigation.

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APPENDIX I

Sample Questionnaire for Farmers

DEMOGRAPHIC DATA

REGION.....DISTRICT.....COMMUNITY..... .. Date of Interview……...

1. Name of Respondent..... 2. Sex…… 3. Tel: ……

4. Age..... 5. Household Size .....

6. Educational status: 0. No formal education 1. Formal education

7. If formal education, number of years in school……

8. Membership of a Farmer Based Organization (FBO): 1. Yes 0. No

11. Number of years in farming.....

12. In the 2015 cropping season, how many **fields** did you cultivate? .....

13. What was the total number of acres you cultivated for the 2015 cropping season? (**NB. Total acres of all crop fields**) .....

14. Do you own the land used for the cultivation? 1. Yes 0. No

15. Do you listen to the Radio concerning agricultural production practices and new technologies? 1. Yes 0. No

16. If yes, please share with us the specific issues discussed since last year (2015)

……

……

…….

FI01 Did this household sell any crop produce from the 2015 cropping season? 0. No 1. Yes

(If No please skip to the next section)

FI02 If yes, please ask the farmer these questions and fill the table.

Crop sold	**Year sold 2015= 1 2016= 2**	**Month** 1=Jan - 12=Dec	**Sales**	
			Quantity (Kg)	**Total sales (Ghana cedi)**
FI03	**FI04**	**FI05**	**FI06**	**FI07**

SLM01. Please indicate if you practice any of the following crop production management practices (**multiple answers are accepted**)

1. Cover cropping 2. Mulching 3. Contour vegetative barriers 4. Zero tillage with weedicide application 5. Zero tillage without weedicides 6. Agro-forestry 7. Tied ridges 8. Contour bunds 9. Stones lines 10. None of these practices

SLM02. Could you please state the constraints associated with the management practice (s) that you have chosen in **SLM01** above?

……
……
……

SLM03. If none of the practices above, please indicate the specific crop management practices that you practice (e.g. slash and burn, application of chemical fertilizers, weedicides, etc.)

……
……
……...

SLM04. If you applied chemical or organic fertilizer or **both** during the 2015 cropping season, please state their quantities

1. NPK (Quantity in Kg) ……..... 2. Ammonia (Quantity in Kg) …… 3. Organic fertilizer, if any (Kg)……

SLM05. Total land area fertilizer was applied (both chemical and inorganic) …….

SLM06. Do you think soil and water conservation (sustainable land management) is a priority for you? 1. Yes 0. No

SLM07. If yes, what specific activities have you done on your field in respect of sustainable land management?

……
……
……

NON-FARM INCOME

NFI01 Besides your farm produce, do you have any other source of income?

1. Yes 0. No

If yes, and if your source of non-farm income includes any of the below, please state the total amount that you obtained from their sales for the 2015 cropping season

Activity Number	**Economic activities**	**Fill with a ZERO if you did not get a cash income from the activity AMOUNT (GHS)**
	NFI02	**NFI03**
1	Horticultural crops and fruit sales	
2	Sale of products like milk, eggs	
3	Animal sales	
4	Fish sales	
5	Casual labour/ Salaried work, if any	
6	Sales from charcoal and/firewood	
7	Trading	
8	Received remittance or pension	

DM01. For the last one year, have you had a visit from an agricultural extension officer?
1. Yes 0. No

DM02. If yes was there a discussion on soil erosion, land degradation, or land care in general?
1. Yes 0. No

SLM05. Please indicate your yield trend from 2013 2015

Crop	**Area of land under cultivation (acre)**	**Yield (Kg)**		
		2013	**2014**	**2015**
1. E.g. Maize				

SLM06. Do you have problems of bushfires on your crop fields? 1. Yes 0. No

SLM06. What are the main causes of the bush fires? 1…… 2…….. 3…….

SLM07. Do you perceive soil erosion to be a problem on your farm or in your community?
1. Yes 0. No

SLM08. Please propose measures that you think can solve the problem of soil erosion on your farm or in your community?
……
……
……

SLM09. Do you think agricultural extension, research and/ NGOs have interacted with you on **issues of soil erosion and land degradation**?
1. Yes 0. No

SLM10. If no, what do you think might have accounted for that?
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……

SLM11. Do you think it is your responsibility to conserve soil and water for the use of future generations?
1. Yes 0. No

SLM12. If yes, please mention some specific activities you can do to achieve soil and water conservation?

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……
……

GR01. Which of the following roles are mostly performed by men, women or both?

Labor use	Men	Women	Both
Land preparation			
Transplanting/Sowing			
Weeding			
Fertilizer application			
Harvesting			
Threshing/processing			
Marketing/selling			

GR02. Do women have access to farm land in this community? 1. Yes 0. No
GR03. Do women own farm land in this community? 1. Yes 0. No

Appendix 2. Check-list for Radio Stations

ASSESSMENT OF THE CONTRIBUTION OF RADIO TO AGRICULTURAL EXTENSION DELIVERY IN THE UPPER WEST REGION OF GHANA

1. Please rank the following programmes based on air time you allocated to each category for the past one year (2015)
   1= the category which received most air time n= category which received least airtime

Programmes	**Ranking: 1=most air time n=least airtime**
Religion/ Preaching	
News (both local and non-local)	
Issues on Education	
Issues on health	
Entertainment	
Issues on Gender and Children	
Agriculture	

Please give very brief reasons for the programme with the highest rank
……
……
……
……
Please give very brief reasons for the programme with the least rank
……
……
…….....

2. Please rank the following topics under Agriculture based on airtime allocation for the past one year (2015)

1= the topic which received most air time n= the topic which received least airtime

Topic	**Rank: 1= most airtime n=least airtime**
New crop varieties	
Pest and disease control	
Post-harvest techniques	
Use of chemical fertilizers	
Sustainable land management practices	
Animal husbandry	

Please give very brief reasons for the programme with the highest rank

……
……
……

Please give very brief reasons for the programme with the least rank

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……
……

3. What was the source of funding for the airtime on agriculture?

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   ……
   ……

4. Please suggest to us any ways you think can improve agricultural extension using the radio

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