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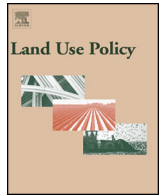
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Socio-economic impacts of private land use investment on rural communities: Industrial forest plantations in Niassa, Mozambique



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ABSTRACT

East Africa has experienced an increase of private land use investments in the past years. Rural households have consequently faced crucial changes in their livelihoods. This paper explores the socio-economic impacts of industrial forest plantations on rural communities in Niassa, Mozambique. According to our results private forest plantations have the potential to positively impact local people's wealth and well-being, if enough emphasis is given to minimizing the negative impacts. The household survey data of 218 observations from five villages were analyzed using binary and multinomial logistic regression analyses. The study shows that forest plantations have threatened the basis of traditional rural livelihoods by reducing the availability of natural resources and through the relocation of agricultural plots. However, investments have also supported the diversification of livelihood strategies in the communities by providing formal employment and by increasing business and trading activities. As growing population and traditional agricultural practices have led to the overexploitation of natural resources, non-natural resource-based livelihood strategies increase the resilience of a household. The majority of respondents reported plantations to have either no overall impact or a positive impact on the well-being of their household. According to our results, socio-economic household characteristics only marginally explain respondents' perceptions of the impacts of forest plantations but perceptions differ significantly between individual villages.

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1. Introduction

At the global level private forest plantations have become increasingly important for timber supply (Evans and Turnbull, 2004). According to the Food and Agriculture Organization of the United Nations FAO (2010) there were 264 million hectares of planted forest worldwide in 2010 and the area is rapidly increasing. South America and South-East Asia have the largest areas of industrial forest plantations (Barua et al., 2014). However, interest toward Africa is significantly increasing due to vast land availability, low labor costs and incentives created by the governments (Barua et al., 2014). East Africa already faces increased land pressure due to a high number of transnational land deals in the past years targeted toward agricultural production as well as forest plantations (German et al., 2011; Anseeuw et al., 2012). Foreign

direct investments (FDI) have been found to be a major component for the growth and development of national economies (e.g., UNCTAD, 2012; Kurtishi-Kastrati, 2013). However, the knowledge of the socio-economic impacts of plantations financed through FDI on local livelihoods in the affected region is limited.

The socio-economic impacts of industrial forest plantations in general are widely discussed (Charnley, 2005; Maung and Yamamoto, 2008; Gerber, 2011). Most rural households in East Africa depend heavily on land and natural resources, especially water, firewood and non-wood forest products (NWFPs) (e.g. Heubach et al., 2011; Persha et al., 2011). Industrial forest plantations require large land areas, decrease land availability, and are thus likely to constrict agricultural activities and cause negative environmental and socio-economic impacts (e.g., Evans and Turnbull, 2004). On the other hand, large-scale forest investments provide the possibility of economic development and alternative income sources in the form of formal employment and infrastructure improvement (Carvalho et al., 2005; Schoneveld et al., 2011; Obidzinski et al., 2013).

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Many earlier studies examining plantation forestry have concentrated on land conflicts (Gerber, 2011; Kröger, 2012; Fairbairn, 2013). Gerber (2011) identified these conflicts as one of the major negative impacts on local communities caused by forest plantations worldwide, including the displacement of local households or their farm plots and limitations in access and control over natural resources. A severe case of the displacement of households and farmland due to a forest plantation project has been observed in South Africa (Tropp 2003) and, more recently, in Uganda where the displacement of households and violent land evictions have been reported (Lyons and Westoby, 2014). Ill-defined property and land use rights are one of the main underlying causes for these conflicts. The governments of many East African countries own the land and local communities use the land under traditional customary rights. Investments from external parties (national as well as foreign investors) thus disrupt traditional land and resource use (Gerber 2011; German et al., 2011; Derkyi et al., 2014). Reductions in agricultural activities could be offset by employment creation, making households less dependent on natural resources. Employment enables households to diversify their livelihood strategies and be less dependent on natural resources. Diversification of a household's livelihood with non-natural resource-based strategies makes the household less vulnerable and enables them to increase their standard of living (Ellis, 2000; Morris et al., 2002). In the general context of industrial forest plantations Tyynelä et al. (2002), Sitari (2005) and Schoneveld et al. (2011) have emphasized that although employment opportunities are offered by forest plantations, only few of the households benefit and are able to improve their livelihoods. Furthermore, Lyons and Westoby (2014) reported that positive impacts on employment were observed in their study, but local communities stated that the urge for agricultural land is more important and that employment cannot make up for degraded natural resources.

Besides the displacement of agricultural plots, studies have also reported a decline of other natural resources e.g., firewood and NWFPs caused by deforestation and transformation of natural forests with forest plantations (Gerber, 2011; Nahuelhual et al., 2012; Nube et al., 2012; Obidzinski et al., 2012; Heilmayr, 2014). Especially; in cases where natural habitats are changed toward monocultures households are forced to walk further distances to collect products from the forest or completely lose the benefit from ecosystem services (McElwee 2009; Kröger, 2012). Plantations may also impact water, which is crucial for rural communities (see e.g., Bowyer, 2001; Gerber, 2011; Obidzinski et al., 2012). Gerber et al. (2009) stated that forest plantations in Cameroon and Ecuador were reported by locals to have caused the pollution of local water streams.

