Food and Agriculture Organization
of the United Nations

Greenhouse gas appraisal for the joint World Bank-GEF-SIDA Environmental Services Project in Albania

EX-ACT CASE STUDY

Albania

Identifying ecosystem benefits and climate change mitigation achievements in agriculture and forestry with EX-ACT

The Environmental Services Project (ESP) aims at improving the conservation and management of water resources by reducing the sedimentation in rivers and dams from land degradation. To serve this purpose, various sustainable land management (SLM) activities ranging from afforestation to forest management and grassland restoration were performed. The ESP also intended to implement activities that would enable the establishment of financing mechanisms, notably Payment for Environmental Services (PES) to reduce land degradation and support sustainable livelihoods through the provision of and compensation for ecosystem services that would otherwise be uncompensated. However, the PES scheme was never launched due to the Albanian Water Directorate insisting its inability to meet the short- and medium-term financing needs for such a scheme.

KEY MESSAGES

- The ESP produces a set of benefits that are not restricted to mere climate change mitigation achievements. Such benefits include the accumulation of biomass and carbon, and the regeneration of the ecosystem. This shows the potential for a revival of a PES scheme.
- PES contracts would make reforestation more attractive and ensure it is maintained over time by combining support to reforestation with a longer-term payment for the resulting forest. The underlying gains from a PES scheme would include the reversal of environmental damage that had been caused by deforestation, the restoration of carbon stock, the reduction of damage to hydrological services, and the rehabilitation of biodiversity.

EX-ANTE CARBON-BALANCE TOOL EX-ACT

1 Background

1.1 Country context

Albania is a small, mountainous country located in south-eastern Europe facing the Adriatic Sea. The country has abundant water reserves that constitute a vital source of hydropower, including torrential rivers and tectonic, karstic and glacial lakes. After nearly fifty years of Communist government banning private enterprise and private ownership and isolating the country economically, important economic reforms were undertaken and the country achieved rapid economic growth. The majority of the population lives in rural areas, where poverty is 66 percent higher than in the capital city, Tirana. Poverty levels are 50 percent higher in rural areas than in other urban centres (World Bank, 2019). Agriculture represents the main income source of rural people, with 74 percent of farms in Albania being small family farms with a very limited amount of holdings (FAO, 2018). The high rate of poverty and the steep topography in Albania make the country more vulnerable to extreme climate-related events such as floods, forest fires, earthquakes, extreme temperatures, epidemics, and sea level rise. More frequent and severe extreme events consequently put significant pressure on the agricultural sector at national scale. Currently, some major threats are already weakening the agricultural production of the country, as most of the forests and pastures are in poor condition, and fragile soils combined with unsustainable forestry and agricultural practices (including under- and over-grazing) have caused sediment to be eroded into Albania's rivers, lakes and streams. In more general terms, erosion reduces the carrying capacity of pastures, decreases agricultural yields, increases fertilizer costs on agricultural land, and leads to the siltation of hydropower and other water reservoirs (World Bank, 2014).

The Albanian forest sector has undergone a reform process over the past decade that led to substantial changes in the relationships and mandates between the state, the municipalities, the private sector and traditional users. Sixty percent of state owned forest and pasture were transferred from the Government of Albania to communal ownership (World Bank, 2014). Those forests and pastures transferred to the municipalities are however highly degraded. This is the result of continuous unsustainable exploitation of natural resources, especially wood and grassland. Most of the municipalities that received forest and pasture land lack sufficient means and revenue to control and support forest management in the near and long-term future.

The unsustainable exploitation of natural resources, especially wood and grassland, has made the Albanian agricultural sector both a victim and a contributor to climate change.

Climate

Albania has a warm temperate moist Mediterranean climate. The country is characterized by hot, dry summers (May to September) and mild winters (October to April) with abundant precipitation. The temperature varies across the country from an average of 8.5 °C in the mountainous zone in the east to 16.9 °C in the coastal zones in the west (ECMWF, 2018). The total number of days with precipitation (> 1 mm) varies between 80 and 120 days per year. The mean annual precipitation (MAP) is 1330 mm and varies along a north-south divide (Funk *et al.*, 2014). The potential evapotranspiration (PET) is 1309 mm (NTSG, UMT and NASA, 2014).

Potential evapotranspiration

Potential evaporation or potential evapotranspiration (PET) defined as the amount of evaporation that would occur if a sufficient water source were available. If the actual evapotranspiration is considered the net result of atmospheric demand for moisture from a surface and the ability of the surface to supply moisture, then PET is a measure of the demand side. Surface and air temperatures, insolation, and wind all affect this. A dryland is a place where annual potential evaporation exceeds annual precipitation. The PET is the amount of water that would be evaporated and transpired if there were sufficient water available. This demand incorporates the energy available for evaporation and the ability of the lower atmosphere to transport evaporated moisture away from the land surface. The PET is higher in the summer, on less cloudy days, and closer to the equator, because of the higher levels of solar radiation that provides the energy for evaporation. The PET is also higher on windy days because the evaporated moisture can be quickly moved from the ground or plant surface, allowing more evaporation to fill its place. The PET is expressed in terms of a depth of water, and can be graphed during the year. The PET is usually measured indirectly, from other climatic factors, but also depends on the surface type, such as free water (for lakes and oceans), the soil type for bare soil, and the vegetation (NTSG, UMT and NASA, 2014).

<u>Soils</u>

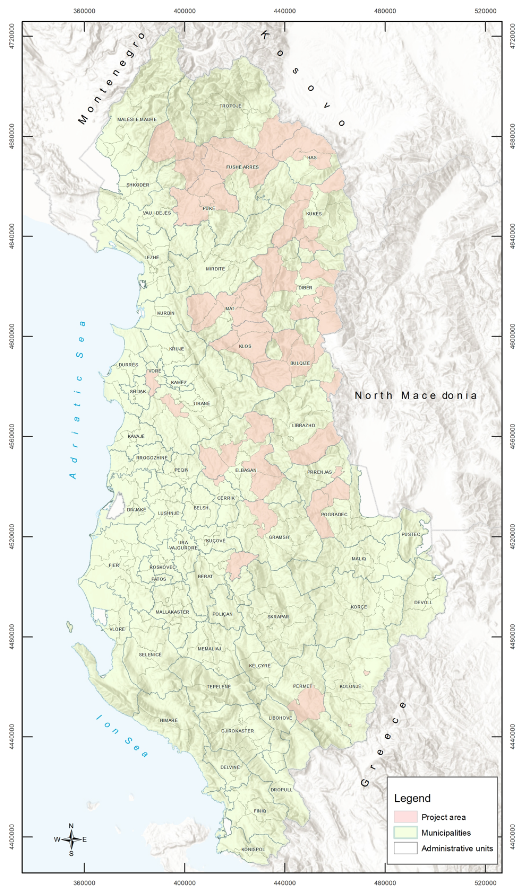
According to the joint FAO-UNESCO soil maps (*see Annex 1*), the country is dominated by two major soil types, namely Chromic Luvisols in the eastern part of the country and Calcaric Fluvisols in the western part of the country. Those soils can be reclassified according to IPCC's soil classification of 2019: Chromic Luvisols can be defined as High Activity Clay (HAC) soils and Calcaric Fluvisols as Low Activity Clay (LAC) soils. Soils with high clay activity (HAC) have appreciable amounts of high-activity clay (e.g. 2:1 layer clay) that promote long-term stabilisation of organic matter, especially in many carbon-rich temperate soils. In contrast, soils with low-activity clay (LAC) (e.g. kaolinite) have a much lower ability to stabilise carbon, respond more rapidly to changes in the soil's carbon balance, and include highly-weathered acid soils.

