



Sustainability of greening measures by Common Agricultural Policy 2014-2020 in new climate scenarios in a Mediterranean area

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Objective

- A simulation of the *Greening* impact in a Mediterranean area using
 - a territorial farm-types model
 - the Discrete Stochastic Programming (DSP)
 - ✓ to consider the probability distributions of crops yields and water requirements in two different climate scenarios (Current and Future)

- Impact in terms of sustainability indicators
 - land allocation
 - resource uses: water, labor, nitrogen
 - economic results: total area and farm-types

Greening - Regulations

- Regulation (EU) No 1307/2013 establishing the rules for direct payments to farmers under support schemes within the framework of the common agricultural policy
- Delegated Regulation supplementing Regulation (EU) No 1307/2013
- Delegated Regulation supplementing Regulation (EU) No 1306/2013

Greening - Three basic elements

1. diversifying cultivation, by growing at least two crops, where the arable area of the farm exceeds 10 ha, and at least three crops where it exceeds 30 ha, and limiting the main crop to 75% of the arable area and the two main crops to 95% of the area
2. maintaining permanent grassland (at national or regional or farm level)
3. maintaining at least 5% of the arable area of farms larger than 15 ha as ecological focus areas (field margins, hedges, trees, fallow land, landscape features, biotopes, buffer strips, afforested area)

Greening – crop and period

A **crop** means any of the following:

- a) a culture of any of the different genera defined in the botanical classification of crops
- b) a culture of any of the species in the case of Brassicaceae, Solanaceae, and Cucurbitaceae
- c) land lying fallow
- d) grasses or other herbaceous forage

The **period** shall be the most relevant part of the cultivation period taking account of the traditional cultivation practices in the national context

Study area



UAA: 54,000 ha total

- 36,000 ha in WUA – irrigated districts
- 18,000 ha rain-fed area

Main crops:

- Corn silage
- Alfalfa
- Ryegrass
- Permanent grassland and pasture
- Wheat
- Rice
- Vegetables

Milk production:

- dairy milk in the *Arborea* district
- sheep milk in the rain-fed area

Structure of the economic model

	Represented farms (n)	Farm land (ha)	Family Labour (units)	Net Income (€ 000)
WUA facilities				
Specialist rice	24	115	2.0	134
Specialist citrus fruits	68	13	1.7	39
Specialist dairying A	130	31	4.4	207
Specialist dairying B	40	32	6.3	177
Specialist market garden vegetables under glass	46	13	3.5	29
Mixed cropping - Vegetables	562	22	1.7	36
Mixed cropping - Rice	55	146	1.2	89
Mixed cropping - Field crops and permanent crops	100	6	2	12
Rainfed				
Mixed cropping - Vegetables and permanent crops	100	4	1.7	11
Mixed cropping - Field crops	94	25	1.2	30
Specialist sheep A	45	87	2.1	53
Specialist sheep B	188	41	1.5	10
Specialist sheep C	129	62	1.6	30

- territorial farm-types model
- the model constraints are defined by the land, labour, water, animal feed and the CAP

Discrete Stochastic Programming model (1)

To consider the various uncertainty elements about the crops yields and the water requirements in the decision making process

Six types of states of nature:

- pasture and grazed herbage yields in the autumnal period
- pasture yields in the spring period
- herbage hay yields
- water requirements and yields of the ryegrass
- ETN on the June – August period that affects the water requirements of the summer crops and the alfalfa and corn silage yields

Different probability distributions of the states of nature

- current climate scenario
- future climate scenario

Also the impact of THIndex (temperature and humidity) on milk quality and quantity, and heads mortality is considered

Discrete Stochastic Programming model (2)

$$\max_{x, z_a, z_y} z_{dsp} = \sum_s P_s * (G I_s * x - C z_a * z a_s - C z_y * z y_s)$$

subject to

$$A * x \leq B$$

$$A_s * x \leq B + z a_s \quad \forall s$$

$$N * y_s * x + z y_s \geq R \quad \forall s$$

$$x \geq 0, \quad z a_s \geq 0 \text{ and } z y_s \geq 0 \quad \forall s$$

Modelisation of greening measures

- Definition of different crops

$$dx_{dj} = \sum_{j \in dj} x_j$$

- Diversification 75% if *Arland* > 10 ha

$$Rland_{dj,t sel} * dx_{dj} \leq 0.75 * Arland$$

- Diversification 95% if *Arland* > 30 ha

$$Rland_{dj,t sel} * dx_{dj} + Rland_{dj dj,t sel} * dx_{dj dj} \leq 0.95 * Arland$$

