Eskişehir, Turkey

Study site details

The Eskişehir study site is located in the western part of the central Anatolian Plateau, at its northern margin, and partially at the floor of a through-going depression, called the Eskişehir Basin.

- **Coordinates:**
  Latitude: 39°53'8"N
  Longitude: 30°16'12"E
- **Size:** 90 km^2
- **Altitude:** 819 – 1362 m
- **Precipitation:** 380 mm
- **Temperature:** generally below 0°C during winter and may exceed 40°C in summer days
- **Land use:** arable land (cereals, sugar beet, sunflower), pastures, forest
- **Inhabitants:** 3,040
- **Main degradation processes:** Water and wind erosion, droughts, urbanisation
- **Major drivers of degradation:** Inappropriate land management, urban expansion

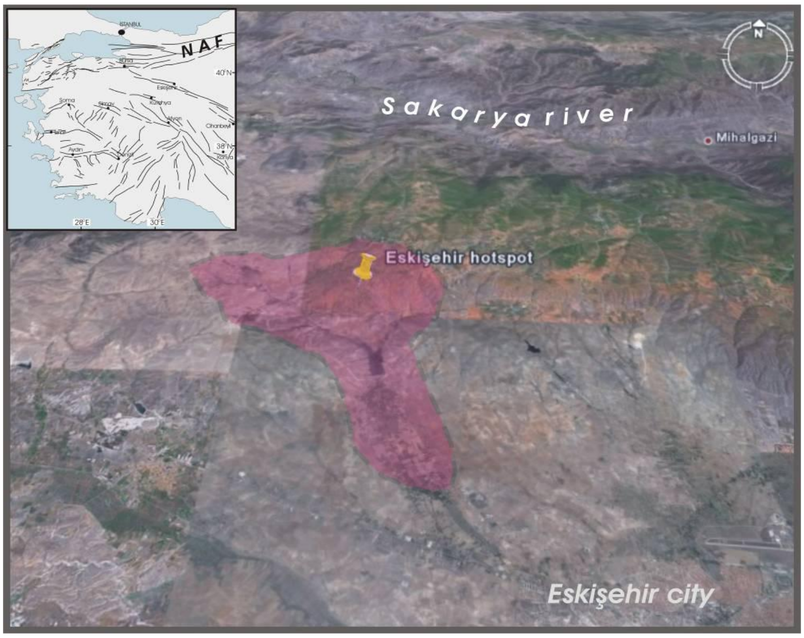

Figure 1: Study site location

Overview of scenarios

1. Baseline Scenario: PESERA baseline run
2. Technology Scenario: Contour ploughing (ETH43)
3. Technology Scenario: Woven fences with contour ploughing (TUR05)
4. Policy Scenario: Subsidising woven fences (TUR05)
5. Global Scenario: Food production
6. Global Scenario: Minimizing land degradation

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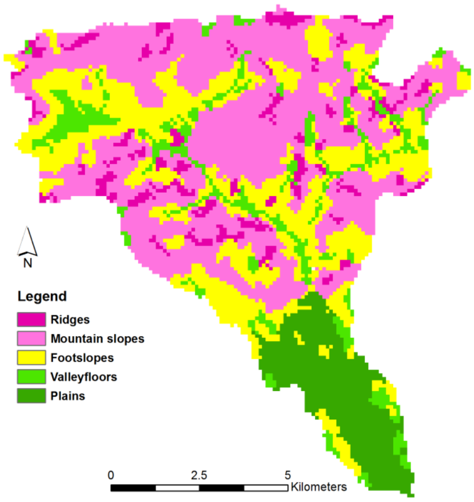
Baseline Scenario

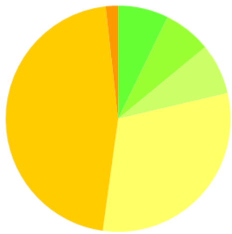
PESERA baseline run

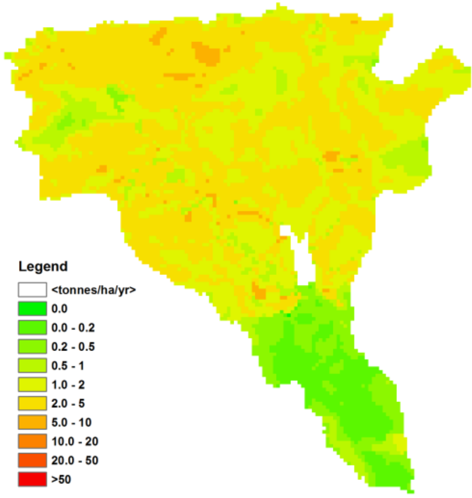
The baseline run clearly shows distinct erosion rates for two areas: the mountain slopes and the plains. Several valleyfloors also have low erosion rates. Roughly 80% of the area has simulated erosion rates of over 1 ton/ha/yr, but only a very small area experiences erosion rates of over 10 ton/ha/yr. Biomass production output shows a clear cut difference between dryland farming (mostly 500-1000 kg/ha) and irrigated farming (typically larger than 3500 kg/ha). Pastures occupy the intermediate ranges.

