MARN
Ministerio de Medio Ambiente y Recursos Naturales

IUCN

STRENGTHENING THE NATIONAL RESTORATION STRATEGY

1. INTRODUCTION

Lack of resilience to climate variability and extreme events associated with climate change increases the vulnerability of a society because of the poor ability to resist, absorb, adapt and recover from climate threats (Berrizbeitia et al., 2014). El Salvador is a country vulnerable to climate change (ECODIT, 2016). This vulnerability affects a wide range of areas of life such as the mobility of the people, health, food production and security, construction and development of urban spaces and rural settlements, as well as physical infrastructure for road connectivity, among others (Barry, 2012).

About 89% of the national territory is at risk due to severe environmental degradation which has magnified the vulnerability (Barry, 2012; PRISMA, 2015). It was noted that 42% of landslide-prone areas and 64% of major water recharge areas are areas lacking tree cover. Furthermore, 67% of the riparian forests of the main rivers have been lost (MARN, 2014).

In response to extreme events and climatic variability, El Salvador formulated in 2012 the National Environmental Policy (GOES, 2012a). This policy has as one of its main components of action the restoration and conservation of ecosystems to reduce risks, sustain productive activities and ensure the well-being of the population (MARN, 2013). Within this framework, the National Program for Restoration of Ecosystems and Landscapes[1] (PREP, for its acronym in Spanish), was structured in synergy with the other strategies of the National Environmental Policy: Biodiversity, Environmental Sanitation and Water Resources and the National Plan for Climate Change in El Salvador (PRISMA, 2015).

Today landscape restoration is recognized as a key strategy not only to restore ecological integrity, but also to generate additional local, national and global benefits. Landscape restoration seeks to improve livelihoods, strengthen territorial development, and increase food and water security (Doswald and Osti, 2011). The restoration of natural infrastructure and the integrated management of natural resources enables the population to adapt to the adverse effects of climate change, helping to deal with problems such as rising sea levels, floods, hurricanes and modification of water regimes (Lhumeau, 2014; Rizvi et al., 2015).

1 http://www.marn.gob.sv/programa-nacional-de-restauracion-de-ecosistemas-y-paisajes-prep/.

In September 2011, the **Bonn Challenge**[2] was launched with the support of the German government, the Global Partnership on Forest and Landscape Restoration (GPFLR) and the International Union for Conservation of Nature (IUCN). With this global initiative, commitments were made to restore 150 million hectares of degraded and deforested land in the world by 2020; and 350 million hectares by 2030. In 2012, **El Salvador undertook the commitment to restore one million hectares.**

It is in this context that the Ministry of Environment and Natural Resources (MARN, for its acronym in Spanish) of El Salvador and IUCN have been jointly designing and implementing tools and instruments to strengthen and prioritize PREP actions and coverage. For this purpose, the Restoration Opportunity Assessment Methodology[3] (ROAM) was applied to determine and analyze restoration options based on biophysical, social and economic criteria, following the steps detailed in Figure 1.

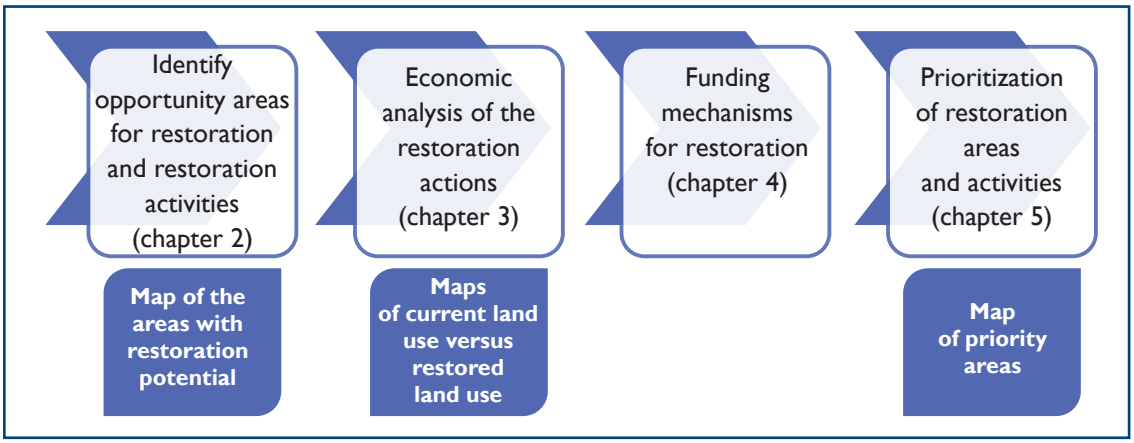

Figure 1: The different phases of ROAM. Source: Authors based on IUCN and WRI, 2014

The following is a summary of the main results generated in the ROAM application. The results are part of the inputs for the decision making for landscape restoration in El Salvador.