To most effectively mitigate the negative impacts of plantations, the identification of the most vulnerable population groups is important. Women in general and single mothers in particular, elders, the least educated and the poorest are often identified as part of this group (McElwee, 2009). Concerning impacts of plantations e.g., Vihervaara et al. (2012) found differences between female and male respondents in Uruguay despite the majority of households in a study stating a positive opinion concerning forest plantations. According to Tyynelä et al. (2002) wealthier households have a higher likelihood to benefit from forest investments, as they have better access to education, and hence higher chances to be employed. A case study by Sitari (2005) in Zanzibar showed that especially females struggle to adapt to the changes brought by the forest plantations and are often unable to benefit from them. As situations are very different in different parts of the world, country- and region-specific studies on these impacts are needed.

However, despite this growing interest the knowledge concerning the actual socio-economic impacts on rural communities beyond land conflicts is still insufficient. This study contributes to

the literature by examining the impacts of existing forest plantations on the wealth and livelihoods of local people in selected rural communities in Niassa, northern Mozambique. New insights into perceived changes in ecosystem services and livelihood strategies are provided and factors affecting the perception on the impacts of forest plantations are examined. Results and recommendations from this study will help to improve the implementation of forest investments and collaboration between stakeholders.

Over the past years several private forest companies have allocated land concessions for plantation projects in the province of Niassa with a planned investment volume of approximately US\$ 70 million (Nhantumbo et al., 2013). Reasons for the investments in this province include good soil and good climatic conditions for silviculture and a scarce population (DNTF, 2012). Land in Mozambique is owned by the state and forest investors acquire land use rights (DUATs) from the government, which allows them to occupy and use a certain area for 50 years, with the option of extending this right for another 50 years. If the areas granted to the investors are overlaid with community land, the forest companies are required to hold consultations to negotiate with communities on areas to be allocated and on compensation. Although the legal framework forms a basis for protecting the land use rights of local communities, the implementation of land use rights is weak in reality (e.g., Siteo, 2009; German et al., 2011).

Prior to our study, Landry and Chirwa (2011) analyzed the perception of local communities on planned forest plantations. According to their study, improvements in infrastructure and employment were anticipated by local communities as a result of the introduction of forest plantations close by. The overall expectations were positive, as respondents stated that sufficient land would be available for the forest plantations. The study captured only the expectations of local communities, but presented no results on actual impacts. Nube et al. (2012) evaluated the impacts of the establishment of industrial forest plantations in the Lichinga, Lago and Sanga districts of the Niassa province. They found that forest plantations have increased the well-being of local communities through better employment and trading opportunities. However, they examined the perception of forest plantation impacts only on a general basis and did not further analyze the factors and reasons causing negative or positive responses. Other studies (Norfolk and Tanner, 2007; Siteo, 2009; Lemos, 2011; Siteo et al., 2012; German et al., 2011) contrastingly reported conflicts over land caused mainly due to the weak implementation of land use rights for the local population.

In our study we examine villagers' perceptions of the impacts of plantations on the availability of natural resources (land, water, firewood, NWFPs). We examine how households have perceived the overall impact of plantations on their livelihood. We further analyze whether any groups have been impacted more than others. We also analyze the link between different livelihood strategies and the impacts of forest plantations. Our main hypotheses are the following: (i) local households perceive the impact of forest plantations on natural resources negatively, (ii) forest plantations have positively impacted the livelihood diversification of households, (iii) the introduction of forest plantations is perceived more negatively by poorer households and more positively by wealthier households.

2. Data and methods

2.1. Study area

Our study was carried out in five villages in Niassa, Mozambique: Malulu, Ligogolo, Colongo, Mapaco and Mussafa. The main criterion for village selection was proximity to a forest plantation. Malulu,