Landforms

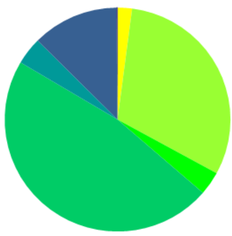


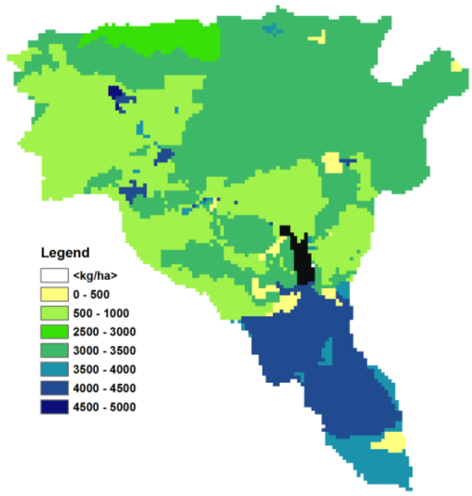
Soil erosion





Biomass production





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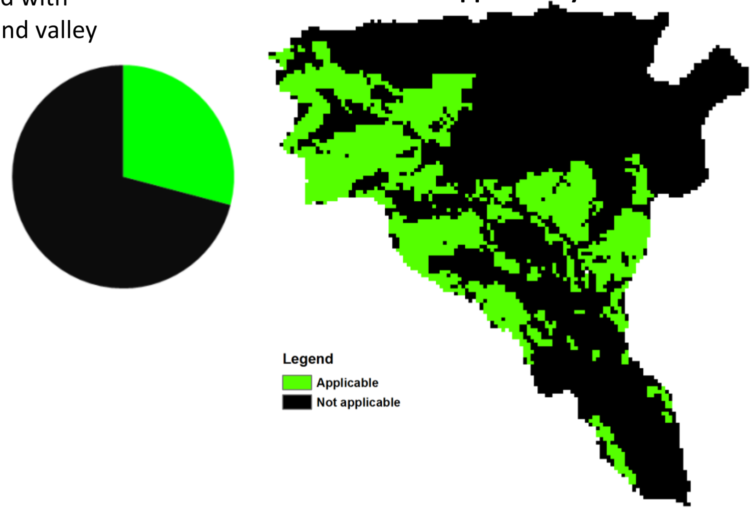
Technology Scenario:
Contour ploughing (ETH43)

- Total operation costs under different practices:
  - traditional ploughing 286 TRY/ha (€216)
  - contour ploughing 286 TRY/ha (€216)
- The above operation costs include renting of equipment to implement each practice
- A harvest index for grains of 45% of total biomass was assumed
- NPV was calculated on 20 year period basis at 10% discount rate
- The price of grains is 0.384 TRY/kg (€0.16)

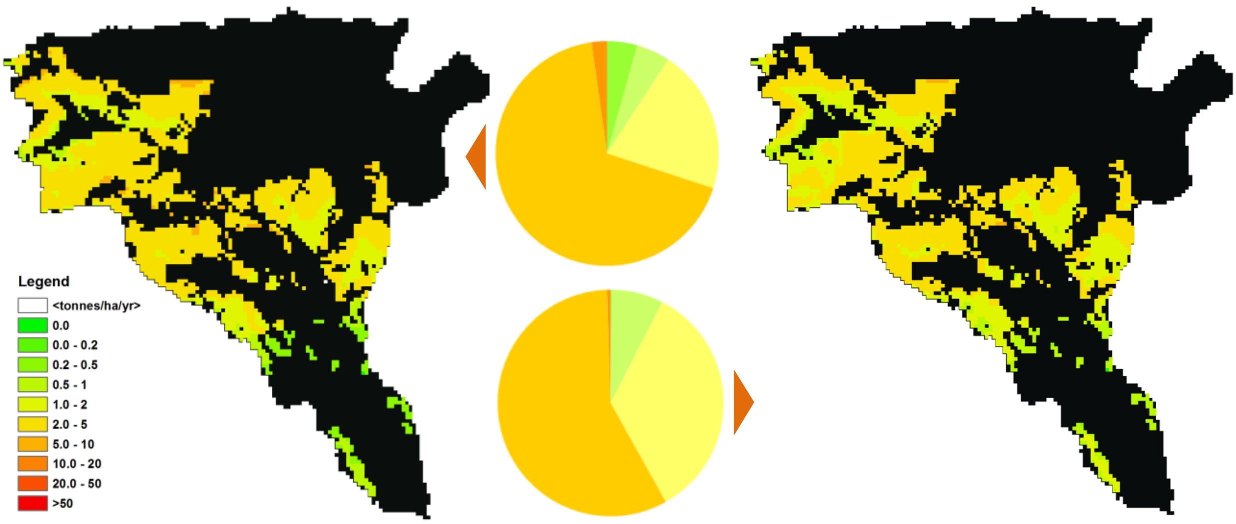
Applicability

- The technology is applicable on arable land with slopes between 2 and 35% (not in plains and valley floors).

