Karapinar, Turkey

Study site details

The rectangular Karapinar study site is located in the Great Konya Basin of south central Anatolia, 120 km east of Konya city. It includes a military zone (40 km^2) and an erosion control area (15 km^2).

- **Coordinates:**
  Latitude: 37°37'8"N
  Longitude: 33°21'20"E
- **Size:** 156 km^2
- **Altitude:** 998 – 1178 m
- **Precipitation:** 285 mm
- **Average temperature:** 11.5°C
- **Land use:** arable land (cereals, maize, sugar beet, potato, fodder crops), pastures
- **Inhabitants:** na
- **Main degradation processes:** wind erosion, salinization, overgrazing
- **Major drivers of degradation:** inappropriate land management and irrigation techniques

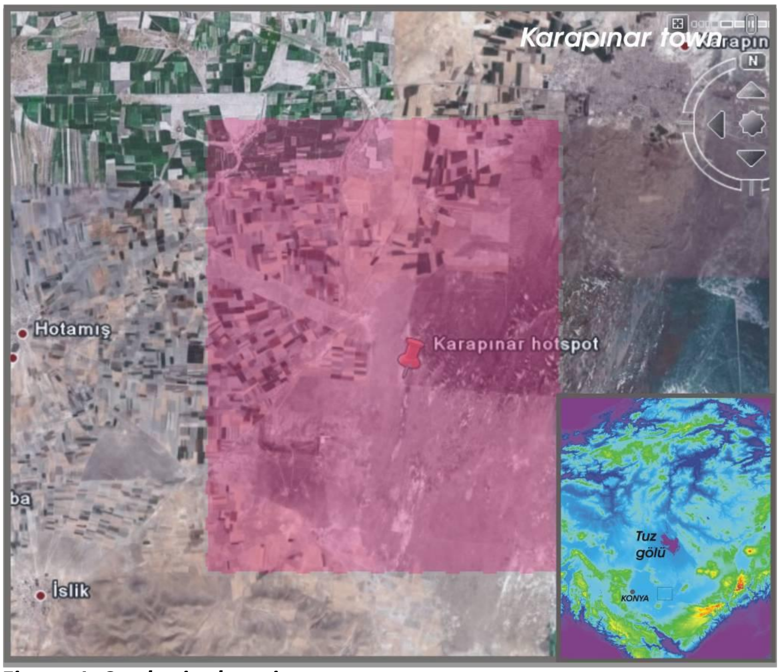

Figure 1: Study site location

Overview of scenarios

1. Baseline Scenario: PESERA baseline run
2. Technology Scenario: Minimum tillage
3. Technology Scenario: Stubble fallowing
4. Technology Scenario: Ploughed stubble fallowing
5. Global Scenario: Food production
6. Global Scenario: Minimizing land degradation

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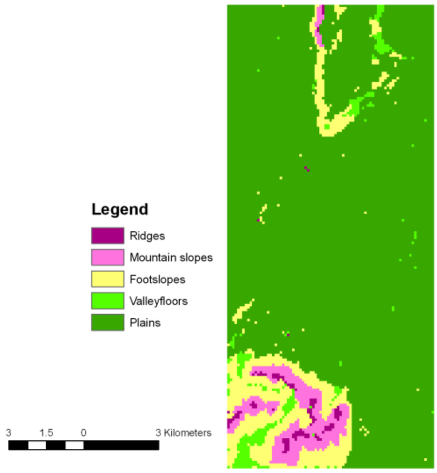
Baseline Scenario

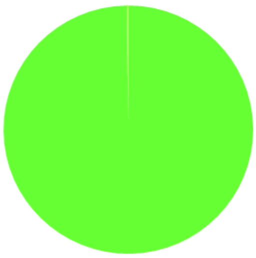
PESERA baseline run

The baseline run shows very low erosion rates across the entire study site area (below 0.5 ton/ha). The biomass production varies with land use, where arable land has low values. The 200 m altitude range within the study site does show as landforms in the southwest and north of the area, but this has no noticeable further influence on erosion and biomass production.