2 www.bonnchallenge.org.

3 Methodology elaborated by IUCN and the World Resource Institute (WRI). https://www.iucn.org/theme/forests/our-work/forest-landscape-restoration/restoration-opportunities-assessment-methodology-roam.

2. OPPORTUNITY AREAS FOR RESTORATION AND RESTORATION ACTIVITIES

The criteria for identifying the areas that provide a specific ecosystem service to be recovered or improved and the priority objectives were defined in a participatory and intersectoral manner with different actors involved in restoration (Figure 2).

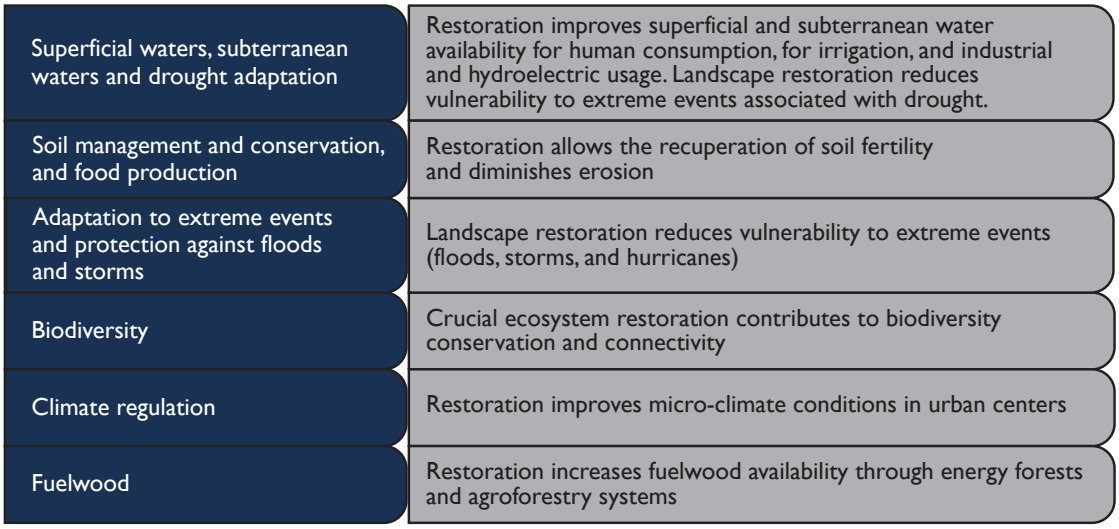

Figure 2: Criteria for defining opportunity areas.

Through a multi-criteria analysis at the spatial level, the map of areas with restoration opportunities in El Salvador was generated. These areas total 1,253,077 hectares. The restoration opportunity map was overlapped with the map of current land uses to identify prioritized restoration actions.

From the different current land uses, the transitions[4] prioritized to improve and recover the relevant ecosystem goods and services were identified. The transitions were also based on the restoration actions identified earlier in the PREP and were based on criteria of climate-smart agriculture (World Bank 2015). In order to continue with the application of the ROAM, seven current land uses (Figure 3) and nine transitions towards a more sustainable use of the soil were prioritized, covering around one million hectares (Table 1).

4 Transition refers to restoration options. These are the restoration strategies and techniques that are considered for analysis and implementation within the ROAM process.

