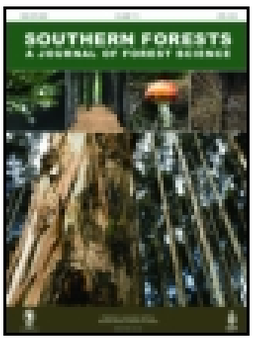

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Socio-economic factors influencing household dependence on forests and its implication for forest-based climate change interventions§

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In most African countries, forest-based climate change intervention initiatives such as nationally appropriate mitigation actions (NAMAs) and national adaptation programmes of action (NAPAs) are widely accepted. This is mainly due to the fact that they are relevant in addressing multiple challenges associated with rural development, mitigation and adaptation to climate change, and sustainable forest management. However, there are concerns about the implications of strategic and practical steps taken in this context on forest-dependent communities. Thus, there is need to reconcile local socio-economic vulnerabilities and forest-based climate change intervention initiatives. In the current study, socio-economic factors influencing households' dependence on forest resources and associated implications on climate change interventions were investigated. Proportionate stratified random sampling was used to select 366 households from forest-based rural communities in Vhembe District of South Africa. A structured questionnaire was administered to household heads in 21 villages. The Pearson's chi-square test was used to analyse the factors that influence household dependence on forest. The effects of household socio-economic characteristics on households' forest dependence influencing factor were determined using the binary logit model. Up to 97% of the respondents depended on the forest resources predominantly because of low costs associated with using them. It was observed that socio-economic characteristics of households such as farm husbandry skills, years of residence (53–65) in the community and age of respondents (≤38–65) significantly ($P < 0.05$) influenced use of the forest resources. Thus, effectiveness and sustainability of forest-based climate change intervention initiatives can be promoted if the socio-economic conditions prevailing within households in areas next to forests are improved.

Keywords: household, livelihood, rural community, vulnerability

Introduction

Forests provide vital goods and services that are crucial to the wellbeing of rural households in South Africa and other African countries (Shackleton et al. 2002; Mamo et al. 2007; Babulo et al. 2008). Rural households often depend on forests either as sources of income or to meet their consumption requirements (Babulo et al. 2008; Das 2010; Belcher et al. 2015). Forest products are also used for cultural and recreational purposes (Adhikari et al. 2004; Kar and Jacobson 2012). However, households utilise these benefits in different ways and to varying degrees. Households' socio-economic characteristics dictate both what the forest resources are utilised for and also the extent to which they are harnessed (Mamo et al. 2007; Vedeld et al. 2007; Babulo et al. 2008). Nevertheless, the impact of climate change is projected to have extensive consequences, many of which constitute major threats (Bryan et al. 2009; Mertz et al. 2009; Kalinda 2011; Mengistu 2011; Capstick 2012; Jindal et al. 2012; Chinara et al. 2013), and pose significant risks to forests, livelihoods and rural development. Although forests are vulnerable to climate change impacts, they play a pivotal role in climate change mitigation and adaptation. For example, they enhance the lives of people who reside in rural areas and ensure livelihood resilience to climate variability and change (Dlamini 2014).

Many rural communities rely on forests, which makes sustainable forest use and management central to their livelihood and resilience to climate change (FAO 2015). Forest-based climate change mitigation and adaptation projects are widely promoted to enable households to adapt to the challenge of climate change (Chia et al. 2013; Rennaud et al. 2013; FAO 2015). These projects are used to target the combined outcomes of forest ecosystem sustainability, social equity and livelihood sustainability (Hajost and Zerbock 2013). Forest-based climate change intervention such as reducing emissions from deforestation and forest

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degradation (REDD), and community forest management are some of the initiatives being implemented in several rural communities across Africa (FAO 2015). Although the forest-based climate change intervention initiatives have potential to provide host communities with important co-benefits such as employment, income generation opportunities, forest conservation and provision of forest products (Ratsimbazafy et al. 2012), lessons from community forest initiatives suggest that when projects fail to accommodate socio-economic characteristics and the needs of host communities, efficiency and sustainability are compromised (Wittman and Caron 2009; Kar and Jacobson 2012; Hajost and Zerbock 2013). Hajost and Zerbock (2013) noted that forest-based adaptation initiatives were more likely to succeed if they built on the lessons learned from community-based forest management. Therefore, reliable information on the factors that influence rural people's engagement in sustainable use and management of forest resources, and how the socio-economic characteristics of people influence them is crucial (Cardona 2005; Chia et al. 2013).

