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Integrated Land Management Institute (ILMI)
13 Storch Street
Private Bag 13388
Windhoek
Namibia

T: +264 61 207 2483
F: +264 61 207 9483
E: ilmi@nust.na
W: ilmi.nust.na

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Ecosystem Services and small-holder farming practices - between payments, development support and right- an integrated approach

Lena Bloemertz[1], Martha Naanda[2], Vladimir Wingate[1], Simon Angombe[2], and Nikolaus Kuhn[1]
[1] University of Basel
[2] University of Namibia

ABSTRACT

Small-scale farmers in north-central Namibia face numerous challenges, ranging from low crop yields, high rainfall variability and land degradation which is threatening the long-term productivity of the land, to social changes that are reducing the work force available for farming. This paper aims to assess existing land use practices (LUPs) and to determine their relationship to ecosystem services (ES). As agriculture (crop and livestock farming) is the dominant land use in northern Namibia, it is the main driver influencing environmental services and will be in the focus here. We suggest ways of combining an improvement of provisioning services (especially food production and thus livelihoods of small-scale farmers) together with regulating services (e.g. climate regulation through carbon storage and soil fertility conservation) to create multiple benefits at the landscape level. In addition to identifying suitable LUPs, we argue that any activity trying to improve ES should count on the already existing initiatives and interventions and look for synergies and complementarities. Considering biodiversity, food security and carbon sequestration together, provides the opportunities of combining local and international goals at the same time and gives people the right to development support instead of making them receivers of aid.

ABOUT THE AUTHORS

Lena Bloemertz, Vladimir Wingate, and Nikolaus Kuhn are at the Physical Geography & Environmental Change Research Group, Department of Environmental Sciences, University of Basel, Basel, Switzerland.

Martha Naanda is at the Faculty of Humanities and Social Sciences Geography, History and Environmental Studies, University of Namibia, Windhoek, Namibia.

Simon Angombe is at the Faculty of Agriculture and Natural Resources, University of Namibia, Windhoek, Namibia.

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ILMI is a research centre at the Faculty of Natural Resources and Spatial Sciences (FNRSS) at the Namibia University of Science and Technology (NUST).

1. Introduction

In recent years, there has been a growing interest in understanding agricultural farming practices in drylands (Reynolds et al. 2007). Namibia, the driest country in Sub-Saharan Africa, is classified as the seventh most at risk country globally, in terms of agricultural production losses due to climate change, but also due to unsustainable land management putting pressure on ecosystems (e.g. biodiversity, climate regulation, flood and erosion control). Namibia is presently within the upper Middle Income Countries (MIC) (World Bank 2013) with a stable growing economy, however, inequality and poverty remain high (NPC 2015a). Nearly 60% of Namibia's population lives in rural areas (NSA 2013a), and 48% of these are directly dependent on environmental natural resources (MET 2014b). The agricultural sector is perceived as fundamental for livelihood security, through the provision of crops, livestock, tourism, wildlife resources, firewood and wild fruits, as well as poverty reduction (NPC 2014). Namibia faces the challenge of pursuing social and economic growth without compromising its long-term ecosystem integrity (Naidoo et al. 2011).

To address these challenges, payments for ecosystem services (PES) are advanced as a means to support land use practices (LUP) that maintain ES by giving them an economic value (Forest trends et al. 2008). Ecosystem services have no standardized definition but are broadly called "the benefits of nature to households, communities, and economies" (Boyd/Banzhaf 2007). They can be divided into provisioning (e.g. food, fuelwood, biochemical), regulating (e.g. climate or disease regulation or water purification), supporting (services needed for the production of all other ecosystem services) and cultural services (e.g. recreation and tourism, spiritual or aesthetic services) (MEA 2005).

PES are market-based mechanisms, which pay individuals or communities to undertake actions that increase the levels of a desired ES (Wunder 2007). Payments are 'voluntary transactions' in which a 'well-defined environmental service or a land use likely to secure its provision' is bought by at least 'one buyer' from at least 'one provider or seller' 'if and only if the environmental service provider secures service provision (conditionality)' (Wunder 2008). PES schemes have emerged as a preferred policy response and solution for realigning the private and social benefits that result from decisions related to the environment (Boyd/Banzhaf 2007; Jindal et al. 2007).

This paper presents initial results on LUPs and ES in rural small-holder communities of Namibia. In order to assess the potential for a carbon-based PES, we researched carbon storage in soils and biomass in three land use types: a) cropland, b) grassland, and c) scrub land (also used interchangeably with woodlands). Subsequently, we surveyed farmers' motivation for undertaking farming and their willingness to shift LUP to protect and create new ES. Based on our results, we discuss Namibia's developmental efforts and in particular the experiences with the implementation of the Community Based Natural Resource Management (CBNRM) and their relation to PES schemes.

2. Selection of ecosystem services in small-scale farming communities of the northern communal areas of Namibia

2.1 Setting in northern Namibia

This paper focuses on the north-central regions (NCR), which include Ohangwena, Omusati, Oshana, and Oshikoto (Figure 1), and are the most densely populated regions in Namibia (Table 1). At independence in 1990, the NCR held more than 65% of the population (DRFN/SIDA 1992; Republic of Namibia 2005) in an area of 10% of the country (NSA 2013b). While according to the Namibia Statistic Agency (2013b) the rural setting of the NCR nowadays only holds 40% of the Namibian population, this is not a result of population decrease in the North, but rather of increased migration to other parts of the regions and country (especially towns).

Although a number of income generating activities are gaining momentum, the majority of the population still practices subsistence small-scale crop framing of pearl millet (*Pennisetum glaucum*)[1] and livestock husbandry to supplement income from non-farming activities (Mendelsohn 2006; NSA 2014; Angombe et al. 2016). Access to land is predominantly organised at the household level, although group management arrangements for cattle rearing in grazing areas and biodiversity conservation are sometimes practiced. The latter is more predominantly in areas designated as Conservancies and Community Forests.

Figure 1 Study region (NCR) including the four regions of Ohangwena, Omusati, Oshana, and Oshikoto.

