Non-timber forest products income from forest landscapes of Cameroon, Ghana and Nigeria – an incidental or integral contribution to sustaining rural livelihoods?

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SUMMARY

This paper discusses the relative importance of non-timber forest products (NTFPs) for rural households in Cameroon, Nigeria and Ghana. It aims to compare and contrast the significance of NTFPs for income generation in rainforest areas, both within and across these countries to draw out regional patterns in a wider ecological, social and political context. In doing so, we bring the added value of highlighting the different roles which NTFPs currently play, or might likely begin to play out, in wider landscapes. The contribution NTFPs make to rural livelihoods depends largely on the availability of forest resources and access to markets, as well as socio-economic variables including wealth, gender and migration status. The findings indicate that remote communities and poorer households rely more on NTFP-based income compared to more accessible communities and wealthier households. NTFPs are relatively unimportant as an income source for households in more accessible rural areas, where farm-related income dominates. These findings support the theory that NTFPs are an important component to rural livelihoods and make significant and timely income contributions to poor households. Furthermore, in times of economic and climatic uncertainty, NTFPs and the forest and agricultural landscapes within which they are found, make a significant contribution to the resilience of rural forest dwellers' livelihoods.

Keywords: NTFPs, household surveys, multi-functional landscapes, resilience, West Africa

Revenus provenant des produits forestiers autres que le bois dans les cadres forestiers du Cameroun, du Ghana et du Nigéria: contribution hasardeuse ou intégrale au soutien des revenus ruraux?

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Cet article examine l'importance relative des produits forestiers autres que le bois (NTFPs) pour les foyers ruraux au Cameroun, au Nigéria et au Ghana. Il cherche à comparer et à contraster la signification des NTFPs comme créateurs de revenus dans les zones de forêt vierge, à l'intérieur et au travers de ces pays, pour brosser des courants régionaux dans un contexte écologique, social et politique plus large. En faisant cela, nous ajoutons le bénéfice de pouvoir également voir les différents rôles que les NTFPs jouent actuellement, ou seront probablement à même de jouer dans des contextes plus larges. La contribution des NTFPs aux revenus ruraux dépend largement de la disponibilité des ressources forestières et de l'accès aux marchés, ainsi que des variables socio-économiques incluant la richesse, le sexe et le statut d'émigration. Les résultats indiquent que les communautés les plus isolées et les foyers les plus démunis dépendent plus des revenus basés sur les NTFPs que les communautés plus accessibles et que les foyers à revenus plus confortables. Les NTFPs sont relativement peu importants comme source de revenus pour les foyerrs des zones rurales accessibles où les revenus liés aux fermes dominent. Ces résultats confirment la théorie que les NTFPs sont un élément important pour les revenus ruraux et offrent des contributions notables et nécessaires aux revenus des foyers démunis. De plus, en temps d'incertitude économique et climatique, Les NTFPs et les cadres forestiers et agriculturels dans lesquels ils se trouvent fournissent une contribution palpable à l'assurance des revenus des habitants ruraux de la forêt.

Ingresos de productos forestales no maderables de los paisajes forestales de Camerún, Ghana y Nigeria: ¿una contribución ocasional o integral para los medios de vida rurales?

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En este trabajo se analiza la importancia relativa de los productos forestales no maderables (PFNM) para los hogares rurales de Camerún, Nigeria y Ghana. Su objetivo es comparar y contrastar la importancia de los PFNM para la generación de ingresos en las zonas de pluviselva,

tanto dentro de estos países como entre ellos, para extraer patrones regionales en un contexto ecológico, social y político más amplio. Con esto, aportamos un valor añadido al poner de relieve las diferentes funciones que desempeñan actualmente los PFNM, o que podrían comenzar a desempeñar en un paisaje más amplio. La contribución de los PFNM a los medios de vida rurales depende en gran medida de la disponibilidad de los recursos forestales y el acceso a los mercados, así como de variables socio-económicas, entre ellas la riqueza, el género y el estatus migratorio. Los resultados indican que las comunidades remotas y los hogares más pobres dependen más de los ingresos basados en PFNM, en comparación con las comunidades más accesibles y los hogares más afluentes. Los PFNM son relativamente poco importantes como fuente de ingresos para los hogares de las zonas rurales más accesibles, en donde predominan los ingresos relacionados con la agricultura. Estos hallazgos apoyan la teoría de que los PFNM son un componente importante de los medios de vida rurales y hacen contribuciones significativas de ingresos en períodos clave para los hogares más pobres. Además, en tiempos de incertidumbre económica y climática, los PFNM y los paisajes forestales y agrícolas en los que se encuentran realizan una contribución significativa a la resiliencia de los medios de vida de los habitantes de los bosques rurales.

INTRODUCTION

Socio political context

West African economies have experienced an average economic growth rate of more than 5% per year since 2005, making the sub-region one of the areas developing most rapidly in the world, with the GDP of petroleum-producing Nigeria and Ghana in particular, increasing between 8 and 9% over the past two years (UNECA 2013). Conversely, Cameroon's crude oil reserves and consequential production are now declining, with concomitant economic impacts, although it is hoped that gas reserves may help bolster the economy (Business Monitor International 2012). Unfortunately, regional economic growth to date has largely failed to increase employment for an expanding population. Indeed unemployment, owing to poor structural transformation of economies and persistent inadequacy of training, remains a major challenge to poverty reduction and improved living conditions, particularly for young people and women (UNECA 2013).

Ghana is developing rapidly as a result of increased gold mining and intensified cocoa production, the latter having triggered migration to cocoa growing zones in the Western Region in particular. In Nigeria, population growth is stimulating domestic migration and emigration into neighbouring Cameroon, which has witnessed increased deforestation rates and agricultural conversion, attributable to the biophysical suitability of vast areas of land (CIFOR 2012). In spite of ongoing questions around the legal basis for the concession, forest clearance is underway for the recent allocation of 60,000 hectares of oil palm plantation, bordering five protected areas, in Cameroon, (Greenpeace 2012). This regional economic growth and an expanding agri-business sector, has in part stimulated a livelihoods transition away from the reliance on subsistence activities, in favour of cash crops. Arnold and Townson (1998) predicted that NTFP related activities in Africa being 'generally labour intensive with low economic returns' would likely decline in importance in the future. As market integration and economic opportunities increase, so do opportunities for households to move into the production of cash crops, provided they have access to land and markets to do so. The impacts of this are witnessed at the landscape scale, where land cover change resulting from agricultural expansion, has been accompanied by migration to areas of intensive cocoa and oil palm plantations.

However, it is anticipated that the income contribution of NTFPs, and the role they play in providing a safety-net, will remain important both to the poorest rural households who may not be able to access new economic opportunities, and for those who have sought external employment options in a changeable economic climate, and may need to fall back on NTFP income. NTFP harvesters are typically people who live at the margins of economic and political systems (Shanley *et al.* 2002), and indeed the CIFOR global comparative study characterised the NTFP case studies in Africa as predominantly part of a 'coping strategy' (Sunderland *et al.* 2004). Although typically less than 50% of household income came from NTFPs, the importance of this contribution was linked to its accessibility during times of need, or when agricultural labour needs were low (*ibid*, Kusters *et al.* 2006). Hence, whilst NTFPs are not a panacea for poverty reduction and forest conservation, they do make a significant contribution to rural livelihoods in various and diverse ways (Agrawal *et al.* 2013). NTFP activities characteristically require low entry requirements, and provide accessible means of buffering against risks and shocks and reducing livelihood vulnerability through the provision of cash in times of need (Arnold *et al.* 2011, Marshall *et al.* 2006, Neumann and Hirsch 2000). Furthermore, drawing on a wide range of forest products for livelihoods strengthens rural people's ability to deal with and adapt to both a changing climate and extreme events. (Angelsen and Wunder 2003, Fisher *et al.* 2010, Liswanti *et al.* 2011; Wunder *et al.* 2014).

NTFPs exemplify an important and often complex interface between people and forests, which is indirectly and directly subject to and at risk from, an array of different management practices and resource pressures. As such the forest/farm interface, and more specifically the role NTFPs play in reducing vulnerability, may arguably be best understood within a more integrated approach to managing diverse, multi-functional landscapes, characterised by intact biodiversity, increase resilience against risks and shocks. The ecosystem management approach aims to provide practical and conceptual methods for sustainable land management in areas where competing land use results in trade-offs between different goods and services, such as between conservation, extractive activities (including NTFP harvesting) and agricultural production (Sayer *et al.* 2013).

