




## Impact of Forest Landscape Restoration (FLR) on rural households' livelihood: The case of Sodo FLR, South Central Ethiopia

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### ABSTRACT

Ethiopia has pledged to restore 22 million ha of degraded and deforested lands by 2030. With the massive Forest Landscape Restoration (FLR) efforts underway, however, there are no sufficient empirical studies that signify the effectiveness of FLR in the country. Therefore, the study evaluated the impact of the FLR program on rural households' livelihoods in Sodo, Southern Central Ethiopia. A two-stage random sampling technique was followed to draw the sample households, and 260 sample households (120 households from FLR participating and 140 households from non-FLR participating) were chosen randomly. Data on socio-demographic characteristics, head of household assets, access to credit, land size, household income and related expenditures were considered. In addition, data was gathered through key informant interviews, focus group discussions, direct field observations, and reviewing project documents and activity reports. 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 10252.4 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. Moreover, several households benefited from the FLR initiative's program offer to sustain their livelihoods by producing sheep and poultry. In conclusion, FLR initiatives should be combined with agricultural intensification and diversification as well as business-oriented forest development for better impact.

**Keywords:** FLR, Impact, Livelihood, Perception, Forest degradation

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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). FLR is an important strategy to restore land resources and improve the resilience of local communities globally, and a means of implementing Bonn Challenge targets to restore 150 million ha of degraded lands by 2020 (Pistorius *et al.*, 2017). To reverse deforestation, land degradation and generate economic benefits from timber, non-timber forest products, and fodder while achieving environmental services, the Government of Ethiopia (GOE) has 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 in collaboration with development partners has been engaged in forest plantation development and forest land rehabilitation to reduce climate change, poverty, hunger and other human deprivations. The program was initially launched in nine districts, later accommodating 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 Program (IS-FSDP) project. 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 through support from development partners. A total of 31 rural kebeles have participated in the program.

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 in the area and elsewhere in Ethiopia on its impacts and as a basis for 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 strived to address two major issues: i) the community's perception of FLR in response to FLR program implementation ii) the impact of the FLR programs on the livelihoods of rural households.

## Methodology

### Study area

This study was conducted in Sodo district, Southern Nations, Nationalities, and Peoples' Region, Ethiopia. Geographically, the district lies between 8°26'56"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 the dry Afromontane Forests and the Acacia-Commiphora woodland types. Enset (*Ensete ventricosum*), barley, legumes, wheat, and potatoes are the principal food crops.

