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ANALYTICAL ASSESSMENT OF THE SOCIO-ECONOMIC DYNAMICS OF THE BUSH FALLOW AGRICULTURAL SYSTEM IN SIERRA LEONE

Okoni-Williams, A.D.
Department of Biological Sciences, Fourah Bay College, University of Sierra Leone.
Tel: +23279626154; Email: aokoni2001@gmail.com

ABSTRACT

This study focuses on socio-economic dynamics of fallow agriculture in rural farming communities in Sierra Leone, addressing two objectives: to determine the impacts of socio-economic status of farming households on the fallow cycles and fallow activities; and assess the level of income and benefits from fallow agriculture compared to other local forms of livelihoods. Data was obtained through questionnaires and interviews to 120 experienced fallow farmers across six communities. The data was analysed using Spearman's Correlation and Generalised Linear Modelling. About 60.4% respondents lack any formal education, and 21 – 50 was most active age group. Household size was found to be strongly correlated with the proportion of household involved in other farms of employment ($r^2 = 0.815$; $p < 0.05$) and declines with remoteness to nearest urban settlement ($r^2 = 0.857$; $p < 0.01$). Access to extra labour was influenced by household socio-economic status ($F = 13.45$; $p < 0.01$) and value of farm assets. Average annual farm income was strongly correlated with relative benefits from farms and fallows ($r^2 = 0.8340$; $p < 0.05$). Petty trading contributed significantly to alternative incomes. Lack of access to credit facilities and extension services are hampering farmers' ability to sustainably manage farms and fallows.

Keywords: Agriculture, Bush fallowing, Socio-economic, Generalised linear modelling, Easterlin Paradox Concept.

INTRODUCTION

Bush fallowing is the key temporal component of shifting cultivation, which is an archaic faming system that has been practiced over centuries and considered one of the major historic and current causes of deforestation (Coomes *et al*., 2000; IPCC, 2007), especially in tropical countries. However, some of the conceptual and philosophical thinking around shifting cultivation are still debatable, considering the human survival issue surrounding it. Whereas, some schools of thought considered the practice as the ideal solution for tropical agriculture, others condemned it as being destructive and wasteful, depletes biodiversity and renders the soil vulnerable to erosion and runoffs. According to Ickowitz *et al*. (2014), the good aspect of fallowing is that it has the potential to provide global environmental services (e.g. carbon sequestration and biodiversity conservation) and contribute to improved local ecological conditions, including erosion and watershed protection. In fact, some authors have argued that shifting cultivation maintains a state of dynamic equilibrium with the natural environment and is in most cases, the only agricultural system that was considered to be a highly effective and ecologically balanced adaptation that reflects centuries of accumulated indigenous knowledge, with an intricate balance between cultivated crops and ecological resilience and an impressive degree of agro-biodiversity (Ickowitz, 2006; Matthews-Njoku and Onweremadu, 2007).

In recent times, anecdotal evidences show that the practice seems to have deviated from the traditional concept of fallowing, especially in terms of the use of the plot under fallow, and this may be having serious implications on the ecology of fallow system in general, and the socio-economic status of the farming communities in particular. In Sierra Leone, fallow agriculture is the dominant livelihood and in academic circles it is still perceived to be the same old traditional system whereby farmers cultivate a plot of land for between one to two years and abandon it, and only return to re-cultivate it after about six to ten years. As an integral part of the social, cultural and indeed the economic mainstay of the country's rural population, there is much knowledge among the local populations on current practices of bush fallow system that local scientists need to learn about and document.

In ideal situations, it is assumed that the farmer and family may only visit the fallowing plot to collect non-wood products including medicinal plants, wild fruits and wild tubers, and obtain some building poles for construction of

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their houses and subsistence at various chronological stages. Once the fallow is mature and ready for cultivation, slashing and burning of the mature bush usually takes place during late dry season (February to March), within weeks of the imminence of the rains. However, apart from the studies done in the 1970s and 1980s (Christanty, 1986; Russel, 1988; Gleave, 1996), there is a serious paucity of information on socio-economic dynamics of bush fallowing outside the confines of local farming communities.

Current trends in the general economic situation in Sierra Leone shows an increasing rate of unemployment, especially among young people in rural areas, in the midst of growing population and increasing desire for modern lifestyles (including possession of jeans and mobile phones) and rural-urban migration. Thus, there is need to establish an understanding of factors that influence the state of rural agriculture and the extent to which they affects the integrity and sustainability of the traditional bush fallow practice in the country. This study has focused on the realistic ten-year bush fallow system that is widely practiced in the country and seeks to address the following objectives: (i) to determine the impacts of socio-economic status of farming households on the fallow cycle and fallow activities; (ii) to assess the level of income and benefits from fallow agriculture to the household and community compared to other local forms of livelihoods and income activities.

METHODOLOGY

Sampling sites' locations: The study was conducted in six farming villages in three different political regions in Sierra Leone (Fig.1), characterised by different socio-cultural settings, but similar key crop production systems (see Table 1 below).