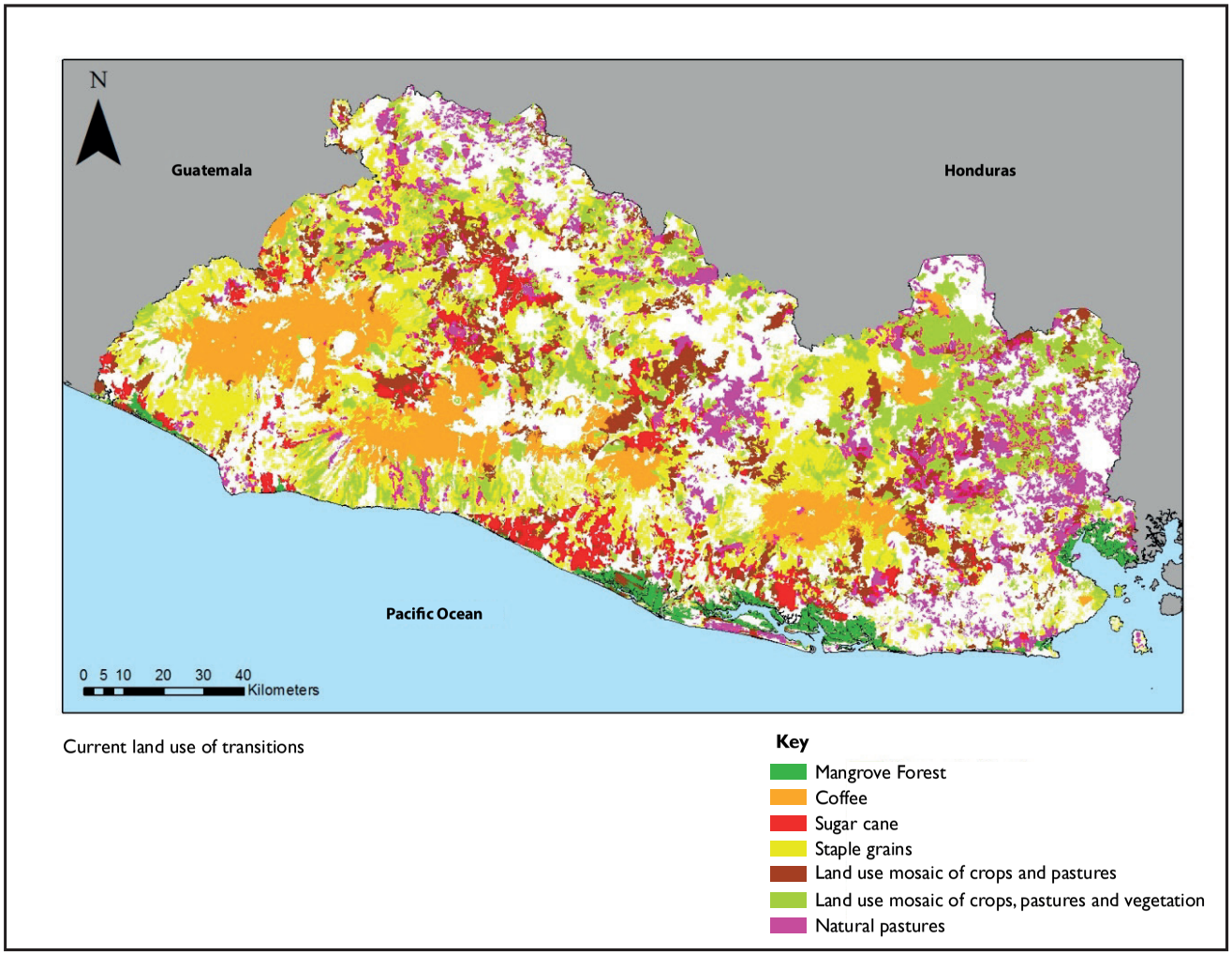

Figure 3: Map of current land uses where the implementation of transitions is analyzed.

Table 1: Prioritized transitions in current land uses, and area (in hectares).

Transitions	Current land uses	Potential area (ha.)
1. Staple grain agroforestry system	Staple grains	359,208
2. Silvopastoral system	Natural pastures	195,590
3. Agrosilvopastoral system	Land use mosaic of crops and pastures	84,536
4. Cacao agroforestry system (1)	Land use mosaic of crops pastures and vegetation < 900 masl	82,716
5. Green harvest in sugar cane	Sugar cane	77,441
6. Cacao agroforestry system (2)	Coffee < 900 masl	66,369[(a)]
7.1. Lowland coffee rehabilitation	Coffee < 800 masl	47,615
7.2. Medium altitude coffee rehabilitation	Coffee 800 - 1,200 masl	41,000
7.3. Highland coffee rehabilitation	Coffee > 1,200 masl	26,000
8. Riparian forest restoration	Crop mosaic, pastures and vegetation	5,653
	Sugar cane	4,298
	Crop mosaic and pastures	3,821
	Natural pastures	3,158
	Staple grains	2,000
9. Mangrove restoration	Degraded mangroves	2,000
Total		**935,036**

(a) Same area as lowland coffee and portion of medium altitude coffee.

Source: Raes et al., 2017.

3. RESULTS OF ECONOMIC ANALYSIS

In order to quantify and qualify the potential impacts of implementing restoration actions, the long-term[5] financial and economic results of current land uses and transitions were evaluated in accordance with the different management systems[6] considered, and the results of both land uses were compared. In addition to estimating direct income (monetary benefits), the analysis consisted of evaluating the co-benefits that correspond to the environmental and social benefits of restoration actions.