Firstly, this paper aims to provide a socially differentiated perspective of the relative importance of forest related income for rural people living in high forest zone settlements in Cameroon, Ghana and Nigeria with contrasting access to markets and forests. Secondly, it aims to compare and contrast the significance of NTFPs for income generation in rainforest areas, both within and across these countries to draw out regional patterns in a wider ecological, social and political context. In doing so, we bring the added value of highlighting the different roles which NTFPs currently play, or might likely begin to play out, in wider landscapes. It provides a baseline against which changes in socio-economic dynamics and resource use patterns can be monitored and documented in the context of a rapidly developing region, characterised by accelerating economic growth and resulting land use change.

Forests, NTFPs and Livelihoods

Forests and trees on farm make essential contributions to human livelihoods and well-being through the provision of ecosystem services, including wild foods, fuel, shelter, medicines, and provision of shade, shelter, and soil retention. It is estimated that the as many as 1 billion of the world's poorest people rely in some way on forests for their livelihoods (Agrawal *et al*. 2013, Arnold *et al*. 2011). In terms of income generation, on-going global research cites environment-related income as making up a significant 20% of household income for forest dwelling people, which is closely comparable to the contribution from agriculture. This thereby illustrates how complementary contributions of forests and agriculture are to food and livelihood security (CIFOR PEN study 2013). Encouraging farmers to focus on a diversity of food sources including NTFPs not only contributes to a more diverse and nutritious diet (Sunderland *et al*. 2013), but also helps maintain biodiversity and associated ecosystem services on farm and forestlands. As Sherbinin *et al*. (2008) note, rural smallholders are important stakeholders in natural resource use and landscape change, especially in rainforest frontier zones, and understanding who and how people use, and control forests and farmlands is key to achieving sustainable agricultural and forest management, which focuses not only on production but also on economic, social and environmental sustainability (Colfer and Pfund 2011, McIntyre *et al*. 2009).

Claims in the 1990s that the commercialisation of NTFPs could alleviate poverty while promoting forest conservation have been challenged (Belcher and Schreckenberg 2007, Sunderland *et al*. 2011), and it has been argued that NTFPs tend to provide only basic levels of income for the very poor, and are not a direct pathway out of poverty (Neumann and Hirsch 2000). Initial arguments that the commercialisation of NTFPs may provide viable rural development options are now being tempered by a growing realization that many attempts to commercialize NTFPs have failed to significantly improve the livelihoods of rural poor, because of transport problems, and lack of access to market information and financial support including credit and loans (Marshall *et al*. 2003).

Where commercialisation is successful however, Marshall *et al*. (2006) report that, whilst that NTFP income varies greatly between households involved in the same activities, in many instances, these activities can make an important contribution to poverty reduction and regularly providing a safety net. Furthermore, there is scant evidence that they lead to an increase in poverty, or indeed be "poverty traps" as described by some authors (Angelsen and Wunder 2003).

Consequently, the focus of NTFP research has been redirected in recent years to determine more accurately the role of forest biodiversity in reducing vulnerability to external shocks and stresses, generating income, achieving food security and ensuring dietary and nutritional diversity. More specifically, NTFP research has focused on evaluating the social, economic and environmental contexts that shape patterns of use and trade and providing a socially differentiated assessment of the significant of forest resources in rural livelihoods (Arnold *et al*. 2011, Paumgarten and Shackleton 2009, Ros Tonen and Wiersum 2005). This paper attempts to undertake such an analysis with a focus on three countries in West and Central Africa, and presents findings on the relative importance of NTFP income to households with different levels of access to markets and forest resources, in relation to differing socio-economic variables including wealth, gender, education, and migration status.

METHODS

Study Area Description

Three study areas in Cameroon's Southwest Province, Ghana's Western Region and Nigeria's Cross River State were selected on the basis that they contained relatively large tracts of tropical rainforest. Accessibility is one of the main differentiating factors between rural villages in these areas. Within each of these regions three distinct zones were identified on the basis of accessibility to local and cross-border markets and forest resources. These zones are referred to as "remote", "border" and "on-road" zones, and whilst these are not recognised administrative units, the settlements within each zone have similar socio-economic and locational characteristics. One to three settlements (depending on size) were purposefully selected for study within each of the above zones. Tables 1, 2 and 3 summarise the main characteristics of these study settlements.

A combination of participatory techniques and structured surveys were used to gather demographic and household socio-economic data. A total of 1080 households were identified. A household census was administered along with a participatory wealth ranking exercise at the outset of the project. A multi-round survey was then administered every four months over a two-year period, to provide a total of six data sets per household, and capture seasonal changes in, and relative importance of, different income sources. For a detailed discussion on the methods employed, see Malleson *et al*. (2008).

TABLE 1 *Summary characteristics Cameroonian study settlements*

Zone	"Remote"	"Border"	"On Road"
Location of settlements	Takamanda on southern boundary of Takamanda Forest Reserve, and the villages of Obonyi I and Obonyi III within the TFR (acronym?)	Northwest foot of Mount Cameroon, Western border with Nigeria. Mbongo, Boa and Diongo, on the Boa plain, all border Mokoko River Forest Reserve.	Bombe and Ediki located on major road, Ediki also accesses a railway line. Bopo located 12km off major road, on laterite road 4x4 year round accessible otherwise only during dry season. All settlements located close to Southern Bakundu Forest Reserve boundaries.
Market access	Limited by no roads, but construction of one already improving access (Sunderland-Groves *et al* 2003). Nearest road-point from Obonyi I and III is 6 hours walk and 3 from Takamanda, in dry season (Schmidt-Soltau *et al* 2001).	Good access by boat to both Cameroonian and Nigerian markets. Access to Cameroonian markets via seasonal roads.	Relatively good access to urban markets by road.
Forest access	Mature high forest, with large areas of farmland around settlements. Timber exploitation taking place along navigable waterways.	Mosaic of relatively undisturbed forest (within the forest reserve), swamps, secondary forest, fallow, and farmland.	Farm/fallow patchwork, scarcity of farmland has led to encroachment into forest reserve. Large parts of forest reserve now devoid of economically important NTFPs
Population trends	Relatively low population density. Estimated population of Bombe	Moderate population density. High proportion of recently settled migrants (one third of sampled adults moved into area less than 5 years ago), or reside temporarily, returning annually to in Nigeria.	Relatively high population density, large settlements of over 1,000 people. About 70% of the population in this area are migrants, mainly Cameroonians from the Northwest Province and Nigerians (Asaha 2002).
Ethnic make-up	Mainly indigenes, socially homogenous. The people of all three villages belong to the Anyang ethnic group.	Mbongo, Boa and Diongo belong to the Balondo ethnic group. In addition, there are many Nigerians (42% of adults sampled), mostly Ibibios from the Akwa Ibom State.	The indigenes of Bombe and Bopo belong to the Bakundu ethnic group, whilst those from Ediki are from the Ekombe ethnic group.
Infrastructure and facilities	A primary school serves Obonyi I and III. No secondary schools. No tapped water, electricity (apart from individual generators) or government medical facilities.	Primary schools at Mbongo and Boa, a secondary school at Mbongo, no tapped water or electricity. Pharmacy at Boa.	Primary schools in all villages, secondary school at Bombe. Electricity at Bombe only. No tapped water or government medical facilities.
Livelihood opportunities	Subsistence food crop farming, some oil palm and sale of NTFPs	Oil palm and rubber plantations. Smallholder cocoa, food crop farming, NTFPs, and fishing.	Commercial food crop farming, smallholder cocoa and oil palm, NTFPs, trading and jobs with civil service.

Data

Both household census and multi-round income survey data are analysed in this research paper. Household census data provides information on individual household members (including location, age, gender, level of education, occupation, length of residence, land ownership and household assets) and data were grouped by country and zone.

Households were grouped into different wealth categories depending on the number of different household items the household possessed, material used in house construction, whether they rented or owned the house and whether they rented or owned the land they farmed. The maximum possible score was eighteen, the higher the score wealthier the household. Households scoring eight or above were grouped as "relatively wealthy" and those that scored below eight were grouped as "relatively poor". This categorization was consistent in all zones and in all countries.