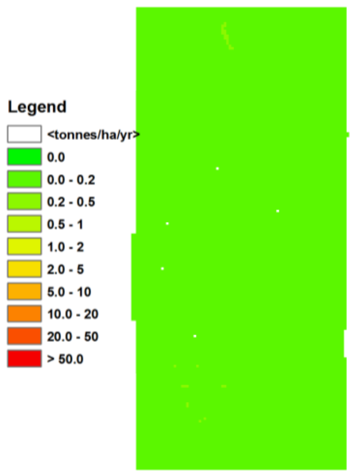
Landforms



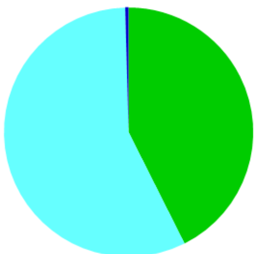
Soil erosion



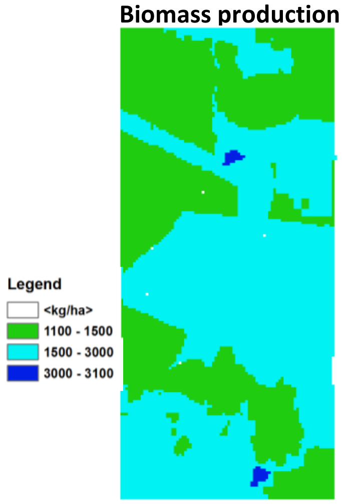
Soil erosion



Biomass production



Biomass production



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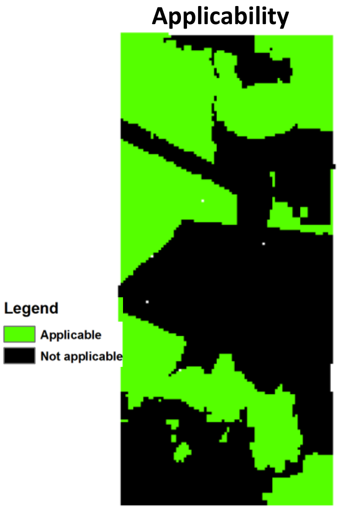
Technology Scenario:
Minimum tillage

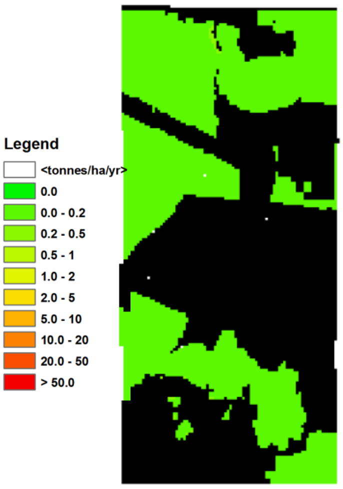
- Total operation costs under different practices:
  - traditional ploughing 736 TRY/ha (€298)
  - Minimum tillage 736 TRY/ha (€298)
- The above operation costs include renting of equipment to implement each practice
- A harvest index for grains of 45% of total biomass was assumed
- The price of grains is 0.5 TRY/kg (€0.20)

Applicability

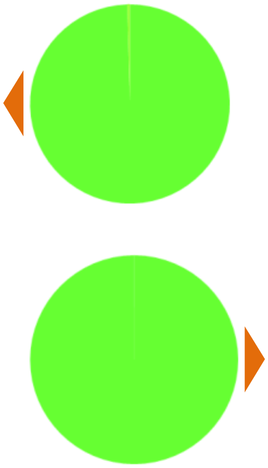
- The technology is applicable on arable land