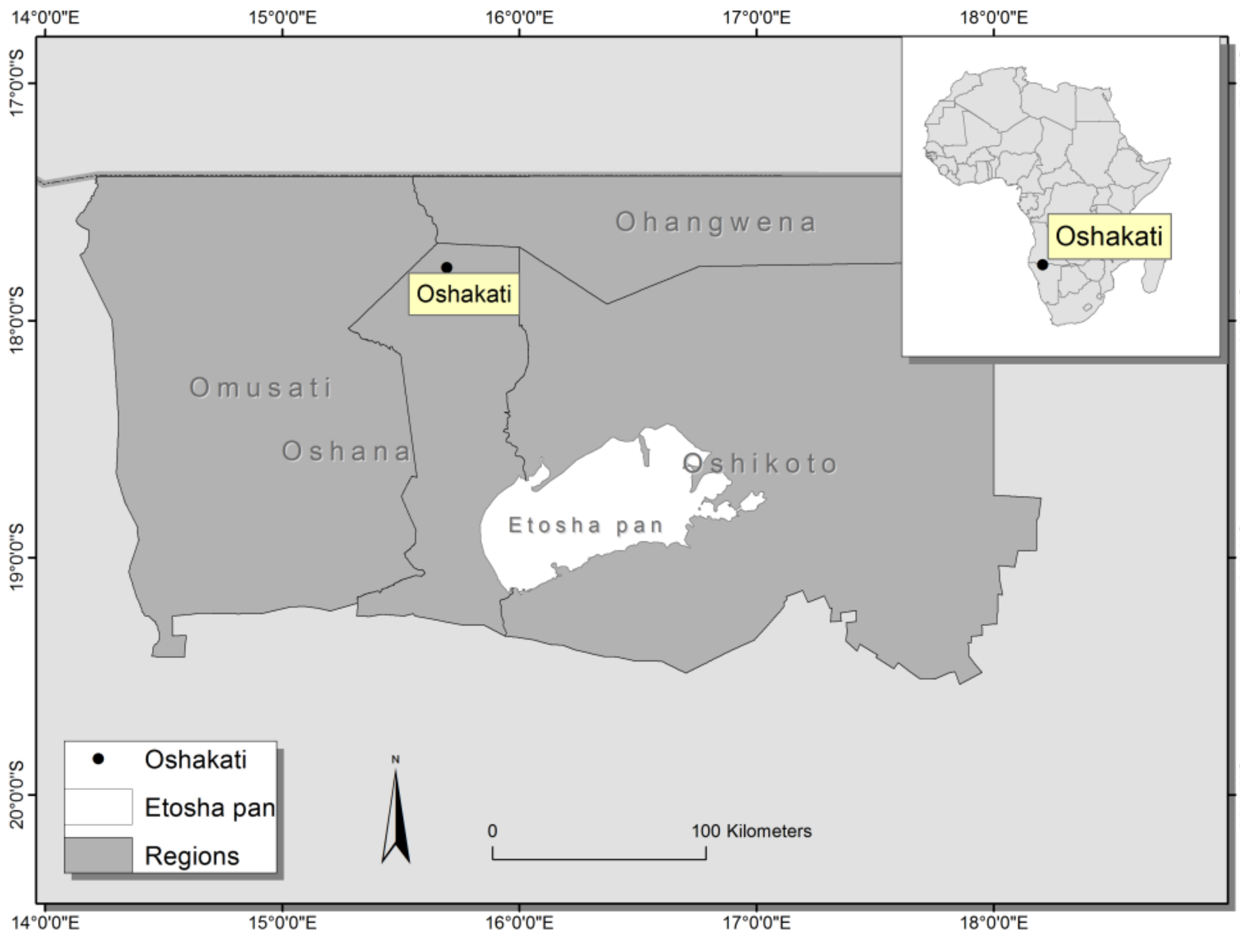


Table 1 Regional population demographics, Namibia Population Census (NSA, 2011).

Region	Population	Female	Male	Total households	Land Size [km²]	Population density [Persons/km²]
Namibia	*2,113,077*	*1,091,165*	*1,021,912*	-	*824,232*	*2.9*
Ohangwena	245,446	133,316	112,130	43,723	10,703	22
Omusati	243,166	133,621	109,545	46,698	26,573	9.1
Oshana	176,674	96,559	80,115	37,284	8,653	20
Oshikoto	181,973	94,907	87,066	37,400	38,653	4.7
Total NCR	847,259	458,403	388,856	165,105	84 582	10

[1] Locally known as *mahangu*

2.2 Ecosystems and environmental change

North-central Namibia lies within the Cuvelai Wetland Seasonal Ecosystem, which is characterized by the Cuvelai drainage system. Indeed, most of north-central Namibia consists of floodplains (locally called *oshanas*), with generally sandy soils unsuitable for crop production due to their low nutrient content, high salt concentrations and poor water holding capacity (Mendelsohn et al. 2000). The predominant soils found in north central Namibia are Haplic Calcisols, Eutric Cambisols, and Cambic Arenosols (Mendelsohn et al. 2009). Soils vary from sands to sandy loams, with an average sand content of 87%, clay content of 9.5% and silt content of 3.5% (Rigourd/Sappe 1999). Nonetheless, there are micro zones of higher fertility due to sedimentation of clay soils transported by water, soil variability is high (Hillyer et al. 2006).

The climate in north-central Namibia is semi-arid (Mendelsohn et al. 2000) with an average annual precipitation of 300 to 450 mm mainly falling between November and April (Mendelsohn 2006). However rainfall variability is high. For example, according to the FAO/GIEWS (2016) cereal production in Namibia was down to 68 000 tonnes in 2015 (compared to an average yield of 113 000 tonnes for the period between 2011-2015). While crop failure is often associated with poor rainfall and persistent drought, it is also a consequence of inappropriate management practices, population growth and livestock pressure, which are threatening ecosystem integrity and agricultural production (DRFN/SIDA 1992; Kreike 2010). Wingate et al. (2016) found that 10% of savannah woodland area in Ohangwena Region was converted to arable land uses between 1975 and 2014. In Oshikoto region they found an 11% increase in the area under cultivation during the same period. Most conversion from savannah woodland to arable land took place adjacent to villages, roads and rivers. While the overall woody vegetation is declining, backward conversion from arable land to wooded savannah is occurring at the same time, probably due to land abandonment as the result of land degradation. In effect, land degradation processes including diminishing perennial grasses cover soil erosion, shrub encroachment and deforestation are occurring throughout the region and are the major environmental problems faced by the country (Strohbach 2001).