Applicability



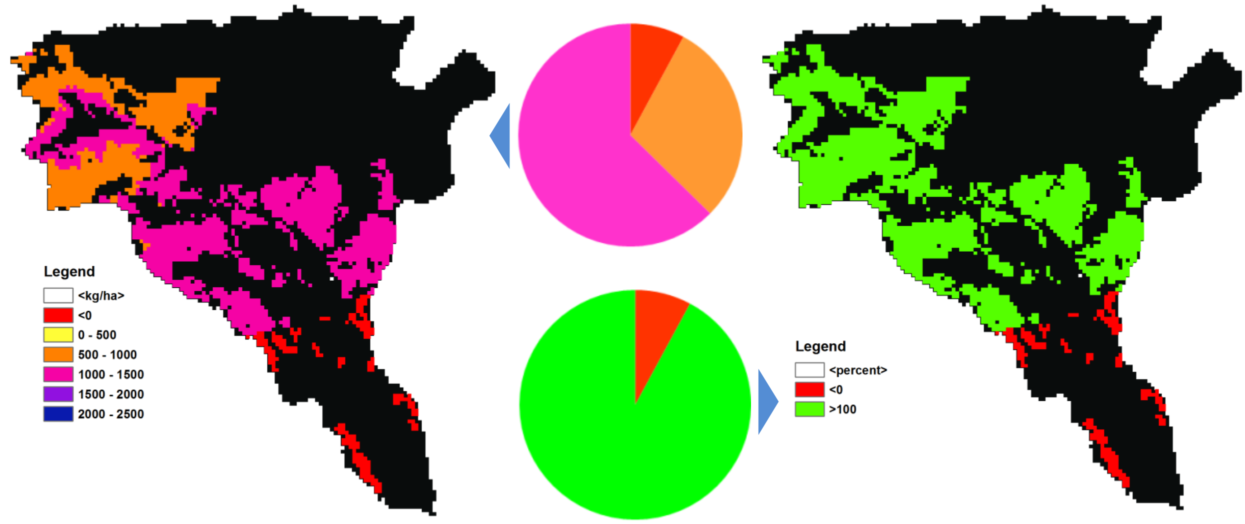
Biophysical impact: soil erosion



Under traditional ploughing **Under contour ploughing**

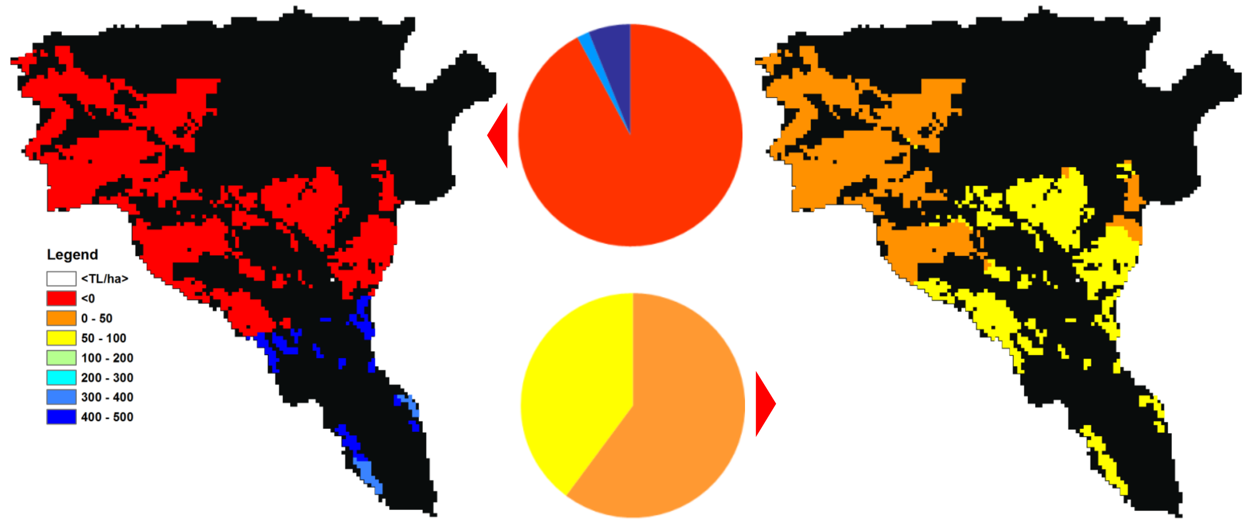
Biophysical impact: change in biomass

Biomass change | **Percentage biomass change**

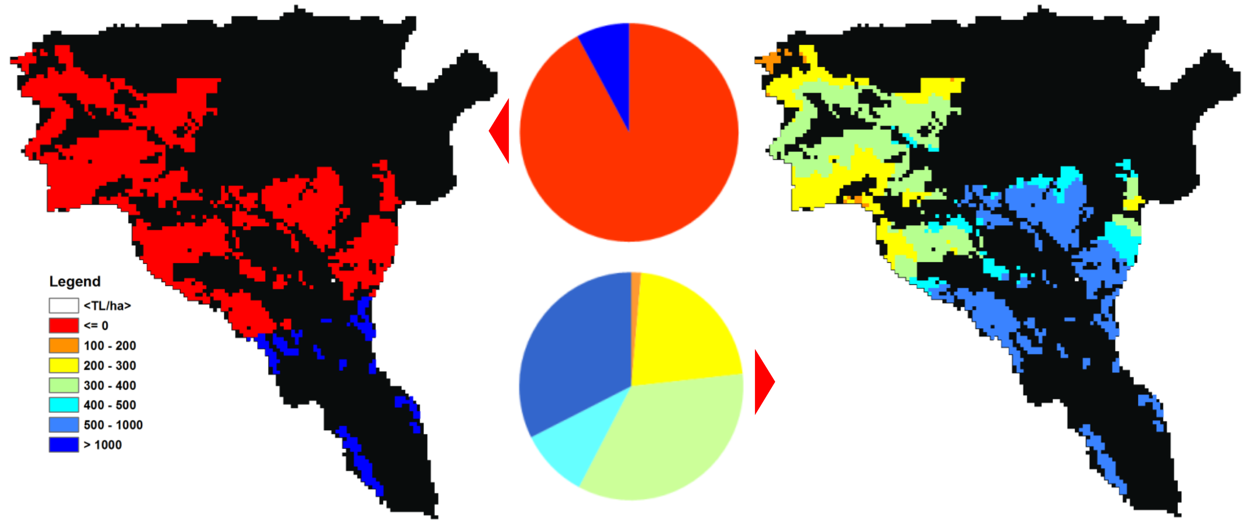


Economic viability

Net profit under traditional ploughing | **Net profit under contour ploughing**



NPV under traditional ploughing | **NPV under contour ploughing**



- Contour ploughing is profitable as it does not require extra costs but increases production.

