Cointzio, Mexico

Study site details

The Cointzio basin is situated in the altiplano of the Transmexican Volcanic Belt and consists of a small plain surrounded by mountains, the outflow of which is controlled by a dam.

- **Coordinates:**
  Latitude: 19°23' – 19°38' N
  Longitude: 101°10' – 101°34' W
- **Size:** 640 km^2
- **Altitude:** 1999 – 3007 m
- **Precipitation:** 750 – 1100 mm (annual mean)
- **Temperature:** 12° – 20°C (annual mean)
- **Land use:** scrublands, forests, rainfed and irrigated agriculture, and grasslands
- **Inhabitants:** 42,150 (2000)
- **Main degradation processes:** water erosion
- **Major drivers of degradation:** lack of awareness, low profitability, inappropriate land management (overgrazing)

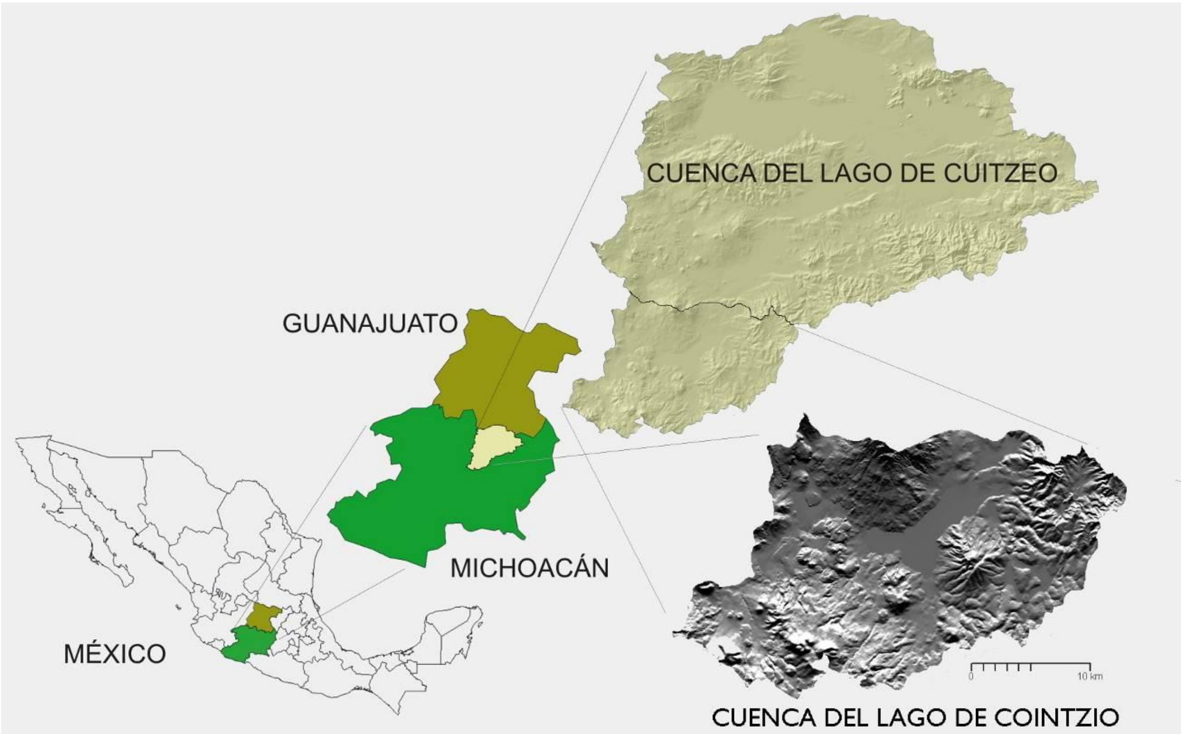


Figure 1: Study site location.