People in the NCR depend on the landscapes natural resources for (i) the provision of food, timber, medicine, water, and land; (ii) the regulation and control of water flows in *oshanas* during extreme flood and drought events; (iii) supporting valuable habitats and landscapes for people and wildlife; and (iv) practicing cultural and customary traditions through dances, arts, and crafts (DRFN/SIDA 1992; Hangula 1993; Libanda/Blignaut 2008). In the following sections we focus on ecosystem services that are directly relevant to agriculture and local households (i.e. food provision/agricultural productivity) and can be supported through established market financing mechanisms (i.e. carbon sequestration). As biodiversity is already protected in the community conservancies and forests of Namibia, this study focuses on the ES of carbon storage and food production.

3. Methods and results –assessment of small-scale farming and ecosystem services

Basic data from soil surveys (e.g. Rigourd et al. 1999) exist, however only limited focused research on soil carbon (C) storage in relation to land management practices has been conducted. Our study attempts to fill this gap by focussing on soil carbon storage in croplands, grasslands, and scrubland soils, as well as above ground vegetation C (biomass). In order to understand which PES activities are likely to be viable in the long-term, we collect a range of socio-economic and biophysical data at the homestead scale. In carrying out our analysis, we attempt to account both for the manifold constraints faced by farmers with regards to undertaking agricultural activities, but also to what extent ecosystem services support livelihoods.

3.1 Land use and Carbon storage

Land use maps show scrub land and grazing lands are present on each farm (see Figure 2). The size of the cultivated land was found to vary annually depending on available inputs (e.g. for ploughing). On average cropland made up of 27% of the individually allocated land, grassland (59%) and shrub land 12% (Table 2).

Figure 2 Farm level Land use maps showing the different land use categories i.e. homestead, scrub land, cropland.

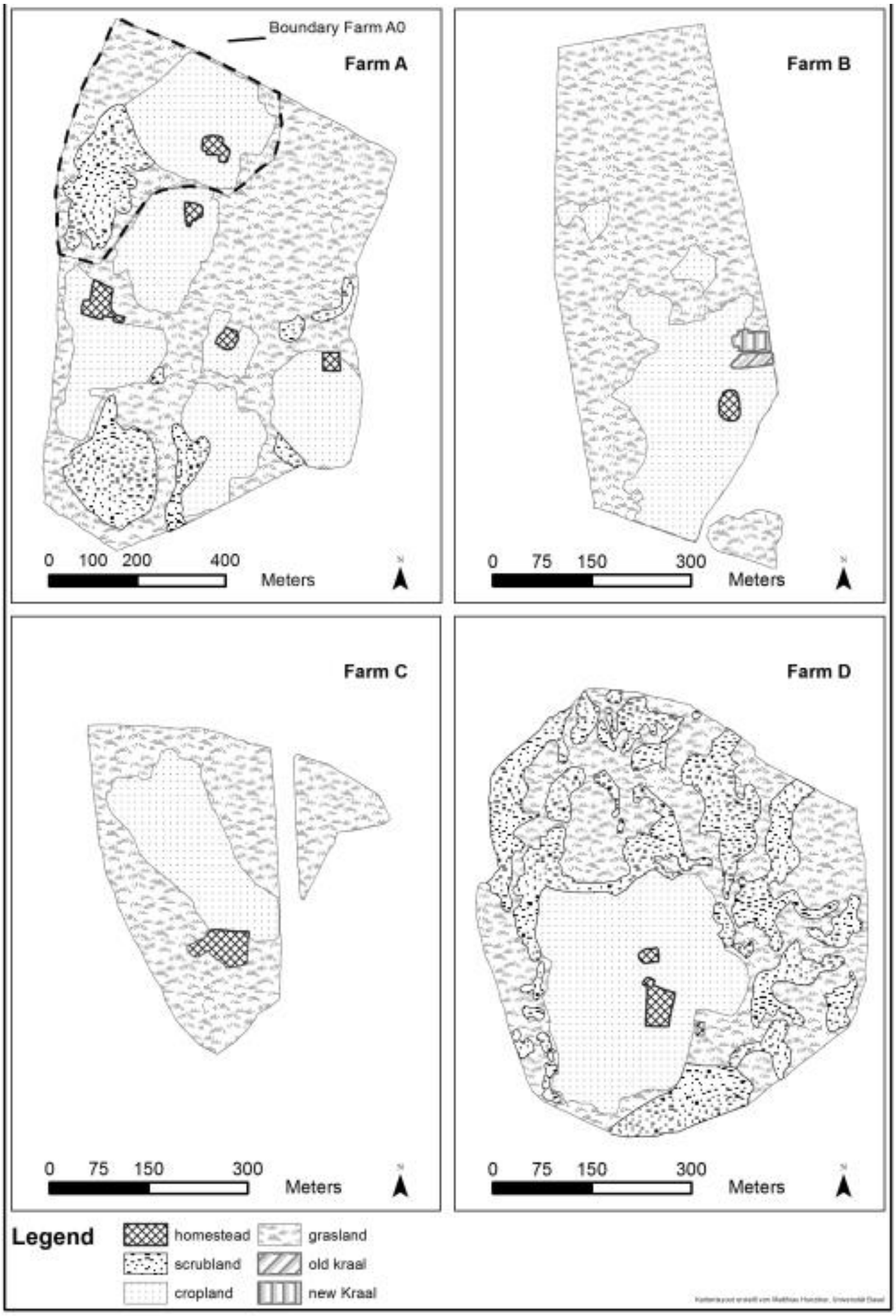


Table 2. The average percentages of land use classes for the homesteads sampled

Area [ha]	Farm A0	Farm A	Farm B	Farm C	Farm D	Sum[ha]	Percentage
Cropland	6.7	18.3	6.4	3.5	7.8	42.8	**27%**
Scrubland	3.7	5.8	X	X	10.0	19.5	**12%**
Grasland	6.3	46.2	20.4	8.5	12.5	94.0	**59%**
Homestead	0.2	0.9	0.1	0.4	0.3	2.0	**1%**
Kraals[2] (old and new)	X	X	0.2	X	X	0.2	**0%**
Sum	**17.0**	**71.3**	**27.2**	**12.4**	**30.7**	**158.5**	

3.2 Soil carbon stock assessment

As a first step, the potential to increase soil carbon stocks through a change in land use was assessed. The carbon stock assessment included soil sampling and the mapping of crop, grass and scrub land vegetation on the four farms that were sampled (Table 2). Soil sampling was carried out on different parts of the cropped land within the homestead boundaries that had been identified by farmers as differing in fertility. The sampling involved a pattern of one to five centrally located soil pits, depending on the size of the sampled field, each surrounded by six additional sampling points at a logarithmically increasing distance from the central pit. This study focuses on the samples taken within the middle of the plough layer or similar depth on bush- and grasslands (around 10cm). This sampling pattern ensured capturing both changes within the soil profile for a general description of soil type, as well as the spatial variability of the soil properties relevant for fertility. A total of 619 soil samples were collected (Käch 2013).