Eskişehir, Turkey

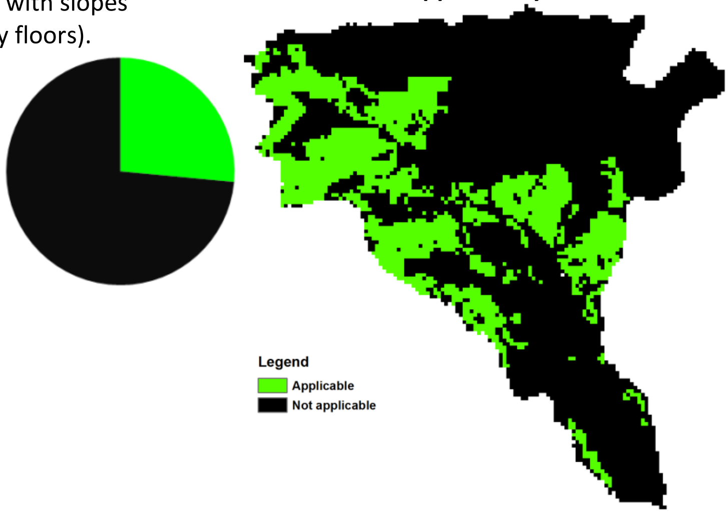
Technology Scenario:
Woven fence and contour ploughing (TUR05)

- Total operation costs under different practices:
  - traditional ploughing 286 TRY/ha (€216)
  - woven fence and contour ploughing 286 TRY/ha (€216with an initial investment cost of 2500 TRY/ha (€1014 – first year only), annual maintenance cost of 5% of investment cost
- The above operation costs include renting of equipment to implement each practice
- A harvest index for grains of 45% of total biomass was assumed
- The life of the technology is 20 years.
- The price of grains is 0.384 TRY/kg (€0.16)
- 10% discount rate was used for calculating NPV

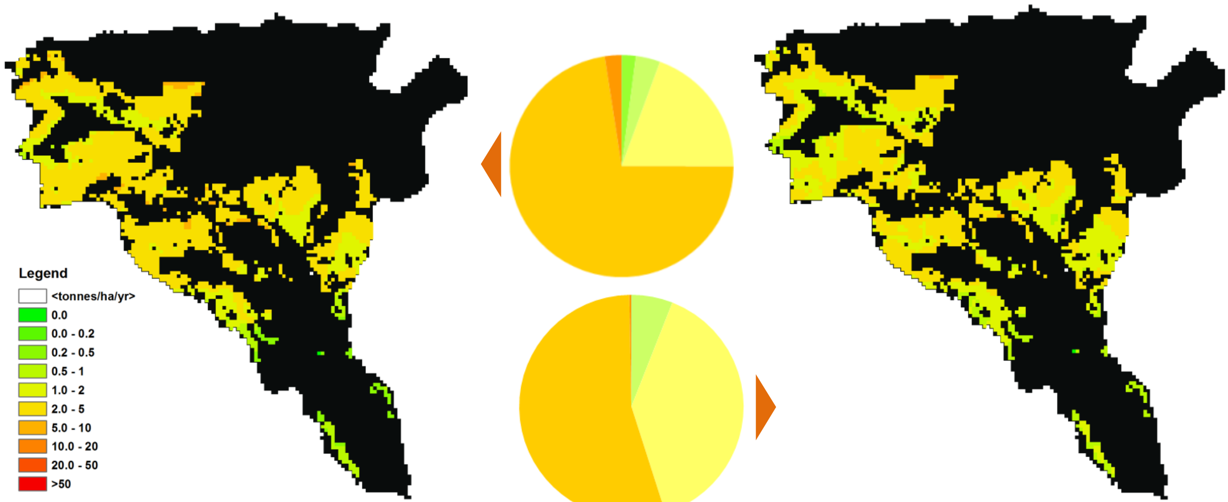
Applicability

- The technology is applicable on arable land with slopes between 3 and 35% (not in plains and valley floors).