Responses to specific questions on migration in the questionnaire, including the length of residence, were used

TABLE 2 *Summary characteristics Ghanaian study settlements*

Zone	"Remote"	"Border"	"On-Road"
Location of settlements	Within vicinity of Draw River Forest Reserve, Wassa West District.	On banks of Tano River boundary between Ghana and Côte D'Ivoire.	On Esaaman – Daboase road. Within vicinity of Subri Forest Reserve
Market access	Limited, no roads, footpath access from Gwira Banso. Ankobra River used to transport produce to Gwira Banso.	All settlements accessible by road from Elubo, a major town on border with Côte D'Ivoire. Tano River is used to access Elubo during rainy season	Limited because of poor state of road.
Forest access	Relatively intact, mature high forest in close proximity to settlements, large areas of farmland around settlements. Limited timber exploitation due to difficult terrain.	Relatively intact forest in nearby Ankassa Protected Area. Large areas of farmland around settlements.	Farm/fallow patchwork, scarcity of farmland has led to encroachment and degradation of Subri Forest Reserve.
Population trends	Excess of adult males (57%) over females, with 57% of male-headed households sampled headed by men under the age of 40. High in-migration, with over half of adults sampled having moved there less than five years ago.	Relatively balanced gender ratio. Over a third of adults sampled have resided in these settlements for 20 years or more.	Relatively balanced gender ratio. Over a third of adults sampled have resided in these settlements for 20 years or more.
Ethnic make-up	High proportion (87%) of adults sampled in remote settlements studied, recent in-migrants largely from Eastern region, who moved to the area less than five years ago.	Relatively socially homogeneous.	Relatively low proportion of migrants, but still relatively socially heterogeneous. 41% of adults are indigenous Wassa, 29% of adults are Fantis, mainly from Central Region.
Infra-structure & facilities	No schools. No tapped water, government medical facilities or electricity (only individual generators).	Ghana Nungua and Cocoa Town have primary and junior secondary schools. Domeabra and Fawoman have primary schools. Nearest hospital in Elubo. No tapped water or electricity.	Wassa Esaaman has a primary and a junior secondary, Aboaboso only a primary school. No electricity or tapped water, health post in Wassa Essaaman.
Livelihood opportunities	Cocoa and other perennial cash crops, such as oil palm, are the principal commercial crops grown.	Cocoa and other perennial cash crops, such as oil palm are the principal commercial crops grown.	Cocoa and cassava, are important sources of income. Shortage of farmland for farming. Rattan basketry an activity for the majority of households.

to determine the migration status of the household as non-migrant, migrant or return-migrant.

Cash-earning activities in the multi-round income survey were grouped into different categories and into different seasons, either dry or rainy. Income categories included: *Farm income:* own account farming; *Off-farm income:* wage labour on other people's farms; *Non-farm rural self-employment*: semi-skilled worked e.g. hairdressing, carpentry; *Non-farm wage employment*: civil service jobs e.g. teaching; *Fishing*; *Non-timber forest products:* trade in wild and semi-domesticated fruits and vegetables, plant parts, bush meat; *Rental income:* leasing land or property; *Remittances:* from relatives and friends working in urban areas; *Other transfers:* e.g. pension payments to retired civil servants (Malleson *et al*. 2008).

Comparing proportions

Chi-square test was used for single pairwise comparison of proportions and for multiple pair wise comparison with the addition of Bonferroni adjusted alpha levels for multiple testing (Wright 1992). Multiple pairwise comparison procedure was used to test if a household characteristic differed in all three countries.

Association analysis

Odds ratio was used to compare the association between two categorical variables. The odds ratio is the ratio of the odds of an event occurring in one group to the odds of it occurring in another group. The odds ratio was used to investigate the

TABLE 3 *Summary characteristics Nigerian study settlements*

Zone	"Remote"	"Border"	"On-Road"
Location of settlements	Old Ekuri and New Ekuri are located in Akamkpa LGA.	Danare I and Danare II, are on Nigeria's eastern border with Cameroon in Boki LGA.	Located in Boki LGA on the tarred, but pot-holed, Ikom-Obudu road, about 29 km from Ikom.
Market access	Limited market access, via laterite road built by the communities from the Calabar – Ikom highway. Road impassable to most vehicles during rainy season.	Located Bashua Biajua Danare road: Danare I accessible all year; Danare II's in dry season. Reasonable market access compared to Ekuri settlements, limited compared to on-road	Relatively good market access,
Forest access	Located in 'support zone' of Cross River National Park, with easy access to relatively intact forest. WWF, DFID, Ford Foundation and Cross River State Forestry Department support the Ekuri Community Forest Management Initiative.	Close proximity to relatively intact forest.	According to the LENF (1998) there is no 'virgin' forest left around Abontakon because of farming and timber exploitation. The Afi Forest Reserve is located nearby.
Population trends	Relatively balanced gender ratio. Relatively stable populations, over half of all adults sampled residing in these zones have been there for over 20 years or more.	Relatively balanced gender ratio and stable populations, over half of all adults sampled residing in these zones have been there for over 20 years or more.	Relatively balanced gender ratio. Relatively stable population, over half of all adults sampled residing in these zones have been there for over 20 years or more.
Ethnic make-up	Relatively socially homogeneous, the majority of people belong to the Ekoi ethnic group (Dunn and Otu 1996).	Relatively socially heterogeneous. Indigenes of Danare I and II belong to the Boki ethnic group. Around a quarter of adults included in this sample originate from outside Cross River State, of these 19% originate from Ebonyi/Imo States and 6% from Akwa Ibom State.	Relatively socially heterogeneous. Around 40% of all adults included in Nigeria's on-road sample originate from outside Cross River State, 27% originate from Ebonyi and Imo States, whilst 13% originate from Akwa Ibom State.
Infrastructure and facilities	A primary school managed by the government is shared between the villages. No health facilities.	Danare II has a primary and a secondary school which serves both communities in this zone. A government health post, located between the two settlements, serves both communities in this zone.	A primary school and secondary schools exist in neighbouring villages. No hospital but there is a health centre under construction.
Livelihood opportunities	Food crop production, particularly plantains and forest -related enterprises (including timber exploitation and NTFPs (*Gnetum spp.* and bush meat significant income activities).	Perennial cash crop (cocoa) and commercial food crop farming (cassava, plantains, bananas) as well as NTFPs (*Irvingia* spp.) are some of the main cash earning activities.	Perennial cash crop (cocoa) and commercial food crop farming (cassava, plantains, bananas) and NTFPs (*Irvingia* spp.) are the main cash earning activities.

level of association between two income categories, farm and NTFP, across zones and during different seasons. The value of the ratio at 1 implies no association and values further from 1 present strong association (Agresti 2007). A statistical significance finding is when the confidence interval of the ratio does not include one.

Regression modelling

A logistic regression model was fitted to the data to look at the joint effect of location (zones), wealth category (rich/poor) and migration status on the likelihood of reporting the source of income from NTFP activities verses farm income (FI). The dependent variable income category was coded 0 for FI and 1 for NTFP. The model predicts the probability (p) of reporting NTFP as the source of income and takes the form:

$$p = \frac{\exp(Z)}{1 + \exp(Z)}$$

where $Z = \beta_0 + \beta_1 \times \text{Zone} + \beta_2 \times \text{WealthCategory} + \beta_3 \times \text{MigrationStatus}$. Maximum likelihood method is used to estimate the coefficients (β_0, β_1, β_2 and β_3).

All analyses were performed using the R environment for statistical computing (version R 2.15.0) (R Core Team 2013) in a Windows platform. The functions **chisq.test** and **pairwise.prop.test** were used for single and multiple pairwise comparisons of proportions. The **glm** function in the base package of R was used to fit the logistic regression model and the plot package ggplot2 was used to produce the graphs (Hadley 2009).

RESULTS

Cross comparison of household characteristics by country and zone

Table 4 and Figure 1 summarise the basic household characteristics across the three zones in all three countries. The proportion of houses with cement block or plank was lowest in remote zones, irrespective of country (see Figure 1-a). Less than 10% of houses in remote settlements were constructed from wooden planks or cement blocks and a relatively low proportion of households in these settlements had corrugated metal roofs. The overall average per zone (Figure 1-a, solid dot) showed a strong trend that the occurrence of houses constructed from cement block or wooden planks was significantly higher in border and on-road zones compared to remote settlements, but there was no significant difference between border and on-road settlements.

