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THE EFFECTS OF CAP GREENING ON ITALIAN AGRICULTURE

JEL classification: Q18, Q24, Q58

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Abstract. *The greening of direct payments has been introduced into the first pillar of the CAP post-2013 with the objective of promoting sustainable agricultural practices more effectively through simple, generalised, non-contractual and annual actions that go beyond cross-compliance. The main objective of this article is to analyse the effects of this new policy instrument on Italian agriculture by evaluating, through the data from the 6th Agricultural Census of ISTAT, the number of farms and the areas potentially affected by these new environmental obligations. Even though the analysis is mainly focused on the greening obligations as have been agreed in the final regulation on direct payments, the article also looks at the main differences, in terms of farms and areas covered, between the final version of the greening measures and the environmental requirements as were proposed by the European Commission in 2011. The article shows that, in its final form, the greening has considerably diminished its potential in promoting sustainable practices on a large scale, since it will affect quite a small percentage of holdings concentrated in specific areas. This is particularly evident in Italy, where arable land is very fragmented and where the average size of farm is well below the thresholds established for the greening requirements. By starting from the Italian case, the article provides a critical discussion on the future CAP and on the main difficulties of implementing a coherent agri-environmental strategy through the direct payments of the first pillar.*

Keywords: *CAP, greening, Italy, arable farming, agri-environment.*

1. Introduction

During recent years the academic and institutional debate on the CAP has been strongly focused on the effectiveness of this policy in providing agri-environmental public goods on the required scale (see Cooper *et al.*, 2009; Hart *et al.*, 2011; Zahrnt, 2009). In particular, the majority of studies and position papers have acknowledged that, in order to increase their legitimacy and to meet the expectations of European citizens, direct payments of the first pillar of the CAP needed to be strongly re-oriented towards the provision of agri-environmental public goods. As a result of this debate, in 2011 the European Commission launched a legislative proposal for the future programming period of the CAP (2014-2020) where it was proposed to assign 30% of the national envelopes of direct payments to mandatory measures beneficial to climate and the environment. These measures, known as *greening*, have been amongst the most controversial aspects of the negotiations of the CAP post-2013, since they originated a very animated debate regarding both the environmental and the economic effectiveness of the proposed measures.

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The most criticised issues were related to the possible effects of greening on the competitiveness of European farms, and since then several alternatives have been proposed in order better to reconcile the environmental objectives with the market objectives and food security (Hart and Little, 2012; Matthews, 2012). In the context of this debate, the majority of Member States and the main producers' organisations proposed several amendments to the initial proposal, with the main purpose of reducing the economic impacts of greening and its effects on farming practices and on farmers' production choices. These changes were largely included in the final regulation on direct payments (European Parliament and Council of the European Union, 2013) which, compared to the initial European Commission proposal, includes much more flexible and lighter greening obligations.

The main objective of this article is to analyse the effects of greening in Italy in terms of areas and farms potentially affected by these new environmental obligations. Even though the analysis is mainly focused on the greening obligations as they appear in the final agreement, the article also looks at the main differences, in terms of farms and areas covered, between the final version of these measures and the environmental requirements as were proposed by the European Commission in 2011.

The paper is structured in five parts. After a short description of the greening of the future CAP, together with a brief overview of the related debate at Italian level (section 2), section 3 provides a short description of the article's objectives and methodology. The simulations on the number of Italian farms and on the related areas that are likely to be covered by the greening requirements are presented in section 4. By starting from the Italian case, section 5 provides a critical discussion on the main limitations of this agro-environmental strategy, also in the light of the overall structure of the CAP post-2013. As discussed in the conclusions (section 6), it is likely that the greening of direct payments, in its current form, will affect the farming practices of a limited number of European holdings and, for this reason, it is likely that it will not deliver the expected environmental benefits.

2. The greening of direct payments

One of the main objectives of the new CAP is increasing the provision of environmental public goods associated with agriculture. Among the policy tools that have been proposed to achieve this goal, the greening of direct payments plays a central role, since through a mandatory "greening" component of direct payments, the CAP aims at promoting both climate and environment policy goals on a larger scale compared to the voluntary agri-environmental measures (Povellato, 2012). Indeed, through the greening of direct payments, the CAP aims at promoting simple, generalised, non-contractual and annual actions that go beyond cross-compliance. At the same time, the new greening requirements follow the same approach as cross-compliance, which is based on a mechanism of "exchange" between the direct payments of the first pillar and selected environmental standards. These environmental rules will apply from January 2015 to farmers who are entitled to receive direct payments, and failure to comply with greening requirements may affect up to 125% of the share of green payments received by farmers. In order to finance the green payments, Member States will use 30% of their annual national ceilings.

The regulation provides exemptions for the area of farms cultivated with (certified) organic methods and also for farms that have opted for the small farms scheme. In addition, farmers who

adopt practices covered by agri-environment-climate measures or certification schemes that are similar to greening and that yield an equivalent or higher level of benefit for the climate and the environment are also exempted from the greening rules.