Biophysical impact: soil erosion



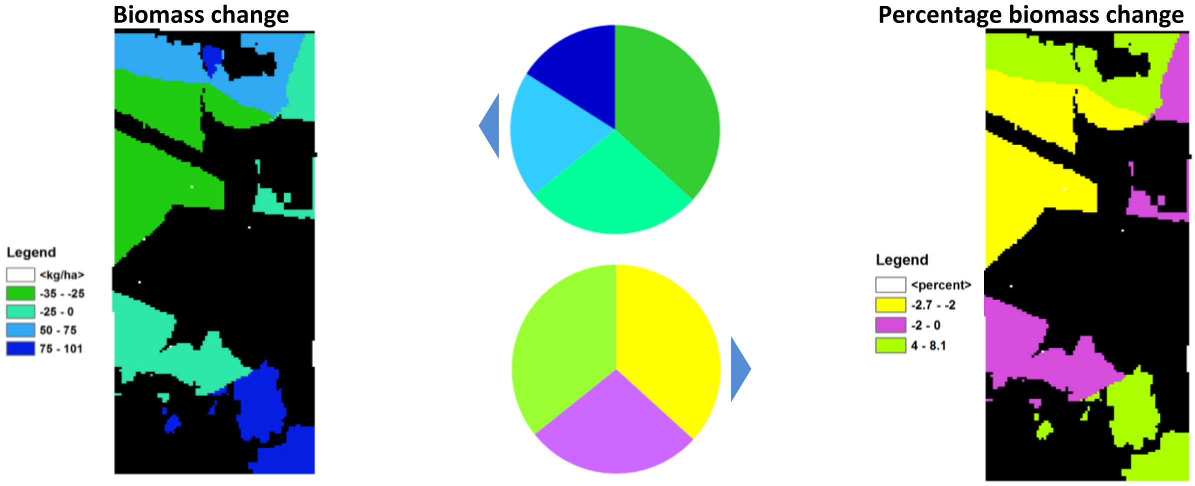
Under traditional ploughing



Under minimum tillage

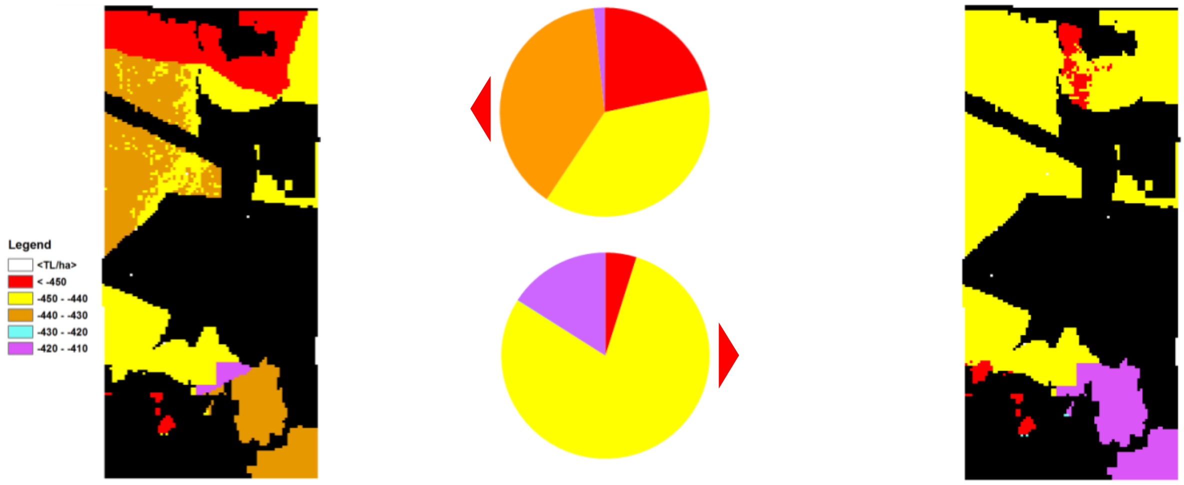
Biophysical impact: change in biomass

Biomass change **Percentage biomass change**



Economic viability

Net profit under traditional ploughing **Net profit under minimum tillage**



Minimum tillage has mixed effects on biomass production: in about a third of the applicable area it leads to yield increases of 4-8%, in the remaining area it leads to yield reductions of 0-3%. These differences are mostly due to differences in soil type. As the cost of minimum tillage does not differ from traditional ploughing, the effect on net profit is either slightly positive or slightly negative, but under the assumptions made cereal farming is not profitable in either case.