- constraint on maintaining permanent grassland at the farm level
- 5% of the arable land was allocated to "ecological focus area" in the more intensive farm types: specialist dairying and mixed crops with vegetables

Simulated scenarios

Current climate

- *2010* scenario: the model was calibrated to the situation observed in 2010
- *CAP 2013* scenario: this scenario were transformed to the policy and market condition observed in the 2013 (decoupling of direct payments, price increase for corn silage for biogas)
- *Greening* scenario: The greening measures were applied to the *CAP 2013* scenario

Future climate

The greening measures have been applied in this scenario and was compared with the *Greening* scenario of the Current climate

Results: land allocation and resource uses

	Current climate		Future climate
	<i>CAP 2013</i>	<i>Greening</i>	<i>Greening</i>
Arable land	41,280	-3.2	-0.2
<i>corn silage for biogas</i>	4,617	-40.7	-10.3
<i>corn silage feed</i>	2,881	16.9	3.0
<i>alfalfa</i>	1,121	48.5	-28.9
<i>ryegrass</i>	5,700	-29.2	11.7
<i>herbage</i>	9,709	9.1	-3.2
Permanent grassland and permanent pasture	12,020	0.0	4.7
Total water	102,581	-3.7	0.7
Total labour	5,054	-0.1	-0.4
Nitrogen	10,311	-5.8	0.1

Results: economic – total area

	Current climate		Future climate
	<i>CAP 2013</i>	<i>Greening</i>	<i>Greening</i>
Revenues total	204,556	-3.2	-1.8
revenues crops	114,750	-5.6	-0.7
revenues animal	89,806	0.0	-3.1
Direct payments	31,626	0.0	0.0
Costs	126,478	-3.4	1.4
input	62,210	-3.4	-0.3
WUA water	2,158	-11.0	-2.4
water pumping	274	0.1	2.3
extra labour	7,179	-3.6	-1.1
feeds	30,382	-7.1	9.3
other costs	24,276	1.8	-2.5
Gross Margin	109,704	-2.0	-4.9
Net Income	81,417	-2.6	-6.6

Results: net income – farm types

	Current climate		Future climate
	<i>CAP 2013</i>	<i>Greening</i>	<i>Greening</i>
Specialist rice	3,299	0.0	0.0
Specialist citrus fruits	2,666	0.0	0.0
Specialist dairying A	26,990	-6.2	-11.3
Specialist dairying B	7,091	-6.4	-11.4
Specialist market garden vegetables under glass	1,311	0.0	-0.1
Mixed cropping - Vegetables	20,125	-0.1	-1.7
Mixed cropping - Rice	5,702	0.0	-1.5
Mixed cropping - Field crops and permanent crops	1,284	0.0	-1.9
Mixed cropping - Vegetables and permanent crops	1,019	0.0	0.0
Mixed cropping - Field crops	2,700	0.0	0.0
Specialist sheep A	1,902	0.0	-12.8
Specialist sheep B	1,902	0.0	-19.1
Specialist sheep C	5,427	0.0	-10.4

Discussion

- In many irrigated Mediterranean regions the production of silage corn for biogas has in recent years become of economic interest
- This change exposes the Specialist dairying farms to the constraint related to the diversification
- Also the Mixed cropping are interested (in minor entity)
- In both types, the most intensive above 15 hectare, the measure relating to the EFA could act and determine the reduction of arable land
- The application of the measures greening in the current climate scenario seems to have a more significant impact respect to the future climate scenario
 - general worsening of crops yields large cultivated in the territory leads to greater crop diversification and extensification of the cropping patterns

Conclusions

Methodological aspects:

- farm-types model with dimensional differentiation
- territorial model: some farms types could be involved indirectly
- specification of social and environmental indicators

Political aspects:

- many farms in Italy are below the application threshold and therefore will not be affected
- the *greening* might be in contrast with the strategy objectives such as the 2020 bioenergy development
- *greening* appears to have a positive impact on chemical use, particularly nitrogen
- the production specialization can be maintained because the revenues lost and the additional costs resulting from greening may be greater than the *greening* payments

Forthcoming developments

Inclusion in the model of

- Convergence and Regionalization
- Proportional greening payment
- Reduction of the greening payment in case of non-compliance
- Coupled payments
- Better specification of crops in the EFA (e.g. nitrogen-fixing crops)
- ...

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