In greater detail, the greening of direct payments is structured in three environmental requirements[1]:

- *Crop diversification*. This requirement applies only to arable land exceeding 10 hectares and involves the presence of at least 2 crops on arable land between 10 and 30 hectares (with the main crop which cannot cover more than 75% of that arable land), and the presence of at least 3 crops on arable land exceeding 30 hectares (with the main crop that cannot cover more than 75% and the two main crops together cannot cover more than 95% of that arable land)[2];
- *Permanent grassland.* The ratio of the land under permanent grassland and the total agricultural land cannot decrease by more than 5% compared to a reference ratio which is to be established by Member States in 2015. Member States may decide to apply this obligation at national, regional or sub-regional level. Furthermore, they have to designate environmentally sensitive permanent grassland in areas covered by the Directives on the conservation of the natural habitats (Council Directive 92/43/EEC) and on the conservation of wild birds (Council Directive 2009/147/EC);
- *Ecological focus area*. This requirement is applied only to farms with at least 15 hectares of arable land. These farms must ensure an ecological focus area corresponding to at least 5% of the arable land[3]. The following land uses can be considered as ecological focus area: fallow land, terraces, landscape features, buffer strips, areas with short rotation coppice with no use of chemical products, afforested areas, areas with catch crops and areas with nitrogen fixing crops[4]. Member States may decide to implement up to 50% of the ecological focus area at regional level in order to obtain adjacent ecological focus areas and may also decide to permit farmers whose holdings are in close proximity to fulfil this obligation on the basis of a collective implementation.

Important details regarding the equivalent measures, the exemptions and the types of landscape features that can contribute towards the EFA areas will be contained in implementation rules and the delegated acts to be supplied by the Commission. These rules will be a crucial step for evaluating the effective environmental role of the greening measures. At the same time it is also evident that the environmental requirements as approved in the final Regulation differ to a large extent compared to those defined by the European Commission in 2011. This proposal comprised much more stringent measures, such as the application of crop diversification on farms with arable land of more than 3 hectares, the obligation for the maintenance of permanent grassland at farm level and the introduction of ecological focus areas on 7% of all agricultural

[1] For full details on these rules, see Chapter 3, articles 43-37 of the Reg. (EU) No 1307/2013 (European Parliament and Council of the European Union, 2013).

[2] This requirement does not apply where more than 75% of the eligible agricultural area is permanent grassland, used for the production of grasses or other herbaceous forage or crops under water or a combination of these uses, provided the arable area not covered by these uses does not exceed 30 hectares.

[3] In 2017, the Commission will present an evaluation report on the implementation of this requirement and the threshold could be increased from 5% to 7% as the result of a legislative act of the European Parliament and the Council.

[4] This requirement is not applied even where more than 75% of the eligible agricultural area is permanent grassland, used for the production of grasses or other herbaceous forage or cultivated with crops under water for a significant part of the year and where more than 75% of the arable land is used for production of grasses or other herbaceous forage, land lying fallow, cultivated with leguminous crops or a combination of these uses. The requirement is, however, applied in cases where the arable area not covered by these uses would exceed 30 hectares.

area, excluding permanent grassland. These requirements were widely criticised, especially by the main farmers' association (Copa-Cogeca, 2012) and by several Member States, since they were particularly concerned about the negative effects of greening on the competitiveness of the EU agricultural sector. More precisely, the main concerns were related to the reduction of farmers' production capacity, to the increase of production costs and the monitoring and enforcement costs of the new environmental obligations (Matthews, 2012; 2013).

The introduction of green payments has been a very much disputed issue also in Italy where, with the exception of the environmental organisations, all the national stakeholders involved in the debate agreed that the environmental obligations, especially those proposed by the European Commission in 2011, would have had a strong negative economic impact on Italian agriculture. This argument was based on the evidence that the Italian agricultural system, similarly to those of other Mediterranean countries, is characterised by small size and specialised farms (usually with permanent crops), where the availability and the productivity of land is a key factor for their economic sustainability. Nevertheless, recent analyses on the economic impacts of greening in Italy show a considerable variation amongst the different areas of the country and, above all, amongst the different types of crops (Arfini *et al.*, 2013; Vanni *et al.*, 2013). In general terms, these studies demonstrate that the economic effects of greening differ to a large extent according to the structural characteristics of the farms and the various territorial specificities.

Concerning the effects of greening measures in terms of the area and farms potentially involved, an initial assessment was carried out by Povellato and Longhitano (2011), who analysed the impact of the European Commission proposal by using the data of the Italian Institute of Statistics (ISTAT) survey on farm structure and production (FSS), referred to 2007. With regard to the impact of crop diversification on agricultural land, the results of this study show that about 4,6 million hectares would have been subjected to this measure of which 2 million hectares were cultivated with only one or two crops, with more than 190.000 farms involved. Moreover, the authors show that in Italy the presence of ecological focus areas is concentrated in 185.000 farms, which correspond to almost 2 million hectares.

As will be described in detail in the next section, the analysis presented in this article aims at up-dating the calculations currently available on the impact of greening on Italian agriculture (Povellato and Longhitano, 2011; Povellato, 2012), with the purpose of looking in more detail at the effects expected to derive from the new thresholds and exemptions as agreed in the final regulation of direct payments.

3. Objectives and methodology

The main objective of this article is to estimate the number of farms potentially affected by the greening requirements in Italy, as well as to identify the relative areas covered and their location. In order to achieve this goal, the data collected in the 6° national Census of Agriculture (ISTAT, 2010) were used, with an initial database composed of the micro-data regarding all the Italian holdings registered in this Census (1.620.884 units).