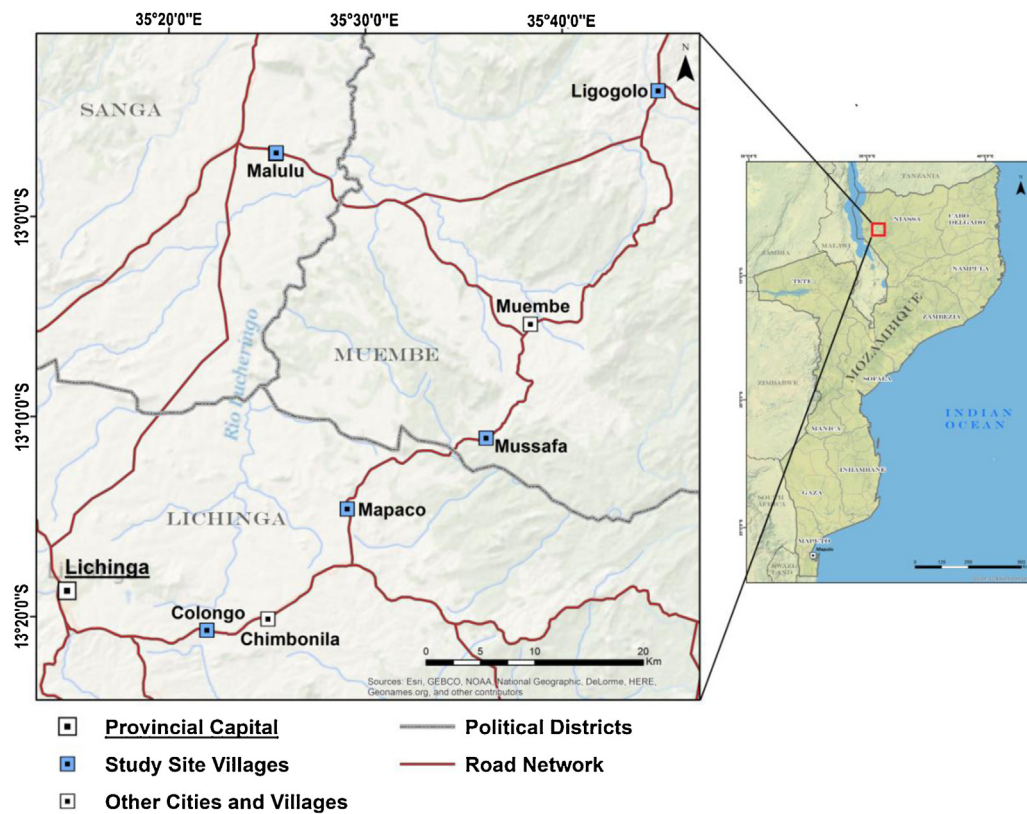


Fig. 1. Research villages and their locations in relation to the Niassa province capital Lichinga, Mozambique. (map by Bergroth and Willberg, 2014).

Ligogolo, Colongo and Mapaco were all located near one or several forest plantations, whereas no plantations were located near Mussafa and it therefore acted as a control village. In fall 2013 5 different companies were present in Niassa, and a second selection criterion was to examine at least one plantation from each company. The number of households in a village was additionally taken into consideration to ensure a sufficiently large sample size. According to administrative posts and village chiefs the number of households in the villages is altogether approximately 2100. Plantations near villages are owned by several different companies, both domestic and international. Plantations are mostly eucalyptus or pine plantations and their age at the time of the study was less than 7 years.

Malulu village is the largest in the study, with approximately 670 households. The forest company Green Resources began acquiring land in the area close to the village in 2007 and established pine and eucalyptus plantations. There are five water pumps, a hospital and a secondary school in Malulu.

Ligogolo is furthest away from the province capital Lichinga (Fig. 1, map). Compared to the other villages, the forest plantation is further away from the village. This is a result of successful community consultations (Sitoe, 2009). Additionally, Ligogolo has two old pine plantations that used to belong to the state during colonial times providing the village with additional firewood. The village has a health care center and a primary school, which were sponsored by the plantation company New Forests in 2010.

Colongo is located closest to Lichinga. The forest company Chikweti Forests of Niassa began planting close to the village seven years prior to our study. The village has a primary school and a health care post and six boreholes for water, although only one is functional according to the villagers.

Mapaco is the only village that has plantations owned by two different forest companies, Florestas de Niassa and Florestas do Planalto (as part of UPM Uruguay Group). The plantations are very

close to the village area. Mapaco is located in the Lichinga district and has approximately 400 households. It has two water pumps, a primary school and a health care post, which was funded by the company Florestas de Niassa.

Mussafa did not have a forest plantation close by at the time of our household survey, and thus serves as a control village. The village has one water pump and some households use a well located close to the village. There is a primary school in the village, but no health care center.

The basic activities undertaken by most households in the study sites are food crop production, livestock rearing, and the selling of charcoal and NWFPs. There is also non-farm employment at a very small scale. The land has been under state ownership since independence in 1975 but, as for much of rural Mozambique, the land is governed by a traditional system based on lineage and headed by chiefs. Acquiring land requires a request to be made to the traditional leaders. However, the forest is considered common property, and everyone has the right to harvest and use forest products and services as long as they respect the sacred forests.

2.2. Data collection

Data were collected in a household survey. The study was carried out in August–October 2013. The questionnaire was pretested before application with African students staying in Finland. The final draft of the questionnaire was tested with households from the research villages in Niassa. Focus group meetings and key informant interviews were also used in the actual study in addition to household interviews.