The understanding referred to above helps gain insight on modalities of ensuring effectiveness and sustainability of forest-based climate change intervention initiatives (Cardona 2005; Chia et al. 2013). However, there is a weak empirical basis for this insight (Belcher et al. 2015). Most studies that have been carried out to assess households' dependence on forests and the related socio-economic factors did not include an analysis of the implications for effectiveness and sustainability of climate change intervention initiatives. For example, a study conducted in the Philippines revealed that elderly people were more likely to collect forest plants and wildlife because of their more extensive knowledge of forest plants and wildlife (McElwee 2008). Similarly, Mamo et al. (2007) found that larger families were more likely to depend on forests than other families. In Vietnam, households comprising young people were more dependent on forest-collected products because they set out to start families and had lower agricultural assets than older, better-established households (McElwee 2008). Belcher et al. (2015) concurred that educated individuals were more likely to be in a better position to tap into income flows from natural stocks in India. Zenteno et al. (2013) conducted a study in Bolivia and observed that geographical location within the landscape influenced resource use patterns. However, none of these studies addressed how socio-economic variables influencing dependency on forests might affect the effectiveness and sustainability of climate change intervention.

Taking into account the preceding arguments, it is crucial for governments and forest-based climate change intervention developers to address the socio-economic needs and characteristics of host communities (Ratsimbazafy et al. 2012). Thus, in this study the socio-economic drivers of rural household engagement in sustainable forest use and management with respect to effectiveness and sustainability of forest-based adaptation were examined. In order to achieve this, the following research questions were used to guide the study:

(1) What are the key factors that condition households' engagement in forest resource use and management with respect to climate change mitigation?
(2) How do households' socio-economic characteristics influence the factors that condition households' engagement in forest resource use and management?

Methods

Description of study areas

The current study was conducted in Vhembe District Municipality, which is situated in the north of Limpopo province of South Africa. The district extends over 21 349 km^2. It shares borders with the Kruger National Park in the east. To the north and north-west of the District are the international borders with Zimbabwe and Botswana, respectively (Mpandeli 2014). Thohoyandou is the district's administrative capital. Rural settlements constitute approximately 90% of Vhembe District. According to the Department of Cooperative Governance and Traditional Affairs (CoGTA 2012), the population is mostly women and those more than 20 years old are the majority. Agriculture and forestry are the major sources of livelihoods of local households (Linkd 2013). These features make Vhembe District a strategic case study for understanding the influence of drivers of household dependence on forests and associated implications on climate change intervention initiatives. Out of the four municipalities in the district, Makhado, Mutale and Thulamela were chosen for the study. They represented well forest types and forest-based livelihoods (Figure 1).

Data collection and sampling procedure

In each selected municipality, seven rural communities were chosen. Thus, a combined total of 21 villages were included in the study. Stratified proportionate random sampling was then used to select 366 households. This was done in order to account for a better precision of the sample size (Clewer and Scarisbrick 2001). The sample size was estimated from the total population of the study unit which was 8 500 (Statistics South Africa 2012). A questionnaire was administered to purposively sampled respondents. The respondents selected from each household were those at least 20 years old and had lived in their communities for more than five years.

The questionnaire used in this study contained both open and closed-ended questions, which had been translated into Tshivenda, which was the vernacular language commonly spoken in the area. The questionnaire was pre-tested and adjusted accordingly. Questions were designed to gain an understanding of household dependence on forest resources. Data on household socio-economic and demographic characteristics of households were also collected. A four-point Likert-type scale (1 = high, 2 = medium, 3 = low, and 4 = no contribution) was used to examine the importance of forests to household income, sustenance, livelihood and resilience to climate variability and change.

Data analysis

Data collected through the questionnaire-based survey were subjected to weighting adjustment in order to correct for the possible over- or under-representation of variables (Bethlehem 2015). The sample was weighed against the actual population to arrive at a weighted sample. The