In order to estimate the farms and the areas potentially affected by the crop diversification requirement, organic farms (farms with all the agricultural area under organic) and farms with less than 10 hectares of arable land were excluded. The following step was calculating the percentage of land under different crops on the remaining farms, in order to exclude farms that had more

than the 75% of their agricultural area under permanent grassland, with crops under water, with fallow land or with a combination of these uses.

Finally, in order to identify more carefully the farms that will have to change their current practices as a result of the crop diversification measure, the remaining farms were split up in two groups: (i) farms with between 10 and 30 ha of arable land and (ii) farms with more than 30 ha of arable land. We then identified: (a) the number of farms (and the related arable land) of group (i) either cultivating only one crop or cultivating two or more crops but with the main crop covering more than 75% of the arable land; (b) the number of farms (and the related arable land) of group (ii) cultivating either less than three crops or cultivating three or more crops but with the main crop covering more than the 75% of the arable land. The number of farms (and the arable land) potentially affected by the crop diversification requirement were estimated on the basis of these groups of farms (a+b).

With regard to the estimation of farms potentially affected by the second greening requirement, we selected, amongst all Italian farms, those with permanent grassland and meadows, excluding the farms with all the agricultural area cultivated by organic methods.

Finally, as regards the introduction of Ecological Focus Areas, the first steps were similar to those of crop diversification, excluding the organic farms (farms with all the agricultural area under organic) and farms with less than 15 hectares of arable land. Amongst the remaining holdings, farms with more than 75% of their agricultural area under permanent grassland, with crops under water, with fallow land or with a combination of these uses were also excluded. In order to estimate, amongst the remaining farms, the land that can already qualify for EFA, we used the percentage of fallow land. In detail, the number of farms (and the arable land) potentially affected by the introduction of the EFA were estimated by adding the two following groups of farms: (a) farms without fallow land; (b) farms with a quota of fallow land lower than 5% of the arable land.

The use of micro-data also allowed us to cross-check the data, in order to estimate the number of farms that would be potentially affected by a single requirement or by a combination of two requirements: crop diversification and EFA. The requirement "maintenance of permanent grasslands" was not crossed with the other requirements because, as will be discussed later, it is likely that this measure will be applied at regional or national level and not at farm level.

In order to estimate the potential impacts of the greening requirements as were conceived by the European Commission proposal in 2011, the methodology described above was repeated. The main differences compared to simulation regarding the final regulation on direct payments are:

– crop diversification: a threshold of 3 ha of arable land was applied (instead of 10 ha); the number of farms (and the arable land) potentially affected by the crop diversification requirement was estimated by identifying the farms either with less than three crops or with three crops but with the main crop covering more than 70% of the arable land;
– EFA: all farms were included (instead of farms with more than 15 ha of arable land); the quota of EFA to be introduced was 7% of the agricultural area excluding permanent grasslands (instead of 5% of arable land).

Before discussing the results of these simulations, it is necessary to recognise the main limitations of this methodology, which may be synthesised in three main points.

First, the main limitation is due to the fact that, using the data from the Agricultural Census, all farms are considered, while the greening measures will involve only holdings receiving direct payments. In this regard, a more accurate analysis could be carried out by using the data from the national payment agency (AGEA). At the same time, while the simulation through ISTAT

data can over-estimate the number of farms subjected to the greening, it is likely that almost all farms analysed here (arable farms with more than 10/15 ha of arable land) are receiving direct payments from the CAP first pillar.

Second, the calculations only estimate the number of farms and the areas potentially affected by single requirement using a binary measure: each farm either complies with the single requirement or it does not. By using this approximation of course it is not possible to observe the different degree of non-compliance of farms with the new rules, while the required changes in farming practices will be very much influenced by the current farming practices. A more exhaustive estimation of the overall impacts of greening should also consider how far the current farming practices of farms are from the greening requirements.

Third, the calculation regarding the introduction of the EFAs was carried out using fallow land as proxy for EFA. We are aware that using only fallow land to estimate the number of the farms potentially affected by this requirement might lead to underestimation of the number of farms already complying with the requirement, since in many areas the presence of other land uses that qualify for EFA (such as terraces and other landscape features) is also relevant. At the same time all these land use areas are particularly present in the medium and small farms located in hills and in mountain areas, while fallow land may be considered a good proxy for arable land in the plains, where the larger farms are located and where the major impacts of the requirement are expected.

4. The effects of greening obligations in Italy

According to our calculations, the crop diversification requirement would affect only 3,8% of Italian farms (about 61.000 units), corresponding to approximately 1,9 million hectares of arable land (27,8% of the total) (Table 1). The small number of farms potentially affected by this obligation is mainly due to the application of the minimum threshold of 10 hectares of arable land, since only 9,7% of Italian farms (157.000 units) satisfy this requirement. From this quota of agricultural holdings it was also necessary to exclude all the farm typologies that are exempted from the crop diversification requirement, namely organic farms[5] and farms with more than 75% of land under permanent grassland, under other herbaceous forage crops, under water or under a combination of these uses. Amongst the remaining 135.710 farms, almost 75.000 were also excluded since they were already meeting the criteria of crop diversification[6]. As can be observed in the table, two thirds of the farms that are likely to be subjected to crop diversification have an arable land of between 10 and 30 hectares, while one third are larger farms that are not meeting the crop diversification requirement.