In the first step, it was possible to calculate the profitability of the different current land uses and the transitions (Table 2). In the second step the incremental monetary benefits of the restoration actions were defined (Figure 4). This benefit is defined as the marginal net present value (NPV) and it is the difference between the net benefit of the transition and the net profit from the current land use.

From the financial analysis, the following results stand out:

- Considering productive activities in the current land use scenario, dual-purpose livestock in natural pasture is the most profitable; and the least profitable is the production of lowland coffee (coffee plantations at an altitude of less than 800 masl).

- In the scenario with the transitions, the most profitable is the silvopastoral system on natural pasture; while the least profitable is the restoration of riparian forest because it is not associated with productive purposes, but to the conservation of this ecosystem.

- The transitions with the greatest incremental monetary benefit are the cacao agroforestry systems. The riparian forest restoration is the only one that has a negative marginal NPV.

5 The time considered was 20 years, both for income generation as for costs, and is based on the duration of growth before harvest of timber species.

6 Including agronomic / forestry practices, crop productivity, and growth of tree species.

Table 2: Costs and benefits of current land use (current value with r=10%[7]) and the transitions.

Land use	Total costs (US$/ha.)	Gross benefits (US$/ha.)	Net benefits, NPV (US$/ha.)
Current use			
1. Staple grains	8,429	12,559	4,130
2. Natural pastures	16,856	24,409	7,553
3. Crop mosaic and pastures	16,896	21,534	4,638
4. Crop mosaic, pastures and vegetation < 900 masl	11,410	14,510	3,100
5. Sugar cane	17,581	20,803	3,222
6. Coffee < 900 masl	3,619	4,826	1,206
7. Coffee < 800 masl	3,289	4,385	1,096
8. Coffee 800 - 1,200 masl	4,115	5,487	1,372
9. Coffee > 1,200 masl	6,826	9,101	2,275
10. Weighted average (1, 2, 3, 4 & 5)	13,436	17,764	4,329
11. Degraded mangroves	0	0	-
Transition			
1. Staple grain agroforestry system	17,632	22,070	4,438
2. Silvopastoral system	24,543	42,812	18,269
3. Agrosilvopastoral system	19,802	31,926	12,124
4. Cacao agroforestry system (1)	22,372	37,845	15,473
5. Green harvest in sugar cane	20,639	24,706	4,067
6. Cacao agroforestry system (2)	20,148	34,915	14,767
7. Lowland coffee rehabilitation	18,695	21,589	2,894
8. Medium altitude coffee rehabilitation	18,695	24,698	6,003
9. Highlands coffee rehabilitation	18,695	31,771	13,076
10. Riparian forest restoration	5,166	0	-5,166
11. Mangrove restoration	15,420	19,481	4,061

Source: Raes et al., 2017.

7 r= discount rate. The 10% discount rate is used by the Government of El Salvador in its financial forecast of the FOMILENIO environmental evaluation (GOESb, 2012).