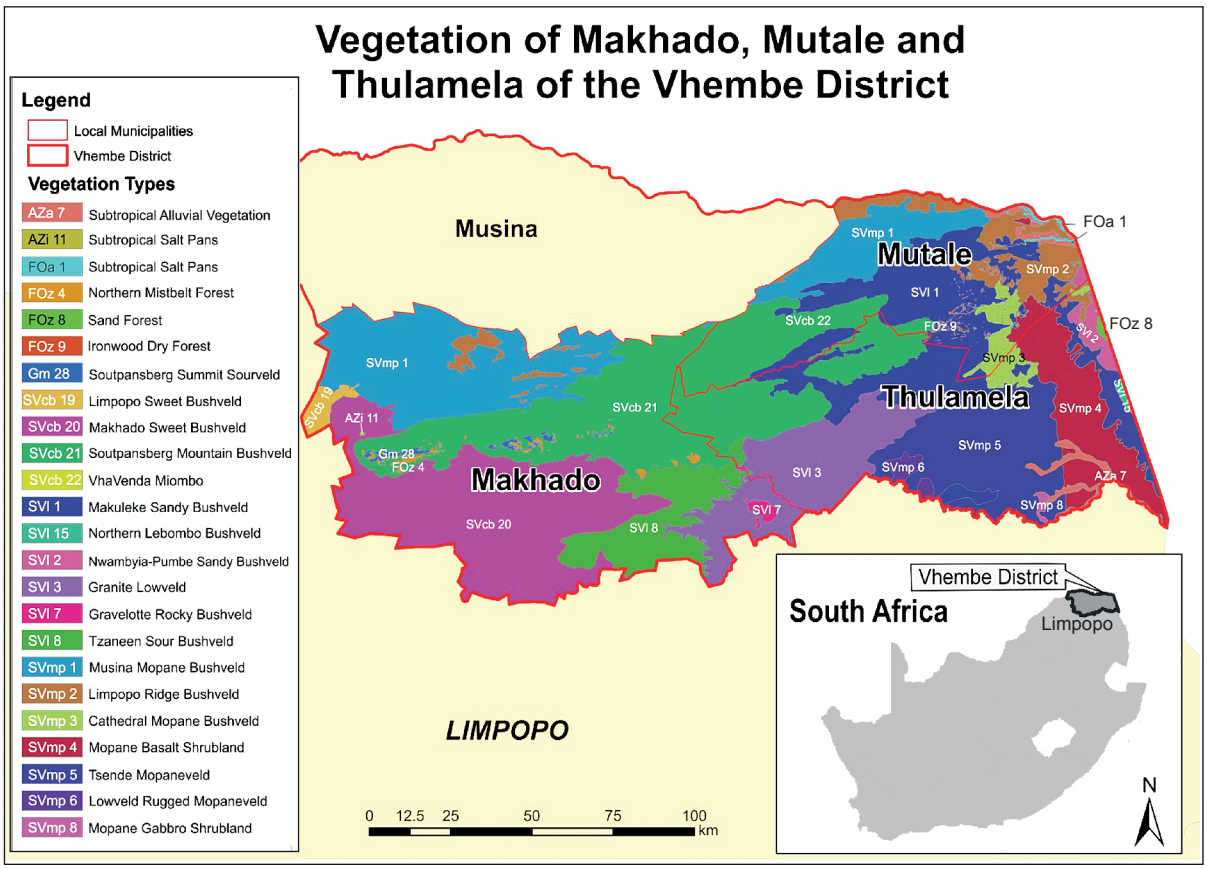

Figure 1: Map of Vhembe District showing the study location and vegetation types

weighted data were then analysed using SPSS 20 statistical analysis software (Levesque 2007).

The Pearson's chi-square test was used to analyse the factors of household dependence on forest. However, in order to identify independent socio-economic predictors of factors of households' dependence on forest, binary logistic regression was conducted. In this analysis, estimated odds ratios (y) were derived to ascertain the effects of the predictors on respondents' dependence on forests. Odds ratios were used to measure the strength of association or non-independence between two binary data values. A p-value ≤ 0.05 represented statistical significance at the 95% confidence interval (Clewer and Scarisbrick 2001).

Specification of the logistic regression model

The target modelled variables were relative low cost of using forest resources, easy accessibility of forest resources, unemployment and importance for surviving shocks. Each indicator was taken as a binary outcome and used in the logistic regression to model various explanatory variables, including employment status (yes = 1; no = 0), farming skills (yes = 1; no = 0), animal husbandry skills (yes = 1; no = 0), carpentry skills (yes = 1; no = 0), years of residence (≤38) (yes = 1; no = 0), years of residence (39–52) (yes = 1; no = 0), years of residence (53–65) (yes = 1; no = 0), years of residence (66+) (yes = 1; no = 0), age of respondent (≤38) (yes = 1; no = 0), age of respondent (39–52) (yes = 1; no = 0), age of respondent (53–65) (yes = 1; no = 0), age of respondent (66+) (yes = 1; no = 0), and educational status (yes = 1; no = 0). The chi-square test at the $\alpha = 0.05$ significance level was used to assess the goodness of fit of the models.