The household survey included questions aimed at assessing the impacts of plantations on respondents. These included perceived impacts of plantations on the use of different natural resources

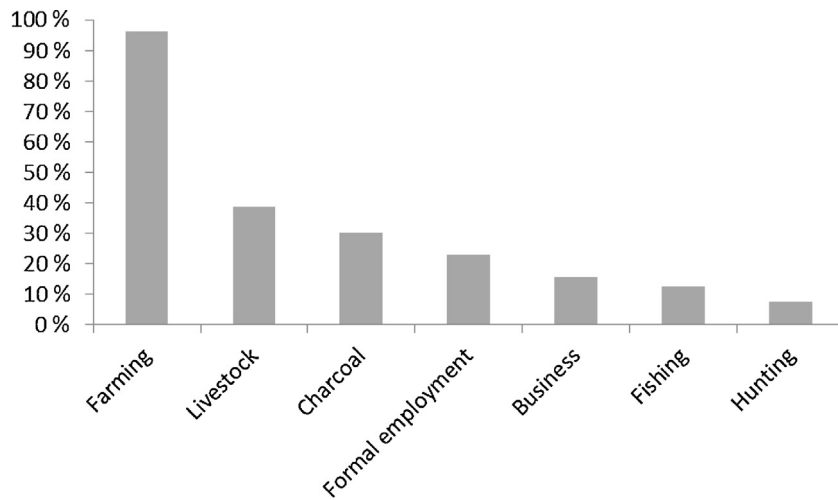


Fig. 2. Proportion of households participating in different livelihood activities, $N=218$.

(water, firewood, NWFPs) and on the availability of land.¹ Furthermore, impacts on employment and infrastructure as well as on overall wealth and well-being of respondents were inquired about.² Questions related to general socio-economic factors and livelihood activities were additionally included.

A total of 218 households were interviewed, which is approximately 10% of all households in the villages. The data were collected systematically so that every 5th or 7th household was interviewed, the interval depending on the population of each village. Interviews were carried out with the head of the household if he or she was present; otherwise another adult was chosen as a respondent. Approximately 49% of the respondents were females and 42% were males. The rest of the interviews were conducted with both female and male respondents present. These were counted into the group of male respondents, because most responses in these cases were given by the males (thus, male respondents 51%). The confidence interval (95%) is 44–57% for male respondents present at the interviews. According to the Mozambican National Institute for Statistics (INE, 2007), the population in Niassa consisted of 51% women and 49% men in 2007. Thus, both genders are represented well in our study, compared to the gender distribution of the entire population.

Most interviews were conducted in Chiyao, the local language, or in Portuguese, with the help of interpreters, fluent in both languages as well as in English. The interviews took 45–60 min. Focus group meetings were held in each village prior to the personal interviews to gain background information, including information on important resource areas and conflict zones, and to introduce the field workers to the village people. The group discussions were held in a minimum of two groups (male and female) in each village, to guarantee female participation.

2.3. Data analyses

Data analyses were carried out using binomial and multinomial logistic regression analyses (see e.g., Hosmer et al., 2013) as well as principal component analysis.

Binary logistic regression analysis was used to examine factors explaining respondents' perceptions of the impacts of plantations

¹ Question on different natural resources: "Have you observed impacts on the following natural resources caused by the forest plantation projects?" (no impact/negative impact/positive impact/I do not know).

² Question on well-being: "Do you feel that your household has in general benefited from forest plantations?" (strongly disagree/disagree to some extent/no effects/agree to some extent/strongly agree/I do not know).

on the availability of different natural resources (land, firewood, NWFPs, domestic water). Logistic regression analyses were carried out separately for each of the resources. The dependent variable in each model had a value of 1 if the respondent reported negative impacts of forest plantations on the specific resource availability, 0 otherwise. Independent variables used in each model were socio-economic or livelihood related factors that were assumed, based on economic theory or practical observations, to explain the impact.

Multinomial logistic regression analyses were used to examine the relationship between wealth and different livelihood strategies (including forest investment-induced employment and trading). Wealth was the dependent variable in the model. Households were divided into wealth groups using principle component analysis. Dividing respondents into different wealth groups based on monetary values was not applicable, since most households sustain their living with their yield from the farm plots. Household wealth was assessed, following Filmer and Pritchett (2001), on the basis of their ownership of different assets (bicycle, motor-bike, TV, mobile phone, fire brick house, house with tin roof, other valuables). The principle component analysis produced weights for each of the assets based on the asset combination with the maximum explained variance. An asset index for each household was created with the gained weights, according to which the households were subsequently classified into three wealth groups. The two lower wealth groups each contained 40% of the sample while 20% of respondents were in the richest wealth group. The "highest wealth group" was the reference category in the multinomial logistic model, which contrasted with the "lowest wealth group" and "middle wealth group". Different livelihood strategies, apart from agriculture, were used as independent variables.

Multinomial logistic regression was also used to examine household perceptions concerning the impact of forest plantations on their overall well-being and to identify groups vulnerable to changes caused by plantations. The dependent variable in the model had a value of 1 if the respondent reported plantations to have a negative overall impact on his or her households' welfare. Negative reported impacts were contrasted with the category for respondents reporting no impacts with a value of 0 and positive reported impacts with a value of 2. Similar independent variables were used as in the binomial regression models.

McFadden pseudo R^2 , Hosmer–Lemeshow test, maximum likelihood ratio test and $-2\log$ likelihood were used in the regression analyses as statistical measures to assess the goodness of fit and eligibility of predictors. A pre-selection of factors for the models was chosen based on cross tabulations with Pearson's χ^2 test. Risk

Table 1
Perceptions on the impacts of plantations on natural resource and land availability (% of respondents), $N = 173$.