On average, our results reveal a 17% decline in topsoil soil organic carbon (SOC) following the conversion of grassland to cropland. Conversion of scrubland to cropland leads to a mean decrease in SOC of 48% (Käch 2013). The average carbon stock in scrub land topsoil varied between 4.90 and 7.08 t/ha, while cropland top soil carbon stock varied between 2.5 and 4.6 t/ha (Käch 2013: 35f). Based on these measurements, a maximum SOC increase can be estimated at 4.58 t/ha and a minimum at 0.3t/ha. Based on that, for the sake of the study we assumed an average potential increase of 2 t/ha.

Vegetation above ground carbon stock assessment

In a second step, estimation of above ground biomass (AGB) for woodlands in northern Namibia used the existing volume data from forest inventories. These forest inventories were carried out by the Directorate of Forestry in communal conservancies (including Ekolola, Mashare, Ohepi, Okongo, Oshaampula and Oshikoto) of northern Namibia between 2000 and 2002 (Kanime et al. 2002; Angombe et al. 2000; Angombe/Laamanen 2002; Kanime 2002) (Figure 3). Two approaches developed by Brown (1997) were used to estimate AGB. In the *first approach*, AGB was calculated as:

$$AGB(t/ha) = VOB \times WD \times BEF$$

Where: VOB = inventoried volume over bark of free bole, i.e. from stump or buttress to Crown Point or first main branch, WD = volume-weighted average wood density (1 of oven-dry biomass per m^3 green volume) and BEF = biomass expansion factor (ratio of aboveground oven-dry biomass of trees to oven-dry biomass of inventoried volume). WD for Africa was used (Reyes et al. 1992). Results using this approach indicate a mean of 97 t/ha of AGB (approx. 48.5 tC/ha) for all communal conservancies

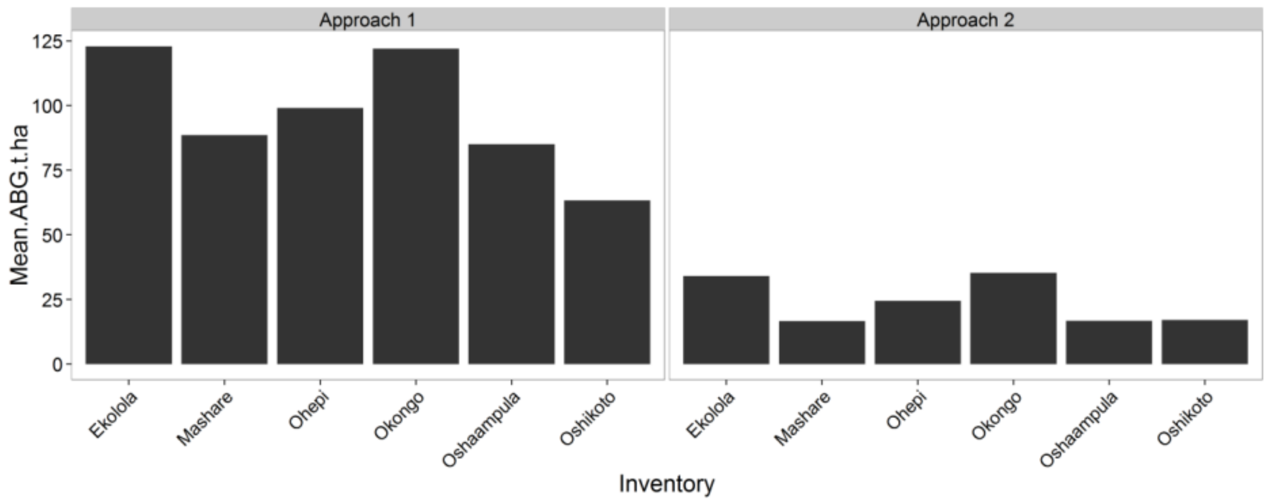
[2] Livestock enclosure at home

combined. The *second approach* involved estimating the average biomass per stand table diameter class and, multiplying by the number of trees in each class, and summing across all classes. Results using this approach indicates a mean value of 24 t/ha of AGB (approx. 12 tC/ha) for all communal conservancies combined (Figure 3).

Wingate et al (2017) measured AGB biomass in Ekolola communal conservancy and found a mean values of 54.5 t/ha. Based on these three separate assessments, we adopt a mean value of 38 t/ha.

These 30tC/ha could be stored in the biomass when croplands are converted back into woodland. In the following analysis (section 3.3) the potential to reduce the size of cropland in order to create space for reforestation was assessed by focusing on the motivations and problems faced by households that are involved in farming. Below ground biomass in drylands was not considered in this study, but can be significant, as plant roots try to lift deep soil water (Saatchi et al. 2011).

Figure 3 Biomass calculated based on existing volume data for forest inventories carried out by Directorate of Forest in the communal conservancies of northern Namibia and using two approaches.



3.3 Farm profit, motivation of farmers and constraints and opportunities for creation of ES on farm land[3]

The development of a viable approach to increasing carbon storage needs to be based on a detailed understanding of the motivations and constraints of small-scale farmers. To address this, the social survey (conducted by Böller in 2013) used semi-structured qualitative interviews with small-scale farmers at five study sites in Oshana and Omusati regions. In total, 47 interviews were held; five on the farms and 42 on the neighbouring farms. The average household size was 5.7 people per household, of which 15.3 percent were pensioners, 43.3 adults (in working age) and 41.1 percent children. Further information and qualitative data was obtained through focus group discussions with academics and small-scale farmers as well as in-depth discussions with key informants in 2014. Additionally, Buholzer (2013) studied the motivations for undertaking farming and quantified the profits related to farming production on 31 farms around Ondobe within Ohangwena region.