Home ownership was generally higher in remote areas compared to more accessible zones. Ghana had the highest levels of home ownership across all zones (Figure 1-c). In contrast, levels of farmland ownership did not significantly change across zones, and approximately 70% of the households owned farmland (Table 4). In Cameroon, more households owned the land they farmed in remote settlements compared to more accessible settlements; whereas interestingly in Ghana, the pattern was reversed, with higher levels of farmland ownership in border and on-road zones.

Irrespective of country, the proportion of households grouped as relatively poor was significantly higher in remote zones. Mean values (Figure 1c, line through solid circle) indicate that the approximately 20% of households were grouped as relatively poor in border and on-road zones compared with 40% of households in remote zones. This pattern was seen in all three countries.

Education levels

Data relating to the length of education of adults in sample households by zones and countries is presented in Table 4, Figure 1 (d). Most adults sampled had between six to ten years' education. Less than 30% of adults sampled had more than ten years' education. Ghana had the lowest proportion of adults with more than ten years' education, whereas Nigeria had the highest proportion with 20–30% of adults with more than ten years' education. The most frequently reported level of education across all three zones in all three countries was between 6–10 years, and less than 30% of individuals surveyed had an education of greater than 10 years (Figure 1d). Ghana had the lowest occurrence of individuals with the highest level of education (+10 years), and Nigeria the highest at between 20–30%. Across all three zones, Ghana was reported to have the highest rate of no formal education.

TABLE 4 *Household characteristics and education levels, as proportion of population, across the three zones of Cameroon, Ghana and Nigeria*

Country	Cameroon			Ghana			Nigeria		
Zone/Characteristic	Remote	Border	On-road	Remote	Border	On-road	Remote	Border	On-road
Households with:									
Brick/plank houses (%)	7	98	75	4	50	39	2	52	80
Metal sheet roofs (%)	62	65	89	3	55	41	57	83	90
Own homes (%)	80	53	59	95	91	75	53	50	24
Own farmland (%)	94	50	60	48	75	71	86	83	72
Households Grouped as "Poorest" (%)	38	32	20	47	21	25	36	10	13
Number of households sampled (n)	*100*	*123*	*110*	*120*	*117*	*120*	*96*	*101*	*100*
Education levels:									
No formal education (%)	24	19	16	34	34	25	11	12	20
1–5 years' education (%)	12	12	13	19	19	15	6	7	16
6–10 years' education (%)	53	46	56	44	44	58	54	57	51
> 10 years' education (%)	9	20	13	2	2	5	29	24	21
Number of adults sampled (n)	*313*	*269*	*355*	*260*	*319*	*278*	*245*	*302*	*303*

FIGURE 1 *Plot of four household characteristics across country and zone. Mean response as percentage with 95% confidence interval (error bar) grouped by zone and country (empty symbols) for a) housing construction material b) home ownership c) poverty level and d) education level among adults. Overall mean estimates for each zone are shown with a solid circle in graphs a-c. In d, proportion of adults in the population with educational attainment levels, ranging from no formal education (NFE) to greater than 10 years, by zone and country*
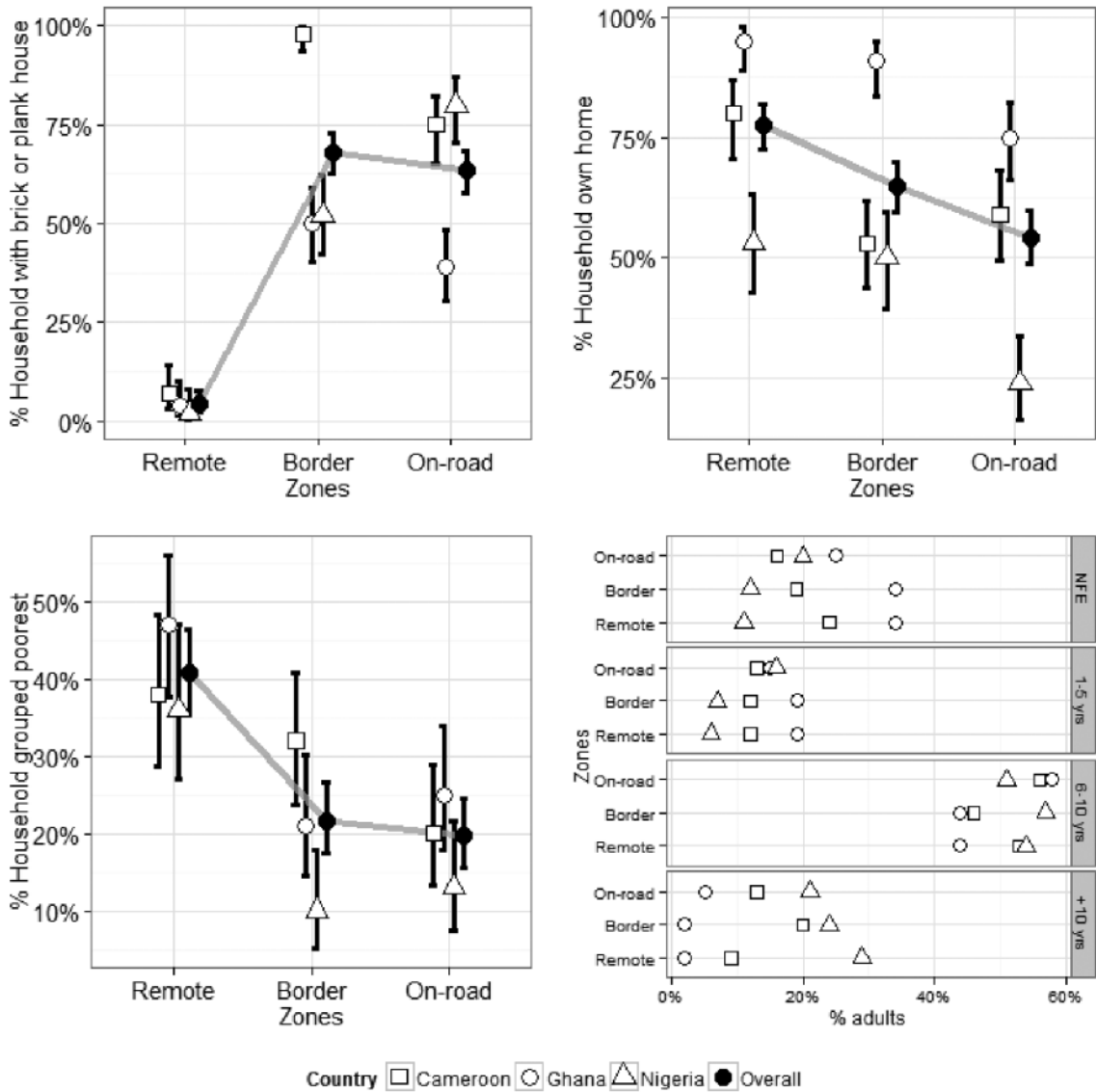
Household heads: Gender

Intra-country comparison:

In all three countries, a significantly higher proportion, ranging from 72–85%, of households were headed by males (Cameroon ($\chi^2 = 125.14$, df = 1, p < 0.001), Ghana ($\chi^2 = 350.14$, df = 1, p < 0.001) and Nigeria ($\chi^2 = 178.31$, df = 1, p < 0.001).

Furthermore, for all three countries, significantly greater proportions of female headed households contained adults with no formal education compared to male household heads. In Cameroon and Nigeria over half of all female household heads contained adults all of whom had no formal education

compared to 9–21% of male household heads. Approximately 51% of female headed households in Cameroon contained adults all with no formal education, compared to 21% of male household heads ($\chi^2 = 26.87$, df = 1, p < 0.001), in Ghana 36% vs. 22% ($\chi^2 = 3.98$, df = 1, p < 0.001) and in Nigeria 54% vs 9% ($\chi^2 = 64.05$, df = 1, p < 0.001).