[5] To simplify the simulations, the organic farms were excluded from the greening while according to the regulation the greening does not apply only to the land where organic farming is practiced.

[6] In the data processing it was not possible to exclude from the sample farms that comply with agri-environmental schemes and/or to certifications other than organic farming.

Tab. 1 - Farms (n.) and arable land (ha) potentially affected by crop diversification

	Farms		Arable land	
	n.	%	ha	%
Total	1.620.884	100,0	7.009.311	100,0
Arable land > 10 ha	156.892	9,7	5.255.889	75,0
Conventional farms	144.172	8,9	4.692.924	67,0
< 75% of land under permanent grassland, grasses, crops under water or a combination of these uses	135.710	8,4	4.413.176	63,0
Affected by crop diversification	60.982	3,8	1.947.850	27,8
of which				
*arable land between 10 and 30 ha not diversified**	*40.667*	*2,5*	*693.137*	*9,9*
*arable land > 30 ha not diversified***	*20.315*	*1,3*	*1.254.712*	*17,9*

** with only one crop or with 2 or more crops but with the main crops > 75% arable land*
*** with less than 3 crops or with 3 or more crops but with the main crops > 75% arable land*
Source: calculations on ISTAT (2010), 6th Agricultural Census

With regard to the second environmental obligation, the data show that in Italy there are more than 3 million hectares under permanent grassland and pasture and, excluding the land belonging to organic farms[7], this type of land use is concentrated in 254.656 holdings (Table 2).

Tab. 2 - Farms (n.) and arable land (ha) potentially affected by the maintenance of permanent grassland

	Farms		Permanent grassland and pasture	
	n.	%	ha	%
Total	274.486	16,9	3.434.073	26,7
Maintenance of permanent grassland*	254.656	15,7	3.084.665	24,0

**organic farms were excluded*
Source: calculations on ISTAT (2010), 6th Agricultural Census

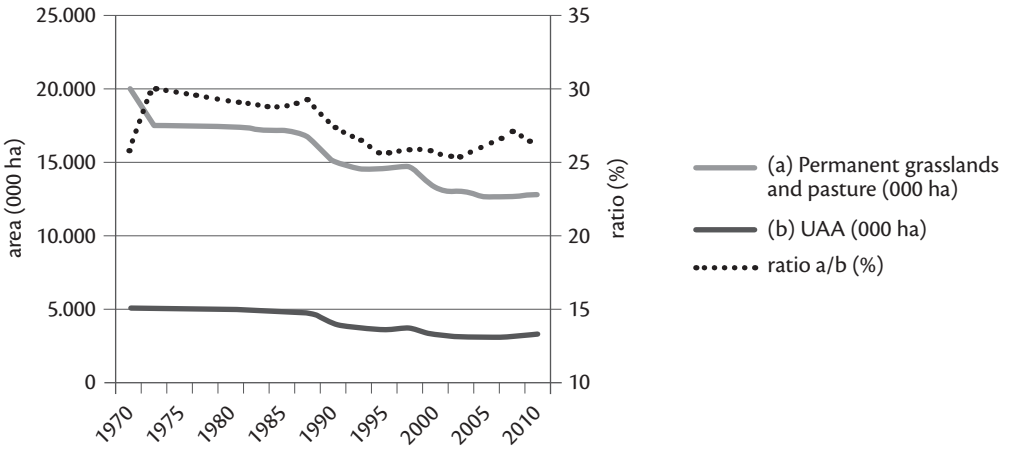
The land which is likely to be subjected to this obligation is about 90% of the total area under permanent grassland, corresponding to 24% of the total UAA. Since the ratio between permanent grassland and the total agricultural area must not be reduced by more than 5%, the total area to be maintained will be approximately 2,93 million hectares.

It must be noticed that the distribution of permanent grassland and pastures in Italy is quite uneven, reflecting the geographical features of the country, since these areas are mainly concentrated along the Alps and Apennines. When looking at the overall trend during the last four decades (Figure 1), a consistent decrease both in the agricultural area and the area with permanent grassland can be observed, resulting in a quite stable ratio between these two types of area, which has always remained between 25% and 30%. For this reason, it appears that this rule will probably not have a significant impact in Italy, especially if implemented on a national basis. Indeed,

[7] It was not possible to exclude farms located in ecologically sensitive areas under directives on the conservation of natural habitats and bird conservation, which are also excluded from the requirement, but it is likely that the number of these farms is quite small.

while the regulation will ensure a strict protection for permanent grassland in environmentally sensitive areas, in the remaining land the introduction of the 5% ratio rule between land under permanent grassland and agricultural land cannot ensure an effective maintenance of permanent grasslands, unless this rule were to be applied at an appropriate sub-regional level.