The analysis of the interviews found the main motivations for farming to be household food security and common cultural practices, but not the generation of a farm income. Of all the farms studied, only

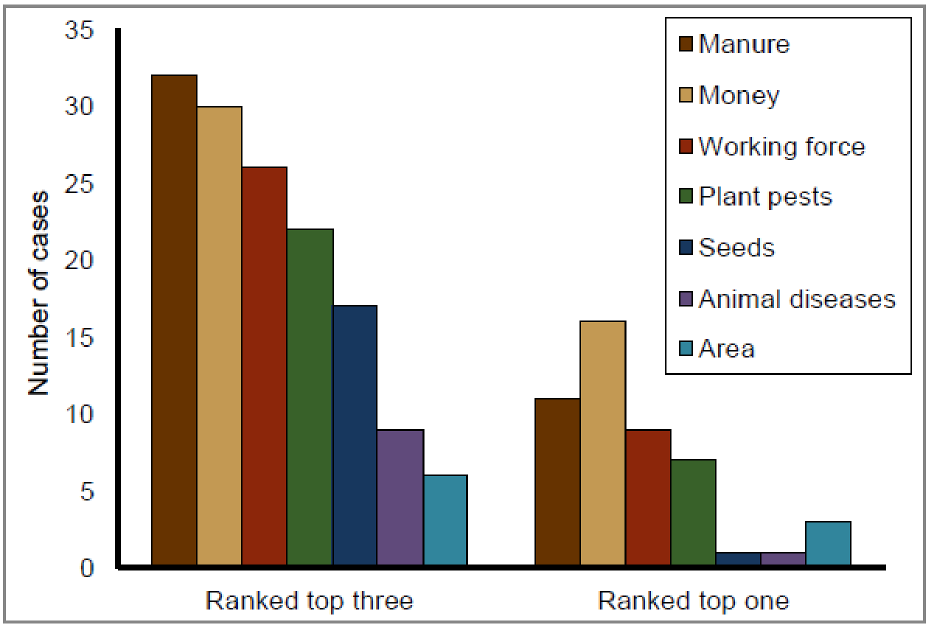
[3] With farm land we refer to the entire land allocated to an individual (the homestead), while with crop land we are referring to that part of the land that is used for crop production.

one farm was found to sell pearl millet, and surplus harvest was often stored as a security net to buffer potentially low harvests in the following years.

Farmers were found to sow their plots (crop lands) according to the availability of labour and other farming inputs (e.g. labour, seeds, organic and inorganic manure). The most severe constraints for farming were said to be (i) lack of manure, (ii) lack of money for investment, and (iii) lack of working force (Figure 4). Böller (2013) excluded rainfall variability and droughts as a potential constraint for farming, as it was seen as an external factor that cannot be influenced, however, it is a major constraint as has been argued in the introduction and by Buholzer (2013).

Additionally, when asked about the willingness to try new farming or land use practices, water shortage was mentioned as serious constraint as well as infertile soils (Böller 2013: 53). Birds and army worms (*Spodoptera frugiperda*) were also found to be threats to arable production (Buholzer 2013).

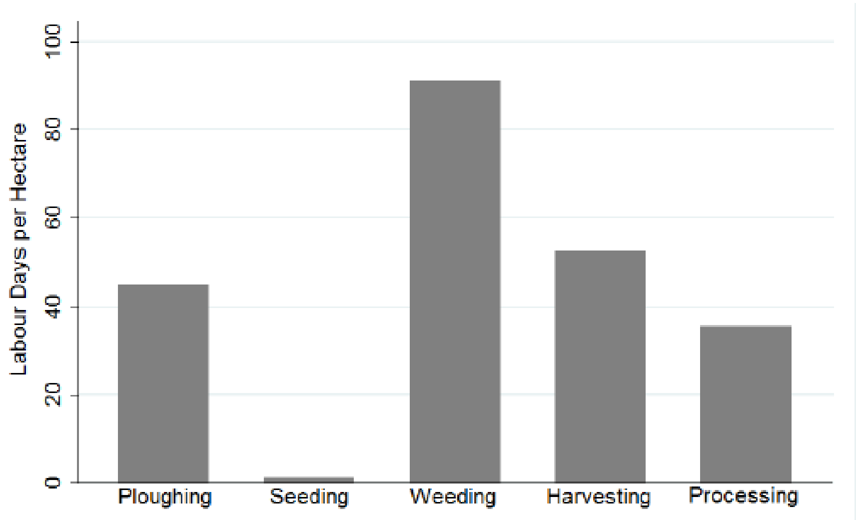
Figure 4 Number of interviews in which key constraints where ranked as top one or part of the top three constraints in undertaking arable farming. “Top three” refers to the number of times an item was ranked 1st, 2nd or 3rd most important. “Top one” represents the number of interviewees saying that this item was the most important for them (Böller 2013).



Peaks of labour demand need to be understood when considering the motivations for farming. Farms in the study area were found to be relying on high labour inputs for ploughing, weeding, harvesting, threshing and storing. Without a tractor or animal plough, small-scale farmers spent the following amount of time for working on 1ha of crop field: 78 labour days (a labour day being counted as 4hours of work) ploughing and seeding by hand (2 days if only seeding is done by hand and the rest by a tractor); 91 days for weeding; 52 days for harvesting and 35 days for threshing and storing (Buholzer 2013: 28) (Figure 5). This amounts to 256 labour days (with one labour day amounting to 4hours in this study). In contrast, Mendelsohn (2006) states an average labour requirement of 49 to 62 days (probably calculating with 8 hours of work per day), however he takes this data from studies by Keyler (1995) and Motinga et al. (2004) and there a labour day was considered to be 8 hours for people between 15 and 55 years. In order to put the 256 days into perspective it is useful to clarify that normally more than one person are doing the field work; most probably at least two adults and two children[4]. This reduces the number of days during which work on the field has to take place to 85 days per homestead.