Overall, in all three countries, male and female-headed households were equally likely to be grouped as "poorest". Though the proportion of female headed households grouped as poor was higher than male headed households in Cameroon (35% vs. 28%), these rates did not differ significantly ($\chi^2 = 1.25$, df = 1, p = 0.26). The same trend was seen Ghana, 38% vs. 33% ($\chi^2 = 0.28$, df = 1, p = 0.56) and in Nigeria 28% vs. 17% ($\chi^2 = 3.66$, df = 1, p = 0.06).

Inter-country comparison:

The results of the pairwise multiple comparison tests are shown in the last three rows of Table 5 for female and male-headed households.

Amongst the three countries, Cameroon had the highest prevalence of female-headed households (28%), which was significantly higher than Ghana (15%), but did not differ significantly from that of Nigeria (22%). The prevalence of male-headed household was highest in Ghana (85%) and differed significantly to that in Cameroon (72%) and Nigeria (78%).

The prevalence of female household heads containing adults all of whom had no formal education was highest in Nigeria (54%) and lowest Ghana (36%), however the results of the pairwise comparisons test showed that there was no significant difference between these rates. This was not the case for male- household heads, where the proportion of male household heads contain adults all of whom had no formal

TABLE 5 a & b: *Household head (HH) characteristics by gender (a) and migration status (b). P-values based on a multiple test for the equality of proportions between countries using a Bonferroni correction. In (a), the first column of numbers is the percentage female headed of household in Cameroon (CM, 28%), Ghana (GH, 15%) and Nigeria (NG, 22%). The results of the pair-wise comparison test show that there is a significantly higher level of female HH in the Cameroon sites vs. sites in Ghana (28% vs. 15%) where as there is no statistical significant difference (NS) between Cameroon vs. Nigeria (28% vs. 22%). In b, the percent of non-migrant HH in the sample differed amongst all the countries, with Nigeria having the highest composition of non-migrants at 83%. The results of within country comparison are shown using bold face numbers. In Cameroon (CM), the analysis shows that the male HH were significantly higher than male HH in Cameroon (28 % (F) vs 72% (M)); level of no-formal education was higher amongst female headed HH (51% vs 21%) and male and female HH were equally likely to be grouped in the poorest category. See text for more detail*

a) Gender

Characteristics		% of all households sampled		% all adult households sampled with no formal education		% of households grouped as poorest	
Gender		**Female HH**	**Male HH**	**Female HH**	**Male HH**	**Female HH**	**Male HH**
Country code	**CM**	28	**72**	**51**	21	35	28
	GA	15	**85**	**36**	22	38	33
	NG	22	**78**	**54**	9	28	17
Pairwise country comparison (p adjusted value)	**CM vs. GA**	28 vs 15 (<0.001)	72 vs 85 (<0.001)	51 vs 36 (NS)	21 vs 22 (NS)	35 vs 38 (NS)	28 vs 33 (NS)
	CM vs. NG	28 vs 22 (NS)	72 vs78 (NS)	51 vs 54 (NS)	21 vs 9 (<0.05)	35 vs 28 (NS)	28 vs 17 (<0.05)
	GA vs. NG	15 vs 22 (<0.05)	85 vs 78 (<0.05)	36 vs 54 (NS)	22 vs 9 (<0.001)	38 vs 28 (NS)	33 vs 17 (<0.001)

b) Migration status

Characteristics		% of all households sampled		% all adult households sampled with no formal education		% of households grouped as poorest		% of households owning farmland	
Migration status		**Non-migrant HH**	**Migrant HH**	**Non-migrant HH**	**Migrant HH**	**Non-migrant HH**	**Migrant HH**	**Non-migrant HH**	**Migrant HH**
Country code	**CM**	**63**	37	**33**	**44**	24	**80**	**82**	58
	GA	43	**57**	**22**	9	17	**27**	**91**	45
	NG	**83**	17	**20**	**12**	15	**41**	**92**	33
Pairwise country comparison (p adjusted value)	**CM vs. GA**	63 vs 43 (<0.001)	37 vs 57 (<0.001)	33 vs 22 (NS)	44 vs 9 (<0.001)	24 vs 17 (NS)	80 vs 27 (<0.001)	82 vs 91 (NS)	58 vs 45 (NS)
	CM vs. NG	63 vs 83 (<0.001)	37 vs 17 (<0.001)	33 vs 20 (<0.05)	44 vs 12 (<0.001)	24 vs 15 (NS)	80 vs 41 (<0.001)	82 vs 92 (=0.05)	58 vs 33 (=0.05)
	GA vs. NG	43 vs 83 (<0.001)	57 vs 17 (<0.001)	22 vs 20 (NS)	9 vs 12 (NS)	17 vs 15 (NS)	27 vs 41 (NS)	91 vs 92 (NS)	45 vs 33 (NS)

education was significantly different across countries, with the highest proportions in Ghana (22%) and lowest in Nigeria (9%).

The prevalence of female-headed household, grouped as poorest, ranged between 28–38%. The results of the pairwise comparisons test showed that these rates did not differ significantly between countries. This pattern was not observed among male-headed households. The country with the highest prevalence of male-headed households grouped as poor was in Ghana (33%) and this rate differed significantly with rates observed in Cameron (28%) and Nigeria (17%).

Household heads: Migration

Intra-country comparison:
In Cameroon the proportion of households headed by non-migrants (63%) exceeded the proportion of households headed by migrants significantly, (37%) ($\chi^2 = 42.26$, df = 1, p < 0.001). The same was true for Nigeria where non-migrant headed households made up 83% of the sample ($\chi^2 = 256.90$, df = 1, p < 0.001). In Ghana, however, this trend was reversed with the proportion of migrant headed households (57%) significantly higher than non-migrant headed households (43%) ($\chi^2 = 15.14$, df = 1, p < 0.001).

In Cameroon and Nigeria the prevalence of household heads with no formal education was similar among non-migrant and migrant headed households, for Cameroon: 33% vs. 44% ($\chi^2 = 3.24$, df = 1, p = 0.07) and Nigeria: 20% vs. 12% ($\chi^2 = 1.17$, df = 1, p-value = 0.28). In contrast, households headed by non-migrant household heads in Ghana were twice as more likely to have no formal education than their counter parts: 22% vs. 9% ($\chi^2 = 10.88$, df = 1, p < 0.001).

There were significantly more poor migrant headed households compared to poor non migrant headed households in all three countries in Cameroon, 24% vs. 80% ($\chi^2 = 21.21$, df = 1, p < 0.001), Ghana, 17% vs. 27% ($\chi^2 = 78.28$, df = 1, p < 0.001) and Nigeria, 15% vs. 41% ($\chi^2 = 92.40$, df = 1, p < 0.001). The overall trend was for migrant headed households to be more likely to be grouped amongst the poorest households, than their counter parts in all three countries.

Farmland ownership differed significantly in Cameroon amongst non-migrant and migrant headed households, 82% vs. 58% respectively as it did in Ghana 91% vs. 45% respectively and in Nigeria 92% vs. 33% respectively. The overall trend was that non-migrant headed households were more likely to own farmland than migrant headed households in all three countries.

Inter-country comparison:
The results of the pairwise multiple comparison tests are shown in the last three rows of Table 5 b for non-migrant and migrant headed households. The prevalence rates of non-migrant headed households differed significantly amongst the three countries. Nigeria had the highest rate (83%), followed by Cameroon (63%) and then Ghana (43%).

In relation to education, a higher proportion of non-migrant household heads in Cameroon (33%) had no formal education compared to Ghana (22%) or in Nigeria (20%), however, this difference was not significant. In contrast, there was a significant difference in the proportion of migrant headed households with no formal education across countries, with 44% of households head by migrants with no formal education compared with Ghana (9%) and Nigeria (12%).

A lower proportion of non-migrant headed households were grouped as relatively poor in Ghana (15%), compared to Cameroon (24%) but these differences were not significant. In contrast, there was a significantly higher proportion of migrant headed households grouped as relatively poor in Cameroon (80%) compared to Ghana (27%).

In relation to ownership of farmland, similar patterns of farmland ownership were observed for non-migrant and migrant headed households across the three countries. However, non migrant headed households are more likely to own farm land than their counterparts. On average the prevalence rate of farmland ownership amongst non-migrant household heads is 88% compared to 45% for migrant household heads across all three countries.