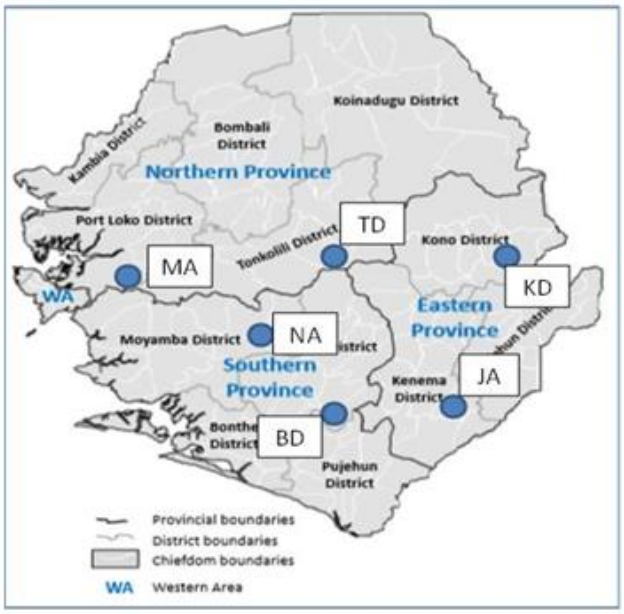

Figure 1: Study sites at different political regions in Sierra Leone

Sampling design: The application of the methods used in the study is based on preliminary understanding of the channel of communication and the level of literacy among respondents in these communities, the nature of the data being collected and the objectives being addressed. Prior consultations were made with traditional authorities, sometimes involving the paramount chiefs, the section chiefs and the local chiefs, in hierarchical order, before direct interaction with the target respondents at the village level, as this was a cultural and traditional requirement for any such research to proceed. Ten local farmers, mainly household heads were randomly chosen from each of the six farming communities that were separated by a distance of at least 80 km. In total 60 local traditional farmers were interviewed.

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Table 1. Summary of the socio-cultural characteristics of the study sites.

Study Site	Central Coordinate	Political Region	Tribe	Dominant religion	Main crops cultivated
Masiaka (MA)	751801 E 937790 N	Northern Province	Temne	Islam	Rice and cassava
Masimgbi (TD)	227995 E 952571 N	Northern Province	Temne	Islam	Rice and cowpea
Kono (KD)	300569 E 957017 N	Eastern Province	Kono	Islam/ Christianity	Rice and cowpea
Joru (JA)	273598 E 851232 N	Eastern Province	Mende	Christianity	Rice and cassava
Njala (NA)	222621 E 892802 N	Southern Province	Mende	Islam/ Christianity	Rice and cassava
Bo-Pujehun (BD)	199563 E 857166 N	Southern Province	Mende	Islam/ Christianity	Rice and cassava

Note: The GPS points are based on UTM Datum. The abbreviations of the sites are consistent with those used in the text

Data Collection: A structured questionnaire was used to obtain data on the following themes: (a) household characteristics, including gender and age structure; (b) household status and holdings within the community, including the number and size of farms and fallow; (c) household income status and income sources, for example the number of income sources and the relative importance of these sources; (d) the household farming and fallow-related issues and future plans, including what they derive (in terms of money and other resources) from the farms and the fallows, and the problems they have encountered in recent times. Households were selected at random by estimating the number of houses in the community, numbering them and selecting ten of those numbers from a balloting process.

The questionnaire used in this study was first pre-tested by a pilot survey on respondents from a similar farming community not in close proximity to any of the study sites, in order to ensure that no form of interaction would influence responses to the questions. As recommended by White *et al*. (2005) a power analysis was performed on the pilot data to provide a guide to the sample size. The questionnaires were filled in by the inquirer through personal interviews for two reasons: (a) most respondents and household heads were not literate enough to fill in the questionnaires themselves; and (b) to ensure that the required number of respondents was achieved, thereby avoiding the issue of non-response bias and obtaining a good representative of the sample population. The interviews were conducted in *Krio*, the common lingua franca, but whenever required, at the consent of the respondents, an interpreter was asked to facilitate the session in the respondent's mother tongue. Additional data was obtained from semi-structured interviews with another 60 key informants within these farming communities in a related study.

Ethical Considerations: All ethical issues regarding the collection of data were addressed prior to the interviews. Prior informed consent was sort at all levels of traditional authority at each of the study area, through the following channels – the Paramount Chief of the chiefdom, the Section Chief and the Town/Village Chief. Once these have given their approval, the consent of the individual household heads, randomly selected by the local chiefs were obtained, respectively before the commencement of the interviews.

Data Analysis and Presentation: Summary statistics were generated for every objective being addressed and it was meant to describe the main features of the data and provide primary impression of the nature of the distribution of a variable within a specific data set. Quantitative variables were processed for normality and if necessary, log transformed. Where appropriate, qualitative variables (for instance "family status") were ranked and converted to quantitative variables, especially for categorisation, prior to analysis. Five main categories were identified to facilitate analysis and understand the distribution of the variables within the communities as follows: (1) Gender division to ensure that gender-based perceptions are covered; (2) Age groups as the considered experience-related age stratification within the farming communities; (3) Income level as an indication of the dependence level on bush fallow agriculture; (4) Social

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status, which to a large extent, determines access to land and labour force (Tschakert *et al*., 2007); (5) Educational status was considered as a factor because it has been found to influence knowledge-driven decisions on farming options (Onweremadu *et al*., 2008).

Objective 1 dealt with the experience, status, and income level of the households in relation to farming and bush fallowing activities. Families were categorised into income levels and a one-way ANOVA test was used to test whether or not income levels and household status are significantly different between households and across communities, and how they affect fallow cycles. A generalized linear model was used to determine the best determinants of household farm income, based on the list and values of their household farms and fallow sizes and plantations, among others. Farm size was based on the number of bushels of rice that can be grown in a plot, corresponding to 1 bushel (≤0.5 ha), 2-3 (0.6 – 0.9 ha) and ≥3 bushels (≥1.0 ha). Objective 2targeteda comparisons between the income/benefits derived from fallow agriculture and other forms of employment, to assess indications of the relative dependence of the household and the community on these sources of livelihoods. Spearman's correlation was used to establish relationship between relevant response and explanatory variables relating to farm and fallow benefits and holdings.

