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Impact of Forest Landscape Restoration on livelihoods of rural households: A case study from Sodo District, Central Ethiopia

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A B S T R A C T

Ethiopia has pledged to restore 22 million ha of degraded and deforested lands by 2030. To this end, Forest Landscape Restoration (FLR) efforts are underway. But empirical studies that critically evaluated the effectiveness of FLR in the country are scanty. This study was conducted to evaluate the impact of FLR initiatives on rural households' livelihoods in Sodo district, Southern Central Ethiopia. A two-stage random sampling technique was used to draw 260 sample households (120 households from FLR participating and 140 households from non-FLR participating). Using a structured questionnaire, data on socio-demographic characteristics such as on household heads, household assets, access to credit, land size, household income and related expenditures were gathered. Besides formal survey, key informant interviews, focus group discussions, direct field observations, and review project documents and official reports were used to gather data. The data was analyzed using descriptive statistics and Propensity Score Matching (PSM) technique. The results showed that FLR participants are likely to gain higher total and crop income than non-FLR participants. The average off-farm income of FLR participants also increased by 10,252.4 ETB (200 USD). The number of beehives and the amount of honey produced was higher with FLR participants. FLR participants received more training and had better access to credit and engaged more in rearing sheep and poultry. In conclusion, to maximize impact on livelihoods, FLR initiatives should be combined with agricultural intensification and diversification as well as with business-oriented forest development activities.

Keywords: Forest landscape restoration, Impact, Livelihoods, Perception

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Introduction

Forest Landscape Restoration (FLR) is a planned process that aims to regain ecological integrity and enhance human well-being in deforested or degraded forest landscapes (Mansourian, 2005; Maginnis and Jackson, 2007). It is an important strategy to restore land resources and improve the resilience of local communities globally, and a means of implementing The Bonn Challenge targets to restore 150 million ha of degraded lands by 2020 (Pistorius *et al.*, 2017). To reverse deforestation and land degradation and generate economic benefits from timber, non-timber forest products, and fodder while achieving environmental services, the Government of Ethiopia (GOE) pledged to restore 22 million hectares by 2030 (MEFCC, 2016; MEFCC, 2017).

The GOE has adopted several forest sector initiatives and devolved a considerable array of forest use and management rights to local communities. Accordingly, the National Forest Sector Development Program (NFSDP) of Ethiopia was issued in 2018 that envisages to promote development, conservation, and sustainable use of natural and planted forests in collaboration with development partners. Forest development and FLR are expected to contribute to mitigating climate change, reducing poverty, hunger and other human deprivations. NFSDP was initially launched in nine districts but expanded to more districts across Ethiopia.

Sodo district of Gurage zone is one of the nine initial intervention areas targeted by the

Institutional Strengthening of the Forest Sector Development Project (IS-FSDP) as part of the NFSDP. In 2016, the project demarcated and enclosed about 16500 ha of degraded land for assisted natural regeneration, and in 2017, the project afforested/reforested 1700 ha of degraded land. A total of 31 rural kebeles participated in the project.

However, after six years of FLR implementation in the area, there is a need for systematic evaluation and empirical data to reach a consensus on the effectiveness of the FLR project implemented in the area. This would shed light on FLR impacts elsewhere in Ethiopia so as to draw lessons that would improve future planning. To this end, an FLR evaluation team was set to evaluate the impacts of FLR project implementation on rural households' livelihoods in Sodo district, Southern Central Ethiopia. The research team attempted to examine two key aspects: i) the community's perception of FLR in response to FLR programs implementation and ii) the impact of the FLR project on the livelihoods of rural households.

Methodology

Study area

This study was conducted in Sodo district, Central Ethiopia Regional State, Ethiopia. Geographically, the district lies between 8°26 5.6"76'N and 38°36"43.56'E and borders in the south with Meskane district, and in the west, north and east with the Oromia Regional State. Sodo district comprises 59 kebeles (54 rural and 5 urban) and Buee is the district's capital and Kela is another major town of the district. Sodo district has a total land area of 93,800 ha. The rain is bimodal with the main rainy season spanning from June to September and the small rainy season lasting from February to April. Most of the soils in the Sodo district are sandy loam (60%), followed by black cotton soil (22%) and red soils (12%), which are susceptible to soil erosion. The dominant vegetation types of the district are dry Afromontane forests and Acacia-Commiphora woodlands. Enset (*Ensete ventricosum*), barley, wheat, legumes, and potatoes are the principal food crops.