Fig. 1 - Overall trends in permanent grassland and agricultural area in Italy (1970-2010)



Source: calculations on ISTAT data

Finally, as in the case of crop diversification, the effects of the introduction of an ecological focus area (EFA) may be approximately estimated by looking at the application of a 15 hectares threshold. Indeed, in Italy, farms with an arable land of over 15 hectares represent only 6,7% of the total, and this quota decreases further, to 5,7% (corresponding to 93.190 farms), when considering the exemption of organic farms and farms with an area mainly under permanent grassland, grasses and crops under water or a combination of these uses (Table 3). However, it is necessary to point out that, unfortunately, at national level there is a lack of coherent and harmonised data on the extension and distribution of land uses that qualify for EFAs (fallow land, terraces, landscape features, buffer strips and afforested areas), which makes it difficult to carry out an accurate estimation of the probable impacts of this obligation. As shown in section 3, in our calculations fallow land was used as a proxy for EFAs.

According to our calculations, amongst the 93.190 farms potentially affected, there are 11.210 which have more than 5% of arable land as fallow land. Thus, it is expected that the most relevant impacts of this requirement would be observed among the remaining 81.980 farms (5,1% of the total), of which almost all (78.859 farms, 96%) are without fallow land. To the 5,1% of farms potentially subject to this obligation correspond 3,4 million hectares of arable land, and according these data, the EFAs would cover an area of 170.000 hectares (5% of arable land), which could be increased to more than 237.000 hectares from 2018 onwards[8].

[8] The share of 5% EFA can be increased to 7% in 2017, as a result of an impact assessment presented by the European Commission accompanied by a specific legislative proposal.

Tab. 3 - Farms (n.) and arable land (ha) potentially affected by the introduction of ecological focus areas

	Farms		Arable land	
	n.	%	ha	%
Total	1.620.884	100,0	7.009.311	100,0
Arable land > 15 ha	108.603	6,7	4.654.397	66,4
Conventional farms	98.569	6,1	4.125.303	58,9
< 75% of land under permanent grassland, grasses, crops under water or a combination of these uses	93.190	5,7	3.883.974	55,4
Affected by the introduction of EFA	81.980	5,1	3.393.081	48,4
of which				
without fallow land	*78.859*	*4,9*	*3.160.513*	*45,1*
with fallow land <5% of arable land	*3.121*	*0,2*	*232.568*	*3,3*

Source: calculations on ISTAT (2010), 6th Agricultural Census

As regards the implementation of EFAs, the regulation on direct payments for the CAP 2014-2020 (Reg.1307/2013, Art. 46) admits a certain degree of flexibility, by giving the possibility of fulfilling the requirement at a regional or collective level in order to obtain adjacent ecological focus areas. However, for the farms subject to this practice, the obligation remains to keep within the farm boundaries at least 50% of the EFAs which they would have introduced individually. Thus, with the exception of maintenance of permanent grassland, that is likely to be applied on a regional or national scale, the requirements of crop diversification and the introduction of EFA will determine, to some extent, direct effects on farms' production processes. As can be observed in Table 4, the number of farms potentially affected by at least one of these two obligations is more than 107.000 (6,6% of total), of which only 35.000 (2,2% of the total) must comply with both requirements.

Tab. 4 - The number of farms potentially affected by greening requirements

	Mountain	Hill	Plain	Total
Crop diversification only	2.271	13.707	9.814	25.792
EFA only	5.281	17.570	23.939	46.790
Both crop diversification and EFA	2.690	15.627	16.873	35.190
Total	10.242	46.904	50.626	107.772

Source: calculations on ISTAT (2010), 6th Agricultural Census

As can be observed in Table 5, the highest quota of these farms is concentrated in the plains (9,9%), while in the hills and mountainous areas the percentages fall respectively to 5,6% and 3,7%. When looking at the regional distribution of farms that are expected to be affected by greening requirements, the highest percentages may be observed in the Po Valley, with values particularly high in Lombardia and Emilia Romagna, where the largest farms specialised in arable crops (especially maize) are concentrated. A relatively high percentage of farms will be subject to greening requirements also in some central and southern regions, especially in the Marche, Molise and Sardegna regions.

Tab. 5 - Distribution % of farms potentially subject to greening requirements				
	Mountain	**Hill**	**Plain**	**Total**
Piemonte	1,6	6,2	29,0	13,3
Valle d'Aosta	0,1	-	-	0,1
Liguria	0,2	0,1	-	0,1
Lombardia	1,1	7,9	37,4	22,6
Trentino Alto Adige	0,3	-	-	0,3
Veneto	2,0	2,3	8,9	7,3
Friuli-Venezia Giulia	0,9	10,5	12,9	11,9
Emilia-Romagna	6,8	14,3	19,5	16,7
Toscana	3,4	9,4	7,7	8,1
Umbria	8,1	7,3	-	7,4
Marche	13,6	10,7	-	11,0
Lazio	1,6	3,7	9,6	4,3
Abruzzo	5,7	2,3	-	3,0
Molise	7,1	12,2	-	10,1
Campania	5,8	1,2	4,6	2,8
Puglia	15,2	6,1	3,3	4,4
Basilicata	4,8	12,8	4,3	8,9
Calabria	0,9	0,8	2,4	1,1
Sicilia	5,2	5,5	2,3	4,9
Sardegna	13,6	11,5	15,3	12,8
Total	3,7	5,6	9,9	6,6

Source: calculations on ISTAT (2010), 6th Agricultural Census

5. A weakened agri-environmental strategy

The institutional debate on green payments that arose after the European Commission proposal led to a final agreement which undoubtedly has weakened this policy instrument, especially in terms of the number of holdings and area covered by the three environmental requirements. The coverage of greening implementation has changed mainly as a result respectively of the 10 ha and 15 ha thresholds relative to crop diversification and EFAs. Furthermore, in a recent analysis carried out by the European Commission (2013), it has also been highlighted that the exclusion from greening of the farms with more than 75% of UAA under grassland, fallow land, leguminous crops and rice, would result in exemption of an additional 34% of UAA at EU-27 level, corresponding to 23% of all holdings.