Overview of scenarios

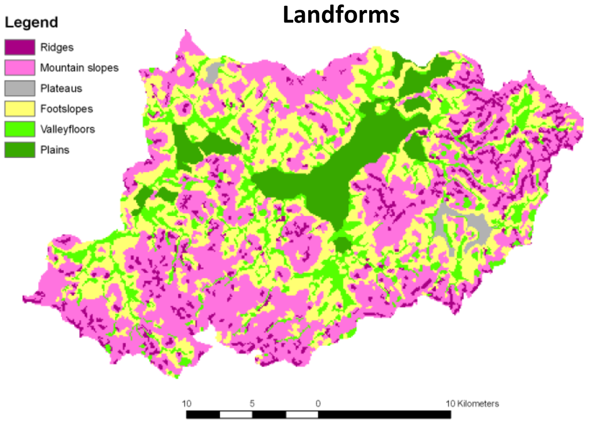
1. Baseline Scenario: PESERA baseline run
2. Technology Scenario: Land reclamation with native Agave and trees through participative action for economical benefits (MEX02)
3. Technology Scenario: Minimum tillage in rainfed and irrigated maize
4. Global Scenario: Food production
5. Global Scenario: Minimizing land degradation

Cointzio, Mexico

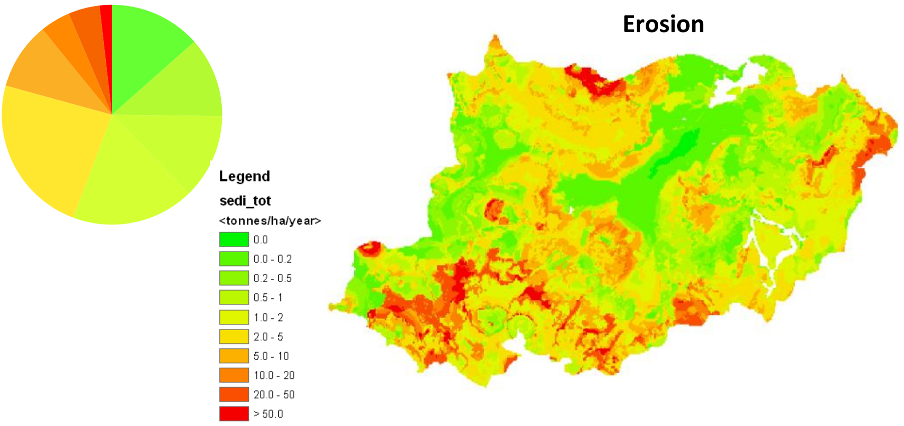
Baseline Scenario

PESERA baseline run

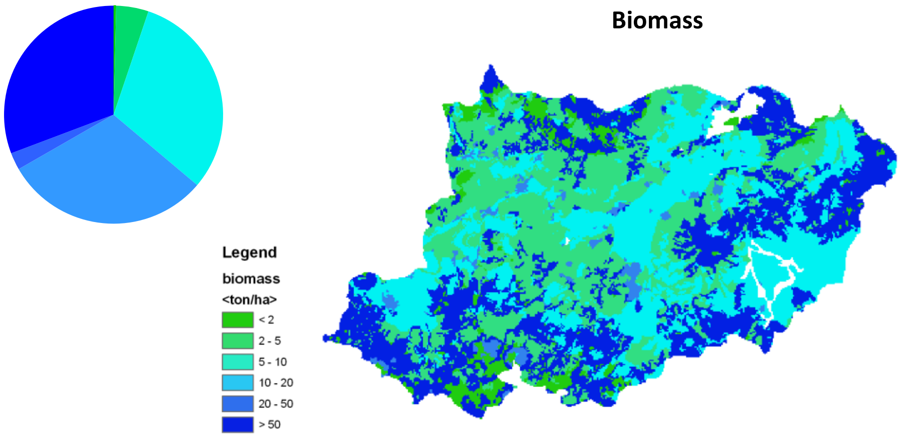
The baseline erosion map clearly follows landforms: mountain slopes demonstrate high soil loss rates whereas plains experience little soil erosion. Some areas are simulated to experience very high soil erosion rates of over 200 tons/ha/year. Biomass production follows the land use pattern, with forests vegetation types representing highest values. Arable land is partially irrigated and have higher productivity than rainfed land. Overall, biomass production is high due to the subhumid climatic conditions and deep soils.