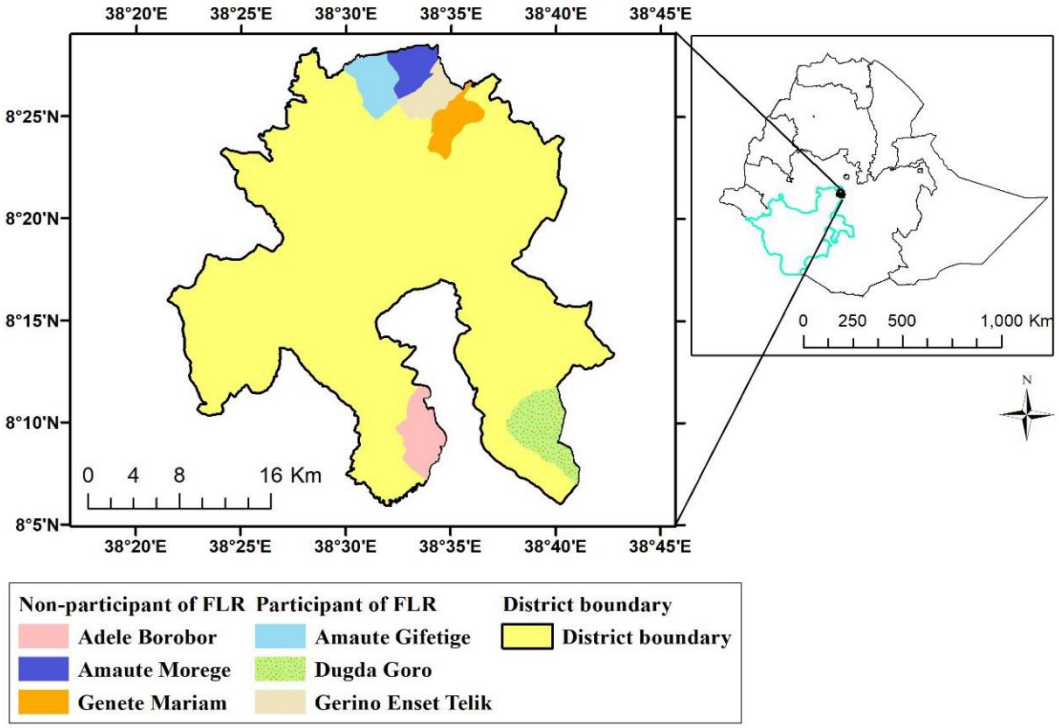

Figure 1. Study area map (Source: Nesibu Yahya, 2022).

According to CSA (2007), the total population of Sodo district is 206,816. The district is one of the most densely inhabited districts in the nation, with a density of 326 persons per km². The majority of people in the district reside are rural and the average family size is 5. The major sources of income for households are crop sales, migratory urban jobs, local employment (mostly casual agricultural work), and animal sales. The crop–livestock mixed farming accounts for about 85% of the rural income. Nearly 25% of farmers live along the Meki River and produce vegetables, mostly for local markets, through small-scale irrigation. In addition, eucalyptus tree sales, livestock trade (from animal fattening), and off-farm activities generate extra income. The youth from rural areas frequently move to Addis Ababa and nearby towns for employment.

FLR Project Background

The FLR project in Sodo district carried out afforestation/ reforestation (A/R) activities on 1700 ha and Assisted Natural Regeneration (ANR) (in the form of exclosure) on 16,500 ha in 2016 and 2017, respectively. The rehabilitation work was conducted after series of consultations and written agreements with the local community. The major activities included area exclosure, constructing soil and water conservation structures, nursery establishment and seedling production, compost preparation, pitting, and planting desho grass and bamboo. The project purchased and provided to community members tools and equipment used for nursery and plantation activities. Supportive activities were also initiated, including the introduction of fuel-efficient stoves with the establishment of women's cooperatives, seedling production, and engagement in poultry, sheep, and modern beekeeping.