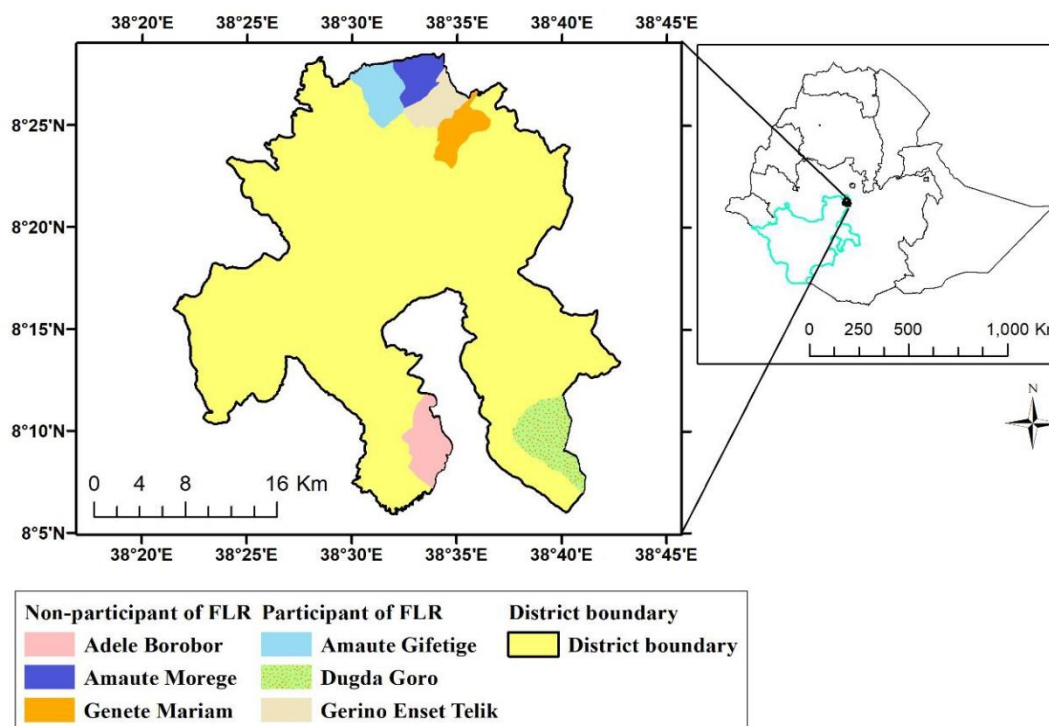


Figure 1. Study area map (Source: Nesibu Yahya, 2022).

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 km<sup>2</sup> of land. The majority of people in the district reside in rural areas and the average family size of the district is 5 people per household. The major sources of income for households in the area 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 through small-scale irrigation mostly for local markets. In addition, eucalyptus tree sales, livestock trade (from animal fattening), and other off-farm activities are extra sources of 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) (plantation) on 1700 ha and Assisted Natural Regeneration (ANR) (enclosure) on 16,500 ha in 2016 and 2017, respectively, with support from development partners. The rehabilitation work was conducted after verbal and written agreements with the local community. The major activities included area closure, soil and water conservation structures construction, nursery establishment and seedling production, compost preparation, pitting, desho grass preparation, and bamboo introduction. The project purchased tools and equipment for nursery and plantation activities, which were provided to farmers. Supportive activities were also initiated, including the introduction of fuel-efficient stoves with the establishment of women's cooperatives, seedling production, poultry, sheep, and modern beehives for the production of honey.

### **Sample size and household survey for data collection**

The household survey study sampled 260 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 locality 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 is used to produce all 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 reviewing project documentation 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 also 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, let  $Y_i$  represent the outcomes of household  $i$  (Khandker *et al.*, 2010). For participants,  $T_i = 1$ , and therefore the value of  $Y_i$  under treatment was represented as  $Y_{i1}$ . For non-participants,  $T_i = 0$ , and the value of  $Y_i$  can be represented as  $Y_{i0}$ . Moreover, variables that are likely to influence participation in FLR and its impacts on outcomes variables of interest were selected and used in the study. 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; ME FCC, 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-intervened households are remoter to the nearest market, have larger family size and are higher in total land owned compared to non-FLR participants (Table 1). The FLR participants are also characterized by lower age. Households that participated in the FLR program had a 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 the sampled households by FLR participation status.

Categorical Variables	Category	Participation in FLR		Total (Frequency and %)	Chi <sup>2</sup> square (Sig)
		FLR (120)	Non- FLR (140)		
Household head sex (HhSEX)	1= Male	95	121	216(83.1)	0.120
	0= Female	25	19	44(16.9)	
Household head education (HhEdu)	1 = Literate	92	93	185(71.2)	0.069
	0 = Illiterate	28	47	75(28.8)	
Household head marital status (HhMTS)	1= Married	110	134	244(93.8)	0.176
	0 = Otherwise	10	6	16(6.2)	
Credit access before FLR (CABFLR)	0= no	83	106	189(72.7)	0.237
	1= yes	37	34	71(27.3)	
Credit access	0= no	92	136	228(87.7)	0.000***
	1= yes	28	4	32(12.3)	
Cooperative formed	0= no	75	124	199(76.5)	0.000***
	1= yes	45	16	61(23.5)	
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 participating 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. The 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 <sup>2</sup>	0.1979		
Prob > chi <sup>2</sup>	0.0000		
LR chi <sup>2</sup> (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 estimated FLR program had a statistically significant impact on FLR participants compared to the non-participants. Accordingly, there were significant differences in terms of the number of bee hives, honey production and income (Table 4 and 5). The average other income of FLR participants decreased by 844.92 ETB and the off-farm income of FLR 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 (difference (ATT) show that the average number of beehives and honey produced increased by 0.49, and 1.3 kg, respectively, in FLR HHs compared to non-FLR HHs (Table 5). These results could be well 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 offices, and non-governmental organizations. Moreover, the findings indicated that FLR participants had more access to credit

than before (Tables 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***
Repetition 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 of Forest Landscape Restoration (FLR)

The results (Tables 6 & 7) showed that 83.1% of non-FLR participants were completely 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 completely 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 there was a very high decrease, 35% decrease, 12.9% saying it remained the same, and 18.8% saying it increased. Moreover, 57.8% responded the species composition has increased with 20.8% saying a very high increase, 12.7% remained the same. On the change in the forest cover inside FLR, about 26.9% respondents said it highly increased, 60.9% increased and 11.3% about the same.