Soil erosion



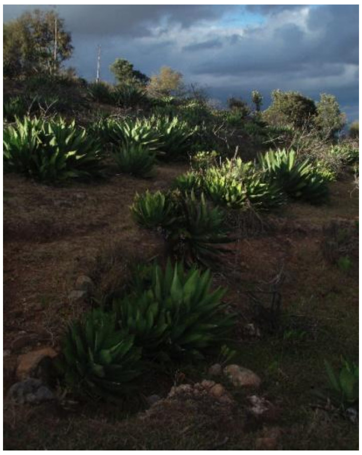
Biomass production



Cointzio, Mexico

Technology Scenario:
Land reclamation with native Agave and trees through participative action for economical benefits (MEX02)

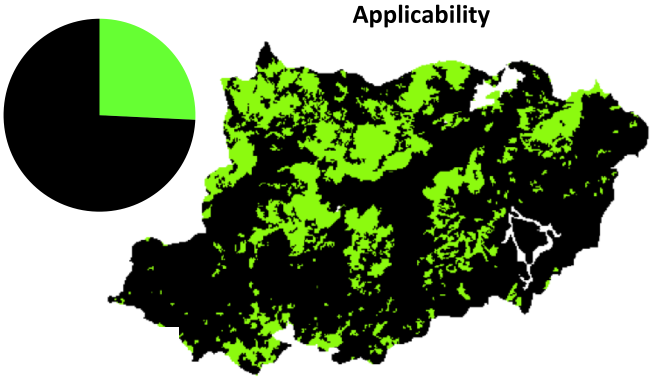
- Total investment costs (seed collection, nursery, transplanting): MXN 20,000 (€1174)
- Without case: unproductive land
- Agave can be harvested after 10 years. It is assumed that on average 1500 litres of Mescal will be produced and sold at MXN 200/litre (€12); the average productivity of 1500 litres is related to average biomass increase in the applicable area and assumed to vary accordingly
- A discount rate of 10% is applied
- Reduction of erosion is assessed as a result of increased biomass



Applicability

- The technology is applicable on degraded land, natural grasslands, and open matorral.