Applicability



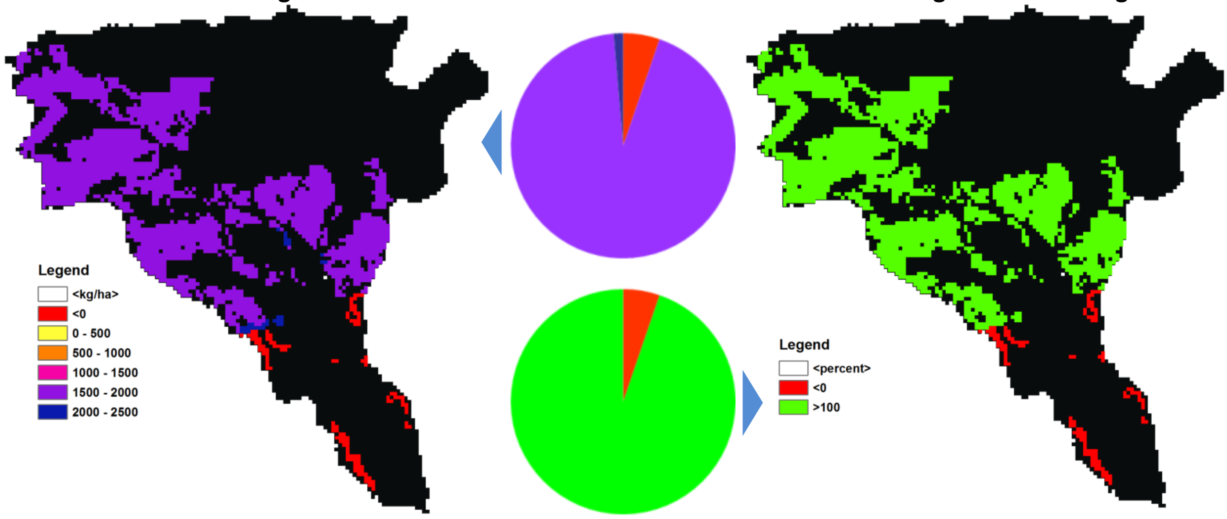
Biphysical impact: soil erosion



Under traditional ploughing **Under woven fence and contour ploughing**

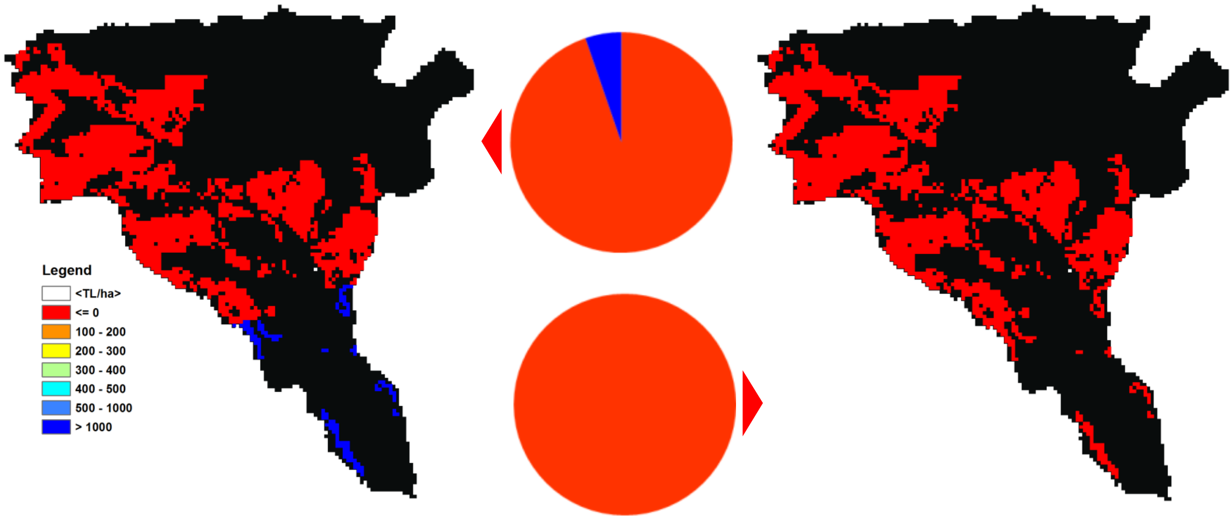
Biophysical impact: change in biomass

Biomass change | **Percentage biomass change**



Economic viability

NPV under traditional ploughing | **NPV under woven fence and contour ploughing**



The technology has, according to the model simulations, the potential to double yields across much of the applicability area. Nevertheless, the net present value of woven fences and contour ploughing is negative due to the substantial initial investment costs. Under these circumstances, the technology is unlikely to be adopted unless policy incentives reduce the initial costs. Also, the technology has been assumed to require annual maintenance costs equal to 5% of the investment costs. Productivity increases are such that these can be easily covered. A third observation which can be made is that traditional ploughing also shows negative returns in most of the area considered. This could indicate that farmers accept lower return to labour than the opportunity cost used in the simulations.

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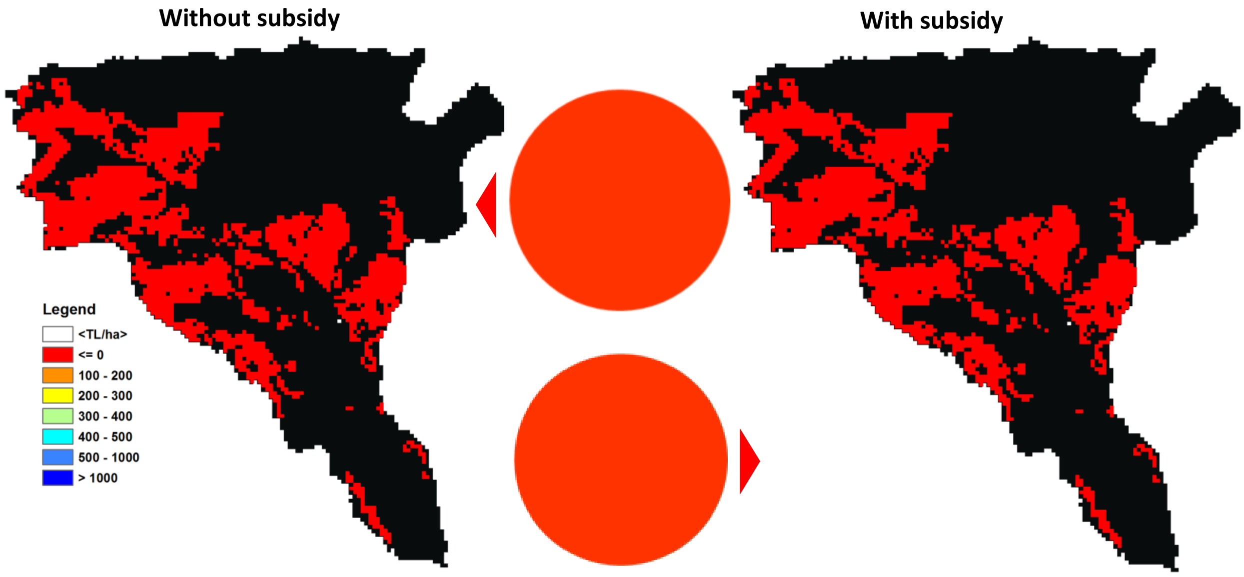
Policy Scenario:
Subsidising woven fence (TUR05)

Due to a high investment cost for building the woven fence, without external financial incentive in all parts of the study area widespread adoption of the technology is very unlikely. In this scenario the effects of a subsidy equal to 50% of the investment costs on profitability of the technology and the potential for mitigating land degradation are explored.

50%

Profitability:



Cost-effectiveness indicators:

- The introduction of 50% subsidy does not have significant impact as the proportion of the study area w negative economic gain remains the same with and without the subsidy.
- The technology was ranked first in the stakeholder evaluation based on its performance in the experiment, which is also supported by model output. However, the investment costs were in the experimental case not borne by the land user, and as such it could have been assumed by the participants that these would be subsidised. This scenario shows that such subsidies would be required to stimulate adoption, as even a 50% reduction in investment cost does not justify the investment. An additional question would be if such high rates of subsidies would still be cost-effective in reducing environmental degradation.