Results

Demographic characteristics of respondents

As shown in Table 1, the most respondents in Mutale were 59–69 years old as opposed to 36–47 years in Thulamela Municipality. The period of residence in communities was at least one year. Approximately 83% of the respondents in Makhado Municipality were female. A similar pattern of there being more female respondents than males was observed in Mutale and Thulamela municipalities (Table 1). Another observation was that most respondents in Makhado (64.6%), Mutale (73.4%) and Thulamela (45.5%) did not have any formal education.

Factors influencing household dependence on forest

The most common socio-economic explanation for households' dependence on forest across the municipalities was 'easy accessibility of forest resources'. Abundance of forests in a community was found to be the major issue that influenced residents in Mutale Municipality to utilise forests resources (67.9%). However, this was not important in Makhado (12.7%) and Thulamela (35%) municipalities (Table 2).

The top four reasons that the respondents cited for engaging in subsistence use of forest resources were (1) easy accessibility of forest resources, (2) relative low cost of using forest resources, (3) unemployment and (4) to survive shocks. The Pearson's chi-square test showed that all these four reasons were significantly ($p = 0.000$) different across the three municipalities for households subsistent on forest resources.

Socio-economic factors of household dependence on forests

The results of the binary logistic regression models are presented in Table 3, showing the relationship between households' reasons for depending on forests and households' socio-economic characteristics.

The relatively low cost of using forest resources was significantly ($P < 0.05$) associated with animal husbandry skills, years of residence (53–65) in the community, and respondents' age, specifically respondents within the ≤38–65 age group. A statistically significant ($P < 0.05$) positive association was observed between easy accessibility of forest resources and years of residence (≤38 and 53–65), and age (39–52 years). In addition, employment status, possession of farming skills, animal husbandry skills, and years of residence (≤38) influenced significantly unemployment ($P < 0.05$). The need to survive shocks such as job loss and crop failure was significantly ($P < 0.05$) and positively associated with farming skills and age of respondent (at least 66 years).

Discussion

Linking socio-economic reasons for forest dependence to households socio-economic characteristics

It was observed that socio-economic conditions and characteristics of households influenced households'

Table 1: Demographic profile of respondents in the study communities

Demographic characteristic	Makhado (%)	Mutale (%)	Thulamela (%)
Age (years)			
≤35	17.8	15.5	34.0
36–47	18.5	12.7	27.0
48–58	21.0	18.2	20.0
59–69	21.7	27.3	14.0
≥70	21.0	26.4	5.0
Gender (%)			
Male	16.7	28.4	20.0
Female	83.3	71.6	80.0
Length of residency			
1–5	23.1	16.4	26.0
6–10	18.6	18.2	19.0
11–15	22.4	29.1	12.0
16–20	19.9	24.5	16.0
>20	16.0	11.8	27.0
Highest level of education (%)			
No formal education	64.6	73.4	45.5
Grade 11 or lower	16.5	17.4	23.2
Grade 12 (Matric, Standard 10)	12.0	2.8	21.2
Post-matric diploma	3.8	4.6	4.0
Baccalaureate degree(s)	1.9	0	1.0
Postgraduate degree(s)	1.3	1.8	5.1

Table 2: Reasons for respondents' subsistence dependence on forests. Each subscript letter denotes a subset of 'Municipalities' categories whose column proportions do not differ significantly from each other at the $\alpha = 0.05$ significance level

Socioeconomic factor	Response	Proportion of respondents in municipality (%)		
		Makhado ($n = 156$)	Mutale ($n = 110$)	Thulamela ($n = 100$)
Abundance of forest resources	Yes	12.7^a	67.9^b	35.0^c
	No	87.3^a	32.1^b	65^c
Relative low cost of using forest resources (2)	Yes	96.8^a	91.7^a	70.3^b
	No	3.2^a	8.3^a	29.7^b
Easy accessibility of forest resources (1)	Yes	96.2^a	96.3^a	74.0^b
	No	3.8^a	3.7^a	26.0^b
Inability to spend on alternatives (e.g. gas, electricity)	Yes	57.7^a	80.7^b	56.0^b
	No	42.3^a	19.3^b	44.0^a
To survive shocks (e.g. job loss, crop failure) (4)	Yes	80.8^a	54.1^b	66.0^b
	No	19.2^a	45.9^b	34.0^b
Unemployment (3)	Yes	83.4^a	54.1^b	88.0^a
	No	16.6^a	45.9^b	12.0^a