2 Project objective, zone and activities

2.1 Project objective

The main aim of the Environmental Services Project is "to assist Albania in its efforts to achieve economic growth, broaden and sustain social gains and reduce vulnerability to climate change" (World Bank, 2014). The Project contributes to the sustainability of water resources management and conservation of water resources by reducing the sedimentation in rivers and dams from land degradation. Given that the project targets remote forest communities that are among the poorest in Albania, the Project Development Objective (PDO) is to "support sustainable land management practices and increase communities' monetary and non-monetary benefits in targeted Project areas which are mainly in erosion prone rural upland areas" (World Bank, 2014). This is conducive to eliminating poverty and promoting shared prosperity in an environmentally sustainable way.

Figure 1. Map of the project areas



Source: World Bank, 2014.

2.2 Project zone

The project targets forest and grasslands all across Albania. Yet, as shown in figure 1, a majority of the project areas is located in the north- and central-east of the country, covering the states of Has, Fushë Arrës, Shkodër, Pukë, Kukës, Dibër, Mat, Klos, Bulqizë, Librazhd, Prrenjas, Pogradec, Elbasan, Tiranë, Gramsh, and Berat. Only Përmet and Kolonjë are located in the southeast of the country. Most of the project areas are on hilly or mountainous terrain that was previously covered by dense dry mountain forests. Over the past twenty years however, large parts of these forests were deforested leaving only limited high forest areas on the project sites. Indeed, the remaining forests are mainly comprised of tree shrubs or coppice and soils show a high level of degradation. Annex 2 shows a map of the land cover in Albania in 2015.

As previously stated in the country context, Albania's soils in the eastern provinces are dominated by Chromic Luvisols according to soil maps of FAO-UNESCO. This corresponds to High Activity Clay soils under IPCC's soil classification. Because of the soil's high heterogeneity, a sensitivity analysis was undertaken for the carbon balance calculations.

As most of the provinces are located in the north- and central-east of Albania, the dominant climate is warm temperate moist with an average annual precipitation exceeding the potential evapotranspiration. However, as two regions are located on the south-eastern edge of the country with the PET exceeding the MAP, a climate sensitivity analysis was also carried out for a warm temperate dry climate in the carbon balance calculations.

2.3 Project activities

2.3.1 Completed project activities

The following agricultural, forestry and land use change activities were undertaken on a total of about 5 880 ha over an implementation period of five years through the implementation of the Environmental Services Project:

A. Afforestation

Afforestation to subtropical mountain systems was carried out on 36.2 ha of previously degraded land with very limited shrub cover, oaks, acacia, spruce, and various pine species (without disturbance to the pines due to harvest). Based on data provided from the Albanian National Forest Inventory 2004 (ANFI, 2004) and complemented by data on the Albanian National Forest Preliminary Inventory 2019 (ANFPI, 2019), the above-ground biomass of subtropical mountain systems in Albania is 47.6 t C/ha and the soil carbon is 75.5 t C/ha.

B. Grassland systems

(1) The project foresaw the installation of water points for livestock on grasslands. The livestock previously met most of its water needs through grazing. By providing the livestock with water points and cisterns for water intake, the demand for grazing is expected to decrease, which ultimately improves the quality of pastures. The surface area of severely degraded pasture land which benefited from this activity amounts to 2 098 ha. With the installation of water points, the soil carbon stocks of the surface area is estimated to increase by 5 percent (moderately degraded grasslands). It is assumed that without the project, the grasslands would have remained severely degraded.

(2) The project furthermore aimed at improving an additional 287 ha of severely degraded pastureland through fencing and weeding. This was assumed to increase soil carbon stocks on the surface area by 10 percent as compared to the previous situation.

C. Forest management

(1) Vegetation acts as an important buffer to erosion as it protects the soil from direct impact by precipitation, slowing down the rain flowing over the surface (baffling effect) and simultaneously binding the soil together with its roots. As trees were previously removed from hill slopes and other lands over a total surface area of 296 ha, disastrous erosion for both agricultural lands and infrastructure were the consequence. Indeed, the soils were in such poor condition that 99 percent of the biomass was lost. The degradation level was so high that a rural school in Elbasan County was threatened from being washed away. The fragile soils had furthermore caused sediment to be eroded into Albania's rivers, lakes and streams. In order to halt further erosion, the project aimed to construct so-called check dams.

The 21 871 m^3 of constructed check dams would:

– stop the river to dig itself deeper into the fragile soils;

– stabilise the fragile soils by stopping them from further slipping through a barrier;

– and allow for subtropical dry forests to be replanted and regenerated on the stabilised soils.

Through the stabilisation of the soils and the afforestation of acacia and other native tree species on the highly degraded forest land (or similar lands), the biomass loss was estimated to be reduced by 20 percent. In addition, the local school was saved from erosion.

(2) Previously a total of 3 161 ha of forests had a relatively low level of degradation as compared to the severely degraded forest land described above, i.e. forest had a total biomass loss of 65 percent. Among the targeted areas, 30 percent were subtropical mountain forests while the remaining 70 percent were subtropical dry forests. Both subtropical dry and mountain forests underwent improved forest management with the project. The project was assumed to decrease the forest biomass loss by 30 percent to a relatively very low level of degradation of 46 percent. Without project intervention, the forests would have lost further 10 percent of their biomass to a comparatively moderate degradation level of 72 percent. Based on data provided from the Albanian National Forest Inventory 2004 (ANFI, 2004) and complemented by data on the Albanian National Forest Preliminary Inventory 2019 (ANFPI, 2019), the above-ground biomass of subtropical mountain systems in Albania is 47.6 t C/ha and the soil carbon is 75.5 t C/ha. The above-ground biomass of subtropical dry systems is 44.2 t C/ha and the soil carbon is 75.5 t C/ha.

2.3.2 Planned project activities

The WB, GEF, SIDA, the Ministry of Environment and Tourism and the Ministry of Finance are currently exploring the possibility to extend the project by another year to improve an additional 1 350 ha through the following activities:

A. Afforestation

In a bid to bring Albanian highland forests to more sustainable conditions, the project will further seek to reforest 270 ha of currently degraded land with subtropical mountain forests, in particular acacia. The above-ground biomass carbon content of subtropical mountain systems of Albania is estimated at 47.6 tC/ha, while the soils store about 75.5 tC/ha.

B. Planting perennials

Another 80 ha of degraded land will be transformed into perennial systems (mainly walnut and chestnut trees).

C. Forest management

The project will strive to expand the surface area of subtropical dry forests with relatively low levels of degradation undergoing improved forest management by 1 000 ha. Better management practices are expected to lead to the improvement of the dry forests to a very low level of degradation by decreasing the forest biomass loss by 30 percent to a relatively very low level of degradation of 46 percent, cf. paragraph 2 of section 2.3.1.c.

The ESP managers and experts have signaled that the above-mentioned additional project activities should be differentiated into a pessimistic scenario, in which only 90 percent of the planned activities may be achieved, and an optimistic scenario, in which following additional project activities would be achieved: 110 percent of the planned areas of afforestation and perennial/tree crops, an additional 100 ha of severely degraded grasslands will receive improved grazing practices alongside the already improved 287 ha described in section 2.3.1.b. (paragraph 2), and another 1 500 ha of dry forests with a relatively low level of degradation (46 percent) will undergo additional improved forest management, similar to the expected additional forest management under 2.3.2.c.

3 Methodology and tools used

3.1 Context of EX-ACT

Agriculture, Forestry and Land Use Change (AFOLU) are major sources of green-house gases (GHG), contributing 24 percent of global emissions or about 10-12 Gigatonnes of CO_2-equivalent (CO_2-e) per year. The climate change mitigation potential for the sector is high. Many of the technical options are readily available and could be deployed immediately:

- decreasing the rate of deforestation and forest degradation, adoption of improved cropland management practices (reduced tillage, integrated nutrient and water management) reduces carbon dioxide emissions;
- reducing emissions of methane and nitrous oxide through improved animal production, improved management of livestock waste, more efficient management of irrigation water on rice paddies, improved nutrient management; and,
- sequestering carbon through conservation farming practices, improved forest management practices, afforestation and reforestation, agroforestry, improved grasslands management, and the restoration of degraded land.