Karapinar, Turkey

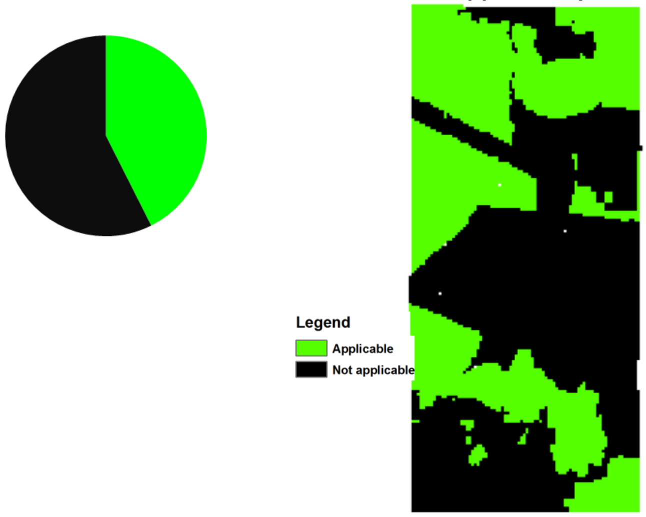
Technology Scenario:
Stubble fallowing

- Total operation costs under different practices:
  - traditional ploughing 736 TL/ha (€298)
  - stubble fallowing 736 TL/ha (€298)
- 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 price of grains is 0.5 TL/kg (€0.20)

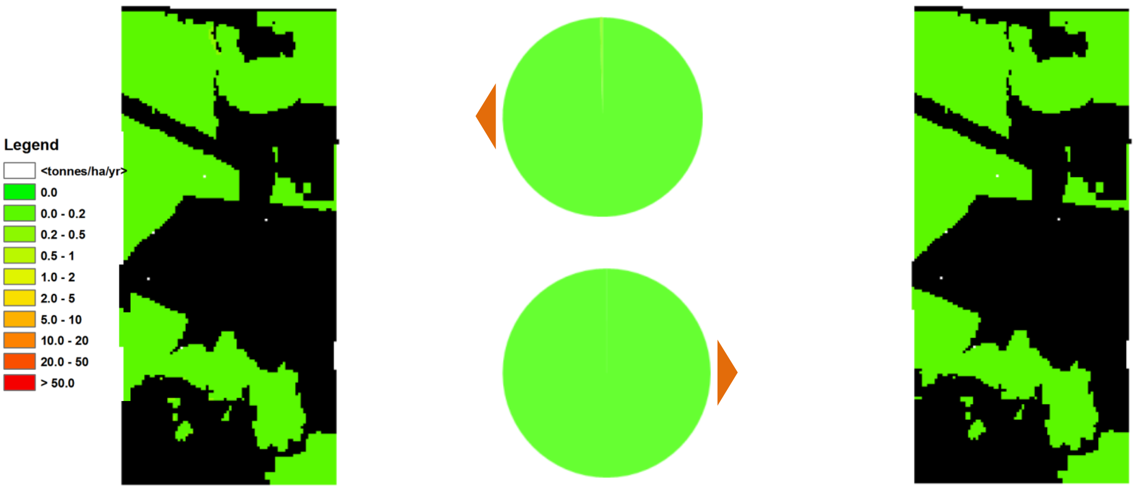
Applicability

- The technology is applicable on arable land.