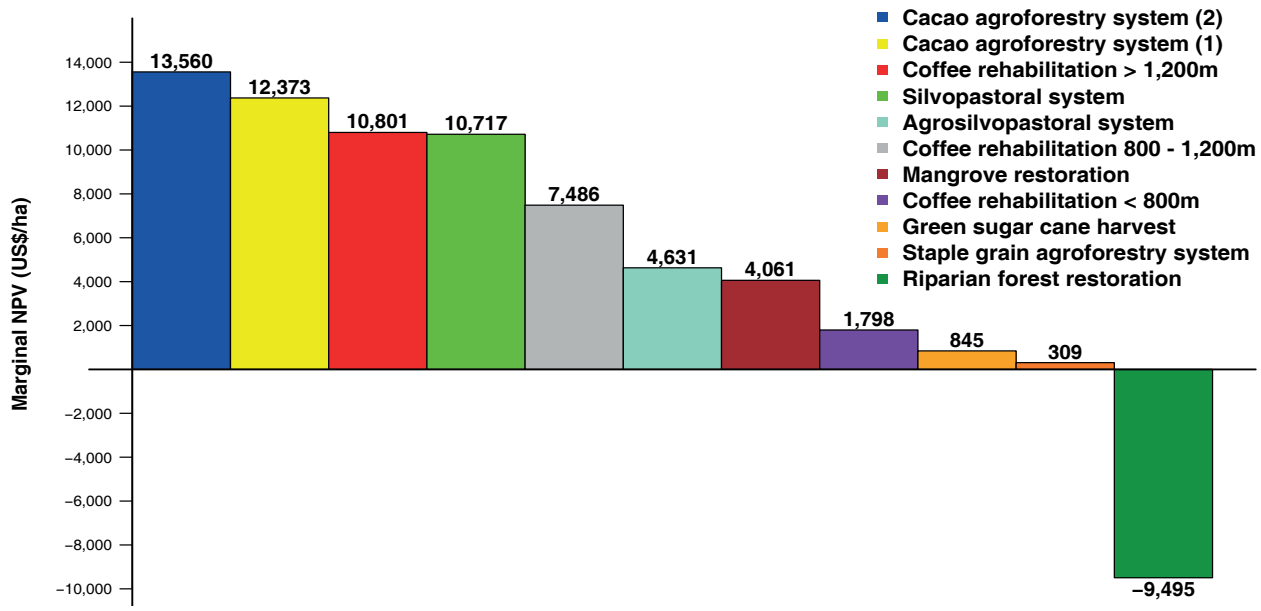

Figure 4: Marginal Net Present Value of Transitions (discount rate r=10%). Source: Raes et al., 2017.

In addition, changes in the generation of co-benefits between current land uses and proposed transitions were evaluated. Specifically, for ecosystem services the following were considered: (1) change in erosion and sediment export; (2) change in the export of nutrients (Nitrogen and Phosphorus) as a result of the application of fertilizers[8] (Table 3); and (3) the impact of transitions on carbon sequestration and storage, i.e. the carbon balance[9] (Figure 5).

8 Erosion and export of sediments and nutrients (N and P) were estimated using the spatial analysis tool InVEST (see http://www.naturalcapitalproject.org).

9 To estimate carbon balance, the EX-ACT tool was used (see English website: http://www.fao.org/tc/exact/ex-act-home/en/).

Table 3: Impact of restoration on ecosystem services.

Transition	Erosion change	Sediment export change	Nitrogen export change	Phosphorus export change
1. Staple grain agroforestry system	↓↓↓	↓↓	↑	↑↑
2. Silvopastoral system	↓↓	↓	↑	↑↑
3. Agrosilvopastoral system	↓↓	↓	↑	↑↑
4. Cacao agroforestry system (1)	↓↓↓	↓↓↓	↓	↓
5. Green harvest in sugar cane	↓	↓	↓	↓
6. Cacao agroforestry system (2)	↓↓	↓↓↓	↑	↓
7. Lowland coffee rehabilitation	↓	↓	↓	↓
8. Medium altitude coffee rehabilitation	↓↓	↓	↓	↓
9. Highlands coffee rehabilitation	↓↓	↓	↓	↓
10. Riparian forest restoration	↓	↓↓	↓↓↓	↓↓↓
11. Mangrove restoration	n/a	n/a	n/a	n/a

↓↓↓ : Reduction comparatively very high.
↓↓ : Comparatively high reduction.
↓↓ : Relatively moderate reduction.
↑↑ : Comparatively moderate increase.
↑ : Comparatively high increase.

Source: Raes et al., 2017.