dependence on forest resources. Socio-economic characteristics such as animal husbandry skills, years of residence in the community and respondents' age significantly influenced households' dependence on forests mostly. The relatively low cost of using forest resources was regarded as the main reason for household dependence on them for livelihoods. In general, people practice subsistence livestock farming and graze them freely on pastures in their communities (Musyoki 2012). Thus, households that possess animal husbandry skills, and have lived long in the community tended to use forests more because this is a relatively low cost with respect to supporting their livelihood strategies. Thus, forest resources in the communities largely support the animal husbandry livelihood strategy. In addition, socio-economic characteristics such as animal husbandry skills and age (≥66 years) influenced households' dependence on forests to survive shocks, for example crop failure and job loss.

Table 3: Socioeconomic variables that explained factors influencing household's forest dependence

Influencing factor	Independent variable	Odds ratio	Lower	Upper	*p*-value
Relative low cost of using forest resources	Employment status (employed)	0.824	0.352	1.929	0.656
	Farming skill	0.889	0.415	1.907	0.763
	Farm husbandry skill	0.493	0.247	0.987	0.046*
	Years of residency (≤38)	2.797	0.808	9.675	0.104
	Years of residency (39-52)	3.359	0.958	11.776	0.058
	Years of residency (53-65)	8.872	2.081	37.831	0.003*
	Years of residency (66+)	2.200	0.726	6.668	0.163
	Age of respondent (≤38)	0.083	0.013	0.538	0.009*
	Age of respondent (39-52)	0.076	0.013	0.444	0.004*
	Age of respondent (53-65)	0.118	0.023	0.602	0.010*
	Age of respondent (66+)	0.225	0.044	1.154	0.074
	Educational status	1.162	0.546	2.471	0.697
	Gender	0.565	0.256	1.250	0.159
Easy accessibility of forest resources	Employment status (employed)	1.118	0.457	2.730	0.807
	Farming skill	0.505	0.204	1.252	0.140
	Farm husbandry skill	0.548	0.260	1.158	0.115
	Years of residency (≤38)	7.065	1.588	31.428	0.010*
	Years of residency (39-52)	2.339	0.612	8.938	0.214
	Years of residency (53-65)	8.186	1.678	39.945	0.009*
	Years of residency (66+)	2.102	0.610	7.242	0.239
	Age of respondent (≤38)	0.127	0.022	0.745	0.022
	Age of respondent (39-52)	0.114	0.023	0.557	0.007*
	Age of respondent (53-65)	0.251	0.061	1.030	0.055
	Age of respondent (66+)	0.958	0.189	4.852	0.959
	Formal educational status	1.283	0.553	2.978	0.562
	Gender	0.791	0.321	1.951	0.610
Unemployment	Employment status (employed)	0.359	0.157	0.819	0.015*
	Farming skill	3.093	1.762	5.429	0.000*
	Farm husbandry skill	1.851	0.990	3.460	0.054*
	Years of residency (≤38)	0.328	0.117	0.918	0.034*
	Years of residency (39-52)	0.478	0.179	1.275	0.140
	Years of residency (53-65)	1.089	0.437	2.710	0.855
	Years of residency (66+)	0.696	0.292	1.659	0.414
	Age of respondent (≤38)	2.368	0.776	7.224	0.130
	Age of respondent (39-52)	2.205	0.807	6.022	0.123
	Age of respondent (53-65)	1.867	0.795	4.384	0.152
	Age of respondent (66+)	1.516	0.694	3.313	0.297
	Formal educational status	1.062	0.555	2.032	0.856
	Gender	0.528	0.281	0.993	0.047
To survive shocks (e.g. job loss, crop failure)	Employment status (employed)	0.666	0.343	1.293	0.230
	Farming skill	2.157	1.291	3.604	0.003*
	Farm husbandry skill	1.645	0.964	2.807	0.068
	Years of residency (≤38)	0.414	0.165	1.034	0.059
	Years of residency (39-52)	0.519	0.216	1.247	0.143
	Years of residency (53-65)	1.715	0.739	3.978	0.209
	Years of residency (66+)	0.795	0.364	1.735	0.564
	Age of respondent (≤38)	1.075	0.387	2.989	0.889
	Age of respondent (39-52)	1.101	0.437	2.774	0.838
	Age of respondent (53-65)	1.316	0.578	2.996	0.513
	Age of respondent (66+)	0.435	0.208	0.910	0.027*
	Formal educational status	1.153	0.651	2.043	0.625
	Gender	0.940	0.520	1.700	0.839

Farm animals are regarded as stocks that the people fall back on to raise money to survive crisis situations. In addition, older people due to their extended knowledge and experience in the use of forests are more likely to adopt forest-based coping practices. In the current study, the most productive age group (39–52 years) was the most dependent on forests for their livelihood. It can thus be inferred that the most active population group in the communities often get involved in forest-based livelihood strategy.