	Negative impact	No impact	Positive impact	I do not know
Firewood	79.8	17.9	2.3	–
Domestic water	21.9	60.1	0.6	17.3
Non-wood forest products	57.0	38.4	1.7	2.9
Land availability	56.1	42.1	–	1.8

Table 2
Perceptions on the impacts of plantations on employment, trading and infrastructure (% of respondents), $N = 173$.

	Negative impact	No impact	Positive impact	I do not know
Employment	1.2	17.9	75.7	5.2
Trading	2.9	41.3	43.6	12.2
Roads	–	29.5	56.6	13.9
Health care	–	41.0	45.7	13.3
Education	–	48.6	36.4	15

levels of 10, 5 and 1% were used in the regression analyses. A 5% risk level was applied for all other tests of statistical significance. SPSS software PASW Statistics 18 was used for all statistical analyses.

3. Results

3.1. Perceived impacts on natural resources, infrastructure and overall well-being

Crop cultivation was the main livelihood strategy for nearly all households (97%) in the study area. Apart from subsistence farming (approximately 26% carry out only substantial farming without selling), 70% of the households sold a minor part of their harvest to generate additional income for the household. Other income-generating livelihood strategies included livestock rearing, charcoal production and formal employment in forest companies or elsewhere (Fig. 2). Forest plantations are perceived to impact the main livelihood, farming, by reducing land availability. More than half of the household survey respondents assessed the plantations to have negative impacts on land availability (Table 1).

The respondents perceived plantations to also negatively impact the availability of resources from natural forests, which are essential to rural livelihoods. Most households collect firewood and various types of NWFPs from the natural forest areas. Contrastingly, according to local households water resources have so far been impacted only marginally compared to impacts on land and forest resources.

Local people have also experienced positive impacts. Possibilities for pursuing alternative livelihood strategies have increased and infrastructure has improved (Table 2). A great majority of respondents considered employment opportunities to have increased because of forest plantations. Furthermore, more than 40% of households in the local communities perceived a positive impact on trading activities (Table 2). The plantation companies have additionally implemented social projects in the villages, e.g., roads and education and health care facilities have been built or improved with the support of the companies.

The majority of households have either perceived positive or no impacts at all on the overall well-being of their household (Table 3). The village where a household is located explains a great share of the variation between positive and negative respondent perceptions (Pearson's $\chi^2: 70.384, p < 0.001$). Households from Malulu and Ligogolo have more commonly reported either no impact or a positive impact, whereas households from Colongo gave more negative responses overall (Table 3).

Table 3
Perceptions on overall impacts of plantations (% of respondents) $N = 173$.

	Negative impact	No impact	Positive impact	I do not know
Malulu	21	27	44	8
Ligogolo	6	33	42	19
Colongo	74	3	24	0
Mapaco	40	5	55	0
Total	32	19	42	7

3.2. Factors influencing perception concerning natural resource availability

The binary logistic regression model on the perceived impact of plantations on farmland availability is presented in Table 4. The dependent variable of the model has a value of 1 if the respondent reported negative impacts of forest plantations on the farmland availability, 0 if otherwise.

The variable “Household had to relocate. . .” has a value of 1 if the household had to move their farm plot because of a forest plantation, “Number of household members” is the total number of people living in the household, “Household owns livestock” has a value of 1 if the household owns at least one type of livestock (e.g. goats, chickens).

According to the results, negative impacts on land availability were mainly perceived by people who either were from villages with a higher number of relocated farm plots (Mapaco and Colongo) or who had to relocate their own farm plot. Furthermore, households whose livelihood activities were more dependent on farmland were more likely to report negative impacts on land availability by forest plantations. Households that depend heavily on land are the ones that sell many crops and where farming is the main income source, have a high amount of livestock for which they need more land as pastures or for fodder production and households with many members for which food needs to be provided.

Binary logistic regression models were also used to examine which factors explained respondent's likelihood to report negative changes in the availability of firewood, NWFPs and domestic water. However, as the entire population in the area is highly dependent on natural resources, and thus homogenous in that sense, only some significant explanatory factors were found. In all three models (firewood, NWFPs, water) the village of respondents was found to be the most important variable explaining negative responses.

The villages differ in natural capital endowment, the distance to plantations and relocation rate. Households in Ligogolo were found to observe significantly less negative impacts in firewood availability compared to the other villages near forest plantations (Pearson's $\chi^2: 34.729, p \leq 0.001$). Old pine plantations from the colonial era depict an alternative firewood source for households in Ligogolo and the current forest plantation has been established at a greater distance to the settling area compared to the other three plantation villages. Colongo on the other hand is located in close proximity to the plantation and faced a resource shortage from natural forests already prior to the introduction of forest plantations. During the focus group meetings participants in Mapaco and Malulu also pointed out that a growing population and charcoal production had caused deforestation already prior to the establishment of forest plantations.

The village a respondent lived in was also found to be a major factor for negatively perceived impacts in the NWFPs model, and respondents from Ligogolo were significantly less likely to report negative impacts than respondents from other villages (for all three $p \leq 0.001$). The same reasons apply for this as for firewood. Alternative sources for firewood, which were available in Ligogolo, reduce the pressure on natural forests, and thus also ensure the availability of NWFPs. The number of different collected types of NWFPs

Table 4
Logistic regression model on the perceived impacts on farmland.