RESULTS

Age, experience and knowledge in Bush Fallowing

Figure 2 illustrates the relationship between respondents' age distribution and their years of experience as farmers and master farmers. As expected, respondent's age strongly determined both their years of experience in fallow agriculture, which in turn was highly correlated with the period over which they have been masters of the trade ($r^2 = 0.9779$; $F = 132.94$; $p < 0.01$), indicating a wide range of age representation and varying degrees of experience in the sample population. A higher proportion of the respondents did not have any form of formal education (60.4% - particularly among people >40 years), and only a few attained secondary education (2.1%) (Fig. 3).The result indicates a relatively good labour availability, but low level of literacy in these rural farming communities

Figure 2: Age distribution and experience among respondent farmers

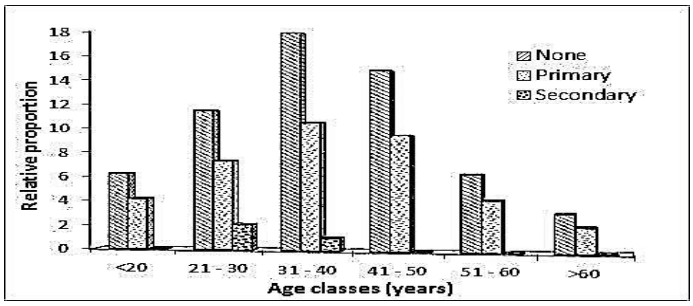

Figure 3: Age distribution in relation to educational level of respondent farmers.

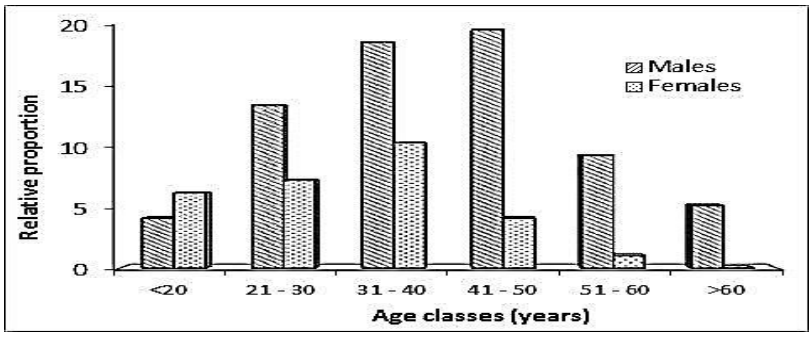

Figure 4: Age and gender distribution among respondent farmers

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There were significantly higher proportions of male respondents compared to female respondents in the sample populations (Fig. 4), reflecting the prevailing imbalance in gender representation among opinion leaders in these rural farming populations.

Availability and access to labour

The labour dynamics within farming communities is such that most families do not have adequate labour to cultivate the land and so depend much on communal labour (village group) or hired labour (Fig. 5). There was no significant difference in the use of the different forms of extra labour between farmers that get adequate labour from within the household as opposed to those who do not. Access to extra labour was found to be significantly driven by the socioeconomic status of the household ($F = 13.45$; $p < 0.01$), which is defined mainly by ownership of land and financial standing.

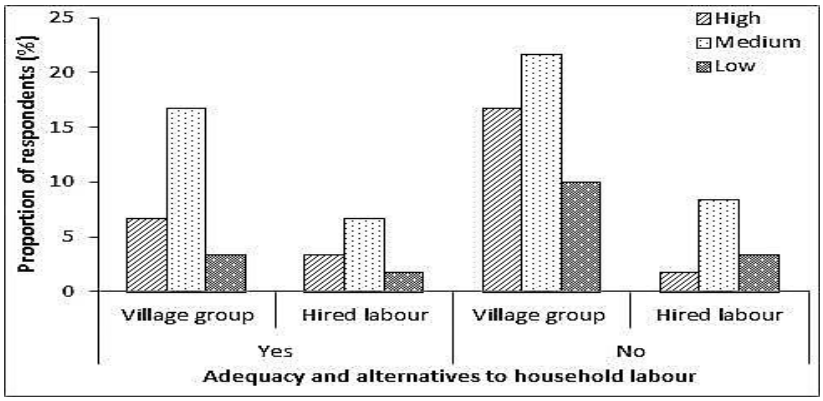

Figure 5: A Comparison of the adequacy of family labour in relation to farmer's use of alternative labour and relative family status (high, medium and low) in the village community.

The relationship between household income and fallow practice

Figure 6 illustrates the levels and adequacy of annual farm income among the study communities; the estimates represent income obtained after sale of surplus farm products. A significantly higher proportion of respondents indicated that farm incomes do not adequately address domestic needs. Ironically, respondents who thought that their annual farm income was inadequate had higher relative incomes. However, the result suggests that people's wants tend to increase with increasing income levels and such observation is consistent with the Easterlin Paradox concept (Easterlin, 1974; 2017).

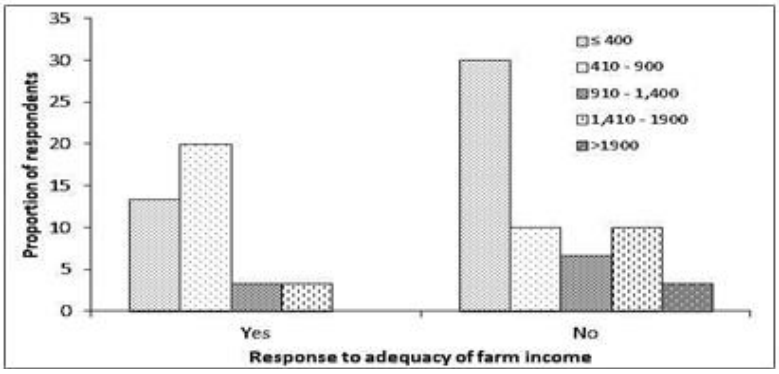

Figure 6: A comparison between adequacy and non-adequacy of household income in relation to income obtained from the sale of farm products (Income levels are in order of 10^3