Household survey

The household survey was administered to 260 randomly selected sample households, 120 of which were FLR participants and 140 non-FLR participants. A two-stage random sampling procedure was followed to draw sample households. First, three FLR intervened localities (Kebeles) viz., Dugda Goro, Gerino Enset-Tekil, and Amoute Gefitige, and three non-FLR localities viz., Amoute Morege, Genete Mariam and Adele Mirit-Meteja, were randomly chosen. Then 40 households from each FLR intervened and 47 households from each non-intervened Kebelles were randomly selected. Data were collected using a structured household questionnaire. The data collected covered individual and household socio-demographic characteristics and annual revenue from forest products, i.e., total annual income (expenses and costs). The questionnaire also included household-level data such as agriculture and livestock holding, livestock production, forest income, petty trading, remittance and gifts. Net income is the gross value minus the expenditure cost, including labor cost. Furthermore, the livestock holding was converted to Tropical Livestock Unit (TLU) (Storck *et al.*, 1991).

In addition to the structured questionnaire, data were gathered through key informants, focus group discussions, direct field observations, and review of project documents and activity reports. Key informants and focus group discussion participants were identified by consulting local experts, village leaders, field workers, and project staff. A total of 10 Key informants were interviewed and 3 focus group discussions (with 6 to 10 people) were conducted to generate more data.

A propensity score matching (PSM) Model for estimating outcomes of FLR and non-FLR was employed (Khandker *et al.*, 2010). The mean difference in outcomes between the two groups was then used to calculate the average impact of the FLR program on FLR participants, often known as the average treatment effect on the treated (ATT) in the evaluation literature. PSM constructs a statistical comparison group based on a household's predicted probability of FLR participation (the propensity score) conditional on observed characteristics X: P(X) = Pr (T = 1|X). The predicted values of FLR participation are estimated using a logit model as the decision to participate (T=1) or not to participate (T=0) in FLR, which is a binary dependent variable.

Once the propensity scores were estimated, the next step in implementing the PSM model was to create matched samples of treatment and control households and compute the mean difference in outcome variable of interest between the two groups. To this end, Yi represents the outcomes to household i (Khandker *et al.*, 2010). For participants, Ti = 1, and therefore, the value of Yi under treatment was represented as Yi_1. For non-participants, Ti = 0, and the value of Yi is represented as Yi_0. Moreover, variables that are likely to influence participation in FLR and its impacts on outcome variables of interest were selected and used. The explanatory and outcome variables were selected based on empirical works of literature on FLR initiatives implementation (Mansourian, 2005; Maginnis and Jackson, 2007; Pistorius *et al.*, 2017; MEFCC, 2017; Kassa *et al.*, 2017; Kassa, 2018; Zeleke and Vidal, 2020; Pedercini *et al.*,2021; Djenontin *et al.*, 2021).

Results and Discussion

Descriptive results

The majority of sample households were male-headed (83%) (Table 1). FLR participant households are remoter to the nearest market, have larger family size and total land holding compared to non- FLR participants (Table 1). The FLR participants are also characterized by lower age. Households that participated in the FLR program had significantly higher number of hives and higher honey production (Table 2). Moreover, they were more likely to have higher total income and crop income with lower other income than the non-FLR participants.

Table 1. Descriptive statistics of sampled households by FLR participation.

Categorical Variables	*Category*	*Participation in FLR*		*Total (Frequency and %)*	*Chi² square (Sig)*
		FLR (120)	*Non- FLR (140)*		
Household head sex (HhSEX)	1= Male 0= Female	95 25	121 19	216(83.1) 44(16.9)	0.120
Household head education (HhEdu)	1 = Literate 0 = Illiterate	92 28	93 47	185(71.2) 75(28.8)	0.069
Household head marital status (HhMTS)	1= Married 0 = Otherwise	110 10	134 6	244(93.8) 16(6.2)	0.176
Credit access before FLR (CABFLR)	0= no 1= yes	83 37	106 34	189(72.7) 71(27.3)	0.237
Credit access	0= no 1= yes	92 28	136 4	228(87.7) 32(12.3)	0.000***
Cooperative formed	0= no 1= yes	75 45	124 16	199(76.5) 61(23.5)	0.000***
Continuous Variables		*Mean (SD)*	*Mean (SD)*	*Mean Difference (SED)*	*T-value*
Household head age (HhAge)		45(11.28)	49.27(12.93)	-3.78(1.52)	-2.489***
Family size (Familysize) in No.		6.06(2.26)	5.28(1.89)	0.77(0.26)	3.001***
Number of economically active persons (18 - 64) (LabAge)		3.72(1.95)	3.42(1.71)	0.30(0.23)	1.333
Distance to market (DISTMarket) in walking minutes		97(88.32)	50(37.93)	46.50(8.23)	5.652***
Total land owned (OwnLand) in ha		1.98(2.96)	1.24(1.22)	0.74(0.27)	2.713***
Livestock in TLU before FLR (LivestockTLUBFLR)		5.73(7.07)	5.05(6.37)	0.68(0.83)	0.819

*Remark: - ***indicates 1% level of significance.*

Table 2. Summary statistics of outcome (economic indicator) variables.