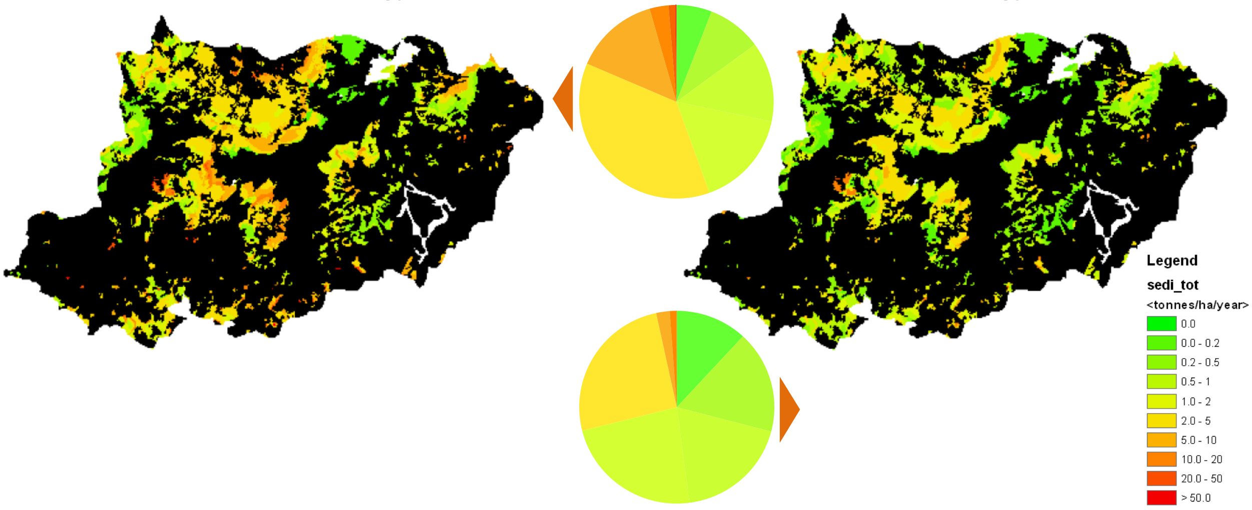
Applicability



Biophysical impact: soil erosion

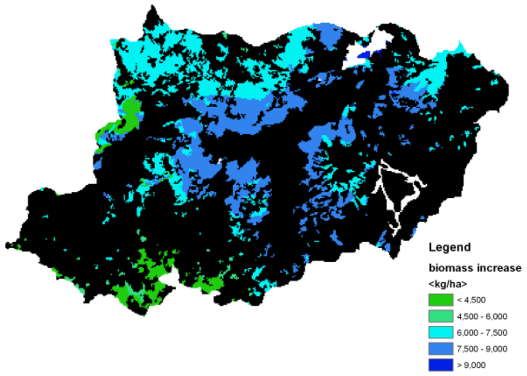
Without technology

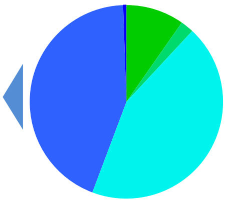
With technology

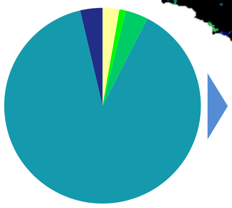


Biophysical impact: increase in biomass

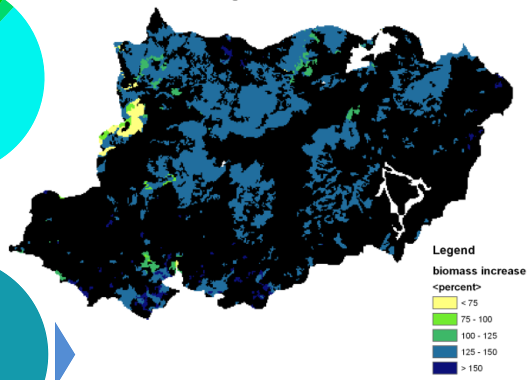
Biomass increase







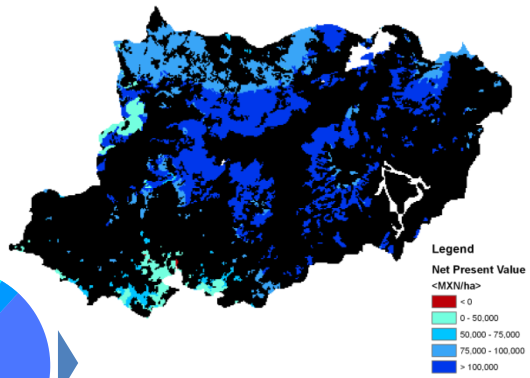
Percentage biomass increase

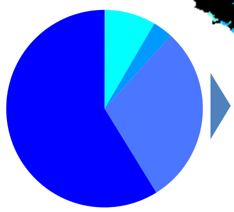


Economic viability

As it is assumed the technology is implemented on unproductive land, there are no foregone benefits. Another approach to this is that any pre-existing use value of the land can continue to be usufruct to similar extent. Due to the distant (in time) benefits, the technology is less viable than if benefits would be obtained instantly, but overall the financial result still looks pretty good, with a tiny bit where there is a negative return on investment and about 10% of the applicable area where the net present value is relatively low.

Net present value after 10 years





Cointzio, Mexico

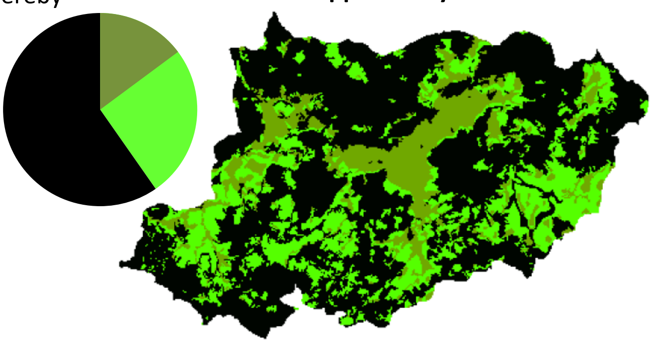
Technology Scenario:
Minimum tillage in rainfed and irrigated maize

- Assumed production costs of maize, both under conventional and minimum tillage:
  - Hills and piedmonts: MXN 1,000/ha (€59)
  - Plains: MXN 1,700/ha (€100)
- A harvest index of 0.4 is applied
- Maize prices are applied as follows:
  - Hills and piedmonts: MXN 5/kg (€0.30)
  - Plains: MXN 6/kg (€0.35)