Applicability



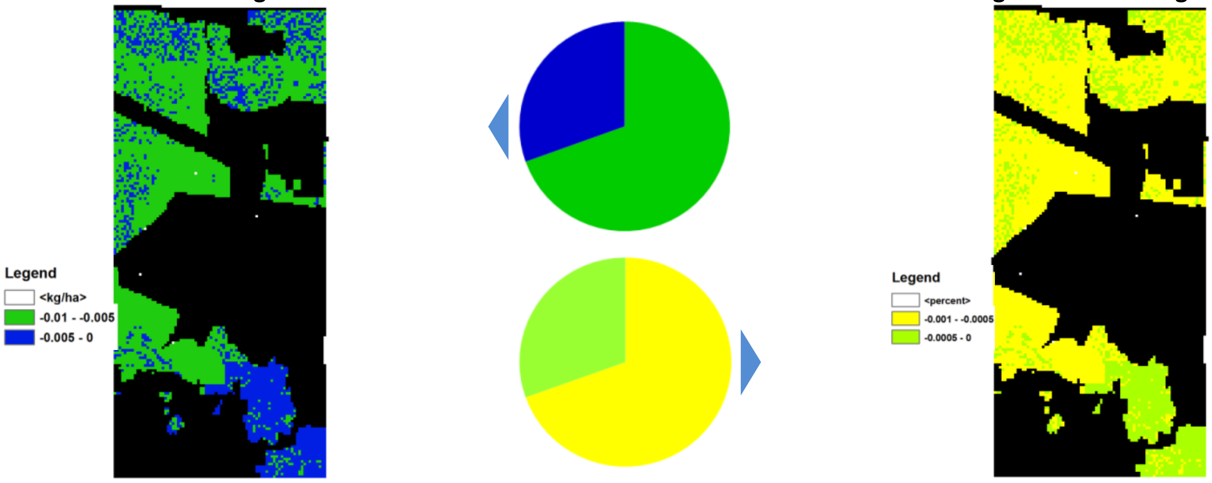
Biophysical impact: soil erosion



Under traditional ploughing **Under stubble fallowing**

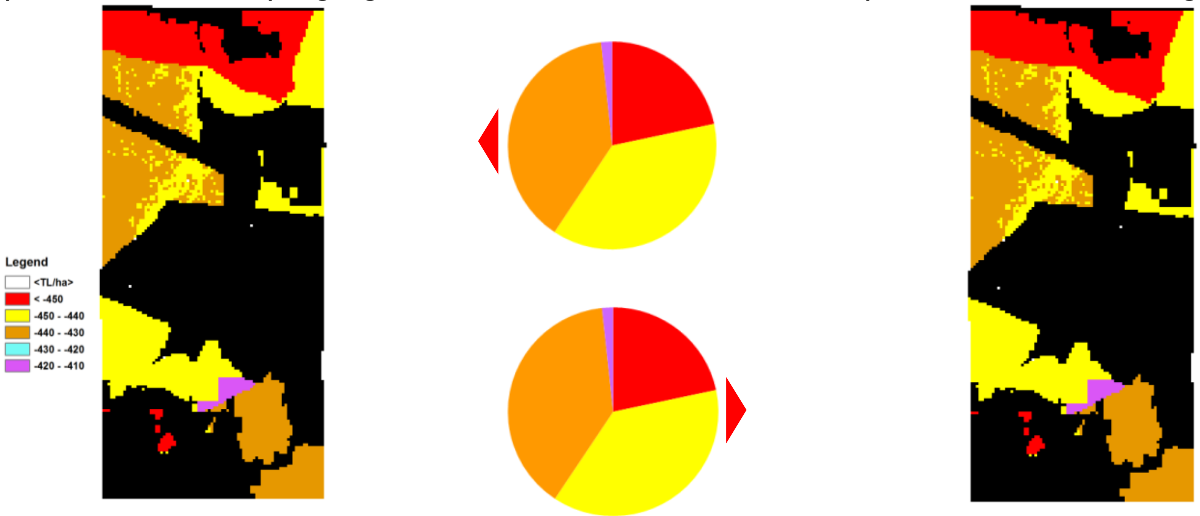
Biophysical impact: change in biomass

Biomass change | **Percentage biomass change**



Economic viabilit

Net profit under traditional ploughing | **Net profit under stubble fallowing**



Stubble fallowing has an insignificant effect on biomass production. As operational costs are not different from traditional ploughing, the economic viability of cereal farming is not altered (i.e. net profits remain negative).