Variables	FLR (N=120)		Non-FLR (N=140)		Mean Difference		T value
	Mean	SE	Mean	SE	Mean	SED	
Crop income	61368.39	5086.38	46514.72	3454.79	14853.67	6007.79	2.472***
Livestock income	25987.19	5105.79	25101.70	8090.52	885.49	9936.54	0.089
Forest income	8217.66	1883.31	4179.21	2289.40	4038.45	3025.97	1.335
Other income	245.91	117.78	824.82	2981.44	-578.90	293.26	-1.974**
Off-farm income	17312.40	3664.90	12816.85	1390.56	4495.54	3709.78	1.212
Total income	113131.56	8537.95	89437.31	9442.40	23694.25	13075.72	1.812*
Livestock in TLU	5.24	0.36	4.94	0.42	0.30	0.57	0.521
No of Beehives	0.49	0.27	0.00	0.00	0.49	0.22	2.225**
Honey production	1.30	0.52	0.01	0.01	1.29	0.48	2.682***
No of training	5.35	0.30	2.90	0.28	2.45	0.42	5.897***
Repetition of training	18.61	3.80	7.38	0.84	11.24	3.63	3.092***

*Remark: *, ** and *** implies significant at 10%, 5% and 1% significance levels, respectively.*

Estimation of results of propensity scores and FLR impacts

Estimation of propensity scores

The logit model estimates of the propensity score as a function of pre-FLR observed characteristics of households are presented in Table 3. The level of participation in FLR is determined by a combination of socioeconomic, demographic and geographical factors. The likelihood of households to participate in FLR increases with family size and the education level of household heads (Table 3). On the other hand, landholding size tends to decrease the probability of participation in FLR. Households headed by females are more likely to participate in FLR. Age of the household head has a negative and significant effect on FLR participation. Additionally, as distance to the nearest market increases, so does the probability of household participation in FLR. The estimated results also indicate that participation in FLR significantly increases as a household's pre-intervention other income declines while participation in FLR decreases as off-farm income rises.

Table 3. Logit Estimates of Participation in FLR.

Variable	Coefficient	Z-value	P-value
Household head sex (HhSex)	-0.70(0.27)	-2.63	0.009***
Household head age (HhAge)	-0.01(0.01)	-1.72	0.086*
Household head education (HhEdu)	0.53(0.23)	2.37	0.018**
Household head Marital status (HhMTS)	-0.21(0.39)	-0.54	0.589
Family size (Familysize)	0.15(0.06)	2.50	0.013**
Total land owned (OwnLand)	0.12(0.06)	1.88	0.060*
Number of economically active persons (LabAge)	-0.11(0.07)	-1.65	0.099*
Distance to market (DistMarket)	0.01(0.00)	4.42	0.000***
Credit access before FLR (CABFLR)	0.06(0.20)	0.33	0.742
Off-farm income before FLR (OffFarmIncBFLR)	-0.00(0.00)	-2.86	0.004***
Other income before FLR(OtherIncBFLR)	0.00(0.00)	1.69	0.091*
Training number before FLR (TrainNoBFLR)	0.03(0.04)	0.76	0.445
Bee hives number before FLR (BeehivesBFLR)	0.03(0.16)	-0.19	0.850
Livestock in TLU before FLR (LivestockTLUBFLR)	-0.01(0.01)	-0.98	0.325
Constant	-0.13(0.55)	-0.25	0.806
Pseudo R^2	0.1979		
Prob > chi^2	0.0000		
LR $chi^2(14)$	71.02		
Log likelihood	-143.94001		
Observations	260		

Note: Dependent variable (participation) equals one if a household participated in FLR programme and zero if not. Standard errors in parenthesis, ** and *** indicate statistical significance level at 10, 5 and 1%, respectively.*