Applicability

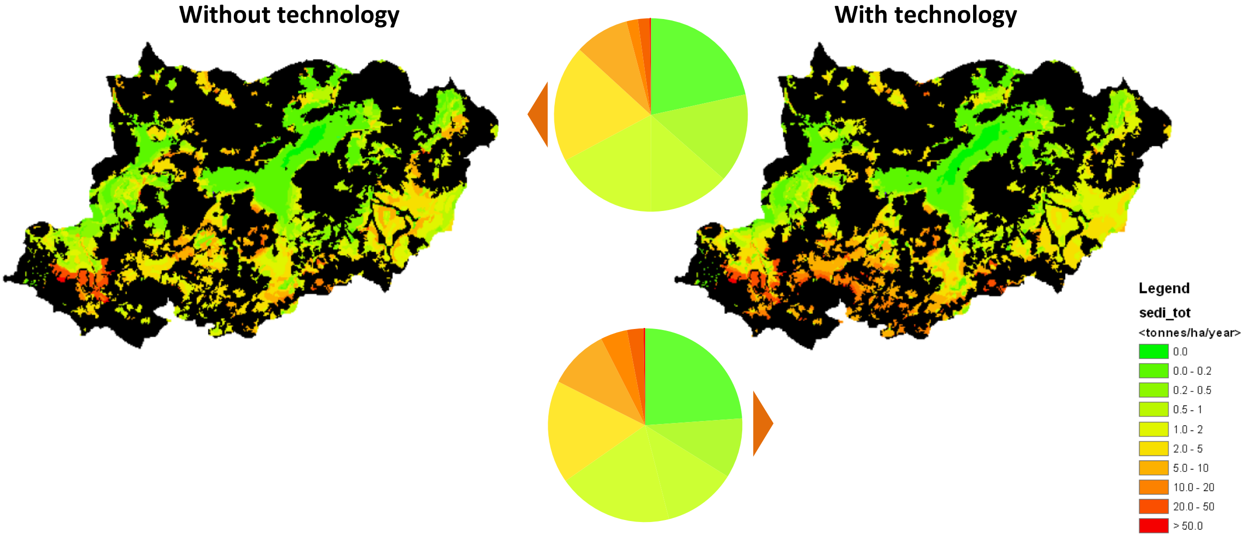
- The technology is applicable on arable land, whereby it is assumed that maize in plains (olive) is irrigated and maize on hillslopes and piedmonts (light green) rainfed.