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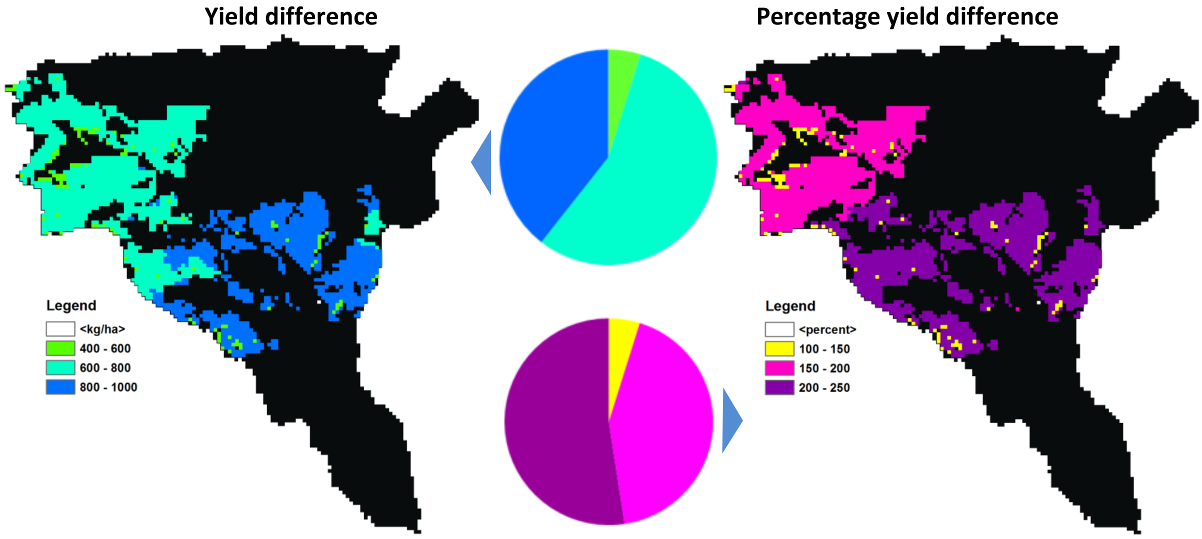
Global Scenario:
Food production

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.

+ 788 kg/ha

+ 607 kg/inhabitant

Scope for increased production



Biophysical impact: yield difference

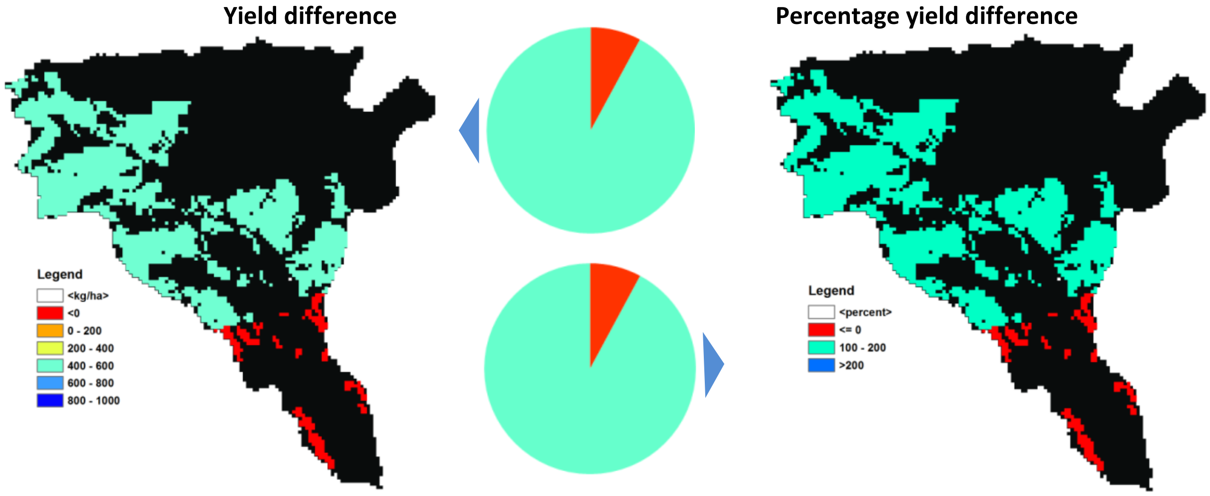
- The implementation of the most productive technology in each location would see yield increase in 91% of applicable area
- Average absolute yield increase: 788 kg/ha
- Average yield increase: 200 %

Economic indicators

Average costs:
- Extra operational cost: €0/ha/yr
- Investment cost: €926/ha/yr
- Unitary cost year 1: €1293/ton
- Unitary cost lifetime: €129/ton

Aggregate indicators:
- Study site: €0
- Study site: €2.4 million
- Augmented annual production: 1845 tonnes
- Augmented total production: 36,900 tonnes

Scope for increased production under ETH43



Biophysical impact: yield difference

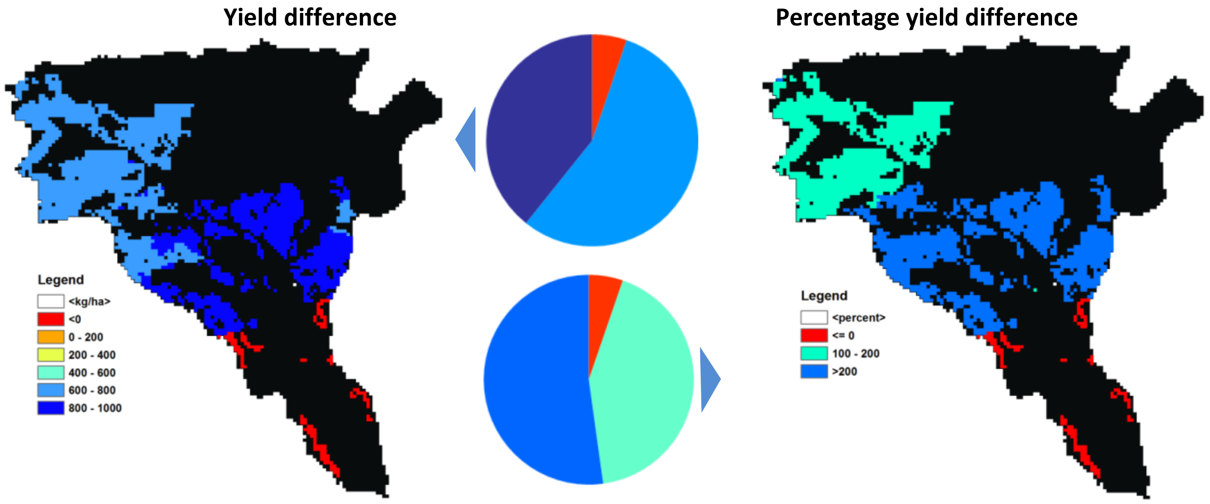
- The implementation of reduced tillage would see yield increase in 92% of applicable area
- Average absolute yield increase: 472 kg/ha
- Average yield increase: 120%