3.2 EX-ACT tool

The Ex-Ante Carbon-balance Tool (EX-ACT) is an appraisal system developed by FAO providing ex-ante estimates of the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance. The carbon-balance is defined as the net balance from all GHGs expressed in carbon dioxide (CO_2) equivalents that were emitted or sequestered due to project implementation as compared to a business-as-usual scenario.

EX-ACT is a land-based accounting system, estimating carbon (C) stock changes (i.e. emissions or sinks of CO_2) as well as GHG emissions per unit of land, expressed in equivalent tonnes of CO_2-e per hectare and year. The tool helps project designers estimate and prioritize project activities with high benefits in economic and climate change mitigation. The amount of GHG mitigation may also be used as part of economic analyses as well as for the application for funding additional project components.

EX-ACT has been developed mostly using the Intergovernmental Panel on Climate Change 2006 Guidelines for

National Greenhouse Gas Inventories (IPCC, 2006) that furnishes EX-ACT with recognized default values for emission factors and carbon values, the so called Tier 1 level of precision. Besides, EX-ACT is based upon Chapter 8 of the Fourth Assessment Report from Working Group III of the IPCC (Smith *et al.*, 2007) for specific mitigation options not covered in IPCC 2006. Other required coefficients are from published reviews or international databases. For instance, embodied GHG emissions for farm operations, transportation of inputs, and irrigation systems implementation come from Lal (Lal, 2004) and electricity emission factors are based on data from the International Energy Agency (IEA, 2013).

This report is prepared to provides an ex-ante appraisal of the carbon-balance of the Environmental Services Project (ESP) of the World Bank, the Global Environment Facility (GEF) and the Swedish International Development Cooperation Agency (SIDA) in Albania. The calculated ex-ante carbon balance is intended to complement conventional ex-ante economic and environmental analyses commonly undertaken in the planning phase of investment projects and development policies. A number of its outputs can further be used in financial and economic analyses. This appraisal also provides the impact of the project on other forms of natural capital, such as the increase in biomass and soil organic carbon, which directly affect the climate resilience of landscapes and watersheds.

4 Project impact

4.1 Completed project activities

4.1.1 Carbon balance (most likely scenario)

Based on the activities described under 2.3.1, a carbon balance was estimated for the monitoring and evaluation (M&E) of the GHG emissions or sequestrations of the ESP. Dominant soils are assumed to be High Activity Clay soils. The climate is defined as warm temperate moist (subtropical Mediterranean).

The IPCC 2006 states that “the length of time that land remains in a conversion category after a change in land use [or management practice] is by default 20 years (the time period assumed for carbon stocks to come to equilibrium for the purposes of calculating default coefficients in the 1996 IPCC Guidelines and retained for GPG-LULUCF[1] and used here also, though other periods may be used at higher Tiers according to national circumstances).” For the joint World Bank-GEF-SIDA project, the implementation phase is five years and the capitalisation phase is 15 years, equalling the default 20 years recommended by the IPCC.

Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -3.4 tCO_2-e per hectare per year, or -400 588 tCO_2-e over the entire 20-year-period of analysis (Figure 2).

The overall uncertainty of this assessment is estimated at 20 percent. High uncertainties are rather common in GHG appraisals for the AFOLU sector as emission processes are very sensitive to environmental conditions (notably the climate and soils) and furthermore difficult to model accurately (Gibbons *et al.*, 2006; Rypdal and Winiwarter, 2001). These high emission level uncertainties generally indicate potential for improvements and, consequently, the need for recalculations including the use of Tier 2 values for carbon stocks in the biomass and soils. For the carbon balance calculations for the ESP, the uncertainty was significantly reduced by using Tier 2 values on biomass and soil carbon stocks in Albanian dry and mountain forests.

Tier 2

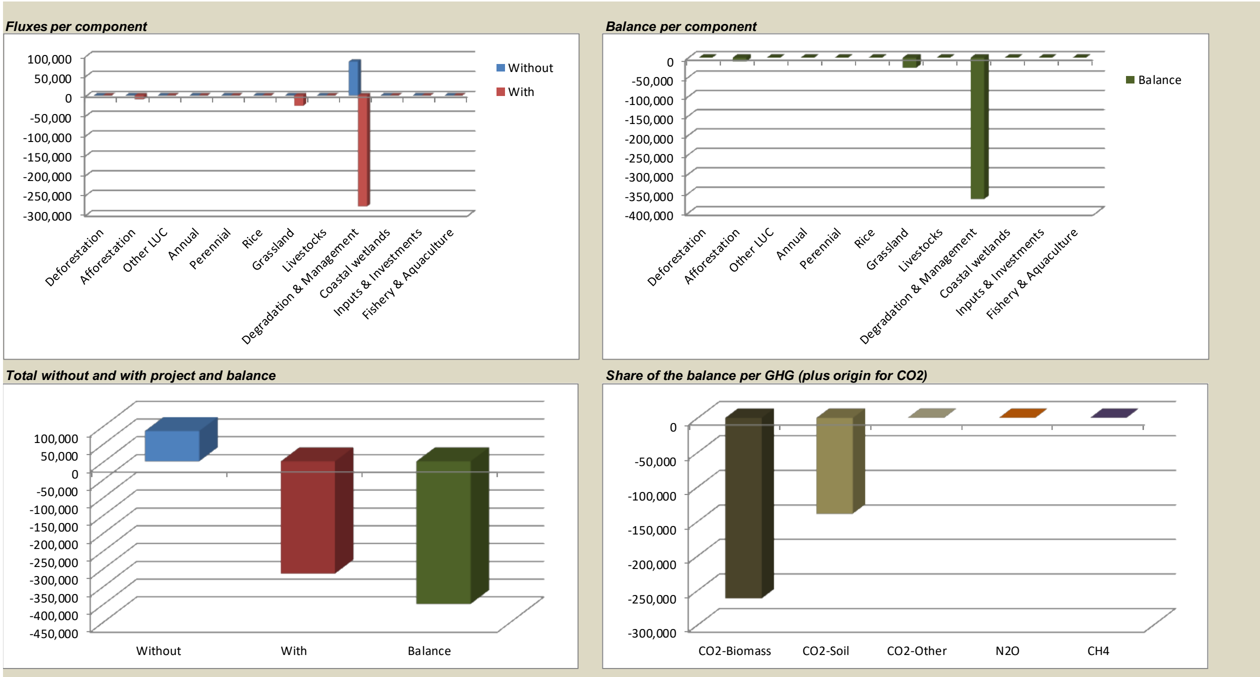
Tier 2 generally uses the same methodological approach as Tier 1 but applies emission factors and other parameters which are specific to the country. Country-specific emission factors and parameters are those more appropriate to the forests, climatic regions and land use systems in that country. More highly stratified activity data may be needed in Tier 2 to correspond with country-specific emission factors and parameters for specific regions and specialised land-use categories. Tiers 2 and 3 can also apply stock change methodologies that use plot data provided by NFIs (IPCC, 2003).

[1] GPG-LULUCF: Good Practice Guidance for Land Use, Land-Use Change and Forestry.