Reporting a negative impact on farmland	B	Sig.	Exp (B)	95% C.I.for Exp (B)	
				Lower	Upper
Household sells crops	.796	.090	2.22	.883	5.568
Household had to relocate farm plot	1.345	.027	3.84	1.164	12.665
Household lives in a village with a high relocation rate	2.819	.000	16.76	6.321	44.414
Number of household members	.138	.066	1.15	.991	1.330
Household owns livestock	.770	.087	2.16	.895	5.205
Constant	-2.520	.000	.08		

N = 160; reference category for dependent variable: non-reporting of negative impacts; -2Log-likelihood: 144.626; Hosmer–Lemeshow test 0.754; C.I.—confidence interval.

additionally significantly ($p=0.016$) influences the perception of negative impacts of forest plantations. The higher the number of different collected products from the forest, the higher the odds to report negative impacts.

In contrast to the other examined resources, according to the respondents water has so far been impacted only slightly by the forest plantations. Factors for reporting negative impacts to water were the individual relocation of farmland and living in a village with a high rate of relocated farmland. In these cases negative responses might arise because of other reasons than actual negative impacts on water availability.

3.3. Forest plantations, wealth and livelihood diversification

The results of the multinomial logistic regression model examining the relationship between different livelihood strategies and wealth are presented in Table 5. The dependent variable in the model is the wealth category of the household. The variable “Number of livestock” depicts the number of different types of livestock that a household possesses; “Number of livestock for sale” is the number of different types of livestock that a household holds with the purpose to sell them. The variable “Educated” has a value of 1 if the education of the household is above the sample average. “Business activity” has a value of 1 if the household owns a business or is engaged in trading activities other than selling crops, livestock or charcoal.

Differences can be found especially between the lowest and highest wealth groups. According to our results households are more likely to be in the highest wealth group if they have members employed in a forest company, carry out different business activities and keep more livestock without the intention of selling it. Poorer households contrastingly are more often forced to sell livestock to generate income and cannot keep the livestock for themselves as a saving account equivalent. Higher education also

increases the odds of being in the highest instead of the poorest wealth group.

As we do not have time series data, it is not possible to certainly say how the plantations influence resident wealth, i.e. whether the establishment of forest plantations directly impacted the wealth groups of individual respondents or whether people employed or carrying out business activities were already in their current wealth groups prior to the arrival of the plantations. A wealth regression analysis indicated, however, that short-term work did not improve the wealth status of the household in the long-term, as previous employment in a forest plantation did not significantly increase the odds of a household to be in the highest wealth group. Two thirds of the people that were employed when the study was carried out had been in their companies for at least three years. According to the study many of the households with long-term employment were able to acquire valuable assets as a consequence of their employment. However, from the livelihood diversification point of view it is important to point out that despite employment increasing, all households in the study still depend on farming as a livelihood strategy.

According to our results there is a connection between wealth and the diversification of livelihoods, especially the commencement of non-natural resource-based strategies. As plantations create possibilities for the diversification of livelihoods, they also increase residents' possibilities to gain wealth and increase their standards of living.

No significant differences were found between the control village Mussafa and other villages in the share of people in different wealth groups and households in the control village also had a diversified livelihood strategy portfolio. However, the control village had significantly (Fischer LSD; $p < 0.05$) less households engaged in trading or business activities than the plantation villages Ligogolo and Mapaco and the lowest share of households with somebody employed in a forest company. The control village contrastingly had the highest share of households producing and

Table 5
Multinomial logistic regression model on the relevance of livelihood strategies on the wealth status of a household, with the wealth categories as dependent variables and the highest wealth group as a reference group.

	B	Sig.	Exp (B)	95% confidence interval for Exp (B)	
				Lower bound	Upper bound
Lowest wealth group	Intercept	2.139	.000		
	Number of livestock	-1.298	.000	.273	.137
	Number of livestock for sale	.832	.050	2.297	1.00
	Educated	-1.233	.002	.292	.133
	Forest company employment	-2.700	.000	.067	.019
	Business activity	-1.470	.007	.230	.079
Middle wealth group	Intercept	1.235	.001		
	Number of livestock	-.974	.002	.377	.203
	Number of livestock for sale	.736	.055	2.09	.984
	Educated	-.410	.283	.664	.314
	Forest company employment	-.880	.066	.415	.162
	Business activity	-.481	.292	.618	.253

N = 218, -2Log likelihood: 129.608, McFadden: 0.128; highest wealth groups is reference.

Table 6

Multinomial logistic regression model for the perceived impact on households' livelihood and overall well-being, with negative reported impact as the reference category.