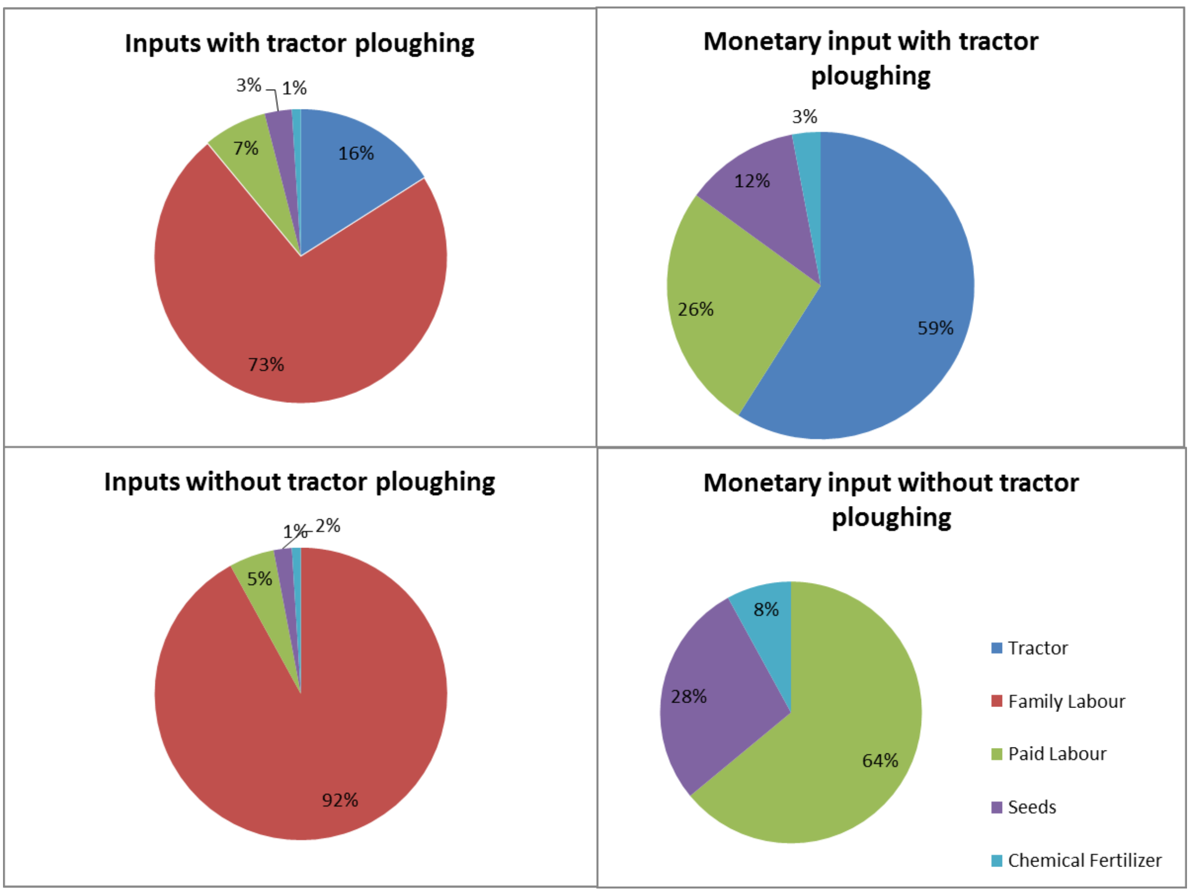
Figure 5 Labour days required per hectare (one labour day amounting to 4 hours) (Buholzer 2013).

[4] Who are assumed here to be working half as much



While labour is by far the biggest farm input (Figure 6), many young people are migrating to towns in search of employment (but might eventually come home during times of peak labour demand). Often only the old people (or women) permanently remain on the farms in order to not lose access to land when it is left uncultivated, and therefore help family members working in towns to secure the land for retirement or as a safety net in case of unemployment. Apart from one that was too elderly, all farmers stated that they intend to continue farming, while only 30 out of 47 farmers stated that they think their children or grandchildren would continue to do so (Böller 2013: 52). Although this is still a big portion of the population, it can be expected that labour will get increasingly scarce in the future.

Figure 6 Inputs needed for farming a crop field [%] (Buholzer 2013: 27)



Yields are relatively low, however, productivity varied considerably, depending on farming practice and rainfall variability. There was a high variability of harvests with lowest values of 88 kg/ha and a mean of 317kg/ha (Buholzer 2013: 29). While Buholzer (2003:41) found that the average farm is profitable at N$1'567 net profit per year (or 771N$/ha; equalling around US$60), a farm worker paid the minimum wage would earn almost double for the same amount of work (NAU 2013). Therefore, any intervention should try to reduce the work load for farmers, or increase the yield per working hour.

Most farmers apply manure (mainly of goat and cattle) on some crop land portions before the onset of rainfall and ploughing. However, due to increased population pressure, grazing areas have declined and only few livestock are kept at the homestead permanently or for a couple of months after harvest, which leads to a scarcity of manure for the crop lands. Currently, a farmer has to make a decision as to where exactly to apply the available manure. Other practices to enrich soils were (i) kraal rotation; (ii) house/homestead rotation; and (iii) tree planting (indigenous trees on cropland or homestead). However, these methods have largely been abandoned because, for example, permanent housing makes homestead rotation impossible. Other practices, such as leaving stalks in the field after harvesting, incorporating termite mound soil, or composting mixtures of cow dung, ash and hay, have also disappeared. Farmers highlighted a lack of knowledge and skill transfer as being a limiting factor for using those practices. However, competitive use for those materials is also a limiting factor. Stalks are now largely used for fencing/cover materials, rooftops and livestock fodder. In conclusion, it can be said that labour and manure shortage appear as major concerns for increasing yields. In the following section, we will discuss which approaches could help to deal with some of these problems.

4. Discussion - Starting points and potential for implementing PES schemes – farmers motivation, institutional structures, possible synergies within Namibia

4.1 Carbon storage and potential PES

With regards to soil carbon sequestration, we assumed that typical agricultural interventions will not increase arable top soil SOC beyond the range we found in scrub land, since such interventions are often limited, for example, by the availability of manure. This limits the overall amount of carbon expected to be stored in the soil to 2tC/ha. Furthermore, given the extreme sandy texture of the soils, any carbon that is likely to be stored in the soil will be rather unstable. Compared to a potential carbon storage of 38tC/ha in the ABG of forests, the potential to store carbon in soils is very low. Efforts that can yield significant results should rather be put in reforestation and the protection of remaining forests. How attractive these activities will be depends on the possibility of farming on the remaining open land, as well as on carbon prices.