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Table 2. Annual farm income, based on income obtained through sale of surplus farm produce. *Exchange rate as at 30/08/17 was Le 7500 = $1

Farm income (x Le 1000)	USD Equivalent*	Number of Respondents	Percentage Respondents
≤400	≤53	52	43.3
410–900	54 - 120	36	30.0
910–1,400	101 - 187	12	10.0
1,410–1,900	188 - 253	16	13.3
>1,900	>253	4	3.3

Table 3. Result of GLM analysis to assess factors that contribute significantly to household income. All t values were significant

Income indicators	t value	p value
No. of plots under fallow	3.775	0.0008
No. of plantations owned by household	2.552	0.0069
No. of bushels of rice	3.268	0.0030

From data provided by respondents, about 43% obtained an annual cash income from the farm of ≤ Le 450,000 (ca $60) and the proportion of respondents belonging to the various annual income category vary inversely with increasing annual income level ($F = 16.63$; $p < 0.05$) (Table 2). Therefore, only 3.3% of the respondents acquire annual farm cash income of over Le 1,725,000 (ca $230). From GLM analysis, the income of farmers in the study communities was found to be dependent on three main land ownership and access related factors: (1) the number of fallows; (2) the number of tree crops plantations owned; and (3) the number of bushels of rice cultivated (Table 3).A much greater proportion of the income and benefits of fallow agriculture comes from farms (70%) rather than from fallows (30%). Furthermore, there was a strong positive correlation between the relative benefit from farms/fallows and the average annual income from the farms ($r^2 = 0.8340$; $F = 15.07$; $p<0.05$) (Fig 7). The result may suggest low pressures on fallows, but considering that incomes are generally low and inadequate, there is a tendency to increase productivity and enhance incomes, thus ultimately exerting more pressure on fallow plots.

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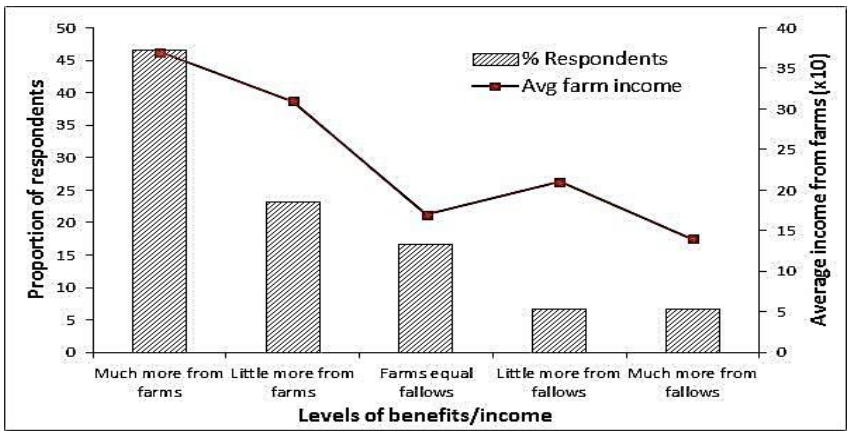

Figure 7: Trends in levels of incomes and benefits from farms and fallows in relation to incomes from farms

Alternative forms of income

The relative proportion of household size (HHN) was found to be strongly correlated with the proportion of the household involved in other forms of employment (OE) (r^2 = 0.815; F = 17.63; $p < 0.05$) (Fig. 8) and declined steadily with the degree of remoteness of the study community from the nearest urban settlement (r^2 = 0.857; F = 23.90; $p < 0.01$). Remoteness, measured from distance of study areas from an urban settlement, is a major determinant of access to transportation and market for farm products. Household sizes, especially in sub-Saharan African farming communities were directly related to remoteness (Gleave, 1996; Apata et al., 2010), and are thought to be larger than those in more urban settings, because the traditional extended family is associated with farm labour availability and education levels are usually low. However, the effect of migration tends to have changed the dynamics and status of rural population in Sierra Leone as most of the promising children and able-bodied young men migrate to the urban areas to seek education and/or better job opportunities. Thus, consistent with empirical evidence by (Afolabi, 2007), rural population is declining and this may have serious implications for fallow agriculture, particularly in terms of intellectual potentials and the supply of farm labour, ultimately impact fallow cycles and farm productivity. This leaves the farming household with little options, but to be engaged in alternative forms of income generation, especially petty trading.

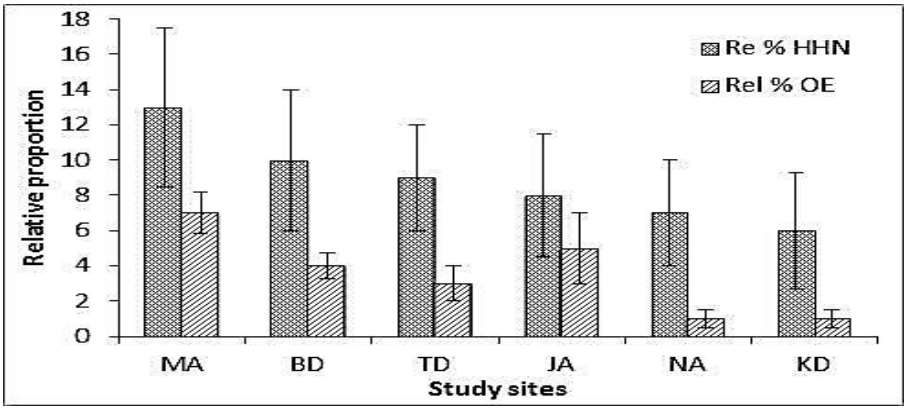

Figure 8: The relationship between relative household sizes (HHN) and the proportion of household engaged in other forms of income (OE)

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Relative dependence on various income sources

Evaluation of the relative dependence on various sources of income as shown in Figure 9 indicates that farming constitutes the single most important means of livelihood in the study communities (36.7%). Petty trading (18.3%) constituted the second most important means of livelihood, but incomes from petty trading in MA surpassed farm incomes, where it contributed about a third of all household incomes (Fig 10); the activity is also prominent in TD. The socioeconomic characteristics of the region in which sites occur did not affect the distribution of livelihood sources in these sites, but the relative importance of these sources differed significantly ($F = 15.27$; $p < 0.001$).