Economic indicators

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

Aggregate indicators:
- Study site: €0
- Augmented annual production: 1105 tonnes

Scope for increased production under KEN05



Biophysical impact: yield difference

- The implementation of reduced tillage would see yield increase in 95% of applicable area
- Average absolute yield increase: 805 kg/ha
- Average yield increase: 204%

Economic indicators

Average costs:
- Investment cost: €1014/ha/yr
- Unitary cost: €1260/ton

Aggregate indicators:
- Study site: €2.3 million
- Augmented annual production: 1793 tonnes

Eskişehir, Turkey

Global Scenario:
Minimizing land degradation

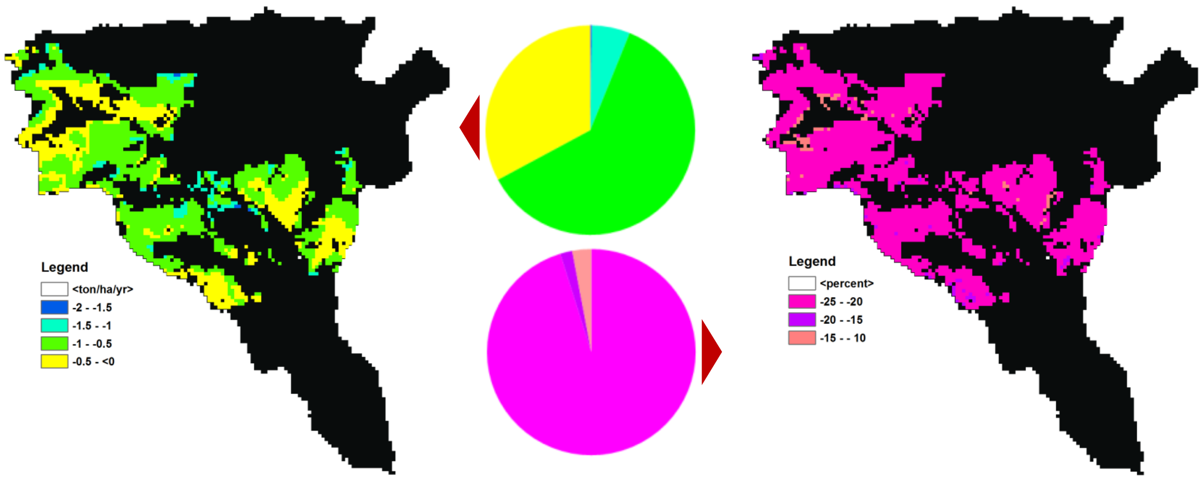
The minimizing land degradation scenario selects the technology with the highest mitigating effect on land degradation or none if the baseline situation demonstrates the lowest rate of land degradation. The implementation costs for the total study area are calculated and cost-productivity relations assessed.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

-0.6 ton soil/ha

€1648/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 91% of applicable area
- Average absolute erosion reduction: 0.6 ton/ha/yr
- Average percent erosion reduction: 22%

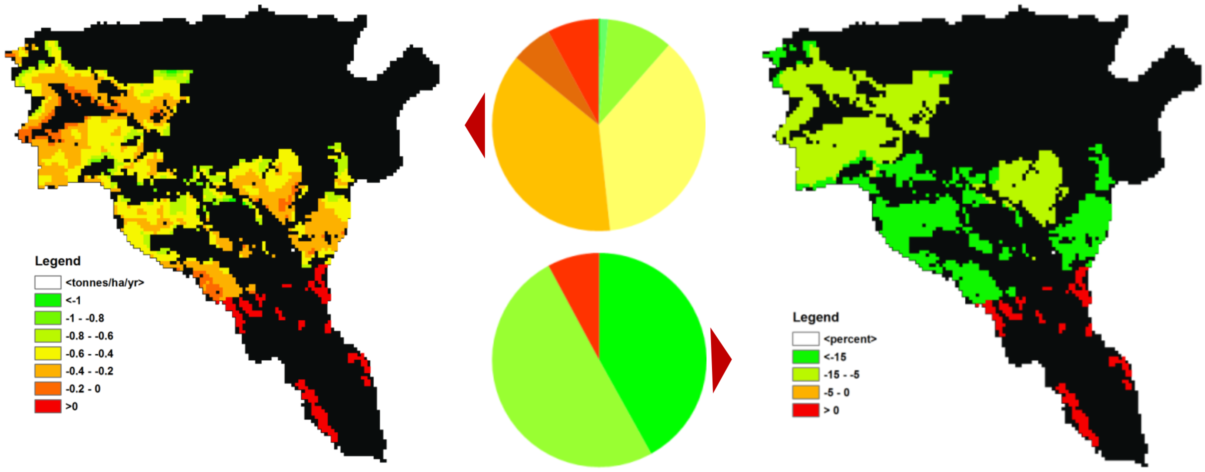
Economic indicators

Average costs:
- Extra operational cost: €0/ha/yr
- Investment cost: €926/ha/yr
- Unitary cost year 1: €1648/ton
- Unitary cost lifetime: €165/ton