Patterns of income generation

Relative importance of different income categories across zones and country
Table 6 summarises the finding of the multi-round survey. Of the ten categories, Farm Income (FI), Non-timber forest products (NTFP) and Non Farm Rural Self Employment (NFRSE) were the top three incomes sources cited, being 70%, 14% and 7% respectively. Together farm and NTFP income sources account for approximately 84% of all income sources cited. The data in Table 6 is used to quantify the relative importance of these two income categories by location and by season.

In Table 7, the relative importance of NTFP verses Farm Income is expressed by the odds ratio. The odds ratio (referred to as OR) is the likelihood of ranking NTFP income higher than farm as the source of income. An OR of greater than one favours the NTFP income category and is statistically significant at P = 0.05 when the 95 % confidence interval of the ratio does not include one.

Analysis of pooled data from all three countries showed that the relative importance of NTFP vs. FI differed across zones. The relative importance NTFP vs. Farm Income (FI) in the Remote vs. Border or On-road had a similar trend. Households in the remote zones were 4.5 times more likely to report NTFP income compared to farm income as the main source of income; compared to the border zone and 2.3 times more likely than the on-road zone. In contrast, the likelihood of NTFPs as the source of income between border and on-road fell below one (OR = 0.5), indicating there was a trend toward reporting farm income as the source of income. The overall trend, independent of country, is that households in remote areas are more likely to report NTFP income as the main source of income, compared to farming income. The relative importance of NTFP vs. Farm income diminishes in the border and on-road zones.

TABLE 6 *Patterns of income generation: number of responses across income groups by zones and country based on the multi-round survey*

Income Groups *	Cameroon				Ghana				Nigeria			
	Zones			Total	Zones			Total	Zones			Total
	Remote	Border	On-Road		Remote	Border	On-Road		Remote	Border	On-Road	
Farm Income	282 (39%)	488 (76%)	575 (84%)	1345 (65%)	1219 (80%)	1080 (79%)	1193 (69%)	3492 (75%)	418 (55%)	445 (70%)	601 (75%)	1464 (67%)
NTFP	336 (46%)	15 (2%)	14 (2%)	365 (18%)	150 (10%)	34 (2%)	305 (18%)	489 (11%)	232 (31%)	118 (18%)	68 (9%)	418 (19%)
Non Farm Rural Self Employment	69 (9%)	64 (10%)	48 (7%)	181 (9%)	33 (2%)	119 (9%)	149 (9%)	301 (6%)	45 (6%)	59 (9%)	69 (9%)	173 (8%)
Off Farm	6 (1%)	14 (2%)	22 (3%)	42 (2%)	75 (5%)	22 (2%)	14 (1%)	111 (2%)	7 (1%)	2 (0%)	18 (2%)	27 (1%)
Non Farm Wage Employment	18 (2%)	26 (4%)	8 (1%)	52 (3%)	2 (0%)	46 (3%)	33 (2%)	81 (2%)	46 (6%)	9 (1%)	31 (4%)	86 (4%)
Remittances	0 (0%)	0 (0%)	0 (0%)	0 (0%)	21 (1%)	32 (2%)	27 (2%)	80 (2%)	0 (0%)	0 (0%)	1 (0%)	1 (0%)
Rental Income	0 (0%)	1 (0%)	3 (0%)	4 (0%)	19 (1%)	27 (2%)	5 (0%)	51 (1%)	0 (0%)	2 (0%)	8 (1%)	10 (0%)
Non Respondent	9 (1%)	29 (5%)	17 (2%)	55 (3%)	9 (1%)	9 (1%)	4 (0%)	22 (0%)	5 (1%)	4 (1%)	1 (0%)	10 (0%)
Fishing	7 (1%)	3 (0%)	1 (0%)	11 (1%)	5 (0%)	3 (0%)	0 (0%)	8 (0%)	4 (1%)	0 (0%)	1 (0%)	5 (0%)
Other Transfers	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0%)	5 (0%)	6 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	727 (100%)	640 (100%)	688 (100%)	2055 (100%)	1533 (100%)	1373 (100%)	1735 (100%)	4641 (100%)	757 (100%)	639 (100%)	798 (100%)	2194 (100%)
Number HH	81	75	80		81	80	81		79	81	81	

Country specific analysis showed that the magnitude of the relative importance of NTFP vs. FI varies between countries. For the remote-border comparison, Cameroon has the highest odds ratio (OR = 38.8) and Nigeria the lowest (OR = 2.1). In Ghana, the likelihood of NTFPs as the source of income between remote and border falls below one (OR = 0.5), indicating that farm income is more important as the source of income. This however was not the case in Cameroon and Nigeria, where the likelihood of NTFPs as the main income source was higher than farm income. In all three countries, households in remote areas were more likely to report NTFPs as the main source of income, than households in the other two zones.

Seasonal variation of the relative importance of different income sources
Analysis of pooled data from all three countries showed that the relative importance of NTFP vs. FI varies significantly with seasons. NTFPS were nearly twice (OR = 1.8) as likely as FI to be reported during the rainy season. (Table 7). The country specific OR fell in the range of 1.9–2.4 and was similar to the overall trend.

Joint effect of location, wealth and migrant status
The probability of a household member reporting NTFPs as a source of income based on their location, wealth category and migration status was analysed via a logistic regression model. For this model to be valid there had to be a sufficient number of responses for all combinations of location (Remote/ Border/ On-Road), wealth category (Rich/Poor) and migration status (Non-migrant/Migrant/Return-migrant). This however was not case, with insufficient number of responses for the combination zone = Remote, wealth = Rich and migration status = Return-migrant. To proceed with the model building the border and on-road zone categories were grouped together because of their similarity in terms of household characteristics (Fig 1), proximity to markets, roads, etc. (Tables 1–3), and return-migrants were dropped from the analysis due to their low numbers. A logistic regression model was fitted to the data with the following categorical variables: zone (Remote/Border+On-Road), wealth category (Rich/Poor) and migration status (Non-migrant/Migrant), to predict the probability of a household reporting NTFP as a source of income.

TABLE 7 *Relative importance between NTFP verses Farm income by country, zone, and season. Country codes: CM-Cameroon, GH-Ghana and NG-Nigeria. See text for more detail*

Country	Location effect (zone)	odds ratio (OR)	95% confidence interval		Sig. Level
All	Remote vs Border	4.5	3.8	5.4	0.05
All	Remote vs On-road	2.3	2.0	2.6	0.05
All	Border vs On-road	0.5	0.4	0.6	0.05
CM	Remote vs Border	38.8	22.6	66.4	0.05
CM	Remote vs On-road	48.9	28.1	85.1	0.05
CM	Border vs On-road	1.3	0.6	2.6	NS
GH	Remote vs Border	3.9	2.7	5.7	0.05
GH	Remote vs On-road	0.5	0.4	0.6	0.05
GH	Border vs On-road	0.1	0.1	0.2	0.05
NG	Remote vs Border	2.1	1.6	2.7	0.05
NG	Remote vs On-road	4.9	3.6	6.6	0.05
NG	Border vs On-road	2.3	1.7	3.2	0.05
	Seasonal effect				
ALL	Rainy vs Dry	1.8	1.6	2.1	0.05
CM	Rainy vs Dry	1.9	1.5	2.4	0.05
GH	Rainy vs Dry	2.1	1.7	2.5	0.05
NG	Rainy vs Dry	2.4	1.9	3.0	0.05

Table 8 shows the parameter estimates, standard error and P value for the coefficients in the regression model. The fit of this model was significantly different from the null model (($\chi^2 = 355$, $df = 3$, $P < 0.001$), which assumed that the reporting of NTFP as a source of income would be equally likely in all combinations of the categorical variables. Consequently some combinations of the categorical variables were more likely to have higher reporting rates for NTFP than others. The sign of the coefficient proved in what direction the reporting rate changed. The negative coefficient for the variable zone implied that the reporting rate of NTFP be far less than in the accessible zone (On-Road & Border) compared to the remote zone. Likewise the negative coefficient value for the wealth category variable indicated that the probability of NTFPs being reported as a source of income was lower among the rich. Finally, the positive coefficient value for migration status implied that non-migrants were more likely to report NTFP as a source of income than migrants.

Figure 2 gives the predicted probabilities of NTFPs being reported as source of income for all possible combinations of location, wealth category and migration status. The figure showed that the poor were more likely to report NTFPs as the source of income regardless of location and migration status. Location effect for both migrants and non-migrants followed a similar pattern. Remote zone inhabitants were more likely to report NTFP as the source of income than inhabitants of on-road or border settlements.non-remote zone. Finally, non-migrants were more likely than migrants to report NTFPs as the source of income, irrespective of wealth category.