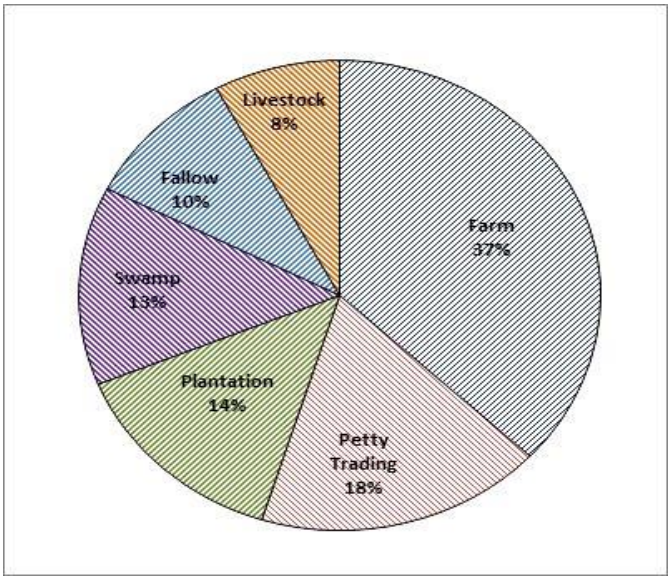

Figure 9: Overall relative proportion of the livelihood sources in the study sites upon which farming communities depend

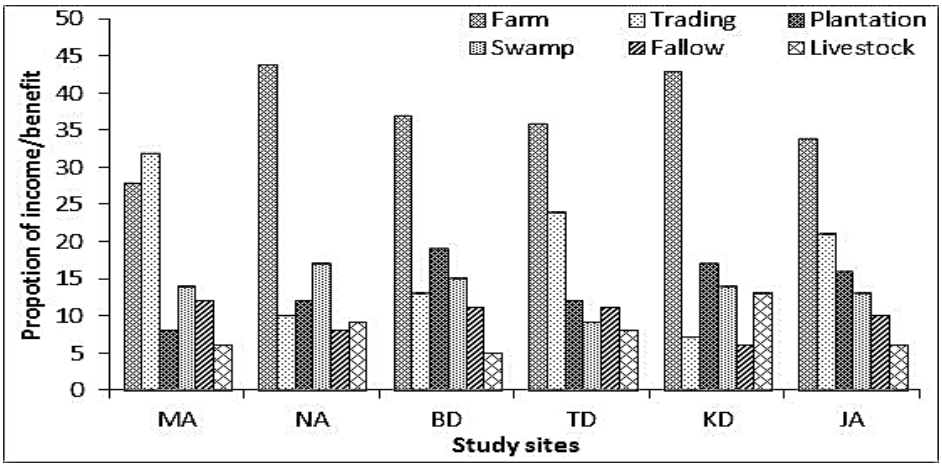

Figure 10: Relative distribution of sources of livelihood within study communities. Proportions are based on assessment of the income and benefits derived from these sources. NB - incomes from other employments are not included because they are negligible.

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DISCUSSIONS

Socioeconomic status among farmers as indicators of capacity to sustain income from fallow agriculture in the study communities

Most active farmers (53%) were able bodied young to middle age men within the age range of 21–50 years, as depicted in the results in Figure 3 and Figure 4. The findings also indicate relatively good labour availability and good farming knowledge; because the most active farmers (53%) were able bodied young to middle age men within the age range of 21–50 years. However, the low level of literacy in these rural farming communities is having serious impacts on resource utilisation and management in rural communities, particularly in relation to access to information on and the application of modern farm and fallow practices. A similar study in Nigeria found that better education enables farming households to access and conceptualise information on good farming methods, access better paying rural labour market and profitably combine better paying rural labour (Apata *et al*., 2010). This was particularly observed in TD where the most educated person (with a high school certificate) is recognised as the richest inhabitant, who is profitably combining his knowledge in farming and petty trading.

Due to cultural reasons, no female respondent was chosen as household head, and so none was subjected to questionnaire surveys, but participated in the semi-structured interviews (Figure 5), and so some gender representation and views were addressed. Unfortunately, final decisions on farm and fallow management are mainly taken by the husbands, although in a significant proportion of cases ($p < 0.05$), wives are consulted. However, women take active part in farming as much as men, but in somewhat different roles from men whilst men provide much of the hard labour in the farm in the form of bush clearing and tilling, women spend much longer hours doing the sowing, weeding, controlling pest and harvesting (AIPP and IWGIA, 2014); nevertheless, some of these activities overlap between the genders.

The age of respondents was an important, but statistically insignificant factor in determining the differences between farmer's knowledge and experiences. Level of knowledge was dependent upon and based on experience within the community and the family ancestry. For instance, the age and experience of the farmer was a factor that determined when that farmer things the fallow plot is fertile enough for cultivation. Whilst the growth of woody plants on the plot was the key indicator used by many farmers, the older and more experienced farmers applied additional criteria like colour of the soil and thinness of the undergrowth, which may also determine the type of crops that will thrive well. More mature and fertile fallows were said to be dark brown in colour and less fertile ones are red/light brown. Also, soils with greater silt content are considered more fertile than those with greater sand content, although the latter are said to be suitable for certain crops such as pepper and cassava. In a few instances, younger farmers had better knowledge of fallow soil conditions than some of their older folks, because such knowledge was acquired from very experienced fathers and grandfathers. In general, knowledge of soil conditions was limited, but wide-ranging and traversed all respondents' age groups.