Figure 2. EX-ACT results for the most likely scenario

Project Name	World Bank Environmental	Climate	Warm Temperate (Moist)	Duration of the Project (Years)	20
Continent	Eastern Europe	Dominant Regional Soil Type	HAC Soils	Total area (ha)	5878.2

Components of the project	Gross fluxes: Without	With	Balance	Share per GHG of the Balance (All GHG in tCO2eq): CO_2 Biomass	CO_2 Soil	CO_2 Other	N_2O	CH_4	Result per year: Without	With	Balance
	All GHG in tCO2eq; Positive = source / negative = sink										
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-9,452	-9,452	-3,577	-5,875		0	0	0	-473	-473
Other LUC	0	0	0	0	0		0	0	0	0	0
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	0	0	0	0		0	0	0	0	0
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-26,404	-26,404	0	-26,404		0	0	0	-1,320	-1,320
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	85,175	-279,558	-364,733	-258,124	-106,609		0	0	4,259	-13,978	-18,237
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	85,175	-315,414	-400,588	-261,700	-138,888	0	0	0	4,259	-15,771	-20,029
Per hectare	14	-54	-68	-44.5	-23.6	0.0	0.0	0.0			
Per hectare per year	0.7	-2.7	-3.4	-2.2	-1.2	0.0	0.0	0.0	0.7	-2.7	-3.4



Source: Author's calculation based on the EX-ACT tool analysis.

When looking at the sub-components of the activities in more detail, the improved forest management (-364 733 tCO_2-e) can be identified as the major contributing factor to carbon sequestration in the ESP. Afforestation and grassland management only play a secondary role in the carbon balance with sequestrations of -9 452 tCO_2-e and -26 404 tCO_2-e, respectively. If the different activities are furthermore differentiated regarding the carbon pools or sinks, the project mostly enriches carbon levels in the biomass (-261 700 tCO_2) and in the soils (-138 888 tCO_2).

4.1.2 Sensitivity analysis

Using the activities described under 2.3.1, a sensitivity analysis was conducted to account for the heterogeneity of soils and climate for the carbon balance calculations.

A. Warm temperate dry climate, High Activity Clay soils

The carbon balance was remodelled with High Activity Clay soils and a warm temperate dry (subtropical Mediterranean) climate. Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -3.5 tCO_2-e per hectare per year, or -408 442 tCO_2-e over the entire 20-years-period of analysis, with 5 years of implementation and 15 years of capitalization. The EX-ACT results are presented in Figure 3. The overall uncertainty of this assessment is estimated at 20 percent.

Figure 3. EX-ACT results for climate sensitivity

Project Name	World Bank Environmental	Climate	Warm Temperate (Dry)	Duration of the Project (Years)	20
Continent	Eastern Europe	Dominant Regional Soil Type	HAC Soils	Total area (ha)	5878.2

Components of the project	Gross fluxes Without All GHG in tCO2eq Positive = source / negative = sink	With	Balance	Share per GHG of the Balance All GHG in tCO2eq CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year Without	With	Balance
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-10,354	-10,354	-4,479	-5,875		0	0	0	-518	-518
Other LUC	0	0	0	0	0		0	0	0	0	0
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	0	0	0	0		0	0	0	0	0
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-11,402	-11,402	0	-11,402		0	0	0	-570	-570
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	90,298	-296,388	-386,686	-280,077	-106,609		0	0	4,515	-14,819	-19,334
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	90,298	-318,144	**-408,442**	-284,556	-123,886	0	0	0	4,515	-15,907	-20,422
Per hectare	15	-54	-69	-48.4	-21.1	0.0	0.0	0.0			
Per hectare per year	0.8	-2.7	-3.5	-2.4	-1.1	0.0	0.0	0.0	0.8	-2.7	-3.5

Source: Author's calculation based on the EX-ACT tool analysis.

B. Warm temperate dry climate, Low Activity Clay soils

The carbon balance was remodelled with Low Activity Clay soils (Calcaric Fluvisols according to the FAO/UNESCO soil maps) and a warm temperate dry (subtropical Mediterranean) climate. Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -3.4 tCO_2-e per hectare per year, or -404 241 tCO_2-e over the entire 20-year-period of analysis, with 5 years of implementation and 15 years of capitalization. The EX-ACT results are presented in Figure 4. The overall uncertainty of this assessment is estimated at 20 percent.

Figure 4. EX-ACT results for climate and soil sensitivity

Project Name	World Bank Environmental	Climate	Warm Temperate (Dry)	Duration of the Project (Years)	20
Continent	Eastern Europe	Dominant Regional Soil Type	LAC Soils	Total area (ha)	5878.2

Components of the project	Gross fluxes Without All GHG in tCO2eq Positive = source / negative = sink	With	Balance	Share per GHG of the Balance All GHG in tCO2eq CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year Without	With	Balance
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-10,354	-10,354	-4,479	-5,875		0	0	0	-518	-518
Other LUC	0	0	0	0	0		0	0	0	0	0
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	0	0	0	0		0	0	0	0	0
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-7,201	-7,201	0	-7,201		0	0	0	-360	-360
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	90,298	-296,388	-386,686	-280,077	-106,609		0	0	4,515	-14,819	-19,334
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	90,298	-313,944	**-404,241**	-284,556	-119,685	0	0	0	4,515	-15,697	-20,212
Per hectare	15	-53	-69	-48.4	-20.4	0.0	0.0	0.0			
Per hectare per year	0.8	-2.7	-3.4	-2.4	-1.0	0.0	0.0	0.0	0.8	-2.7	-3.4

Source: Author's calculation based on the EX-ACT tool analysis.

C. Warm temperate moist climate, Low Activity Clay soils

The carbon balance was remodelled with Low Activity Clay soils and a warm temperate dry (subtropical Mediterranean) climate. Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -3.3 tCO_2-e per hectare per year, or -393 087 tCO_2-e over the entire 20-year-period of analysis, with 5 years of implementation and 15 years of capitalization. The EX-ACT results are presented in Figure 5. The overall uncertainty of this assessment is estimated at 20 percent.

Figure 5. EX-ACT results for soil sensitivity

Project Name	World Bank Environmental	Climate	Warm Temperate (Moist)			Duration of the Project (Years)		20		
Continent	Eastern Europe	Dominant Regional Soil Type	LAC Soils			Total area (ha)		5878.2		
Components of the project	Gross fluxes Without (All GHG in tCO2eq; Positive = source / negative = sink)	With	Balance	Share per GHG of the Balance (All GHG in tCO2eq) CO_2 Biomass	CO_2 Soil	CO_2 Other	N_2O	CH_4	Result per year Without	With	Balance
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-9,452	-9,452	-3,577	-5,875		0	0	0	-473	-473
Other LUC	0	0	0	0	0		0	0	0	0	0
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	0	0	0	0		0	0	0	0	0
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-18,903	-18,903	0	-18,903		0	0	0	-945	-945
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	85,175	-279,558	-364,733	-258,124	-106,609		0	0	4,259	-13,978	-18,237
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	85,175	-307,913	**-393,087**	-261,700	-131,387	0	0	0	4,259	-15,396	-19,654
Per hectare	14	-52	-67	-44.5	-22.4	0.0	0.0	0.0			
Per hectare per year	0.7	-2.6	-3.3	-2.2	-1.1	0.0	0.0	0.0	0.7	-2.6	-3.3

Source: Author's calculation based on the EX-ACT tool analysis.

4.1.3 Incremental value of natural capital (most likely scenario)

The values demonstrated in sections 4.1.1. and 4.1.2. merely provide the expected technical mitigation impact of the ESP. Yet, with the restoration of degraded forest and pasturelands and the afforestation of degraded mountainous areas, the ESP also rebuilds the watershed capacity, regulates the water stream flow and contributes to biodiversity conservation. This shows that the ESP produces a set of benefits that are clearly distinct from their mere climate change mitigation achievements and these benefits are closely related to the incremental existence of additional biomass, carbon and reactivation of the ecosystem. While most of the benefits are of public nature, environmental resources and non-degraded natural capital may also provide a substantial source of income and food security.