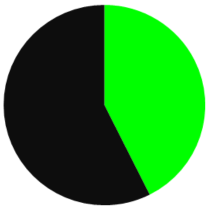
Karapinar, Turkey

Technology Scenario:
Ploughed stubble fallowing

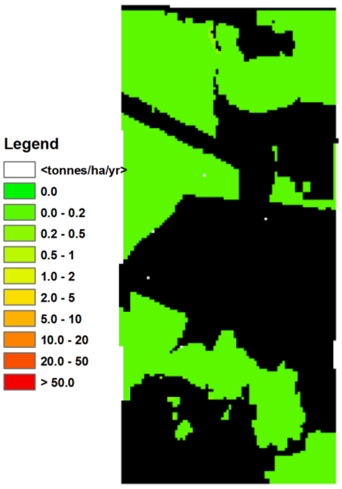
- Total operation costs under different practices:
  - traditional ploughing 736 TL/ha (€298)
  - ploughed stubble fallowing 736 TL/ha (€298)
- The above operation costs include renting of equipment to implement each practice
- A harvest index for grains of 45% of total biomass was assumed
- The price of grains is 0.5 TL/kg (€0.20)

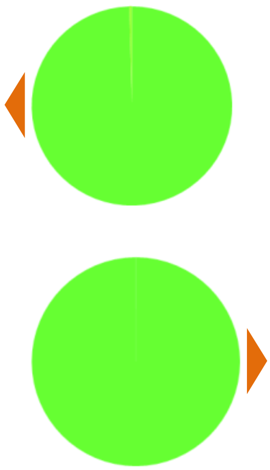
Applicability

- The technology is applicable on arable land.



Biophysical impact: soil erosion





Under traditional ploughing

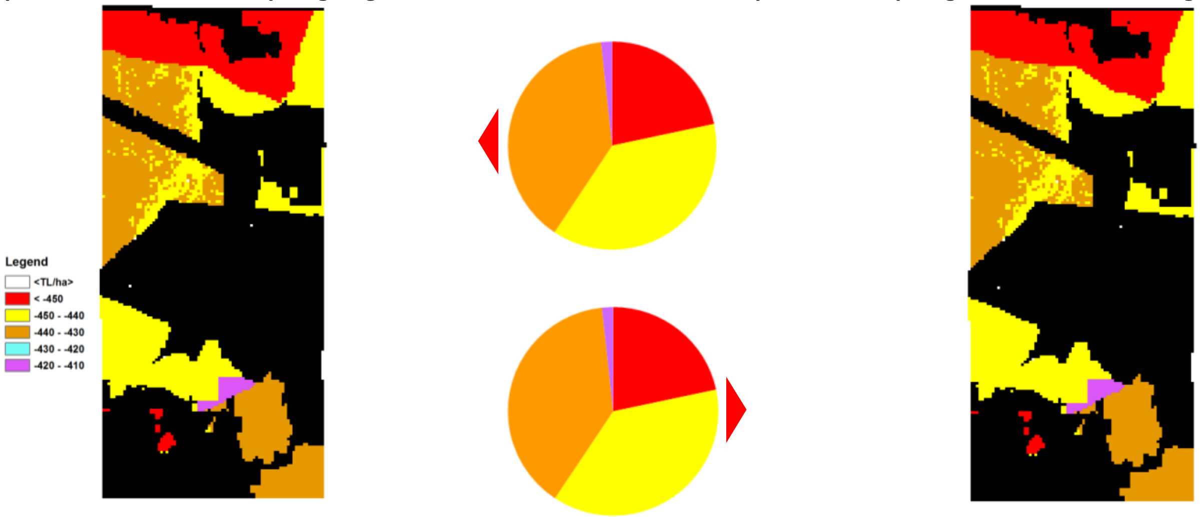
Under ploughed stubble fallowing

Biophysical impact: change in biomass

There is no difference in biomass production between under baseline scenario and under ploughed stubble fallowing.