		B	Sig.	Exp (B)	95% C.I. for Exp (B)	
					Lower bound	Upper bound
No impact	Intercept	–1.226	.401			
	Number of men	.670	.029	1.954	1.071	3.567
	Household sells crops	–1.177	.095	.308	.077	1.229
	Forest company employment	–1.617	.204	.198	.016	2.408
	Household lives in village with a high relocation rate	–3.131	.000	.044	.009	.203
	HoH male*not poorest group**	1.950	.198	7.026	.362	136.469
	HoH male*poorest group**	.843	.572	2.324	.125	43.236
Positive impact	HoH female*not poorest group**	3.534	.044	34.277	1.109	1059.865
	Intercept	–1.084	.213			
	Number of men	.103	.690	1.109	.668	1.841
	Household sells crops	.859	.089	2.360	.878	6.346
	Forest company employment	1.348	.043	3.851	1.046	14.183
	Household lives in village with a high relocation rate	–.934	.032	.393	.168	.921
	HoH male*not poorest group**	1.150	.140	3.157	.687	14.504
HoH male*poorest group**	.802	.311	2.230	.472	10.534	
HoH female*not poorest group**	.905	.465	2.472	.218	27.978	

N = 161; reference category for dependent variable: negative impact; ** reference group = female-headed households from poorest wealth group; C.I.—confidence interval; –2Log likelihood: 114,291; Mc Fadden: 0.228.

selling charcoal. One possible reason for this is that there are relatively many natural forests still left around the village compared to the plantation villages. Households in the control village have diversified their livelihoods mainly through natural resource-based strategies. Forest plantations contrastingly enabled households in the neighboring villages to carry out strategies that are not based on the exploitation of natural resources. When considering the increasing population and increasing scarcity of land and forest resources, the intensive charcoal production in the control village cannot be considered sustainable. Long-term employment and business activities, however, have the potential to sustainably increase household wealth and standards of living.

3.4. Perceived changes in the overall welfare of the household due to plantations

As shown in the previous sections, forest plantations have had positive as well as negative effects on local communities. To assess the net impact on local livelihoods, household perceptions on the impact of forest plantations on their overall well-being was analyzed. As shown earlier (Table 3), more than 60% of respondents either perceived no impacts or positive impacts on their household's well-being. Factors explaining changes in the overall welfare of households were examined using multinomial logistic regression (Table 6).

The variable "Number of men" is the number of men living in the household in question. The variable "Household sells crops" has a value of 1 if the household sells part of their harvest on the market, variable "Forest company employment" has a value of 1 if the household has at least one member employed in a forest plantation company and "Household lives in a village with..." has a value of 1 if the household comes from a village with a high rate of relocated farm plots, i.e., Mapaco or Colongo. The combinations of "HoH male/female *(not) poorest group" describe an interaction effect between the gender of the head of the household and the wealth status of the household, where female-headed households from the poorest households are the reference group with a value of 0 (the other combinations have a value of 1).

The main factor contributing to a positive perception of the impacts of forest plantations has been the employment of a family member in a plantation. Households with a member employed by plantation companies had higher odds to report positive instead of negative impacts on the overall welfare of their household. Contrastingly, living in a village where many households had to relocate

their farm plots because of the plantations has been a major factor leading to a negative overall perception of the impacts on the households. The relocation rates in Colongo and Mapaco were 44% and 38% and correspondingly more households reported negative impacts.

Socio-economic background information, e.g., the number of household members, wealth or education, generally played a minor role in the perception of the overall impacts of forest plantations on the household. Female-headed households from the lowest wealth group reported negative impacts on their households more often than female-headed households from other wealth groups, but otherwise wealth did not show a significant impact on the perception of the overall impacts on the household and is thus not included in the model.

However, the influence that the wealth status of a household has on the overall perception of impacts can be indirectly seen through the correlation of wealth with other factors that are significant in the model. There are significantly more households in the highest and middle wealth groups engaged in business or trading activities than in the lowest wealth group. The share of households with a member employed in a forest company is significantly (Pearson's χ^2 : 14.83, $p \leq 0.001$) higher for higher wealth groups than for households in the lowest wealth group. A relatively higher number of households in the lowest wealth group had to relocate their farm plots.

4. Discussion

The aim of this study was to examine the impacts of forest plantations on local people and their livelihoods. As expected, the households considered plantations to cause a decrease of many natural resources important for all households. In line with the second hypothesis our study also suggests that household livelihood strategies were diversified as employment and trading opportunities increased due to the plantations. In general, the majority of households felt that plantations had either a positive impact or no impact on the households' overall well-being. However, the share of respondents feeling negative impacts was not insignificant and employment effects reached only a small proportion of households.

The relocation of household farm plots and the employment of household members in forest companies significantly impacted respondent perceptions of the impacts of plantations. Furthermore, significant differences were found between villages. People living in villages with high farm plot relocation rates perceived the

impacts of plantations more negatively. However, contrary to the third hypothesis, general socio-economic factors like education or the size and wealth of the household had no major importance as explanatory factors. The poorest and single-mother households were still found to benefit less from the existence of forest plantations compared to other groups.