Applicability



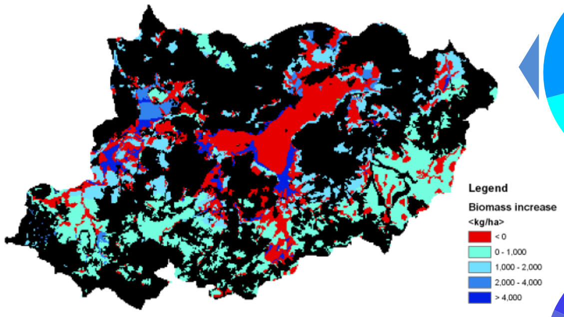
Biophysical impact: soil erosion

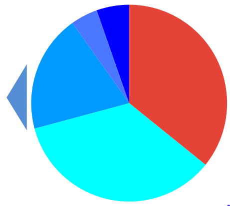
Without technology **With technology**



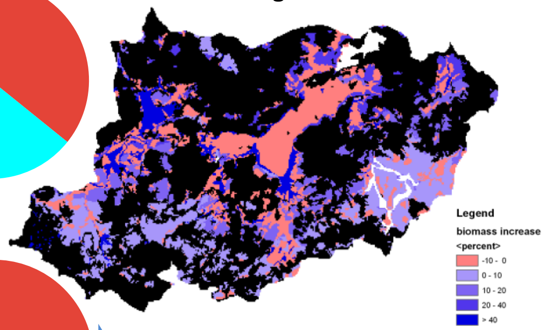
Biophysical impact: increase in biomass

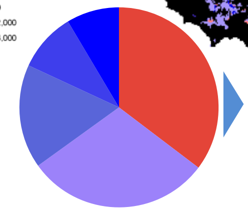
Biomass increase





Percentage biomass increase

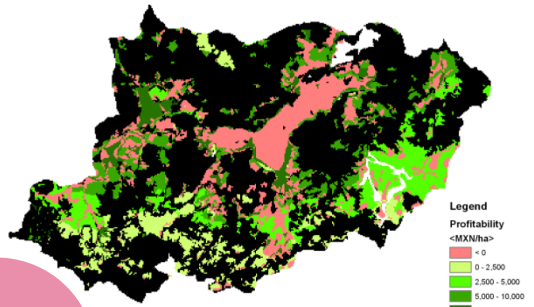


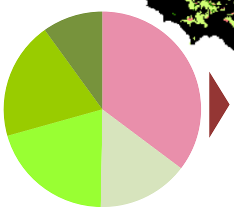


Economic viability

The technology leads to improvements in about two thirds of the applicability area. In irrigated areas, its usefulness is less obvious. We have assumed no difference in operational costs; if efficiency savings can be made the viability might improve.

Net present value after 10 years





Cointzio, Mexico

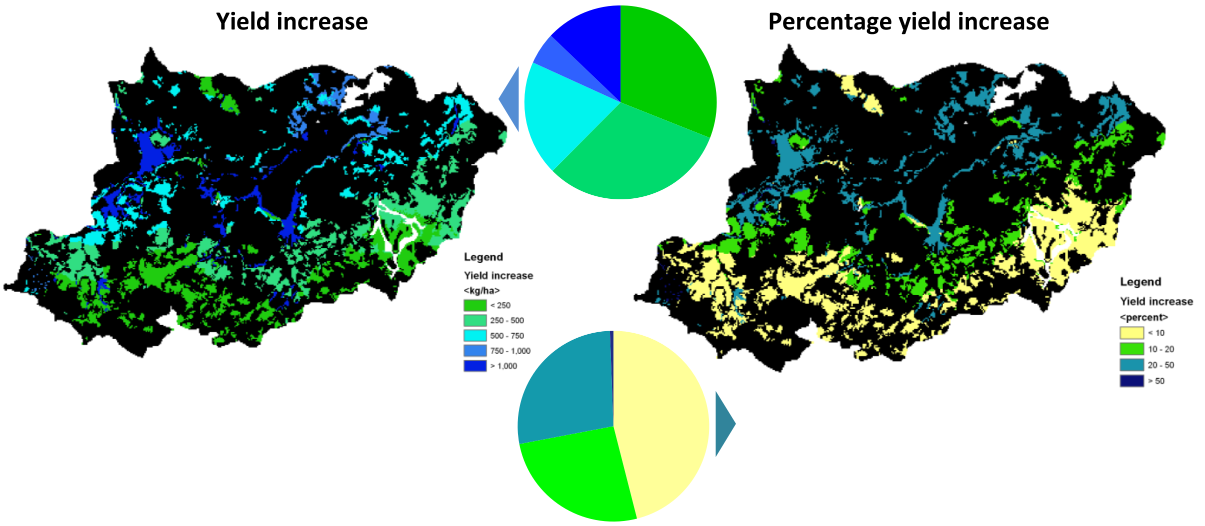
Global Scenario:
Food production

The food production scenario selects the technology with the highest agricultural productivity (biomass) for each cell where a higher productivity than in the baseline scenario is achieved. The implementation costs for the total study area are calculated and cost-productivity relations assessed. To facilitate comparison between different study sites, all costs are expressed in Euro.

+521 kg/ha

+217 kg/inhabitant

Scope for increased production



Biophysical impact: yield increase

- Yield increase in 64 % of applicable area
- Average absolute yield increase: 521 kg/ha
- Average yield increase: 16 %

Economic indicators

Average costs:

- Extra operational cost: €0/ha/yr
- Unitary cost: €0/ton

Aggregate indicators:

- Study site: €0 million
- Augmented annual production: 9,137 ton

Cointzio, Mexico

Global Scenario:
Minimizing land degradation

The minimizing land degradation scenario selects the technology with the highest mitigating effect on land degradation or none if the baseline situation demonstrates the lowest rate of land degradation. The implementation costs for the total study area are calculated and cost-productivity relations assessed. To facilitate comparison between different study sites, all costs are expressed in Euro.