A critical step is therefore to associate an economic or monetary value to the incremental value generated through the added natural capital. This is all the more important in view of a potential introduction of a Payment for Environmental Services (PES) scheme in Albania in the near future. PES has emerged as a substitute or supplement to spatial planning and regulatory schemes in the governance of watersheds (Engel *et al.*, 2008). Society generally attaches a high value to the positive externalities of watershed landscapes and will take action to guarantee that they are provided for and conserved. This is the primary argument for the public funding of watershed management programmes. Command-and-control regulations or approaches to protecting the flow of benefits from watershed landscapes have often failed, because of their inability to include economic incentives (Wunder, 2005). In recent times, efforts have consequently been shifted towards creating markets for these externalities (Zilberman *et al.*, 2006). Under such payment schemes for environmental services, the beneficiaries of externalities or services pay the providers. This transforms an externality into tangible income for service providers. When the provided service is a public good, payments schemes may be designed by public organizations.

A PES scheme was initially part of the Environmental Services Project. The aim of this component was "to assist the development of mechanisms that allow sustainable financing of natural resource management beyond the ESP horizon" (World Bank, 2014). The component intended to implement activities that would enable the establishment of financing mechanisms to reduce land degradation and support sustainable livelihoods through the provision of and compensation for ecosystem services that would otherwise be uncompensated. The component was designed to support the development and piloting of at least two payments for environmental service mechanisms: payments for carbon sequestration and payments for watershed services.

The rationale behind the ESP's payment for environmental scheme was that sustainable forestry and agricultural practices in the highlands of Albania would significantly reduce erosion of sediment into Albania's streams, rivers and lakes. Therefore, Tirana's Water Directorate had an active interest in paying the smallholder farmers in the upstream mountainous communities to preserve and sustainably manage their forests and pasturelands. This would prevent sediment from being eroded into the streams, rivers or lakes, which would in turn increase the water quality and ultimately decrease the costs of water purification in the long run. However, the PES scheme was never launched due to the Water Directorate insisting its inability to meet the short- and medium-term financing needs for such a scheme. Restating the monetary value created by natural capital through the ESP may help foster awareness for the feasibility of payment for environmental services. This might furthermore contribute to alleviating some of the doubts of Tirana's Water Directorate regarding the profitability of PES in Albania.

The carbon-balance appraisal is based, to large extents, on foreseen increases in soil organic carbon (SOC) and biomass stocks and carbon sequestrations. Those three categories are used for the calculation of the monetary value of natural capital.

Soil organic carbon benefits

Although, there are large uncertainties in estimating the terrestrial ecosystem's capacity to act as a net sink of carbon and hence as a climate-change mitigation strategy (Le Quéré *et al.*, 2014, 2009; Friedlingstein *et al.*, 2014; Pugh *et al.*, 2016), an important aspect should be considered: measuring the value of soil organic carbon is not limited to its global warming potential. Indeed, "unlike more inert forms of carbon such as coal, soil organic matter (of which about 40 percent is SOC) performs numerous functions that promote plant productivity, agricultural efficiency, and environmental quality" (Wander *et al.*, 2004). When evaluating programmes to encourage sequestration, the value of these services should be considered and added to the value of atmospheric carbon abatement. In this section, these ecosystem services are highlighted and a framework for estimating their value is proposed.

According to Wander *et al.* (2004), "important soil organic matter (SOM)-mediated processes include mineralization and nutrient supply, enhancement of water relations and water supply, increased soil warming rates in temperate latitudes, reductions in energy required for tillage, enhanced soil tilth, pH buffering and, disease suppression." These simultaneously influence crop production and environmental outcomes.

First, the private value of SOM in an agricultural system has to be considered, i.e. the reduction of production costs and yield improvements for a marginal increase in SOC. The most robust estimate one can make is perhaps the "quantity of inorganic nitrogen (N) made available annually through mineralization of SOM, which can be directly valued with fertilizer prices" (Wander *et al.*, 2004). Based on a C:N ratio of 20:1, a mineralization rate of organic N to inorganic N of 1.8 percent and a fertiliser N cost of USD 0.5 per kilogramme N, Wander *et al.* (2004) found that the benefits for fertiliser replacements amount to USD 0.4 per tonne of carbon per year.

SOM not only supplies a large pool of plant nutrients, but Wander *et al.* (2004) also emphasized the importance of SOM on "crop yields through influence on water infiltration and storage, aeration, and possibly disease suppression. One reason long-term agronomy trials are important is that a period of at least 20 years gives management treatments imposed on the same inherent soil properties and under the same climatic regime time to establish new SOM equilibiria." Wander *et al.* (2004) estimated that the productivity enhancement would generate benefits of USD 2.73 per tonne of carbon per year.

A third consideration for the valuation of soil organic carbon is the measurement of marginal increases in soil carbon on water quality. Lakshmarian *et al.* (1996) and Ribaudo (1989) estimated the economic value of marginal increases in soil carbon on soil and water quality. The RUSLE and metamodel of Lakshmarian *et al.* (1996) suggested that erosion impacts are sensitive to tillage and cropping patterns. Improving land management practices thereby reduces soil erosion. Ribaudo (1989) estimated the value of increased water quality and reduced erosion at USD 1.68 per tonne of eroded sediment. Based on these studies, Wander *et al.* (2004) value the increased water quality for one additional t C per year at USD 0.02.

<u>Biomass benefits</u>

The project also increases the availability of commercial timber. The results section of EX-ACT provides an estimate of tCO_2-e that is sequestered due to newly created biomass through the project.

The wood density of selected subtropical tree species in tonnes of oven-dry biomass per cubic metre green volume are listed in Table 1.

Table 1. Basic wood density of selected temperate and boreal tree taxa able

BASIC WOOD DENSITY (D) OF SELECTED TEMPERATE AND BOREAL TREE TAXA		
Taxon	**D [oven-dry tonnes (moist m^{-3})]**	**Source**
Abies spp.	0.40	2
Alnus spp.	0.45	2
Betula spp.	0.51	2
Fagus sylvatica	0.58	2
Fraxinus spp.	0.57	2
Picea abies	0.40	2
Pinus pinaster	0.44	1
Pinus sylvestris	0.42	2
Populus spp.	0.35	2
Prunus spp.	0.49	2
Quercus spp.	0.58	2
Tilia spp.	0.43	2
1 = Rijsdijk and Laming, 1994 2 = Dietz, 1975		

Note: This analysis is based on table 4.14 of IPCC's 2006 National Greenhouse Gas Inventories.
Source: IPCC, 2006.

The mean basic wood density of selected temperate and boreal tree taxa is .4683 oven-dry tonnes (moist m^{-3}).

FAO (2005) stated in its Global Forest Resources Assessment that global commercial tree growing stock amounts to some 202 billion m^3, which represents about 47 percent of total tree growing stock. Indeed, "commercial growing stock constitutes a lower percentage of total growing stock in tropical regions (e.g. Africa, Central America and South America) than in temperate regions (East Asia, Europe and North America). This is mainly because of differences in the characteristics of the forests in terms of species diversity and different harvesting regimes." Thus, using this estimate for Albania is rather conservative.

In order to calculate the amounts of dry matter generated, the value in tCO_2-e first needs to be converted to tonnes of C (with a conversion factor of 12/44 for the mass weights of carbon and oxygen) and then to tonnes of dry matter. IPCC (2006) estimates the default carbon fraction of aboveground forest biomass in subtropical climates at 0.47 t C d.m.$^{-1}$. The carbon stock (t C ha^{-1}) in a plot is defined as the sum of the dry biomass in a plot (t dry matter ha^{-1}) and the carbon fraction (t C t^{-}1 dry matter). Therefore, the biomass value was multiplied by 12/44 and divided by 0.47.

FAOSTAT (2017) reports import and export quantities (in m^3) and prices (in USD) for the world production of roundwood. As shown in Table 2, the average price per m^3 of roundwood amounts to USD 122.54 in 2017. The volume of roundwood can be converted to the weight of dry matter with a factor of 1.37 m^3 per tonne. The average price for roundwood then corresponds to USD 89.45 t dry matter.