In voluntary carbon markets such as the Pilot Auction Facility for Methane and Climate Change Mitigation, prices of US$ 2.40/ tCO_2e were achieved (Kossoy et al. 2015:38), while the average price of allowances in the EU Emission trading system in 2014 was 7 US$/ CO_2e (Kossoy et al. 2015: 44)[5]. For first calculations we will assume a payment of 5US$ per tCO_2e. Through the conversion of 2ha of farmland into forest, an average amount of 40tC/ha*2ha = 80tC could be stored over a period of 30 years (recovery period for forest regrowth from a cleared field in Namibia (USAID/SAREP 2012))[6]. This amounts to 80tC *3.67 = 293.6 tCO_2e over 30 years or 9.8 tCO_2e per year, equalling a potential annual payment of US$49 per year (however administration costs for production, monitoring and evaluation would have to be subtracted). In comparison Buholzer (2013:29) calculated a harvest of 317kg of maize per hectare, which amounts to around 100 US$ (but here as well production costs would have to be subtracted).

[5] In comparison, national carbon taxes range from less than US$1 per tCO2 e to US$130 per tCO2e, with the majority of emissions (85%) being priced at less than US$10per tCO2 (Kossoy et al. 2015:13).

[6] Williams et al (2008) recorded the recovery rate of AGB at 0.7tC /ha/a in a Miombo woodland in Mozambique, while no change could be shown for SOC over 20-30 years. Rates of 1.4–2.0 t/ ha/a were found for comparable woodlands in southern Africa (Ryan et al. 2012; Chidumayo 1997)

While a payment of less than 39 US$/ha/year and hectare alone is not likely to make people shift from agricultural production to forest protection or even reforestation; such a course of action may be rendered feasible if yields were to be increased on the remaining arable land. As forests demand less labour (especially once they have been established) than crop cultivation, the reduction of field size could also help to deal with the shortage of labour and manure. As farming is not done for commercial purposes, a reduction in field size is feasible, as long as the yield per farm is not decreased. As such, conservation agriculture (CA) methods have been tested in northern Namibia by the Namibia Resource Consultants Conservation Tillage Project (CONTILL). The project could achieve a yield increase for pearl millet of between 200% and 600%, due to better water availability as a result of conservation tillage methods in combination with the application of fertilizer. Monoammonium Phosphate (MAP) at 75kg/ha[7] combined with manure at 5t/ha[8] achieved the best results (Davis as quoted in USAID/SAREP 2012:9). While those inputs would also be costly, some manure could be transported from the cattle posts and the increased yield balances the reduction of field size.

In conclusion, a reduction of crop field size would help to reduce farm labour demand. Additionally, if several farmers would come together to follow this approach, they could put the money gained through PES together in order to transport manure from the cattle posts to the homesteads/farming areas and/or purchase fertilzers. Other possibilities might be to practice some forms of agroforestry that are applicable to drylands and thereby reduce the fertilizer requirements. However, in that case a closer look at water availability would be needed, as e.g. promoting indigenous and adapted tree which are adapted to dry conditions. Importantly therefore, agroforestry-silviculture would therefore have to be based on indigenous tree species to limit these requirements.

The development of a PES project is costly from the onset (e.g. the development of a Plan Vivo Project[9] would already need several thousand US$). Most of the costs can also be exorbitant with the monitoring of activity inputs, as well as recording them for verification. Lastly, the evaluation (i.e. accounting and validation) of the exact amount of carbon to be stored is not only a time consuming, but an elaborate and rigorous scientific process of monitoring, measuring, verification and reporting. In the following section, we advocate to take an integrated approach to PES, which includes PES schemes into development efforts.

4.2 Ongoing projects regarding crop yield improvement and forest protection

The government of Namibia is investing in improving agricultural practices and outputs, as well as protecting forests (Table 3). This section discusses potential synergies between these projects and their impact on carbon storage in relation to potential PES schemes. The specific project interventions focus mainly on broad areas of natural resource management, adaptation, drought resilience and aspects of food security and nutrition. The four most relevant ongoing or already completed initiatives applicable to PES with regard to food production and carbon sequestration services are NCAP, RAIN, SCORE and NAFOLA (see Table 2) which operate in the NCR. None of the interventions contained any built-in support to evaluate the impact of the activities on ES services, however, when combining CA with forestry projects (or agroforestry) the aims of an integrated landscape approach could be achieved (as has been discussed above). As such, combining those efforts could be beneficial to both development (i.e. food provisions) and generating or protecting ES (i.e. increasing carbon stocks and biodiversity) at the same time.

[7] The price for 1 ton of MAP being roughly 500 US$ which amounts to 37.5 US$ per hectare for the 75kg needed.
[8] According to Kreike (2013) one cow produces around 3kg of faecal matter/day amounting to around 1 ton per year, while the carrying capacity of the NCA is said to be around 6ha per cow (Sweet 1998)
[9] See Plan Vivo (n.d.)

Table 3 List of initiatives and their potential intervention mechanisms for improving small-scale farmer livelihoods and reducing land degradation.