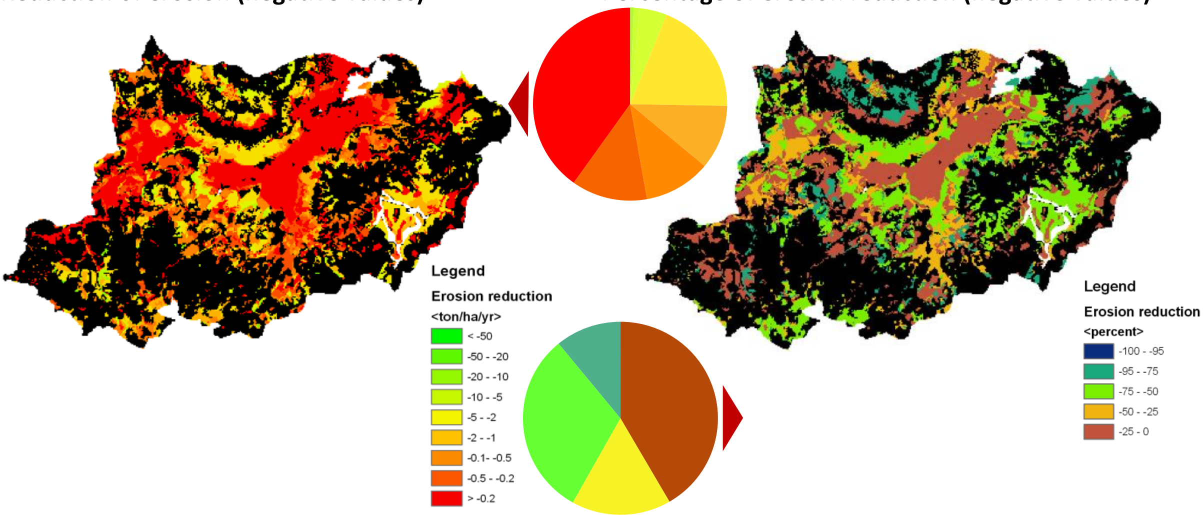
-1.54 ton soil/ha

€323/ton soil

Scope for reduced erosion

Reduction of erosion (negative values)

Percentage of erosion reduction (negative values)



Biophysical impact: erosion reduction

- Reduction of erosion in 70 % of applicable area
- Average absolute erosion reduction: 1.54 tonnes/ha/yr
- Average percent erosion reduction: 39 %

Economic indicators

Average costs:
- Investment cost: €498/ha
- Unitary cost year 1: €323/ton soil
- Unitary cost lifetime: €32/ton soil

Aggregate indicators:
- Study site: €15.47 million
- Aggregate annual erosion reduction: 47,900 ton
- Total erosion reduction: 478,700 ton

Cointzio, Mexico

Concluding remarks

- The PESERA baseline simulation shows a quite severe soil erosion problem in Cointzio, with 20% of the area featuring erosion rates over 10 ton/ha/yr.
- Whereas initially scientists and local stakeholders selected agronomic measures and wood saver ovens as priority strategies, later agave plantations were trialled to counter soil loss by water erosion. The technology scenarios show that erosion rates can be reduced – more so by agave plantations than by minimum tillage in maize. Agave plantation can raise biomass production by as much as 75 – 150%. In contrast, minimum tillage leads to lower biomass increases: up to 50% in rainfed maize, but also leads to reductions of up to 10% in irrigated areas. As a consequence, minimum tillage is not profitable in about a third of the applicability area. Agave plantations take long to produce benefits, but are nevertheless simulated to have positive net present value everywhere where it can be implemented.
- Evaluating the results in a workshop, stakeholders clearly prioritized agave plantations along with wood saver stoves, and downgraded agronomic measures (minimum tillage) to the second tier. Participatory establishment of a pilot agave plantation was instrumental in this result. Agronomic measures were not rated very highly due to low labour input in farming (which only constitutes for 10-20% of rural livelihoods).
- The global food production scenario shows that minimum tillage can boost maize yields by 16% on average in 64% of the applicability area. We suggest this can be achieved at virtually no extra cost. The potential for reducing soil erosion is higher on slopes than in plains. At an average investment cost of almost €500/ha, erosion can be reduced by 1.54 ton/ha/yr. Over 10 years (the lifetime of agave plantations) this investment plays out at 32€/ton soil prevented from eroding.
- Minimum tillage leads to higher yields under rainfed, but not under irrigated conditions. It is therefore recommended to only apply this technology on the first maize production system. Agave plantations are established on unproductive land and there are little risks involved in applying this technology, which can generate an additional source of income in the long run and contribute to more resilient livelihoods.