Estimations of the Impact of FLR

Average effect of participation in FLR

The findings show that the FLR intervention had a statistically significant impact on FLR participants compared to non-participants. Significant differences were observed in terms of the number of beehives, honey production and income (Table 4 and 5). The average other income of FLR participants decreased by 844.92 ETB and off-farm income increased by 10252.4 ETB (Table 4). This may be due to declines from other income sources, such as support from relatives, transfer of funds, etc. The increase in off-farm income may likely have resulted from employment opportunities created by the FLR program for daily laborers. The results show that the average number of beehives and honey produced increased by 0.49, 1.3 kg, respectively, in FLR HHs compared to non-FLR HHs (Table 5). These results could be due to the effect of the FLR interventions. However, the focus group discussions and the key informant interviews revealed a wide range of livelihood opportunities.

Table 4. Matching estimates on average impact of FLR (ATE) in Sodo FLR sites.

Outcome variables	ATET Coefficient	AI Robust S.E	Z	P value
Crop income	-6013.77	12551.01	-0.48	0.632
Livestock income	1399.83	9962.34	0.14	0.888
Forest income	-451.15	3132.16	-0.14	0.885
Other income	-844.92	468.48	-1.80	0.071*
Off-farm income	10252.40	4324.00	2.37	0.018**
Total income	4342.39	13024.55	0.33	0.739
Credit access	0.27	0.04	6.28	0.000***
Cooperative formed	-0.05	0.08	-0.77	0.443
Livestock in TLU	-1.35	1.16	-1.16	0.246
No of Beehives	0.49	0.24	2.05	0.041**
Honey production	1.30	0.47	2.74	0.006***
No of training	3.50	0.44	7.96	0.000***
Repetition of Training	13.74	3.87	3.55	0.000***

*Remark: - *, ** and *** implies significant at 10%, 5% and 1% significance levels, respectively.*

It was observed that the FLR initiatives brought a number of training opportunities to participating HHs from government extension services, FLR project office and non-governmental organizations. Moreover, the findings indicated that FLR participants had more access to credit than before (Table 4 and 5) and as a result, the FLR initiative brought several livelihood options, such as poultry and sheep farming as well as the introduction of fuel-efficient stoves through credit to participants.

Table 5. Matching estimates on average impact of FLR (ATT) in Sodo FLR sites.

Outcome variables	Treated	Control	Difference (ATT)	S.E	T value
Crop income	58743.64	60164.24	-1420.60	9593.03	-0.15
Livestock income	26838.33	18295.78	8542.54	12517.18	0.68
Forest income	8348.88	7189.56	1159.31	2475.31	0.47
Other income	223.36	1232.76	-1009.40	821.88	-1.23
Off-farm income	17268	8164.14	9103.86	4661.32	1.95
Total income	111422.20	95046.49	16375.72	16165.92	1.01
Credit access	0.46	0.20	0.26	0.10	2.72**
Cooperative formed	0.33	0.33	0.00	0.08	0.00
Livestock in TLU	5.07	5.75	-0.69	1.37	-0.50
No of Beehives	0.28	0.00	0.28	0.11	2.62**
Honey production	1.08	0.00	1.08	0.47	2.29**
No of training	5.29	2.00	3.29	0.71	4.62***
Frequency of training	18.47	4.59	13.88	4.31	3.22**

*Remark: - ** and *** implies significant at 5% and 1% significance levels, respectively. Difference indicates the relative mean difference between participant and non-participant households.*

Perception on FLR

The results (Tables 6 & 7) showed that 83.1% of non-FLR participants were highly interested, while 12.4% were somehow interested in participating in FLR activities. The level of perception on participation also varied with 64.6% respondents saying the initiative was highly participatory and 21.5% saying it was somehow participatory. About 91.8% of the households indicated that the FLR initiative benefited society, with an additional 89.5% indicating that the local community was engaged in decision-making. About 92.1% respondents said FLR initiative attempted to consider local conditions of the area during the initiative's establishment. The shift in trust, harmony, and friendly relationships varied with 67.9% saying it increased, 17.1% significantly increased, and 14.2% stayed about the same. Following the FLR's establishment, response on illegal cutting within the FLR area was also variable, with 30% saying illegal cutting highly declined, 35% it declined, 12.9% saying it remained same, while 18.8% said it had increased. Moreover, 57.8% responded the species composition has increased with 20.8% saying the increment was very high, 12.7% remained the same. On the change in the forest cover inside FLR, about 26.9% respondents said the increment was high, 60.9% it increased somehow and 11.3% said that it remained the same.