Initiatives	Objectives	Partners	LUPs (Main Activity focus)	Agro-ecological zone	Time frame
Namibian Agriculture Conservation Project (NCAP)	To mitigate the impact of drought and flood events Increase productivity and resultant cash crop income 54,000 beneficiaries	CES NCBA CLUSA USAID MAWF	Conservation Agriculture methods	Mopane savannah Forest savannah and woodland	2012-2015
Resilience Agriculture Interventions in Namibia (RAIN)	To mitigate the effects of recurrent droughts by introducing farmers, community members and students to improved climate-smart agricultural methodologies that will increase resiliency, food security and nutrition	NCBA CLUSA USAID	Namibia Specific Conservation Tillage (NSCT)	Mopane savannah	2013-2015
Scaling up community resilience (SCORE)	Scaling up climate resilient livelihoods Community level flood and drought management. Climate change mainstreaming into agricultural strategy	UNDP GEF MET MAWF	Conservation Agriculture	Mopane savannah Forest savannah and woodland	2013-2018
Namibia Forested Land project (NAFOLA)	To maintain current dry forests and the ecosystem goods and services they provide in 13 Community Forests covering over 500,000ha of forest lands, through the wide scale adoption of Sustainable Land Management and Sustainable Forest Management and other improved technologies.	MAWF, UNDP, GEF	Sustainable Forest Management	13 hotspots including NCR	2013-2018

List of Acronyms: **CES-** Centre for Entrepreneurship Services, **NCBA CLUSA -**Namibia Cooperative Business Association CLUSA[10], **USAID-** United States Agency for International Development, **UNDP -**United Nations Development Programme, **GEF -**Global Environmental Facility, **MET -**Ministry of Environment and Tourism, **MAWF -**Ministry of Agriculture, Water and Forestry

A remarkable initiative in Namibia which aims at both conserving natural resources and generating ES is Community Based Natural Resource Management (CBNRM), in the form of community conservancies and community forests. However, ecosystem benefits are not explicitly identified (nor labelled as such) in the programme design of the CBNRM. The main focus on most conservancies is to generate income from wildlife management (e.g. trophy hunting) and tourism (both could be seen as being cultural ecosystem services). However, as those services are not accounted for directly, the communities receive payments from tourists (when they decide to pass by the conservancy, e.g. for trophy hunting) on a voluntary ad-hoc basis, and not through a fixed contract or based on a quantitative evaluation of the ES created. While in the CBNRM of Namibia, ES are not accounted for directly, the experience and insight gained through CBNRM with regard to participatory planning, access and benefit-sharing, as well as income distribution plans within the community, are fundamental toward facilitating the implementation of PES schemes. Indeed, the main achievement of CBNRMs can be seen to be the

[10] NCBA is under the Cooperative League of the United State of America (CLUSA), however it is registered simply as Namibia Cooperative Business Association CLUSA

provision of management and decision-making authority to local resource users (inclusive of small-scale farmers) in a variety of resources and sectors, such as land, water, grazing, wildlife, forestry and agriculture (MET 2013).

In contrast to PES projects, conservancies benefit from an upfront support by the international community, which willing promotes nature conservation, hinting at an important difference between conservation projects and PES schemes. The projects presented in Table 3 are mainly executed by the Government of Namibia, implemented by local actors, and funded either through the Global Environmental Facility, Special Climate Change Fund or overseas development aid (ODA). Financing them through PES schemes would need a quantification of the ES produced. In order to keep the administration costs (including monitoring, evaluation and other transaction costs) low, a larger number of farmers collaborating would be needed. We argue that the monitoring requirements are too high to make the implementation of a PES attractive in the short run, and furthermore the longevity of PES schemes as market based instruments cannot be guaranteed (for a critical analysis of soil carbon based PES schemes and their shortcoming see as well IATP (2011)).

PES are often associated with the idea of poverty alleviation. However, as carbon prices are low and transaction costs are high, very few projects achieve the standards proposed by Wunder (see Muradian et al. 2010). This is mostly so if they are stand-alone PES projects instead of integrated packages of support. This might change in the future when carbon prices go up. In effect, Lipper et al. (2010) argue for a minimum price of US$100 per ton in order to change the strategies of herders in the drylands of Burkina Faso. The idea of PES is to correct for market failures (e.g. not accounting for external costs), by using market mechanisms. But Farley/Costanza even go as far as to suggest, that many of the environmental goods produced are public such that a voluntary payment system will not work, as e.g. it does not work for public good services like fire departments or national defence (2010: 4). Given all those points, they state:

> "There are and will remain enormous uncertainties about how ecosystem services are provided, the magnitude of their benefit, and how human activities affect their provision. Stakes are high, the potential for irreversible outcomes are high, and a precautionary approach to decision-making should therefore be adopted." (Farley/Costanza 2010: 2061)

Despite PES schemes having limitations, a key benefit could be, to change development projects that come as a grant into payment scheme, to empower local communities and give them the right to receive payments for the services they produce or protect. As Muradian et al. (2010:1205) argue PES schemes instead of being seen as payments, should rather be seen as "a transfer of resources between social actors, which aims to create incentives to align individual and/or collective land as decisions with the social interest in the management of natural resources".

While the "P" of the PES and how it should be accounted for is questionable, an ES perspective allows consideration of the multiple benefits derived from ecosystems in a coordinated manner[11]. Above we argued for the combination of reforestation together with increasing agricultural productivity. The statement of Bryan (2013:130) summarizes the potential benefits involved in such an approach:

> "whilst most landholders may be unwilling to reforest their land without financial incentives […] they [can potentially] receive benefits from growing trees that are not captured in market transactions. These benefits relate to potential reductions in risk from assured annual payments, and the provision of ecosystem services particularly those that may help sustain agricultural production, but also aesthetic benefits, bequest value, and other benefits."

[11] For details and ways forward on analysing trade-offs between different ecosystem services see Raudsepp-Haerne (2010).

5. Conclusion

We conclude that land use practices in the NCR could be changed in order to increase carbon storage, while at the same time improve food provision through an adapted intensification of crop farming on smaller parcels, and the simultaneous protection of woodland and reforestation of arable land. The analysis found that the potential for increasing SOC is limited. However, combining SOC storage with practices that simultaneously enhance other ecosystem services such as restoring woodlands and improving yields, could give additional incentives to farmers to change their management strategies. Improving carbon sequestration services can both address land degradation and improve crop production. Such sustainable agricultural practices can prevent further conversion of existing woodlands to cropland as a means to increase yields.

Additionally, by targeting the rural poor, PES schemes in the Namibian context can be aligned to achieving the country's long-term development aspirations. While the existing CBNRM initiatives can provide a useful starting point for community involvement, new (or adapted) institutional arrangements for real integrated landscape management which take the generation of ES into consideration are needed. Institutional arrangements and developments to facilitate PES may prove to be challenging, therefore, relevant, timely solutions and incentives in support of small-scale farming to adopt alternative land use practices are required. While PES are not considered to be poverty reduction initiatives *per se*, recognising the ES produced and protection to the poor households might give them a right to receive development support instead of making them receivers of aid.

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