Households that belong to the ruling houses (chiefs or traditional heads) in the community get easier and cheap access to labour, as they are the custodians of the land and the respect and authority they command in the community (Renner-Thomas, 2010). Poor and/or landless farmers pay much for extra labour as the result suggests, except in cases where they participate in communal labour, in which case, they need funds to provide food for work; otherwise they may not engage in any upland farming that season. Two of the 60 farmers (3.3%) interviewed were unable to engage in fallow farming at that season because the labour available within their respective families was inadequate and they could not afford the cost of extra labour.

Communal labour constituted the main source of extra labour (Fig 7), strongly correlating with the findings of Coomes *et al*. (2000) and Bello (2014).These communal groups are formed through village cooperation, comprising mostly young and able-bodied men, who take turns in providing extra labour to members of the group at various stages of the farming activities including slashing, tilling and harvesting, and mainly motivated through the provision of food for work. The limited family labour is usually invested in less laborious alternatives such as swamp rice production and petty trading to compensate for the opportunity cost of not engaging in upland fallow farming. Thus, access to labour is one of the key factors affecting the age at which fallows are slashed and cultivated and there is an increasing tendency towards lower labour inputs and shortening fallow periods in the study communities, as shown by Coomes *et al*. (2000) and Seidenberg *et al*. (2003).

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Contrary to expected responses, a greater proportion of farmers with relatively higher income from sale of farm products indicated that incomes were inadequate (Fig 8). Such responses are consistent with the Easterlin Paradox Concept, which suggests that people's subjective well-being or happiness depends on standards that change over time according to the individual expectations and social comparisons that could influence a person's happiness irrespective of his/her income. In other words, an individual's level of satisfaction could decline with increasing income levels, which may have serious consequences on fallow periods, because of the inherent desire to increase production and income levels. The range of annual farm incomes obtained by these rural smallholder farmers means that they are undoubtedly among the poorest people in the country, reflecting the prevailing situation in many sub-Saharan African countries where farming is mainly done for subsistence (Apata *et al*., 2010; Mnenwa and Maliti, 2010). A combination of these factors, including those propounded by the subjective well-being concept and the levels of income is important in dictating the socio-economic pressure on bush fallowing, whether directly or indirectly.

The impact of socioeconomic status and practices of farming communities on fallow cycles and fallow management.

Income level is a key indicator of socioeconomic status among farming communities and according to empirical data, ownership and access to land (which determines fallow holding), and access to labour are among the key factors affecting of farm income (Coomes *et al*., 2000). The number of fallows, which showed the strongest influence on income level ($p < 0.001$) was correlated with the number of available fallow options and thus age of fallow to be slashed and cultivated, meaning that farmers with larger number of fallows are likely to cultivate mature fallows (>7yrs), thus higher crop yield. The number of bushels of rice cultivated ($p < 0.01$) is used locally as a measure of the size of the farm plot, which in many cases depends on family status in the community and resource and labour inputs. No doubt, the farm provides the largest proportion of income (37%) to local farming communities (Figure 10). However, the access to other viable farm and non-farm related options for household income is a very critical factor in determining the socio-economic status of farming household. These options include the following: (i) petty trading (18%); (ii) plantation (14%); (iii) swamp rice production (13%); (iv) fallow products harvesting (v) livestock raring.

Plantation was the third most important source of livelihood and is considered the most important long-term agricultural investments by these farming communities. The number of plantations ($p < 0.01$) is a key measure of the value of farm assets a farmer possesses in these local farming communities. Therefore, plantations play a major role is farm holdings and fallow periodicity due to the certainty it offers to sustained long-term supply of income to the household. Oil palm is by far the most important plantation crop among farming communities in Sierra Leone (NRDS, 2009) and because of its widespread distribution, the crop is associated with bush fallowing; it is very common to see old disused oil palm stands in young fallow plots. A relatively recent tradition is the establishment of new oil palm plantations on 1Y and 2Y fallows, rather than on newly deforested areas. This practice is a form of fallow management strategy, whereby land under fallow is planted with oil palm as a prospective investment into land that could both be harvested and at the same time made available for cultivation, once mature. Farmers regularly cut down growing wild vegetation in young oil palm plantations to reduce competition for light, space and nutrients, whilst additional nutrient is made available through the decay of fallow plant materials.

Other plantation crops cultivated in the study areas include orange, plantain, banana, cacao, coffee and rubber in decreasing order of distribution and occurrence. Plantation fallowing (using tree crops) provides a potentially viable option for mid to long-term fallow cycling, similar to the planted fallows (using non-crop fast growing species) and is gaining popularity in some parts of sub-Saharan Africa and the tropics (Barrios et al. 2005). An overwhelming proportion of respondents (90%) were willing to engage in plantation agriculture, which is being limited by the current land tenure system, especially ownership and access to land resources. Thus, consistent with the findings of Landry (2009) and Chaubey *et al*. (2018) plantations have a very high potential for enhancing farm incomes, increasing fallow periods and enhancing biodiversity conservation in the long term.