At Italian level, due to the smaller average size of farms with arable land (8,5 ha) compared with the average of the EU-28 farms (12,8 ha), the effects of the 10 hectares threshold for crop diversification are even stronger. Indeed, as may be observed in Table 6, by raising the threshold for the arable land subject to crop diversification from 3 to 10 hectares, compared to the 2011 proposal the final agreement on greening results, in the exemption from the requirement for a very large number of farms (-73,3%). The area covered by crop diversification also decreases

from 3,2 to 1,9 million hectares (-39,6 %), with an inevitable reduction in the expected environmental benefits.

Similarly, when looking at the differences between the European Commission proposal and the final agreement regarding the EFA requirement, data show that the number of households involved falls dramatically (-94,2%), while the arable land involved decreases by 39,5%. These figures can be explained by the combined effect of several factors that have changed the nature of this requirement, and transformed this obligation into a very selective measure. Indeed, while, according to the European Commission proposal, the introduction of the EFAs would affect all farms and all land uses other than permanent grassland, as a result of the CAP negotiations EFAs will be introduced only on farms with arable land exceeding 15 hectares. Moreover, a much wider definition of EFAs was introduced (i.e. nitrogen fixing crops were also included) and the quota of EFA was changed from 7% of agricultural area (except permanent grassland) to 5% of arable land.

Tab. 6 - Greening coverage in Italy in two policy scenarios

	Final agreement 2013	EC proposal 2011	Difference	Var. %
Crop diversification				
Households (n.)	60.982	228.781	-167.799	-73,3
Arable land (ha)	1.947.850	3.222.490	-1.274.640	-39,6
Ecological focus areas				
Households (n.)	81.980	1.421.322	-1.339.342	-94,2
Arable land (ha)	3.393.081	5.612.183	-2.219.103	-39,5

Source: calculations on ISTAT (2010), 6th Agricultural Census

At national level all these changes were considered a very important achievement, since the Italian government, similarly to those of other Mediterranean countries, focused the negotiations on greening just on the objective of excluding permanent crops (vineyards, olive groves and orchards) from the EFAs. The main concerns of these Member States were related to the (negative) economic effects that could derive from taking out of production 7% of their agricultural areas, since their agricultural systems are mainly characterised by farms specialised in high value products and in permanent crops. Even though these concerns were not without foundation, it is evident that this requirement in its final form has decreased to a large extent its environmental role, also because, as observed by Baldock and Hart (2013), it is estimated that many arable farms in Europe already have around 3-4% of land that would qualify as EFA.

In the final agreement of the CAP a greater flexibility has also been introduced concerning the maintenance of permanent grassland. While in the initial proposal of the European Commission this obligation applied at holding level, according to the final regulation on direct payments Member States may decide to apply this requirement at national, regional or sub-regional level[9]. Thus, as discussed above, it is likely that in the majority of Member States (including Italy) this requirement would be applied at regional or even at national level, with very little change com-

[9] In the EC proposal farmers could not convert more than 5 % of their reference areas under permanent grassland, while according to the final agreement the ratio of the land under permanent grassland in relation to the total agricultural area declared by the farmers cannot decrease by more than 5%.

pared to the requirement that is already in place in the framework of cross-compliance[10]. At the same time it must be noted that if the ratio of area of permanent grassland to total agricultural area decreases by more than 5% at regional or national level, the Member states concerned must apply the requirement at farm level in order to reverse this trend, by reconverting land into permanent grassland.

Another element that will probably reduce the environmental benefits that greening could bring about is related to the equivalence mechanisms, since certification schemes and some voluntary agri-environment schemes can be considered to be "equivalent" to the three greening obligations[11]. The main constraints of the equivalence mechanisms are related to the vast array of environmental certification systems that are present at EU-28 level, as well as to the different models of implementation of agri-environmental measures. Indeed, as observed by Hart and Menadue (2013), even though there is a great range of management practices supported by agri-environmental and certification schemes with the potential for similar impacts to those identified for the greening measures, the main difficulties arise regarding the extent of take-up of these schemes at farm level and, more generally, regarding the different inspection and administrative regimes which are in place. Moreover, although it seems logical to acknowledge a role for the certification schemes and for the agri-environment-climate measures that have already been adopted by farms, this principle may also generate some problems of equity: while some Member States may pursue equivalent measures with the intention of improving environmental outcomes, others may be just interested in reducing the environmental obligations on their farmers.