Socio-economic characteristics were observed to dictate the nature and extent of households' dependence on forest resources for livelihood. Similar observations were made in Cameroon, Uganda and Tanzania (Jindal et al. 2008; Chia et al. 2013). Shylajan and Mythili (2003), Bwalya (2011) and Pascaline et al. (2011) observed that income and minimum consumptive demand of households for forest products increased their likelihood of engaging in forest-based livelihood activities.

Linking households' socio-economic dependence on forests to effectiveness and sustainability of forest-based climate change intervention initiatives

Forest development is critical for the sustainability and resilience of households' livelihoods (DAFF 2010). This means that any development initiative that affects the socio-economic dependence and use of forest resources will greatly affect their skills, education and employment status (DWAF 2005). Households' socio-economic characteristics and reasons for dependence on forest resources can influence the promotion of sustainable forest use and management in rural communities in response to the requirements for sustainability and effectiveness of climate change intervention (FAO 2009).

Forest-based climate change intervention initiatives can provide significant socio-economic benefits to local host communities. However, this has to be aligned with households' socio-economic characteristics and reasons for dependence on forests so as to ensure its effectiveness and sustainability (Jindal et al. 2008). If forest development initiatives do not align with the socio-economic needs and characteristics of households, it is likely that the effectiveness and sustainability of such initiatives will be compromised. Hajost and Zerbock (2013) and Zomer et al. (2008) contended that the long-term interest and active participation of rural host communities in forest development initiatives is closely linked to its alignment with the people's socio-economic need and characteristics. This was confirmed in this study, which revealed that there was a significant relationship between the people's dependence on forest livelihood strategy and various socio-economic characteristics. Thus, meeting the people's socio-economic needs through forest-based climate change interventions is essential for the effectiveness and sustainability of such initiatives. Chia et al. (2013) also carried out a study in Cameroon which concurs with these findings. Factors linked to socio-economic conditions influenced motivation of host communities and willingness to participate in forest carbon conservation activities. Moreover, Jindal et al. (2012) observed that the ability to meet a wider socio-economic need, for example non-forest based employment opportunities for host communities, influenced long-term interest in forest carbon projects.

Lessons from implementation of community-based forest development initiatives in several Third World countries support the argument that effectiveness and sustainability of climate change intervention depends on alignment with host communities, socio-economic needs and characteristics. For instance, Groom and Palmer (2012) analysed REDD+ projects and reported the creation and amelioration of alternative income-generating activities such as beekeeping and mushroom farming. Forest-based adaptation initiatives significantly improved the positive impact and sustainability of such projects. In addition to this, Chia et al. (2013) reported that conservation and restoration of degraded forests had considerable impact on adaptation initiatives in Cameroon's rural communities.

Even though forest-based climate change initiatives are effective in enhancing livelihood sustainability and resilience, extensive implementation and scaling up of forest-based adaptation initiatives in many developing countries are currently very limited (Rahlao et al. 2012; Chia et al. 2013). Similar trends were reported in African countries such as Cameroon, Uganda and Tanzania (Jindal et al. 2008). Insight from the present study therefore can be helpful in paving the way for scaling up and extensive implementation of efficient and sustainable forest-based climate change initiatives in Africa.

Conclusion

It was observed in this study that households' dependence on forest resources was closely linked to their socio-economic needs and characteristics. For example, households that possessed animal husbandry skills were more likely to depend on forest resources because of the relatively low cost in supporting their livelihood strategies. This type of association between households' socio-economic characteristics and forest dependence can be impacted by forest-based climate change adaptation projects. Thus, aligning forest-based climate change intervention to address rural host communities' socio-economic needs and characteristics will greatly enhance the effectiveness of such initiatives. However, incorporating the needs and characteristics of host communities' in rural communities in the design of forest-based adaptation initiatives may require in-depth knowledge often not readily available in literature. It is recommended that a critical evaluation of communities' demographic, social network and leadership functioning structure be carried out as a prerequisite to designing and implementation of forest-based climate change interventions.

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