Table 2. World prices for roundwood in USD per tonnes of dry matter

<table>
<tr><th>Item</th><th>Year</th><th>Unit</th><th>Value
in thousands</th><th>USD per m^3</th><th>Average USD per m^3</th><th>Conversion factor: m^3 per metric tonne</th><th>Average USD per tonne</th></tr>
<tr><td>Roundwood quantity</td><td>2017</td><td>m^3</td><td>137 494</td><td rowspan="2">130.24</td><td rowspan="4">122.55</td><td rowspan="4">1.37</td><td rowspan="4">89.45</td></tr>
<tr><td>Roundwood value</td><td>2017</td><td>USD</td><td>17 907 387</td></tr>
<tr><td>Roundwood quantity</td><td>2017</td><td>m^3</td><td>138 514</td><td rowspan="2">114.85</td></tr>
<tr><td>Roundwood value</td><td>2017</td><td>USD</td><td>15 908 853</td></tr>
</table>

Source: FAOSTAT, 2019; author's calculations based on data inputs.

Overall carbon benefits

While there are considerable uncertainties to future climate change impacts and hence also to the actual costs induced to society from emissions of a tonne of CO_2-e, it is nevertheless necessary to assume a reference price for current policy making purposes that helps provide a rough orientation for the value of mitigation measures. The valuation of one tonne of CO_2-e varies considerably between cost-benefit guidelines from different countries. Mackie *et al.* (2014) reviewed some of these CO_2-e valuations:

- Great Britain calculates with a cost of USD 67.57 per tonne of CO_2-e for 2010 and a cost of USD 261.39 per tonne of CO_2-e in 2050.[2]
- Germany uses sensitivity analysis to calculate the cost of a tonne of CO_2-e. For 2008, the lower value is estimated at USD 22.25, the central value at USD 77.87 and the higher value at USD 311.46 per tonne of CO_2-e.[3]
- The Netherlands estimate a central cost of USD 69.70 per tonne of CO_2-e.[4]
- Sweden estimates a short run appraisal cost of USD 9.53 per kg of CO_2-e and a long run appraisal cost of USD 14.30 per kg.[5]
- The United Sates Interagency Working Group estimates a central appraisal cost of USD 21 per tonne of CO_2-e for the US.

For the valuation of the social cost of a tonne of CO_2-e, the lower bound of USD 21 of the US Interagency Group was used.

Results

Based on the most likely scenario described above and discounted at 10 percent, the net present value of the incremental value of natural capital is USD 4.9 million over the 20 years of the carbon balance appraisal. The detailed results for each subcomponent is provided in Table 3.

[2] Converted from GBP to USD with an exchange rate of .793 (UN Operational Rates of Exchange, 2019).
[3] Converted from EUR to USD with an exchange rate of .899 (UN Operational Rates of Exchange, 2019).
[4] Ibid.
[5] Converted from SEK to USD with an exchange rate of 9.535 (UN Operational Rates of Exchange, 2019).

Table 3. Valuing the incremental value of natural capital (completed activities)

			Unit	Increase in unit	Economic price in USD yr^{-1}	Value in USD for 20 years	
A	Soil carbon benefits			SOC		**119 317.51**	
	A1	Fertiliser replacement	t C		0.40	15 151.43	a)
	A2	Productivity enhancement	t C	37 878.57	2.73	103 408.51	b)
	A3	Water quality enhancement	t C		0.02	757.57	c)
B	Commercial timber			BIOMASS		**2 989 766.54**	
	B1	Commercial timber	t dm	151 857.04	89.45	2 989 766.54	d)
C	Social cost of carbon			CO_2-SEQ		**8 412 356.33**	
	C1	Carbon balance	t CO_2e.	400 588.40	21.00	8 412 356.33	e)
					Total	**11 521 440.38**	
					NPV	**4 904 425.84**	

Notes:
a) Based on Wander et al. (2004) with a C:N ratio of 20:1, mineralization rate of organic N to inorganic N of 1.8 percent, and fertilizer N cost of USD 0.50 kg^{-1} N.
b) Based on Smith et al. (2000), with fertilizer replacement value subtracted out.
c) Based on sensitivity of erosion rates to changes in soil carbon, based on RUSLE and metamodel of Lakshmarian et al. (1996). Value of reduced erosion set equal to USD 1.68 t^{-1} eroded sediment (Ribaudo. 1989). Does not include substantial influence of surface residues.
d) Based on IPCC (2006) basic wood density of selected temperate and boreal tree taxa of .4683 oven-dry tonnes (moist m^{-3}) and the default carbon fraction of biomass, the portion of commercial tree growing stocks (FAO, 2005), and roundwood prices t^{-1} roundwood (FAO, 2019).
e) Social cost of one tCO_2e varying from USD 21 to over USD 300 (Mackie et al. 2014). The lower bound of USD 21 per tCO_2e is assumed for the calculation.

Source: Wander et al., 2004; Smith et al., 2000; Lakshmarian et al., 1996; IPCC, 2006; Mackie et al., 2014.

4.1.4 Other non-quantified positive impacts of the ESP

Labour generated

The afforestation of previously degraded land with very limited shrub cover, oaks, acacia, spruce, and various pine species (without disturbance to the pines due to harvest) was done by local farmers. These farmers were involved in the selection process of the sites and they were directly paid for the land preparation and the planting of the seedlings. The project simultaneously benefits the local population and the environment through an increase in revenue for smallholder farmers in the project zones and the promotion of sustainability in the management of the newly generated forests due to the active participation of the smallholder farmers in the plantation process.

Transferring land ownership to municipalities

As described in the country context, a considerable portion of land (forest and pastures) was transferred from state to communal ownership over the past decade. The ESP further supported this process and aimed at transferring additional lands to communal ownership with all the subsequent rights and obligations. The aim of this land transfer is to make the municipalities and traditional users aware of the responsibility they have for their land management. Indeed, this shift of ownership is expected to increase sustainable land management practices throughout the country. As there is no established data available on the causal relationship between the establishment of communal ownership of forests and the level of improvement of forests, the transfer of land ownership to the municipalities is herein solely described as a potential positive impact of the ESP.

Habitat and supporting services

Forests and landscapes play a crucial role in providing habitats for fauna and flora. Subtropical climates are characterized by species that are highly specialized and adapted to the specific climate conditions including wet winters and dry summers. Many species, therefore, potentially have great value in efforts to adapt to climate change.

4.2 Planned project activities

4.2.1 Carbon balance (most likely scenario)

Based on the activities described under 2.3.2, a carbon balance was estimated for the planned activities of the GHG emissions or sequestrations of the ESP. Dominant soils are assumed to be High Activity Clay soils. The climate is defined as warm temperate moist (subtropical Mediterranean).

With the additional project activities, the joint World Bank-GEF-SIDA project is extended by one year. The implementation phase is hence six years and the capitalisation phase is 14 years, equalling the default 20 years of the IPCC.

Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -4.1 tCO_2-e per hectare per year, or -597 390 tCO_2-e over the entire 20-year-period of analysis. The EX-ACT results are presented in Figure 6. The overall uncertainty of this assessment is estimated at 23.1 percent.

Figure 6. EX-ACT results for most likely scenario of planned activities

Project Name	*World Bank Environmental*		Climate	*Warm Temperate (Moist)*			Duration of the Project (Years)		*20*		
Continent	*Eastern Europe*		Dominant Regional Soil Type	*HAC Soils*			Total area (ha)		*7228.2*		

Components of the project	Gross fluxes Without	 With	 Balance	Share per GHG of the Balance All GHG in tCO2eq CO_2 Biomass	 Soil	 Other	 N_2O	 CH_4	Result per year Without	 With	 Balance
	All GHG in tCO2eq Positive = source / negative = sink										
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-78,192	-78,192	-29,918	-48,274		0	0	0	-3,910	-3,910
Other LUC	0	-15,023	-15,023	-323	-14,701		0	0	0	-751	-751
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	-11,116	-11,116	-10,164	-952		0	0	0	-556	-556
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-25,649	-25,649	0	-25,649		0	0	0	-1,282	-1,282
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	110,894	-356,514	-467,409	-333,263	-134,145		0	0	5,545	-17,826	-23,370
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	110,894	-486,495	**-597,390**	-373,668	-223,722	0	0	0	5,545	-24,325	-29,869
Per hectare	15	-67	-83	-51.7	-31.0	0.0	0.0	0.0			
Per hectare per year	0.8	-3.4	-4.1	-2.6	-1.5	0.0	0.0	0.0	0.8	-3.4	-4.1

Source: Author's calculation based on the EX-ACT tool analysis.