Swamp rice cultivation is an integral part of livelihood sources as nearly 80% of respondents engaged in the practice. However, it contributed only 13.7% to the overall income sources because, according to respondents, swamps have limitation on the variety of crops that can be

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cultivated. Only certain varieties of rice, potato and cocoyam can be cultivated on swamps, depending on the inundation levels. Contrary to widely held views, local farmers opined that there is higher labour efficiency in swamp cultivation with relatively higher yield compared to upland fallow farming. However, the supplementary use of swamp is associated with some difficulties according to respondents, which include *inter alia*: infestation by leeches and filarial disease vectors (like snail and black fly) as one of the most common complaints; low productivity in eutrophic conditions (which local farmers interpret as the swamp being acidic); and losses and seasonal constraints associated with flooding,

Livestock is also an important component of the assets of the study communities, but it is mainly free-range and these are kept for subsistence and cultural/ceremonial purposes. Chicken was the most widespread livestock indicated by respondents, followed by sheep and goats. Cattle was encountered in only one of the six study sites (KD), where it was observed that they play a major role in nutrient cycling in fallows. Empirical data demonstrates the well-known linkage between livestock and soil productivity in the cycling of biomass (natural vegetation, crop residues) through animals (cattle, sheep, goats) excreta (manure, urine) that fertilises the soil (FAO 2018). However, compared to other means of livelihoods, livestock accounted for the least source of alternative incomes in the study communities for a number of reasons highlighted by respondents as follows: (i) livestock are expensive to rare in large numbers and require high initial capital input, which is often inaccessible to smallholder farmers; (ii) livestock often creates conflicts between people (e.g. for grazing and related resources); and, (iii) livestock are susceptible to theft and diseases, with associated huge financial losses. Nonetheless, livestock raring was identified by respondent as one of the potentials for enhancing farm income and reducing pressure on farms and fallows, consistent with findings from a study by Saxena *et al*. (2017). However, depending on the type of livestock and level of investment, empirical evidences show that the trade-off on the environment could be counter-productive on large-scale, through deforestation, land degradation and production of greenhouse gases (Herrero *et al*., 2009).

Income from paid employments unrelated to agriculture was very negligible because of the generally low employment opportunities in such rural settings. This emphasizes the level of dependence of rural farming communities on the natural environment, in a country having among the ten lowest GDP per capita in the world (UNDP 2019) and a sustained dependence on fallow agriculture. Petty trading, for instance forms a major livelihood alternative to agriculture, yet the main commodities include products from the farms (e.g. rice, cassava and pepper), plantations (e.g. palm oil, banana and pineapple) and fallows (e.g. wood and charcoal). According to local farmers, the lack of credit facilities and ineffective agricultural extension services are the major external factors negatively affecting productivity and income mobilisation in the fallow agriculture in Sierra Leone. Thus, despite the low returns from farming, there is a very high dependence on fallow agriculture and most households engage in alternative forms of income generation purposefully to subsidise domestic needs, as observed by Coomes and Burt (1997; 1999).

Another significant observation was that younger fallows are cultivated with degradation-tolerant crops (e.g. pepper) with the key purpose of augmenting incomes, especially in situations where, for example, a poor old and landless farmer could not afford the labour and cost of slashing and cultivating an old fallow plot. Such instances reflect the degree to which personal and domestic needs and situations can affect fallow cycles and fallow holdings, consistent with the findings of Coomes *et al*. (2000).The sites MA and TD farming communities occur in one of the most degraded areas among the study communities and most of their fallow holdings were found to be below five years. They experience some of the lowest crop yield and so petty trading is the most common means of augmenting farm incomes. To put this in context, petty trading is a socio-economic activity that is associated with the culture of the main occupants of these two study communities (see Table 1), and is intricately linked with their farming activities and fallow management practices.

Conclusions

The results revealed wide-ranging age and farming experiences and expertise among farmers, including knowledge on fallow maturity and soil condition. Whereas, the long periods of experience is good for farmers, the low education is an impediment to farmers ability to access and utilise opportunities for improving farm and fallow management, especially among female farmers. These include farmers' inability to access to credit facilities and support from extension services, which are very vital in enhancing the operations, income levels,

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farm yields, fallow management and the socio-economic status of small-holder farmers.

Farm income was generally low among study communities and is having negative impact on fallow management. Availability and access to extra labour (communal and hired) was found to be correlated with size of farm under cultivation, and the age of fallow cultivated. The low returns from farming, mainly resulting from lowering yield and declining fallow periods has necessitated engagement in wide-ranging alternative means of income generation, the most widespread being petty trading. In fact, because of the relative fast returns from petty trading, many young and energetic people are moving to urban areas, which negatively affecting both the availability of labour at both the family and community levels, and fallow management and traditional knowledge transfer.

Petty trading, plantation, livestock and swamp cultivation were found to be potential areas for improving family income, reducing stress on fallow cycling and enhancing fallow management. However, these alternatives and/or parallels to upland farming need careful planning and resource inputs to obtain the desired returns and achieve sustainable environmental practices. Alternative income from non-agriculture related employments is negligible, thus the high dependence on fallow agriculture. Remoteness of the community and socio-economic status of the household were found to have strong influence on the age of fallow cultivated. In general, the study reveals serious management issues that local farmers face in traditional fallow agriculture and the need for institutional and other resource inputs to enhance income levels and the socio-economic status of traditional small-holder farming communities.

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REFERENCES

Afolabi, M.O. (2007). Rural-Urban migration and production in Nigeria agricultural sector. MPP Thesis, Simon Frazer University, Burnaby, B.C., Canada.

AIPP and IWGIA (2014). Shifting cultivation and food security: New and old challenges for indigenous people. Published by Asia Indigenous Peoples' Pact (AIPP) and the International Work Group for Indigenous Affairs (IWGIA), Chiang Mai 2014. Supported by the Food and Agriculture Organisation of the United Nations (FAO), Rainforest Foundation Norway and the Danish Ministry of Foreign Affairs.

Apata, T.G., O.M. Apata, O.A. Igbalajobi, and S.M.O. Awoniyi (2010). Determinants of rural poverty in Nigeria: Evidence from small holder farmers in South-western Nigeria. *Journal of Science and Technology Education Research*; 1 (14): 85-91.