The weak definition of property and land use rights in Niassa has caused conflicts over land area, forest and other natural resources (Gerber et al., 2011; Siteo et al., 2012). The relocation of farmland, also observed in our study, poses a major problem for local communities. In the study by Landry and Chirwa (2011), also conducted in Niassa but prior to the plantation project implementations, local people assumed that enough land was available. Our study shows that competition over arable land is perceived to be higher than prior to the establishment of forest plantations. Similar to e.g., Gerber (2011); Nahuelhual et al. (2012); Obidizinski et al. (2012), communities in our study were found to experience increasing difficulties in collecting firewood and NWFPs as a side effect of the established plantations. However, our focus group meetings and the results by Landry and Chirwa (2011) showed that the households faced difficulties with the collection of firewood already prior to the introduction of forest plantations due to growing population size and charcoal production. Contrary to other studies (Gerber et al., 2009; Gerber, 2011; Obidzinski, 2012; Andriani et al., 2012), the respondents in our study did not observe any major problems with water resources so far, but neither have positive effects been reported.

Even though livelihood diversification was observed, similarly to earlier studies (Charnley, 2005; Sitari, 2005; Schoneveld et al., 2011) we also found diversification to be experienced only by a small part of the population. Our study furthermore observed that previous employment and short-term contracts in forest plantations had no impact on the wealth of a household, whereas a majority of those households with somebody currently employed on a long-term basis in the forest companies belong to the highest wealth group. Forest activities in general are highly seasonal leading to short-term contracts for local employees and new forest investments are mainly labor intensive only in the initial phase of the project and many workers might be laid off after the planting phase (Tynnelä et al., 2002; Charnley, 2005). According to the results of our study, most households remain highly dependent on their agricultural activities even if members of the household find employment or are engaged in trading or business activities. This is similar e.g., to studies by Schoneveld et al. (2011); Lyons and Westoby (2014).

Dependence on natural resources and negative impacts of plantations on those resources were observed in all wealth groups. Similarly to Vihervaara et al. (2012), the majority of respondents in the study area perceived that forest plantations positively impacted their overall well-being or that no impact was observed. Contrastingly to Vihervaara et al. (2012); Tynnelä et al. (2002) our study identifies the respondents' home village as a major factor influencing how respondents view the impacts on overall well-being and natural resources while household characteristics and respondent gender had only a minor impact. Similarly to Sitari (2005), the results of our study identified female-headed households from the poorest wealth group as especially vulnerable to negative impacts. As argued by Landry and Chirwa (2011), secure long-term employment would be required to support these households.

Most of the plantations in the study area were rather young (less than 7 years) during data collection. The trees were still small and not all the areas for which land use rights had been acquired had been planted so far. This may have impacted respondent perceptions and the negative impacts. Benefits experienced may also change as the plantation trees and the total plantation area are growing in size.

In the study area the establishment of forest plantations has increased the households' possibilities to adopt new livelihood strategies, which are not predominantly based on natural resources and are thus more sustainable (Ellis, 1998). It seems that households involved in formal employment in the forest plantations or engaged in business activities were able to increase their standard of living. However, the transition process is slow. Changing the base of living is not an abrupt process and is dependent on the trust of the new base of living. A majority of the households in the study area are still heavily dependent on agriculture and natural resources.

5. Conclusions

Private forest plantation investments have multiplied in the last ten years in Niassa, Mozambique. The pressure on land and forest resources has increased due to investments. As rural households in the area are still predominantly dependent on land and ecosystem services, the relocation of farm plots and decreased availability of firewood and NWFPs have negatively impacted the majority of local people.

Access to farm plots and extractable forest goods were already weakened to some extent prior to the building of plantations due to pressure caused by growing populations. The establishment of large-scale plantations has further worsened the situation in many villages. Potential for improvement exists with all parties involved. Agricultural practices of shifting cultivation and slash and burn culture cannot be sustainable under the prospect of a growing population. As forest investors seek higher land availability, training for agricultural intensification could be provided to the communities, rather than extensification and improved productivity. This is already a practice in some forest companies, but could be carried out with greater intensity.

According to our results, private forest plantations have the potential to positively impact local people's wealth and well-being, if enough emphasis is given to minimizing the negative impacts. These negative impacts on natural resources can be avoided or at least mitigated by avoiding areas containing important natural resources for the villages and by providing additional firewood or water resources and by supporting livelihood diversification. Our results furthermore showed that the circumstances in the villages differed, which led to differences in the perceived impacts of forest plantations between the villages. Consultations and land use planning should be adjusted to individual villages, even if certain factors are valid in all villages.

Non-natural resource-based livelihood strategies like employment in a forest company or business activities have a positive effect on the households. Forest companies should support the diversification of livelihood strategies by using a long-term basis local labor force as much as possible. Supporting the development of human capital in the form of education, practical training or agricultural knowledge increases local population's possibilities to adapt to change and increase wealth.

To avoid land conflicts, companies need to improve their negotiation process with local communities and assure that all population groups in the villages have the possibility to express their concerns. The risk of land conflicts could be decreased by the actions of national governments to improve the implementation of land use rights. Necessary capacity on the national as well as the local level needs to be provided to assure that local livelihoods are not compromised. Sufficient personal, technical and financial capacity is currently missing to fully implement land use rights in all the regions.

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