4.2.2 Pessimistic scenario

The default parameters for soils, climate and duration remain HAC soils, a warm temperate moist climate and an implementation and capitalisation phase of 6 and 14 years, respectively. Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -4.1 tCO_2-e per hectare per year, or -577 309 tCO_2-e over the entire 20-year-period of analysis. The EX-ACT results are presented in Figure 7. The overall uncertainty of this assessment is estimated at 22.9 percent.

Figure 7. EX-ACT results for pessimistic scenario of planned activities

Project Name	World Bank Environmental	Climate	Warm Temperate (Moist)	Duration of the Project (Years)	20
Continent	Eastern Europe	Dominant Regional Soil Type	HAC Soils	Total area (ha)	7093.2

Components of the project	Gross fluxes Without	With	Balance	Share per GHG of the Balance — All GHG in tCO2eq — CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year Without	With	Balance
	All GHG in tCO2eq — Positive = source / negative = sink										
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-71,297	-71,297	-27,280	-44,018		0	0	0	-3,565	-3,565
Other LUC	0	-13,521	-13,521	-290	-13,231		0	0	0	-676	-676
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	-10,004	-10,004	-9,148	-857		0	0	0	-500	-500
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-25,649	-25,649	0	-25,649		0	0	0	-1,282	-1,282
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	108,251	-348,585	-456,837	-325,749	-131,087		0	0	5,413	-17,429	-22,842
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	108,251	-469,058	**-577,309**	-362,467	-214,842	0	0	0	5,413	-23,453	-28,865
Per hectare	15	-66	-81	-51.1	-30.3	0.0	0.0	0.0			
Per hectare per year	0.8	-3.3	-4.1	-2.6	-1.5	0.0	0.0	0.0	0.8	-3.3	-4.1

Source: Author's calculation based on the EX-ACT tool analysis.

4.2.3 Optimistic scenario

The default parameters for soils, climate and duration remain HAC soils, a warm temperate moist climate and an implementation and capitalisation phase of 6 and 14 years, respectively. Based on these assumptions, the accumulated GHG mitigation potential due to project implementation amounts to -4.3 tCO_2-e per hectare per year, or -767 401 tCO_2-e over the entire 20-year-period of analysis. The EX-ACT results are presented in Figure 8. The overall uncertainty of this assessment is estimated at 22.6 percent.

Figure 8. EX-ACT results for optimistic scenario of planned activities

Project Name	World Bank Environmental	Climate	Warm Temperate (Moist)	Duration of the Project (Years)	20
Continent	Eastern Europe	Dominant Regional Soil Type	HAC Soils	Total area (ha)	8863.2

Components of the project	Gross fluxes Without	With	Balance	Share per GHG of the Balance — All GHG in tCO2eq — CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year Without	With	Balance
	All GHG in tCO2eq — Positive = source / negative = sink										
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-85,087	-85,087	-32,556	-52,531		0	0	0	-4,254	-4,254
Other LUC	0	-16,526	-16,526	-355	-16,171		0	0	0	-826	-826
Agriculture											
Annual	0	0	0	0	0		0	0	0	0	0
Perennial	0	-12,228	-12,228	-11,180	-1,047		0	0	0	-611	-611
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-27,569	-27,569	0	-27,569		0	0	0	-1,378	-1,378
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management	150,540	-475,451	-625,991	-445,973	-180,018		0	0	7,527	-23,773	-31,300
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	0	0			0	0	0	0	0	0
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	150,540	-616,861	**-767,401**	-490,064	-277,337	0	0	0	7,527	-30,843	-38,370
Per hectare	17	-70	-87	-55.3	-31.3	0.0	0.0	0.0			
Per hectare per year	0.8	-3.5	-4.3	-2.8	-1.6	0.0	0.0	0.0	0.8	-3.5	-4.3

Source: Author's calculation based on the EX-ACT tool analysis.

4.2.4 Incremental value of natural capital (most likely scenario)

Based on the most likely scenario described under 4.2.1 and discounted at 10 percent, the net present value of the incremental value of natural capital is USD 7.24 million over the 20 years of the carbon balance appraisal. The detailed results for each subcomponent is provided in Table 4.

Table 4. Valuing the incremental value of natural capital (planned activities)

			Unit	Increase in unit	Economic price in USD yr^{-1}	Value in USD for 20 years	
A	Soil carbon benefits			SOC		**192 197.39**	
	A1	Fertiliser replacement	t C	223 721.83	0.40	24 406.02	a)
	A2	Productivity enhancement	t C		2.73	166 571.07	b)
	A3	Water quality enhancement	t C		0.02	1 220.30	c)
B	Commercial timber			BIOMASS		**4 268 928.48**	
	B1	Commercial timber	t dm	216 828.58	89.45	4 268 928.48	d)
C	Social cost of carbon			CO_2-SEQ		**12 545 184.52**	
	C1	Carbon balance	t CO_2e.	597 389.74	21.00	12 545 184.52	e)
					Total	**17 006 310.39**	
					NPV	**7 239 215.36**	

Notes:

a) Based on Wander et al. (2004) with a C:N ratio of 20:1, mineralization rate of organic N to inorganic N of 1.8 percent, and fertilizer N cost of USD 0.50 kg^{-1} N.

b) Based on Smith et al. (2000), with fertilizer replacement value subtracted out.

c) Based on sensitivity of erosion rates to changes in soil carbon, based on RUSLE and metamodel of Lakshmarian et al. (1996). Value of reduced erosion set equal to USD 1.68 t^{-1} eroded sediment (Ribaudo. 1989). Does not include substantial influence of surface residues.

d) Based on IPCC (2006) basic wood density of selected temperate and boreal tree taxa of .4683 oven-dry tonnes (moist m^{-3}) and the default carbon fraction of biomass, the portion of commercial tree growing stocks (FAO, 2005), and roundwood prices t^{-1} roundwood (FAO, 2019).

e) Social cost of one tCO_2e varying from USD 21 to over USD 300 (Mackie et al. 2014). The lower bound of USD 21 per tCO_2e is assumed for the calculation.

Source: Wander et al., 2004; Smith et al., 2000; Lakshmarian et al., 1996; IPCC, 2006; Mackie et al., 2014.