Barrios E., Cobo, J.G., Rao I.M., Thomas, R.J., Amézquita, E., Jiménez,J.J. and Rondón,M.A. (2005). Fallow management for soil fertility recovery in tropical Andean agroecosystems in Colombia. *Agriculture, Ecosystems and Environment*; 110(1–2): 29-42.

Bello, A.R.S. (2014). Agriculture Communal Labor in the Nuba Mountains. Journal of Research in Peace, *Gender and Development* (JRPGD); 4(3): 48-54.

Chaubey D., Prakash, V., Yaday, C.T. and Singh, G. (2018). Doubling of Farmers' Income though Integrated Farming System Approaches in Bihar - A Review. *International Journal of Current Microbiology and Applied Sciences*; 7(12).

Christanty, L. (1986). Chapter 11 – shifting cultivation and tropical soils: Patterns, problems and possible improvements. In: Marten, G.G. (1986). Traditional Agriculture in Southeast Asia: A human Ecological Perspective. Westview Press, Boulder, Colorado.

Coomes, O. T. and Graeme J. B. (1997). Indigenous market-oriented agroforestry: dissecting local diversity in western Amazonia. *Agroforestry Systems*; 37 (1): 27–44.

Coomes, O. T. and Graeme J. B. (1999). Peasant charcoal production in the Peruvian Amazon: rain forest use and economic reliance. *Forest Ecology and Management*; 140: 39-50.

Coomes, Oliver T., Grimard, F. and. Burt,G. J. (2000). Tropical forest and shifting cultivation: secondary forest

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Indexed By: *African Journal Online (AJOL); Texila American University; Genamics; Scholarsteer; EIJASR; CAS-American Chemical Society*; and *IRMS Informatics India (J-Gate)*

fallow dynamics among traditional farmers of the Peruvian Amazon. Ecological Economics 32, pp 109-124.

Easterlin, R.A. (1974). Does Economic Growth Improve the Human Lot? Some Empirical Evidence, In P.A. David and M.W. Reder (Eds.), Nations and Households in Economic Growth (Academic Press, New York), pp. 89-125.

Easterlin, Richard A. (2017). Paradox Lost? *Review of Behavioral Economics*; 4:(4): 311-339.

FAO. (2018). Shaping the future of Livestock. Food and Agricultural Organization of the United Nations. www.fao.org/3/i8384en/I8384EN.pdf.

Gleave, M. B.(1996). The Length of the Fallow Period in Tropical Fallow Farming Systems: A Discussion with Evidence from Sierra Leone. *The Geographical Journal*; 162(1): 14-24.

Herrero, M., Thornton, P.K., Gerber, P. and Reid, R.S. (2009). Livestock, livelihoods and the environment: understanding the trade-offs. *Current Opinion in Environmental Sustainability*; 1(2): 111 – 120.

Ickowitz, A., Powell, B., Salim, M.A. and Sunderland, T.C.H. (2014). Dietary quality and tree cover in Africa. *Global Environmental* Change; 24: 287–294.

Ickowitz, A. (2006).Shifting cultivation and deforestation in tropical Africa: critical reflections. *Development and Change*; 37(3): 599-626.

IPCC (2007). Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Landry, J. (2009). Analysis of the potential socio-economic impact of establishing plantation forestry on rural communities in Sanga District, Niassa province, Mozambique". Unpublished MSc. Dissertation, Stellenbosch University, South Africa.

Mathews-Njoku, E.C. and Onweremadu, E.U. (2007). Adoptability of Planted Fallows and Efficacy of Natural Types in Fertility Regeneration of Typic Paleudult. *Nature and Science*; 5(3).

Mnenwa, R. and Maliti, E.(2010). A comparative analysis of poverty incidence in Farming systems of Tanzania. Special Paper 10/4 Dar es Salaam, REPOA.

NRDS (2009). "Sierra Leone". Prepared for the Coalition for African Rice Development. Available at https://www.jica.go.jp/english/our_work/thematic_issues/agricultural/pdf/sierraleone_en.pdf

Onweremadu, E.U., Matthews-Njoku, E.C., Nnadi, F.C., Anaeto, F.C., Ogwuoke, F.O., Onu, D.O. and Odii, M.A.C.A. (2008). Deterioration of soil organic components and adoptability of green fallows for soil fertility replenishment. *Journal of American Science*; 4(2): 78-84.

Renner-Thomas, A. (2010). Land tenure in Sierra Leone: The Law Dualism and the Making of a Land Policy. AuthorHouse, UK Ltd: 406 pp.

Russel, W. (1988). Population, swidden farming and the tropical environment. *Population Environment*; 10(2): 77-94.

Saxena, R., Singh, N.P., Choudhary, B.B., Balaji S.J. Paul, R.K., Ahuja, U., Joshi, D., Kumar, R. and Khan, M.A. (2017). Can Livestock Sector be the Game Changer in Enhancing the Farmers' Income? Reinvesting Thrust with Special Focus on Dairy Sector". *Agricultural Economics Research Review*; 30 (Conference Number): 59-76.

Seidenberg, C., Mertz, O. and Kias, M.B. (2003). Fallow, labour and livelihood in shifting cultivation: implications for deforestation in northern Lao PDR. *Danish Journal of Geography* 103(2): 71-80.

Tschakert, P., Coomes, O.T. and Potvin C. (2007). Indigenous livelihoods, slash-and-burn agriculture, and carbon stocks in Eastern Panama. *Ecological* Economics; 60 (2007): 807 – 829.

UNDP (2019). Human Development Index - Sierra Leone. The United Nations Development Programme. Available at https://www.thesierraleonetelegraph.com/global-human-development-index-2019-sierra-leone-moves-up-three-points-from-184-to-181/

White, P.C.L., Jennings, N.V., Renwick, H. and Barker, N.H.L. (2005). Questionnaire in Ecology: a review of past use and recommendations for best practice. Journal of Applied Ecology, 42: 421-430.

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