Aggregate indicators:
- Study site: €0 million
- Study site: €2.4 million
- Aggregate annual erosion reduction: 1447 ton soil
- Total erosion reduction: 28,940 ton soil

Scope for reduced erosion under ETH43

Reduction of erosion (negative values) **Percentage of erosion reduction (negative values)**



Biophysical impact: erosion reduction

- Reduction of erosion in 92% of applicable area
- Average absolute erosion reduction: 0.4 tonnes/ha/yr
- Average percent erosion reduction: 15%

Economic indicators

Average costs:

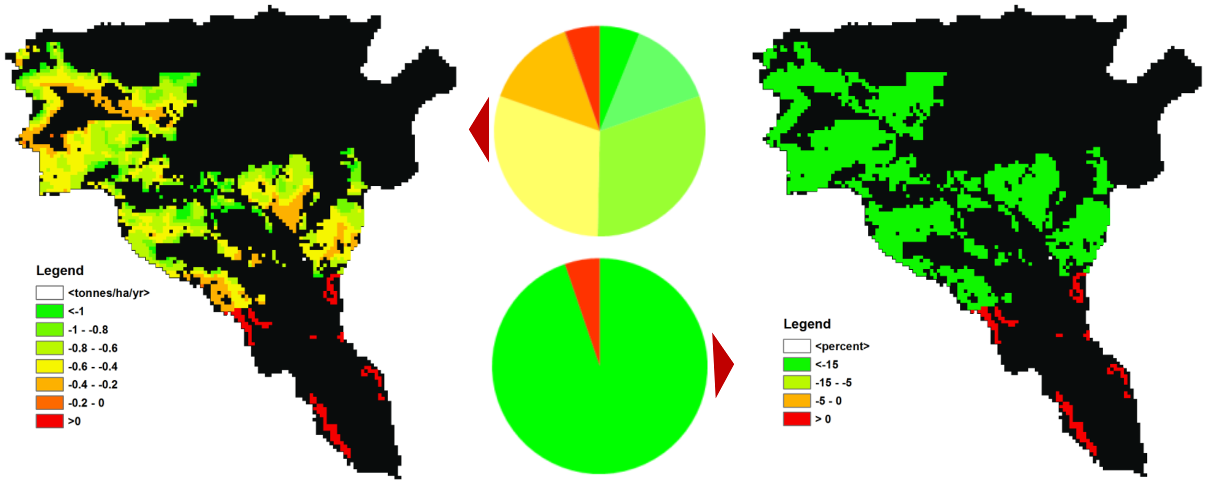
- Extra operational cost: €0/ha/yr
- Unitary cost: €0/ton soil

Aggregate indicators:

- Study site: €0 million
- Aggregate annual erosion reduction: 981 ton

Scope for reduced erosion under KEN05

Reduction of erosion (negative values) **Percentage of erosion reduction (negative values)**



Biophysical impact: erosion reduction

- Reduction of erosion in 95% of applicable area
- Average absolute erosion reduction: 0.6 tonnes/ha/yr
- Average percent erosion reduction: 22 %

Economic indicators

Average costs:

- Investment cost: €1014/ha/yr
- Unitary cost: €1677/ton soil

Aggregate indicators:

- Study site: €2.4 million
- Aggregate annual erosion reduction: 1422 ton

Eskişehir, Turkey

Concluding remarks

- Baseline simulations show that the study site experiences considerable erosion, especially in the sloping areas; roughly 80% of the area has erosion rates of over 1 ton/ha/yr, although only a very small area experiences erosion rates of over 10 ton/ha/yr.
- The technologies simulated are the technologies for which field experiments were conducted. These technologies were further specifications of remediation options selected by scientists and local stakeholders to address water erosion problems. The technology scenario shows that contour ploughing (ETH43) goes some way in reducing the area with erosion rates greater than 2 ton/ha/yr from about 70 to 60% of the applicable area. More impressive is its effect on biomass production, generating a more than 100% increase in about 90% of the applicable area. The technology requires no additional costs, and is thus profitable everywhere where it increases productivity. This only excludes some productive low-lying areas. Similarly, woven fences with contour ploughing (TUR05) have a more notable effect on production than on reduction of erosion. On both criteria, TUR05 outperforms ETH43. Despite of this, application of the woven fences is not economically viable under the assumptions made.
- Evaluating the results in a workshop, stakeholders preferred woven fences over contour ploughing. They did so based on the experimental results, which showed superior performance of the woven fences. There was also concern that contour ploughing would not be effective under high intensity rainfall. The modelling results support the idea that contour ploughing is not very effective in areas with high erosion rates. They acknowledged the investment costs of woven fences, but do not seem to have internalised these to their decision-making perspective – perhaps assuming that this would be subsidised as was the case for the experiment. The statement that incentives would stimulate adoption could imply however that land users are aware of the fact that profitability is an issue.
- A policy scenario subsidising investment costs of woven fences by 50% sorted no effect on its profitability. It could be that labour opportunity costs were too high (i.e. farmers may accept return to labour lower than the going wage rate). Given the vicinity of Eskişehir city this is probably not a very significant factor. High levels of subsidy would be difficult to justify on cost-effectiveness criteria.
- The global scenarios show that the technologies can achieve yield increases and erosion reductions across virtually their entire applicability areas. Yield increases are impressive, at 200% overall and for woven fences in most of the area (i.e. a tripling of yields), and still 120% on average for contour ploughing. Overall, erosion can be reduced by up to 25%, however contour ploughing only delivers reductions of over 15% in about 40% of its applicability area. The average yield increase is 788 kg/ha/yr and the average erosion reduction 0.6 ton/ha/yr, at a cost of €1293 and €1648/ton food product and soil respectively.
- Based on the analyses and perspectives, contour ploughing can easily be adopted but could entail some level of risk in high erosion risk areas and under high intensity events. The effects of woven fences with contour ploughing are clearly demonstrated, but their implementation is not recommended based on economic analysis. A case for subsidies should establish the level of off-site benefits to be obtained.