Economic viability

Net profit under traditional ploughing **Net profit under ploughed stubble fallowing**



Ploughed stubble fallowing has no effect on biomass production. As operational costs are not different from traditional ploughing, the economic viability of cereal farming is not altered (i.e. net profits remain negative).

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Global Scenario:
Food production

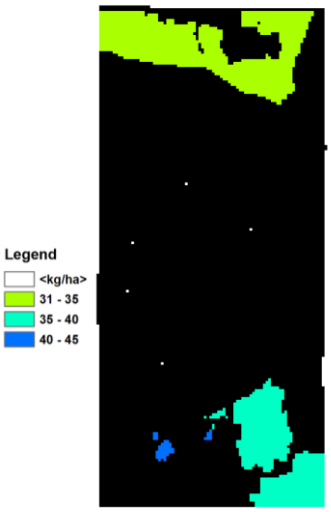
The food production scenario selects the technology with the highest agricultural productivity (biomass) for each cell where a higher productivity than in the baseline scenario is achieved. The implementation costs for the total study area are calculated and cost-productivity relations assessed. To facilitate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

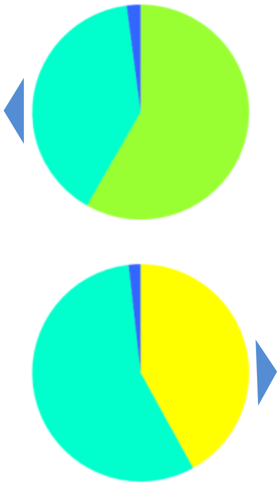
+ 34kg/ha

+? kg/inhabitant

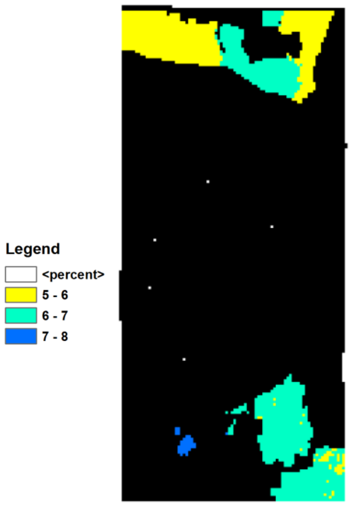
Scope for increased production

Yield increase





Percentage yield increase



Biophysical impact: yield difference

- The implementation of the technologies would see yield increase in 36% of applicable area
- Average absolute yield increase: 34 kg/ha
- Average yield increase: 6%

Economic indicators

Average costs:

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

Aggregate indicators:

- Study site: €0
- Augmented annual production: 81 ton

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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.