DISCUSSION

Across all three countries, households were significantly poorer in remote areas (Figure 1 c). Such households were relatively poorly integrated into the regional economy and have limited access to infrastructure and public services, compared to more accessible on-road and border settlements (see Tables 1–3). Indeed poverty levels in border and on-road zones were approximately half of that recorded in the remote settlements. These findings are consistent with Wiggins and Procter (2001) who point out that remote rural areas tend to be poorer than more accessible "middle countryside" and "peri-urban" settlements. Ellis (1998) states the main factors contributing to rural poverty are locational, reflecting not so much lack of access to land, but rather location-specific lack of access to an array of services and opportunities – roads, schools, markets, input supplies, power, and non-farm activities.

NTFPs do seem to be the domain of the poor, and location and access to infrastructure is a determining factor in livelihood choices, with NTFPs making an important contribution to rural livelihoods. Villages in the remote zones were several times more likely to report NTFPs, compared to agriculture, as the main source of income in all three countries. This can be explained in part by limited market access making transportation of high volume: low value products relatively uneconomic. Households living in remote settlements are engaged in NTFP-related as there are few alternative income sources. Reliance on particular income sources is most likely a reflection of the availability of alternatives, in particular off-farm, of which there appear to be fewer in Cameroon. It is well documented that NTFPs have, for some time, been recognised as one of the larger income-generating components of the non-farm rural economy (Arnold 2004).

Paradoxically, it has been suggested that the same characteristics that make NTFP activities feasible for poor people also make them economically inferior activities (Angelsen

TABLE 8 *Coefficient estimates, standard error, 95% confidence interval (CI) and p values for the logistic regression model. For all three categorical variables, the probability of reporting NTFP as a source of income relative to the reference category decreases for negative coefficients and increases for positive values. All coefficient estimates are significantly different from zero (P < 0.001)*

	Estimate	Std. Error	95% CI		P value
Intercept	−1.46	0.072	−1.60	−1.32	<0.001
Zone					
Border & On-road	−1.10	0.089	−1.28	−0.93	<0.001
Remote (reference category)					
Wealth category					
Rich	−0.62	0.091	−0.79	−0.44	<0.001
Poor (reference category)					
Migration status					
non-migrant	1.06	0.088	0.89	1.23	<0.001
migrant (reference category)					

and Wunder 2003). Some NTFP-related activities yield low returns, offering little prospect for accumulating sufficient capital to escape poverty (Ashley *et al.* 2003), others are arduous and labour intensive and many people would prefer not to engage in them if there are higher income earning alternatives available (Marshall *et al*. 2006). Hence the transition to other more attractive and profitable livelihood options, where location and other socio-economic factors permit. This pattern was observed in this study, with households grouped as poorest, gaining the majority of their income from NTFPs and farm labour, and a strong tendency of the wealthier households sampled, to obtain higher proportions of their income from farming, non- farm self-employment and wages. In the border areas of Ghana, and the more accessible border and on-road zones of Cameroon and Nigeria, wealthier households engaged in perennial cropping of commercial crops including cocoa and oil palm, as well as plantain and banana, leaving poorer, predominantly migrant, households to obtain higher proportions of income from short-rotation crops, such as cassava and annual crops. This difference is in part due to contrasting labour resources and land tenure arrangements between migrants and non-migrant households, with the former tending to rent land on a short-term basis. In general, migrants in Cameroon and Nigeria are not allowed to plant perennial cash crops on the land they lease.

Berry (2007:47) argues that, one of the main constraints for poor African farmers is the scarcity of their own time. This is another reason (in addition to land tenure issues discussed above) why cassava has become such an important crops for relatively poor households with limited labour resources. As Nweke *et al.* (2004) point out, cassava offers flexibility in the timing of labour inputs since it can be planted throughout the rainy season and harvested over a period of up to 18–24 months, making it particularly attractive to households with limited labour. Limited labour is a key problem particularly for female-headed households.

Forests themselves provide a bank for poor NTFP harvesters, who often have no means by which to accumulate credit (Shanley *et al.* 2002). As Guyer (2004) points out many people orient income-generating activities towards anticipated career trajectories. Income from gathering forest spices and making handicrafts tends to flow in relatively large amounts and, because these products generally store well, they provide a useful 'bank' of money that can be used for contingency purposes or to support other occupations. This is particularly important for women, since a large proportion of their income flows in small amounts rather than in lump sums. NTFPs provide many women in remote settlements of Cameroon and Nigeria with one of the few means of accumulating money for other purposes (Malleson 2000). In the same way, older children and women in such settlements harvest NTFPs, such as bush mango, during the school holidays in the rainy season to pay school fees at the start of the academic year (Malleson 2002).

The seasonality of different income streams is closely linked to the agricultural cycle and labour availability, and many NTFP-related activities are carried out during the rainy season, between crop planting and harvesting, and at other slack times during the farming year. In all three countries, there was a significant seasonal effect with NTFP income sources being increasingly prominent during the rainy season. For example, in Ghana, income from chewing sponges, rattan and rattan handicrafts is more significant during the rainy season, with income from basket weaving peaking just prior to the cocoa harvest, as demand for collecting baskets increases. Supplementary NTFP-related income helps to smooth and buffer seasonal cash flow gaps (Chambers and Maxwell 1981: 226), described by Marshall *et al.* (2006) as gap filling activities. supplements These findings resonate with Arnold and Ruiz-Peréz (1998), Falconer (1990), Malleson (2000), and Shreckenberg *et al*. (2002). The significance of some NTFP-related income sources lie not only in the relative amount

FIGURE 2 *Predictions and 95% confidence intervals based on the logistic regression model. On the x-axis is the probability (p) of reporting NTFP as a source of income for migrants and non-migrants (upper and lower panels respectively), within two wealth ranking categories (poor and rich – grey and white filled bars) in two locations (remote and accessible zones, y-axis)*
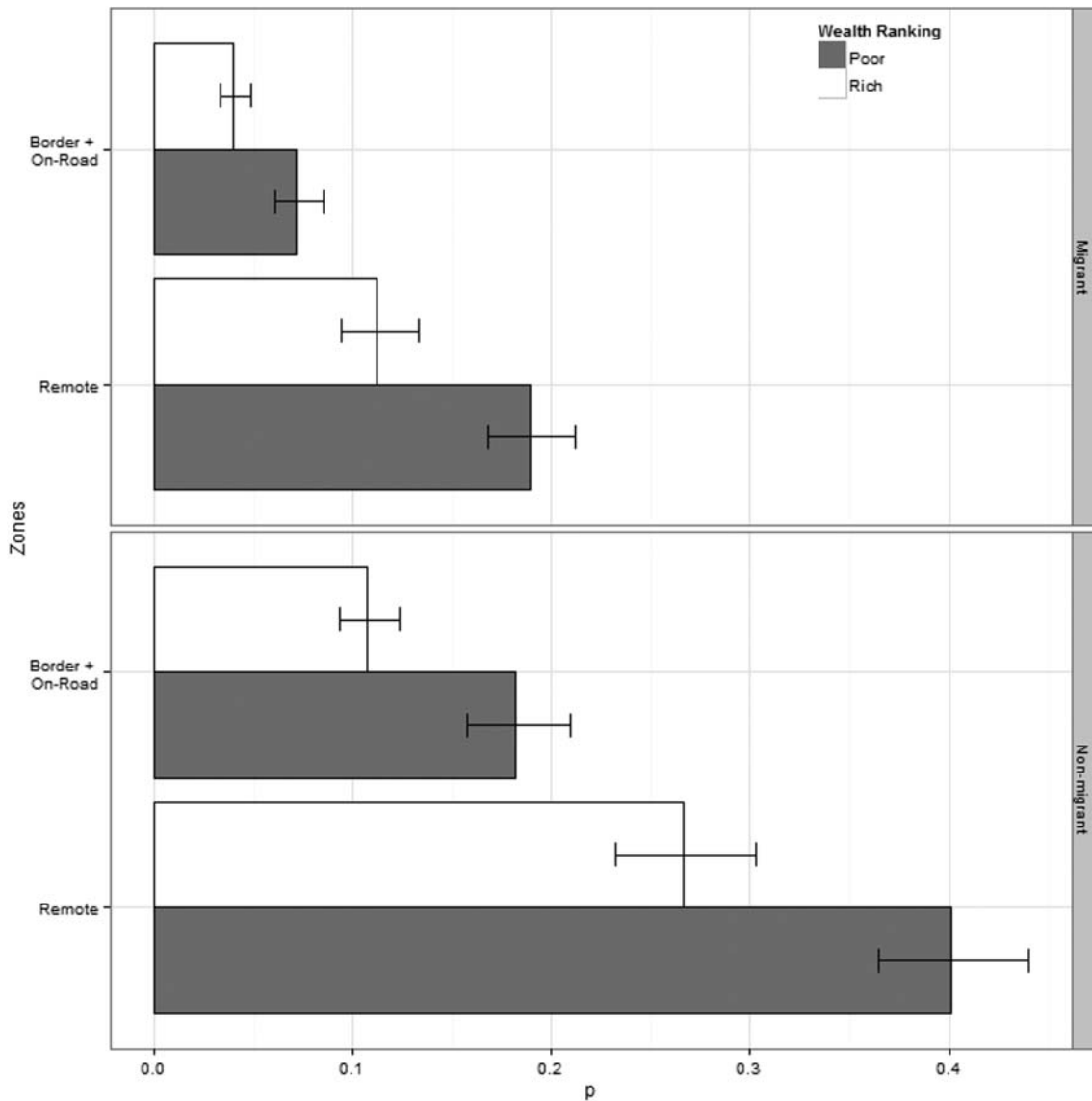
of income generated but in the timing and flow of income and the data set illustrated significant seasonal variations in the importance of NTFP and farm income. During the rainy season, the relative importance of NTFP income almost doubles as farm income drops.