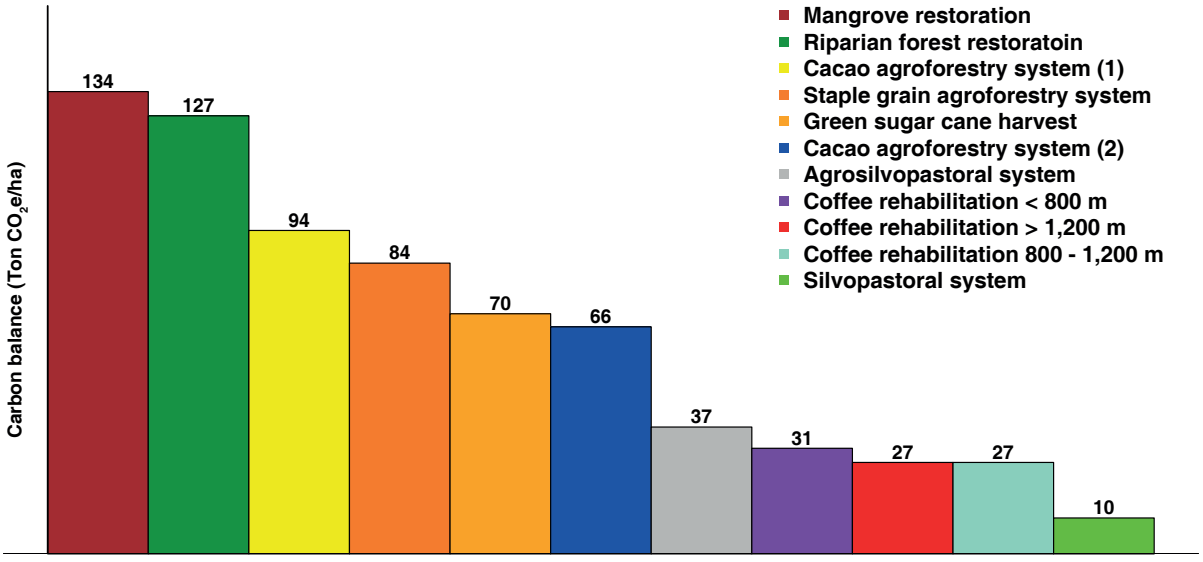

Figure 5: Carbon balance of restoration actions (Tonnes CO_2e/ha). Source: Raes et al., 2017.

To quantify the social impact, the effect of the transitions on job creation[10] was estimated for the implementation year (Figure 6A), as well as for the maintenance of the transitions from year 2 to 20 (Figure 6B). Figure 6 shows that, with the exception of the restoration of riparian forests, all transitions are activities generating additional employment. The green sugarcane harvest is the activity that generates the greatest increase in employment over the 20 years considered.

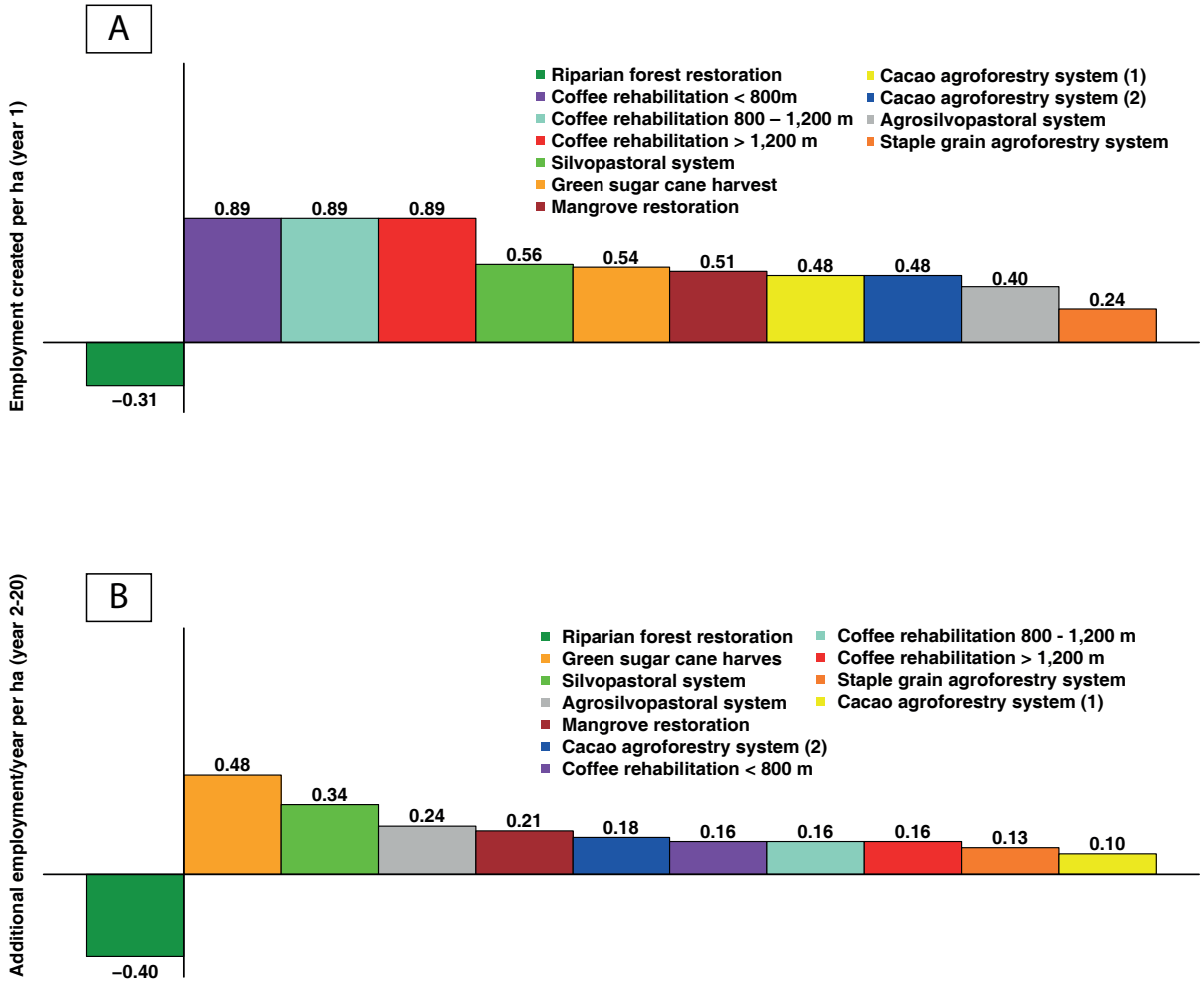

Figure 6A y 6B: Generation of additional employment per hectare for 20 years by transition. Source: Raes et al., 2017.