However, in spite of all the specific changes on greening rules that have been introduced during the CAP negotiations, the most critical issue is whether these three requirements are the most cost-effective way to increase the provision of agri-environmental public goods. In this respect, many authors underline how greening obligations will probably add costs to the farmers, will increase the administrative burden and implementation costs for national authorities, while their environmental effects currently do not seem fully documented (Matthews 2012 and 2013; Bureau, 2013; Roza and Selnes, 2012).

Westhoeck *et al*. (2012) argue that the introduction of the greening measures will not have a significant impact on the quality of the natural environment, given that compliance applies only to 2% of the agricultural area in the EU. These authors show how the EFA requirement is potentially the most effective measure in providing highly valued public goods, but that this effectiveness could be increased by better tailoring this measure to local conditions and, above all, by better stimulating the establishment of green infrastructures at territorial scale through coordination and cooperation.

Thus, from a perspective of policy effectiveness, the majority of authors agree on the fact that increased environmental benefits could be obtained more effectively by using more targeted policies, namely by enhancing agro-environmental measures in Pillar 2.

In this respect, although the budget for the 2014-2020 rural development policy has been considerably reduced compared to the previous programming period (-13,5% at the EU-27 level - for details see Monteleone and Pierangeli, 2012), the new EU Rural Development Policy is strongly oriented to delivering more ambitious environmental objectives and commitments.

[10] According to the current regulation (Commission Regulation (EC) No 1122/2009) Member States must ensure that the ratio between the land under permanent pasture and the total agricultural area cannot decrease by more than 10% (at national or regional level).

[11] In an Annex of the Regulation on direct payments there is a list of measures that can be considered similar to greening and that yield an equivalent or higher level of benefit for the climate and the environment.

Indeed, Member States are required to spend a minimum of 30% of the total contribution from the EAFRD to each rural development programme on climate change mitigation and adaptation as well as environmental issues and, above all, these are considered the cross-cutting objectives to which all the Union priorities for rural development must contribute. Moreover, the rural development policy for the programming period 2014-2020 contains important innovations that could potentially enhance its environmental effectiveness and, to some extent, could also be complementary to first pillar policies. Indeed, the new regulation is based on more strategic and flexible frameworks that can potentially foster effective exchange of knowledge and stimulate innovation for pursuing agri-environmental objectives. The introduction of specific instruments to promote innovation (the European Innovation Partnerships) and to support cooperation (Art. 35 of the new Regulation on rural development) may represent significant opportunities to foster effective exchange of knowledge and may result in more integrated and coherent agri-environmental actions. The new rural development policy is also more focused on promoting a co-ordinated use of measures and on supporting collective and partnership-based modes of intervention that may improve the environmental performance of the CAP, mainly through the implementation of targeted and tailored actions more consistent with local needs (see Allen *et al.*, 2012; Dwyer, 2013; Vanni, 2014). This specific support to collective and territorial agri-environmental actions also has the potential of improving the effectiveness of greening measures, for example, by supporting a collaborative management of the ecological focus areas. On the contrary, the general approach of green payments, which is mainly based on compliance with the environmental requirements at farm level, has little potential for stimulating pro-active and collaborative attitudes of farmers.

6. Final remarks

The greening of direct payments was introduced with the main objective of increasing the provision of agri-environmental public goods through agriculture. This strategy is based on the assignment of 30% of the Member States' budgetary envelope to mandatory measures beneficial for climate and the environment. One of the main strengths of the initial proposal from the European Commission relied on the application of these measures to all farms receiving direct payments. The main objectives of these mandatory measures were achieving more cost-effective environmental outcomes compared to those achieved through the voluntary agri-environmental measures of the second pillar and, above all, promoting sustainable farming practices on a larger scale. Here it is argued that these objectives are very difficult to achieve through the new form of greening, since the environmental obligations introduced in the final Regulation on direct payments have changed drastically compared to those proposed in 2011.

It may be argued that, in the current form, the greening measure has a considerably diminished potential for promoting sustainable farming practices on a large scale, since it has been transformed into a much more selective tool, which probably would affect quite a small percentage of holdings concentrated in specific areas. The new thresholds and exemptions will probably affect only medium and large farms specialised in arable crops, excluding many medium or small farms and farms specialised in other agricultural products that may not adopt the sustainable agricultural practices that were deemed to be supported through the green payments. These limits are particularly evident in Member States like Italy, where arable land is very fragmented and where the average size of farms is well below the thresholds established for the greening re-

quirements. For this reason, at national level green payments seem not to have a great potential to change the agricultural practices adopted by the majority of farmers and, consequently, the potential of increasing the sustainability of Italian agriculture on the required scale.

Finally, the main limitation of greening is linked to the difficulty of implementing an effective agri-environmental strategy following the approach of cross-compliance. This type of approach is mainly determined by the need for legitimising the direct payments of first pillar, but it prevents the design and implementation of policy tools which could be effective in influencing farmers' attitudes and motivations towards the agri-environment. On the contrary, a pro-active attitude of farmers, together with an effective exchange of knowledge regarding more sustainable farming practices, are increasingly recognised as essential drivers for the success of agro-environmental policies. For these reasons the main instruments for reaching the ambitious environmental objectives and commitments of the new CAP will probably be the voluntary agri-environmental schemes of the second pillar, which, hopefully, will be increasingly based on co-ordinated and collective action, and above all, more tailored and targeted to the different environmental priorities across Europe.