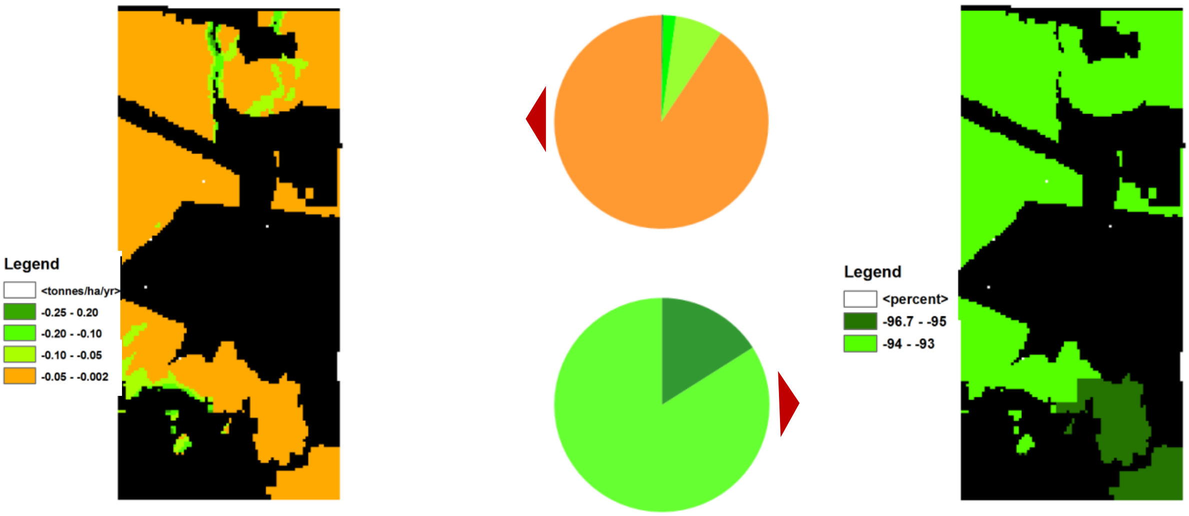
- 0.03 ton soil/ha

€0/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 100% of applicable area
- Average absolute erosion reduction: 0.03 tonnes/ha/yr
- Average percent erosion reduction: 94%

Economic indicators

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

Aggregate indicators:
- Study site: €0
- Aggregate annual erosion reduction: 190 ton

Karapinar, Turkey

Concluding remarks

- Baseline simulations show that the study site experiences low erosion rates, but this might be misleading as the erosion level scale may be more appropriate for water than for wind erosion, which constitutes the dominant degradation process in Karapinar. According to degradation mapping by experts, arable land experiences light to moderate degrees of land degradation by loss of topsoil through wind erosion.
- The technologies simulated are the technologies for which field experiments were conducted. The field experiments concentrated on biophysical indicators in a strip cropping set up which is thought to mitigate wind erosion. Minimum tillage rather than no-till was implemented, together with stubble farming and ploughed stubble farming. Hence, experiments concentrated on variants of no-till technology which was prioritised by local stakeholders to address wind erosion problems. The technology scenarios show reductions in soil erosion and limited effect on biomass production, although soil erosion reductions were small in absolute terms relative to the scale of erosion levels used in presenting maps. Effects on biomass were positive (4-8%) for minimum tillage in part of the applicability area (one soil type). Although the technologies requires no additional costs, their limited effects on biomass production mean that economic viability of arable farming is, under the assumptions made, nowhere improved.
- Evaluating the results in a workshop, stakeholders ranked the three tested technologies in the order stubble fallowing, ploughed stubble fallowing, and minimum tillage. The down-ranking of minimum tillage was a consequence of disappointing yield levels – an observation not confirmed by modelling results. The most significant concern about all technologies was that it requires fallowing, which local stakeholders regarded as having an important opportunity cost. Notwithstanding, the model analyses deemed returns to traditional ploughing very negative. The assumptions made (e.g. about labour costs, or agricultural management operations and inputs applied) were derived from experimental plots and resulting costs may have been too high in relation to the average farm(er) conditions. Despite of this, participants stressed the need for government subsidies to promote the technologies, which does support that land users are aware of the fact that profitability is an issue.
- The global scenarios show that the technologies can achieve significant relative erosion reductions (94%) across the entire applicability area, despite the fact that erosion levels are already quite low. Yield effects are more limited, with a 6% increase possible on 36% of the applicability area. The average yield increase is 34 kg/ha/yr and the average erosion reduction 0.03 ton/ha/yr, at no additional cost.
- From an ecological point of view, all technologies are effective to reduce soil erosion. Effects on biomass and yield levels are relatively small and experimental and modelling results do not fully support each other. The main obstacle for adoption of the technologies is their economic viability, especially if conventional ploughing can be implemented without fallowing and the technologies require fallowing. There is little risk in applying the technologies and stakeholders realise that when water becomes scarcer and more expensive in the future, fallowing can become an increasingly viable strategy. Further confirmation of the (economic) effects is necessary before any of the technologies can be recommended. Given that subsidies are said to be required, it would be important to consider the off-site costs and benefits due to wind erosion in the area.