10 One job is equivalent to the generation of 250 additional work days a year.

4. FINANCIAL MECHANISMS

In addition to creating and utilizing viable financial tools, the fulfillment of restoration goals involves defining, identifying and channeling financing. Therefore, for each of the transitions identified, the existing and potential tools were analyzed and a proposal for a financial mechanism was designed.

For each set of transitions, the types of investments / investors were taken into account for each of the financing tools (see Table 4).

Table 4: Available and potential funding instruments to support restoration.

Funding instruments	Type of investment/investor
a. Obligation/bond.	• Impact investment fund. • Traditional investors (banks, pension funds). • Governments.
b. Investment capital	• Impact investment funds. • Traditional investors. • Development finance institutions.
c. Crédito.	• Traditional investors. • Microfinance institutions. • National and local banks.
d. Donation.	• National and international cooperation. • Private foundations. • Development finance institutions.
e. Subsidy.	• Governments. • Environmental funds. • Development finance institutions.
f. Compensation for environmental services.	• Conservation NGO. • Private businesses. • Governments. • Environmental funds.
g. Buyback agreement.	• Private businesses. • Governments. • Impact investment funds. • Traditional investors.
h. Guarantee.	• Traditional investors. • Development finance institutions.

Source: Adapted from FAO and UNCCD Global Mechanism, 2015.

In order to identify and analyze the financing instruments, the following were taken into account: the existing institutions, the level of and the current current operation of these instruments, and also their degree of adaptation to the conditions required[11] for the successful implementations of the transitions.

The proposed mechanism for the transition "rehabilitation of coffee plantations", including instruments, sources, financing channels and associated actors is shown in Figure 7, as an example.