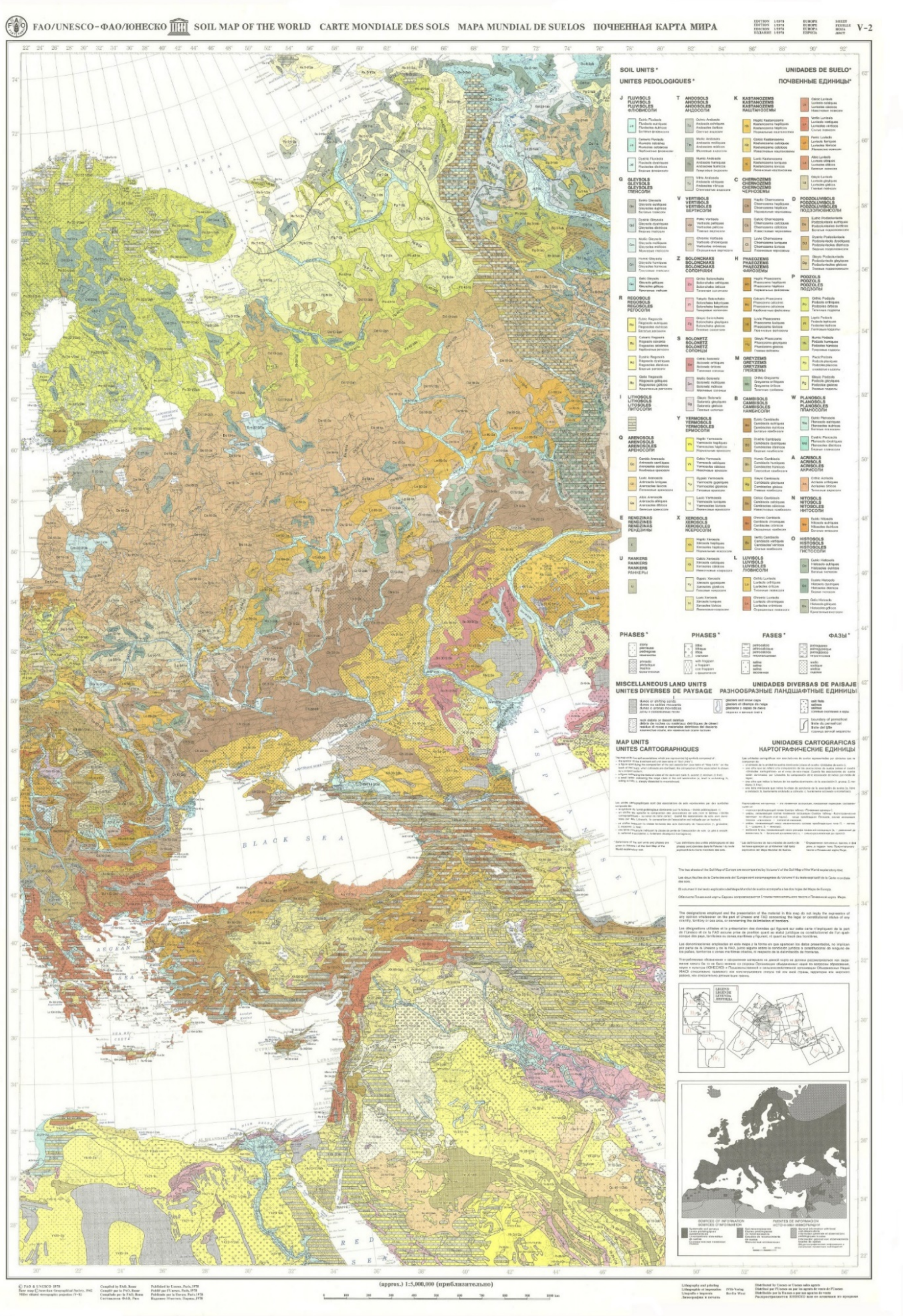
Annexes

Annex 1. FAO-UNESCO soil map

Figure A1.1 FAO-UNESCO soil map – Europe

Source: FAO and UNESCO, 1972.

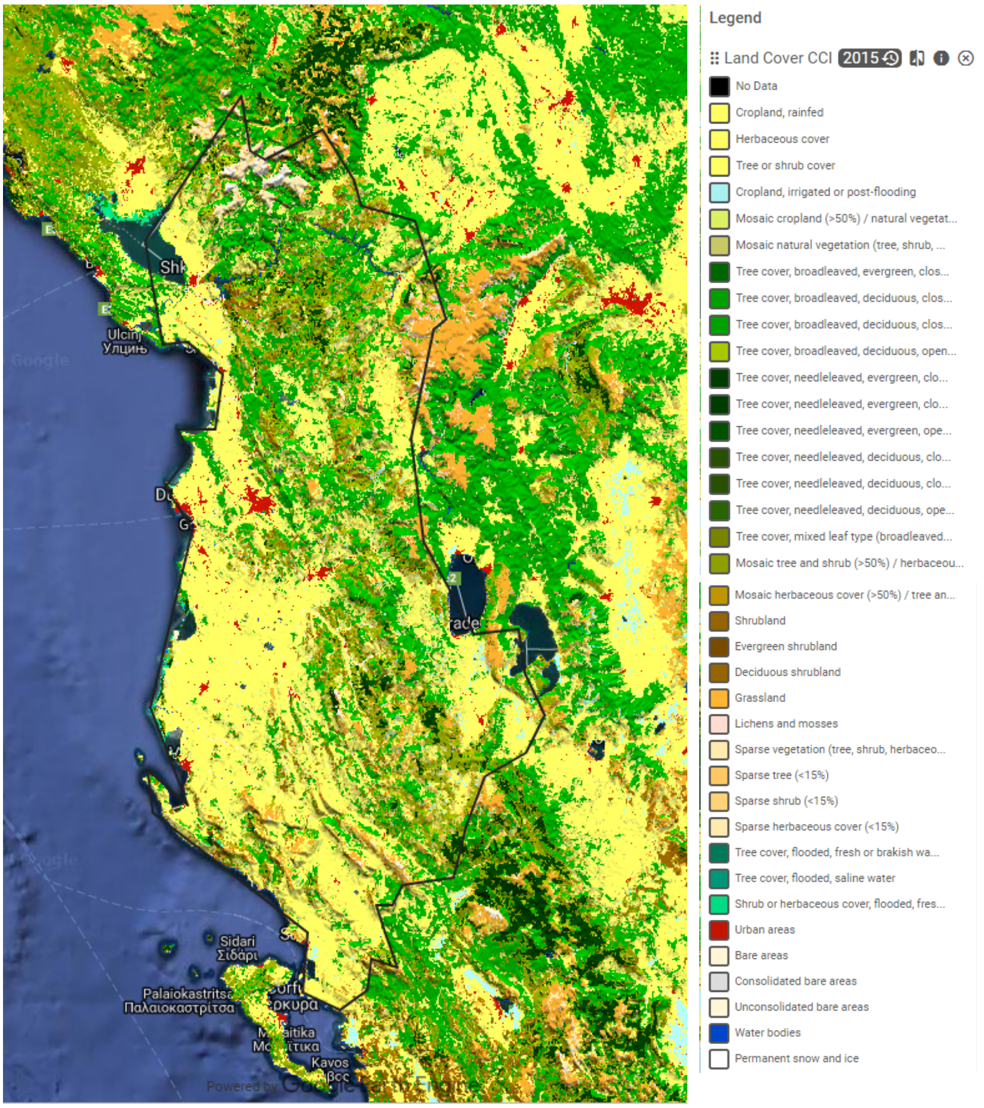
Figure A1.2 Food and Agriculture Organization of the United Nations (FAO) / United Nations Educational Scientific and Cultural Organization (UNESCO) soil map – Eastern Europe



Source: FAO and UNESCO, 1972.

Annex 2. Project boundaries and land cover

Figure A2.1 Climate Change Initiative (CCI) land cover



Source: ESA, 2015.

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EX-ANTE CARBON-BALANCE TOOL [EX-ACT]

The EX-Ante Carbon-balance Tool (EX-ACT) is an appraisal system developed by FAO providing estimates of the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance. The tool helps project designers estimate and prioritize project activities with high benefits in terms of economic and climate change mitigation, and it helps decision-makers to decide on the right course to mitigate climate change in agriculture and forestry and to enhance environmental services.

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EX- ACT COUNTRY CASE STUDIES

This report is part of a series of briefs, presenting project appraisals for different country case studies using either the EX-ACT Tool, which provides the potential climate change mitigation impacts of investment projects in the Agriculture, Forestry and Land Use (AFOLU) sector, or the EX-ACT MRV Tool, a project monitoring mechanism of the impact of greenhouse gases and adaptation to climate change on the same type of projects portfolio. Each brief provides a short description of the project analyzed, the main results obtained and the related materials (case study document, EX-ACT and EX-ACT MRV sheets). The tested projects treat the following areas: rural activities, agriculture, forestry, watershed and restoration of degraded soils.