Table 6. Perception of Forest Landscape Restoration (FLR) (1).

FLR initiative	Strongly agree	Agree	Disagree	Strongly disagree
Increase species richness and diversity	46.5%	51.3%	0.9%	1.3%
Increase soil productivity and carbon storage and fresh water in the area	51.9%	45.9%	1.3%	0.9%
Recovers forests, restore biodiversity, and improve ecosystem services	54.6%	43.3%	1.3%	0.8%
Decrease soil erosion and downstream water runoff decreased	55.8%	42.5%	0.4%	1.3%
FLR initiative increases the greenness of the area	55.2%	42.7%	0.4%	1.7%
FLR site improves the livelihood of the local community	41.6%	52.5%	1.3%	4.6%
The FLR initiative supports the household economically	50.8%	30.1%	18.6%	0.5%
The FLR site has a clear and consistent evaluation and learning framework	54.0%	42.2%	3.1%	0.6%

Table 7. Perception of Forest Landscape Restoration (FLR) (2).

FLR initiative	Excellent	Good	Satisfactory	Poor
Management adaptability 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 focuses on landscape restoration	48.3%	33.9%	14.0%	2.5%
Youth participation	38.5%	38.5%	13.4%	9.6%
Women participation	41.3%	37.4%	11.5%	9.8%
The FLR initiative allows for multiple benefits	50.8%	30.1%	18.6%	0.5%
The rate of the FLR site implemented based on adaptive management	56.1%	22.0%	19.5%	1.2%

Similarly, the expert view on FLR was positive with 65% respondents saying the initiative was mainly participatory, 15% completely participatory, 10% somewhat participatory, and 5% not participatory. Moreover, 60% of experts responded that the FLR initiative benefited society completely, 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, and biodiversity, and improved ecosystem services and 30% agreed.

Table 8. Perception of Experts on Forest Landscape Restoration (FLR).

FLR initiative	Excellent	Good	Satisfactory	Poor	Not applicable
Implementation based on adaptive management in adjusting restoration strategies in response to social, economic and environmental change	50%	45%	5%		
Focus on landscape restoration satisfactory	45%	50%			5%
Ecological functionality restoration is satisfactory	30%	50%	10%	10%	
Allow for multiple benefits satisfactory	45%	35%	20%		
Women participation	40%	40%	15%	5%	
Youth participation	30%	40%	25%	5%	
The management adaptability in adjusting restoration strategies as per condition in the FLR initiative	40%	35%	25%		
The management intervention of FLR site	45%	45%	5%		
<b>FLR initiative</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>	
FLR site has a clear and consistent evaluation and learning framework	20%	70%	5%	5%	
The FLR initiatives address problems of land degradation and forest degradation	45%	45%	10%		
Restore degraded forests, and biodiversity, and improve ecosystem services	70%	30%			
Enhances human well-being	65%	35%			

## Conclusion

FLR initiatives were established in a participatory way, restoring degraded forests, and biodiversity and improving ecosystem services. FLR initiatives also improved the credit access and provisioning of training, and increased the number of beehives and honey production. FLR initiatives restored ecological functionality, increased the greenness of the area, species richness and diversity, youth and women participation and livelihood of the local community. It can be concluded that FLR is executed in the manner that needs to be developed. Forest Landscape Restoration (FLR)

is changing the weather, ecological integrity, and some aspects of participants' livelihoods. FLR must be combined with agricultural intensification and diversification, to have a significant impact on the community's livelihoods. This implies that policy coordination across agriculture, forestry and other natural resources sectors has to be improved. The construction of business-oriented forest development that aids in creating jobs for the community is an additional aspect that must be considered during the initiation and development of FLR.

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