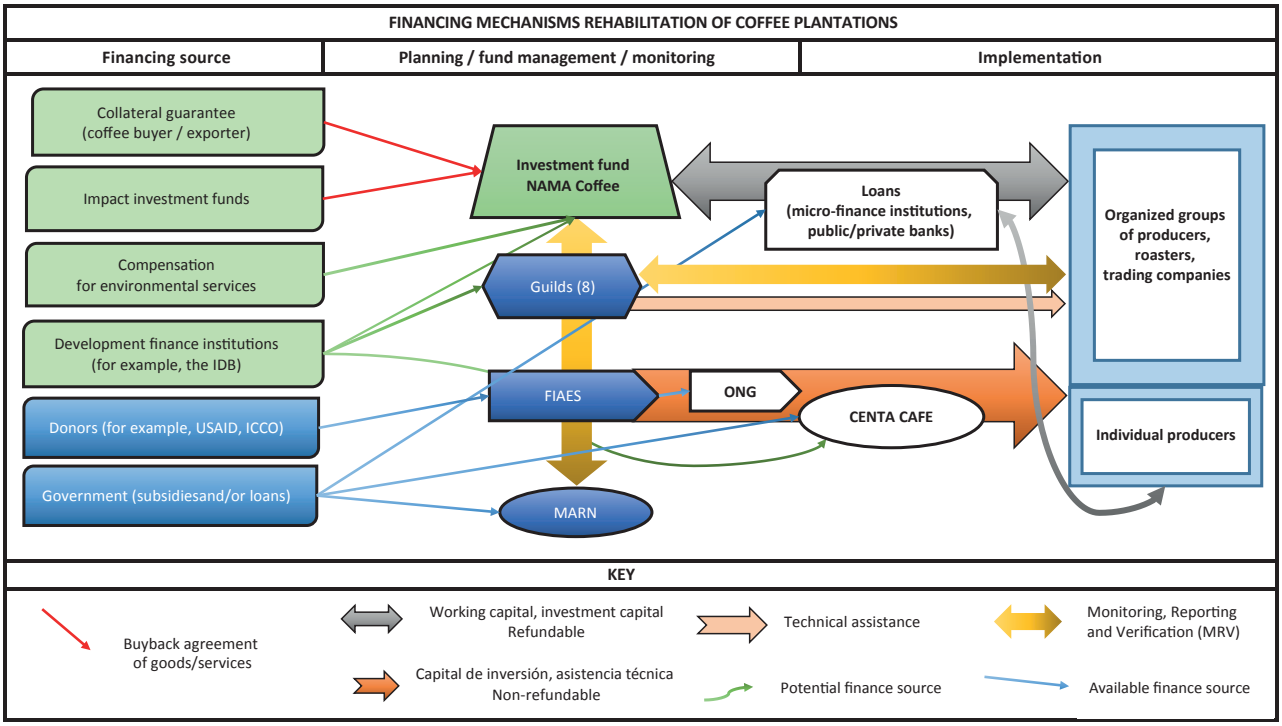

Figure 7: Proposal for a financing mechanism for the renewal of coffee plantations. Source: IUCN, 2017.

11 For example: term, solvency of producers / companies, type of capital required (labor and investment), expected impacts on social and environmental benefits (goods and services for public use).

5. PRIORITY AREAS FOR RESTORATION

The potential restoration area with the identified transitions is practically equivalent to the goal to which El Salvador committed itself. However, it is necessary to point out that the implementation will be carried out gradually. In order to support decision-making for the gradual implementation of the restoration strategy, it was considered necessary to prioritize the associated areas and transitions through a spatial multi-criteria analysis of the financial, social and environmental benefits resulting from the economic analysis previously described.

The spatial multi-criteria analysis retakes some of the criteria of identifying restoration opportunity areas and takes into account the existence of spatial criteria, such as the impacts on the ecosystem service of erosion control and the related sediment export, as well as the spatial variability in demand for these ecosystem services or the importance of the socio-economic impact of transitions (e.g. micro-watersheds used to produce hydroelectricity, the level of unemployment by department or fuelwood consumption by municipality). For this multi-criteria analysis, a wide range of indicators is used, with a weighting for the prioritization criteria obtained in a participatory manner (Table 5). Based on these criteria, the mapping of priority restoration areas and their associated transitions are being carried out.

Table 5: Spatial prioritization criteria and their weighting.

Weighting criteria	Prioritization criteria	Opportunity criteria
1.00	Erosion control for soil fertility	X
1.00	Control of sediment exports for drinking water quality	X
1.00	Control of sediment exports for hydroelectric production	X
0.99	Food security (increase in production)	
0.98	Impact on unemployment (job creation)	
0.98	Impact on poverty (income generation for producer households)	
0.90	Increase in short-term income (r = 15%)	
0.83	Improvement in connectivity (biological corridors)	X
0.83	Nitrogen export control for drinking water quality	X
0.83	Phosphorus export control on eutrophication of water bodies	X
0.81	Increase in long-term income (r = 5%)	
0.77	Production and consumption of firewood	X
0.73	Carbon balance	
0.69	Closeness to national and international markets	
0.57	Distance from major urban centers	

Source: Raes ., 2017.

6. MONITORING

As part of an ongoing process, a national monitoring plan is being defined to monitor and measure the impact of restoration interventions in the medium and long term; and for this purpose, an inter-institutional and interdisciplinary team was formed by MARN, FIAES, PRISMA, WRI, IUCN, and CRS. In addition, support is provided by the Network of Local Environmental Observers, and the integration of existing platforms and information, such as GEOCUMPLIMIENTOS[12], will be strengthened with data from the monitoring plan. Methodologies are being analyzed for obtaining data on aspects and indicators related to examples such as: increasing productivity, connectivity, biodiversity conservation and strengthening livelihoods, among others.

The monitoring plan will have four working axes:

- Participation of strategic actors.
- Administration and information use.
- Training and communication.
- Learning and knowledge management (based on lessons learned).

7. CONCLUDING REMARKS

The ROAM was applied in El Salvador following the country´s national priorities and international commitments. Landscape restoration responds to the need of implementing convergent and intersectoral actions for the adaptation and mitigation of climate change, giving priority to the resilience of communities, and to different productive and business sectors that depend on natural resources.

The inputs generated will enable the PREP to be strengthened, to pool ongoing efforts, initiatives and investments in the territories with a view to contributing to adaptation to climate change. In the short and medium term, it seeks to incorporate restoration patterns and priorities into national planning so as to contribute, among other things, to achieving the national and international commitments acquired by the country such as the 15th Aichi target of the CBD or UNFCCC's REDD + goal.

12 http://apps2.marn.gob.sv/geocumplimiento/restauracion/mapa.php.

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