Table 6. Perception of respondents on Forest Landscape Restoration (1).

FLR initiative	Strongly agree	Agree	Disagree	Strongly disagree
Increased species richness and diversity	46.5%	51.3%	0.9%	1.3%
Increased soil productivity and carbon storage and fresh water in the area	51.9%	45.9%	1.3%	0.9%
Recovered forests, restored biodiversity, and improved ecosystem services	54.6%	43.3%	1.3%	0.8%
Decreased soil erosion and downstream water runoff	55.8%	42.5%	0.4%	1.3%
FLR initiative increased the greenness of the area	55.2%	42.7%	0.4%	1.7%
FLR site improved livelihoods of the local community	41.6%	52.5%	1.3%	4.6%
The FLR initiative supported HHs economically	50.8%	30.1%	18.6%	0.5%
The FLR site have clear and consistent evaluation and learning framework	54.0%	42.2%	3.1%	0.6%

Table 7. Perception of respondents on Forest Landscape Restoration (2).

FLR initiative	Excellent	Good	Satisfactory	Poor
Management was adaptive in adjusting restoration strategies as per condition	41.0%	37.2%	15.5%	6.3%
FLR initiative restored ecological functionality	51.9%	29.1%	15.2%	3.8%
FLR initiative focused on landscape restoration	48.3%	33.9%	14.0%	2.5%
Encouraged youth participation	38.5%	38.5%	13.4%	9.6%
Promoted women participation	41.3%	37.4%	11.5%	9.8%
The FLR initiative allowed for multiple benefits	50.8%	30.1%	18.6%	0.5%

Similarly, the expert view on FLR was positive with 65% respondents saying the initiative was mainly participatory, 15% highly participatory, 10% somewhat participatory, and 5 % not participatory. Moreover, 60% of experts responded that the FLR initiative highly benefited society, 25% mainly benefited and 15% somewhat benefited. While 40% experts responded the FLR initiative was completely engaged, 45% mainly engaged, 10% were somewhat engaged and 5% were not engaged stakeholders in the decision-making processes. About 70% of experts strongly agreed that the FLR initiative restored degraded forest, biodiversity, and improved ecosystem services and 30% agreed to the above.

Table 8. Perception of experts on Forest Landscape Restoration.

FLR initiative	*Excellent*	*Good*	*Satisfactory*	*Poor*	*Not applicable*
Implementation was based on adaptive management in adjusting restoration strategies in response to social, economic and environmental change	50%	45%	5%		
Its focus on landscape restoration was satisfactory	45%	50%			5%
It adequately included ecological functionality in its restoration activities	30%	50%	10%	10%	
It allowed for multiple benefits satisfactorily	45%	35%	20%		
It enabled women participation	40%	40%	15%	5%	
It promoted youth participation	30%	40%	25%	5%	
Adopted adaptive management in adjusting restoration strategies as per condition of FLR sites and local communities	40%	35%	25%		
The management intervention of FLR site was satisfactory	45%	45%	5%		
FLR initiative	*Strongly agree*	*Agree*	*Disagree*	*Strongly Disagree*	
FLR sites have clear and consistent evaluation and learning framework	20%	70%	5%	5%	
The FLR initiatives addressed problems of land degradation and forest degradation	45%	45%	10%		
The intervention restored degraded forests, biodiversity, and improved ecosystem services	70%	30%			
FLR interventions enhanced human well-being	65%	35%			

Conclusion

FLR initiatives in Sodo district were established in a participatory way, restored degraded forests, conserved biodiversity and improved ecosystem services. FLR initiatives also improved the credit access and provisioning of training, increased the number of beehives and honey production. In addition, they restored ecological functionality, increased the greenness of the area, species richness and diversity, youth and women participation and helped improve livelihood of the local community. It can be concluded that FLR is executed in the manner that needs to be developed. It is widely perceived that FLR interventions are contributing to improving to improving the local, weather, ecological integrity, and some aspects of participants' livelihoods. To maximize positive impacts on livelihoods, FLR interventions need to be accompanied with agricultural intensification and forest friendly livelihoods diversification and income generating options. This implies that policy coordination across agriculture, forestry and other natural resources sectors has to be improved. Identification and promotion of business-oriented forest development that help create new jobs for the communities considered during the planning and implementation of FLR interventions.

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