In Cameroon and Nigeria study settlements, bush mango income shows great seasonal variation as the most common species of bush mango (*Irvingia gabonensis)* fruits during the rainy season and much of the processing and marketing is carried out during the slack farming period or when the need for cash is more acute, such as at the start of the school year (Falconer 1990, Malleson 2000, Sunderland *et al*. 2003).

Irrespective of location (zone and country), access into the school system resulted largely in people attaining the same level of education, however the highest rates of no formal education were recorded in the remote zone, correlating with highest poverty indices. Although male and female-headed households were equally likely to be grouped as "poorest", female-headed households were more likely to have no formal education, supporting theories that gender predisposes access to opportunities, and is certainly a predetermining factor in access to education in Central/West Africa. Ellis (1998: 27) makes the point that "Since poverty is closely associated with low levels of education and lack of skills, education is also a key factor contributing to the greater ability of better off families to diversify compared to poorer families". This is further substantiated by the fact that the male-headed household sample was more heterogeneous, illustrating that men were better placed to access additional livelihood opportunities. This may in part be explained by the dependency ratio (a greater number of dependents, age <15 and >60) being higher for female headed-households, increasing the support burden, and restricting labour availability, but it follows that targeting education and skills

training towards poor village households, and in particular female-headed households, is likely to have a relatively large impact on their ability to diversify income sources.

As the analysis illustrates, migration brings another dimension to the socio-demographic characteristics of the settlements studied. The predominantly non-migrant populations located in the remote settlements of Cameroon and Nigeria, and the border settlements of Ghana, were established and homogenous. And whilst non-migrants and migrants in Cameroon and Nigeria had similar levels of education, in Ghana non-migrant headed households were twice as likely to have no formal education than migrant headed households. This may be an artefact of isolation and poor proximity to schools, and immigrants may have had educational opportunities prior to moving. This may also be explained by different schooling infrastructure across zones and some children living with other family members and returning back to their home after completing school.

It does, however, appear from the data that migration status is correlated with poverty, as the highest proportion grouped as "poorest" in all three countries, were migrant-headed households. Furthermore, secure access to resources through land ownership was significantly affected, and across the regions, non-migrant headed households were more likely to own farmland than migrant headed households. Migrants, particularly Nigerians in Cameroon's border zone, either rented land on a short-term basis, or purchased it from non-migrants (African Rattan Research Programme 2002). Inevitably, contrasting land tenure arrangements strongly influence the farming and livelihood opportunities different households have. In Ghana, migrants tended to enter into relatively stable long term leasing arrangements, and there was evidence here of relatively poor, migrant households in remote settlements relying on NTFP income, whilst they waited for newly established cocoa plantations to become productive.

The socio-demographics described in this paper are dynamic, in a region where economic growth continues to stimulate land use change, affecting a multitude of stakeholders. At the time of data collection, remote Ghanaian populations, and Cameroon's border zone settlements, were growing and increasingly consisted of high proportions of households headed by recently settled younger men. In these cases the landscape is likely to be "dominated by the imprint of youthful households" (Sherbinin *et al.* 2008: 49). As Sherbinin *et al.* (2008) point out it is therefore important to understand how these households relate to their environment. Strategic policy development needs to address resource–use conflicts in relation to both regional economic growth, and rural livelihoods, and within rural communities, identify how best to support the most vulnerable. As Ellis (1998) indicates, recognizing this heterogeneity emphasizes the significance of locally specific contexts, reinforcing the importance of tuning local policies to local circumstances. However, it is also important to note that rural smallholders rely on the same natural resources as other external and often more powerful actors, such as illegal loggers, mining and agro-industrial companies, as well as gangs of temporary migrant workers, such as rattan harvesters in Ghana.

Collectively these may not only have a far greater impact on tropical forests per se, but also represent a significant threat to increasing vulnerability through reduced food and income security of rural populations.

CONCLUSIONS

As this paper demonstrates, most rural households are involved in a number of economic activities in order to diversify their income sources. However, as these research findings support, it is the poorest households in remote zones who rely most heavily on NTFP based income because it represents one of only a few opportunities for income generation in such locations. Furthermore, NTFP related activities represent low risk, accessible livelihood options, which require little capital investment or particular skills and are compatible with smallholder farming and traditional domestic roles. Some NTFPs are characterised by relatively low returns, but the significance of their contribution to poverty alleviation is in the timing and flow of the income generated from them, their role in reducing risk through a diversified livelihood strategy, and an increased resilience to shocks and stresses, which are findings supported by Belcher and Shreckenberg (2007), Marshall *et al.* (2006), Ros-Tonen and Wiersum (2005). The assertion of Chambers *et al.* (1981: 218), that "more may be achieved in action against poverty by enabling poor families to rise above thresholds at bad times of year than by trying to generate entirely new, year round livelihoods", is likely to be particularly relevant to NTFP activities.

NTFP income may become even more important to remote rural households in West/Central Africa, as we move forwards in changeable and uncertain times, characterised by rapid economic growth, population expansion and an ever changing, and unpredictable, climate. As per capita access to farmland and forest resources decreases following over-exploitation, deforestation, agro-industrial, forest and land developments, and conservation interventions, it is the most vulnerable and marginalised populations in remote rural areas who will be most affected given their reliance on NTFPs, and their limited capacity to mobilise or further diversify. To this end it is important to recognise the importance of forests both for food and income security and also their wider role in enhancing the adaptive capacity of local populations to change (Sunderland *et al.* 2013). As rural West Africa witnesses a transition away from extensive mixed food and perennial crop production to more intensive monocropping of perennial crop, such as oil palm, the safety-net function forests play is arguably more important than ever to the resource poor who have few alternative livelihood options and may lose access to agriculturally productive land, and also as a fall back option for returning migrants. Cocoa and oil palm plantations may have the potential to remunerate labour more highly, but employment is at a higher risk and with greater insecurity. Prices are subject to external market forces, and land availability and production vulnerable to anticipated increase in resource-use conflicts. Food prices are set to increase, but with increasingly limited access to forest lands,

poor households will be less able to rely on forest resources for subsistence and income.

At a global level, one billion forest dwelling people rely in various ways on the diversity of natural resource system goods and services to offer resilience and longer-term environmental, social and economic sustainability. Based on these research findings, it is proposed that integrated approaches to multi-functional landscape management at a regional level go well beyond managing resource conflicts and promoting ecological sustainability per se, but furthermore, can impact on strategies that will either alleviate or further exacerbate rural poverty.

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