

Models From LRI's Landscape Restoration Interventions for Climate Change Adaptation & Mitigation in Lebanon



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Overview of LRI

- Lebanese NGO specialized in landscape restoration since 2010
- Reforestation one primary activity
- Contributing to the Lebanese Ministry
 Agriculture 40 Million Tree Program

• Surface area planted to date : 1435 Ha

• Seedlings planted by LRI since 2011: 973,935



Historical Carbon Sequestration Service of Lebanese Forests

- Inscriptions to mark the boundary of ~80% of Lebanese forests decreaded by Roman Emperor August Hadrien (117-138 B.C)
- Area of dense forests of *Cedrus libani*, *Abies cilicica*, *Juniperus excelsa* and *Quercus spp*. during the Romain Era : **172,000 Ha**

• 1,201,420 Tonnes of CO₂ annually removed from the atmosphere



Lebanese Forests, Reforestation and Climate Change Mitigation

- Lebanon's INDC :
 - Unconditional Target: 15% reduction in GHG emissions by 2030 compared to the Business-As-Usual (BAU) scenario in 2030
 - Conditional Target: 30% reduction in GHG emissions by 2030 compared to the BAU scenario
- GHGs covered: CO₂, CH₄, N₂O
- Two of the main pillars to mitigate GHG emissions under INDC :
 - ✤ 40 Million Tree Program
 - Landscape degradation neutrality
- Lebanon's green cover removed 3.5 million Tonnes of CO₂ emissions from the atmosphere in 2013



(Source: Ministry of Environment, 2015)

Transportation Sector Emissions in Lebanon

In **2013**:

- Lebanon's emissions reached 26.3 million Tonnes CO2 eq
- 23% of emissions from the transportation sector

(Source: MoE, 2017)



CO column number density (mol/m²) taken with Sentinel-5P-Tropomi

NO2 column number density (mol/m²) taken with Sentinel-5P Tropomi



Date: March 2019

Date: 10 March 2019

Mitigation Through Reforestation A Static Model



GHG emissions from transportation service

• Reputation as green company

Lebanon Reforestation Initiative



• Carbon sequestered equivalent to GHG emitted

Mitigation Through Reforestation A Static Model

Private Sector Company

- 658 cars of different specifications
- Annually travelled distance of car flee

Lebanon Reforestation Initiative

- Area to be converted to forest based on IPCC guidelines (C sequestered in growing trees)
- Number of trees to be planted (500 / Ha)



Agreement

- Funding for mitigation based on cost of planting required number of trees (one-way assumption)
- Reporting based on number of trees planted

Mitigation Through Reforestation A Dynamic Model





A Forest in the Making Characteristics of Study Area

- Area: 45.2 Ha
- Elevation range: 890 1010 m
- Seedlings planted: 45,980
- 13 species (mostly deciduous)
- Planting years: 2011, 2012, 2013



Examples of Monitoring Indices

Satellite	Resolution	Index	Dates	Calculation Method	Proxy For	Site
Landsat 5 & 8	30 * 30 m	Proportion of Vegetation (PV)	Spring 2008, 2009, 2013, 2014, 2016, 2017, 2018	 Radiometric calibration Atmospheric correction Square ((NDVI – NDVI min) / (NDVI max - NDVI min)) 	Green cover change	Change of herbaceous cover (mostly) considering resolution of imagery & age of trees planted
Landsat 5 & 8	30 * 30 m	Normalized Difference Moisture Index (NDMI)	Spring 2008, 2009, 2013, 2014, 2016, 2017, 2018	 Radiometric calibration Atmospheric correction (NIR - SWIR) / (NIR + SWIR) 	 Radiometric calibration Atmospheric correction (NIR - SWIR) / (NIR + SWIR) Moisture content in leaves and reflection of water availability in soil 	
Landsat 8	30 * 30 m	Red Green Ratio (RGR)	Spring 2013, 2014, 2016, 2017, 2018	 Radiometric calibration Atmospheric correction Mean red range bands / mean green bands range 	Green cover foliage growth & canopy stress	Health & growth of herbaceous cover & trees planted (after a certain age)

A forest in The Making - Dynamic Model -

Change in Proportion of Vegetation Before and After Planting in Anjar



A forest in The Making - Dynamic Model



A forest in The Making - Dynamic Model Avoided Social Cost of Carbon

Region	Total Lands converted to Forests from the previous year	New land added to the category: Land converted to Forest	Total lands in the category: Lands converted to Forest	G _W (tonnes d.m. ha ⁻¹ yr ⁻¹)	R (Dimensionless)	G _{Total EXT_MAN} (tonnes d.m. ha ⁻¹ yr ⁻¹)	Carbon Fraction (tonnes C (tonne d.m.) ⁻¹)	DCLF _{Growth} (tonnes C yr ⁻¹)	CO2 removal (tonnes)	Above and Below ground Biomass Starting year 6	Avoided Social Cost of Carbon (USD) (2011 prices) per year
Anjar	45.2	0	45.2	6.45	0.27	8.1915	0.5	185.1279	-678.8		84,850

(Source: IPCC Good Practice Guidance for LULUCF)

Ser 2	Carbon Fraction (tonnes C (tonne d.m.) ⁻¹)	Total above-ground and below-ground non-woody biomass (tonnes d.m. ha-1)	Total increase in above-ground biomass area excluding trees (removal of 26% of total area)	Total Tonnes of C (litter) remaining on site	CO2 removal (tonnes)	Proxy of grass decomposing to soil organic matter	Avoided Social Cost of Carbon (USD) (2011 prices) per year
	0.5	6.1	0.999	3.04695	-11.17		1,396.50

A forest in The Making - Dynamic Model Avoided Social Cost of Carbon

Mass (kg of soil loss per Ha per year)	Total area of site (Ha)	Emission Factor (kg N)-1	Kg of N2O-N released yearly due to erosion of mineral soils	Avoided N2O emissions (Tonnes)	Equivalent to Avoided CO2 emissions (tonnes)	Avoided Social Cost of Carbon (USD) (2011 prices) per year
50000	45.2	0.01	22600	35.51	10,583.25	1,322,907.14
200000	45.2	0.01	90400	142.05	42,333.02	5,291,628.57







THANK YOU