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ASSESSMENT OF THE FUTURE SUSTAINABILITY OF FOOD SUPPLY AND FOOD SECURITY

JEL classification: : Q51, Q56, C53

Safwat H. Shakir Hanna*, Irvin W. Osborne-Lee*, Gian Paolo Cesaretti and Rosa Misso**

Abstract. *The agro-ecosystem is a complex system, with various parameters that can impact on its productivity.*

Over time, human beings have put the sector under stress due to their demands for food and other agricultural products from it. The proposed Ecological-Footprint Agro-Ecosystem Model (EFAM) has shown that the increasing ecological footprint (i.e. demands on the agro-ecosystem) has a negative relationship with the efficiency of productive arable lands. Agricultural lands are extremely scarce. Additionally, in the present study, data on land used for agriculture have been converted into global calories received from the sun which are stored in agricultural products; this shows that land is only marginally producing the calories that human beings need for food security globally. This will lead to economic instability around the world. The policies for agro-ecosystems should monitor the condition of agriculture in the world from climate change to land productivity and good distribution of food throughout the world. This may be done by subsidizing world food production through United Nation programs. In this respect, the UN or governments should have funds reserved to support subsidizing food production in the impacted areas of lower production but without changing the policy for market commodities. This fund is to be used not for emergencies but to support farmers in producing agricultural commodities and to ensure food security.

Keywords: *Agro-ecosystem – Ecological Footprint – Food Security-EFAM Model System – Ecological Footprint Agro-ecosystem Scheme (EFAES)*

Introduction

The agro-ecosystem is a complex system (Millennium Ecosystem Assessment (MA), 2005). The system has many input parameters that may impact on its productivity and the possibility of guaranteeing its continuation. The sustainability of the agro-ecosystem depends on the maintenance of the economic, biological and physical components that make up the system (Belcher et al., 2004). Furthermore, the agro-ecosystem is made up of integrated stocks of man-made, human and natural capital corresponding to the standard factors of production, capital, labor and land (Costanza and Daly, 1992).

Currently, the ecological footprint (Rees, 2001, 2013) has become the new trend for assess-

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ing ecosystems to provide a measure of how much human beings are using natural resources, including the greater part of agro-ecosystems. Ecological footprint analysis (EFA) quantifies the ecosystem area required to support a specified human population (H_p) (Rees, 2013). The human population has increased, and its eco-impact on the earth seems to be irreversible due to the high consumption of natural resources (Shakir-Hanna and Osborne-Lee, 2011). The agro-ecosystems of the world account for more than 36% of the total natural resources of the world. As the intensity of agricultural production increases, as a consequence of the increase in the human population and increasing demand for agricultural crops, the emerging sustainability issue of maintaining the agro-ecosystems becomes vital. The continuation of agro-ecosystems in providing the increasing number of human beings with their needs for food, agricultural products transformed from the agro-products, is very important in supporting current and future generations.

Ecological footprint is used as a tool for measuring sustainability and accountability towards our natural heritage. However, the first author is introducing a new concept related to ecological footprint and naming a new measure which is considering the "***Ecological Human Imprint.***" This new terminology is more comprehensive, covering every aspect of human demands from the earth, the human activities that produce products and the value added to the resources. Using this concept we include the human impacts on resources when measuring and adding economic value to resources (this terminology will be discussed in detail in a separate paper that will cover the issues and concerns about the ecological footprint).

The present paper will assess the impacts of the ecological footprint on the global agro-ecosystems (i.e. the demands of humans and the bio-capacity of this ecosystem) of the earth in order to predict the future of the global agricultural sector in supporting and securing the current and future generations. Additionally, the suggested Ecological-Footprint Agro-ecosystem Model EFAM) that will be presented in this paper will help to measure the important issues of sustainability of food security issues.

An overview of ecological footprint

Ecological Footprint is an instrument that measures the demands of human beings from the earth (Rees, 2001, Venetoulis, J and Talberth, J, 2010). It also provides assessment of global bio-capacity of the earth (Rees, 2001, Rees and Wackernagel, 1994, Shakir Hanna and Osborne-Lee, 2011, 2012, Shakir Hanna, *et al.*, 2013 a, Shakir Hanna *et al.,* 2013 b in press). At the same time, the ecological footprint is a largely heuristic tool that has been widely used in sustainability analyses for over a decade (Venetoulis, J. and Talberth, J., 2010). According to Wackernagel *et al.* (2002), the ecological footprint is "a measure of how much productive land and water an individual, a city, a country, or humanity requires to produce the resources it consumes and to absorb the waste it generates, using prevailing technology." In this regard, there is an important element that must be taken into account for calculating the ecological footprint and for this the first author has suggested the term of "***Ecological Human Imprints (E_{HI})***". This new terminology, that will be discussed in the coming paper by the first author, has a new dimension with respect to the term of Ecological Footprint. The new dimension is to add the value of human activities that have an imprint on ecosystems and, in particular the agro-ecosystems, negatively or positively and the impact values that the ecological footprint did not consider. One of the added values of human imprint on the ecosystem is the social dimension, which is not accounted for in the ecological footprint. Social dimensions of agro-ecosystems are very important to villages and

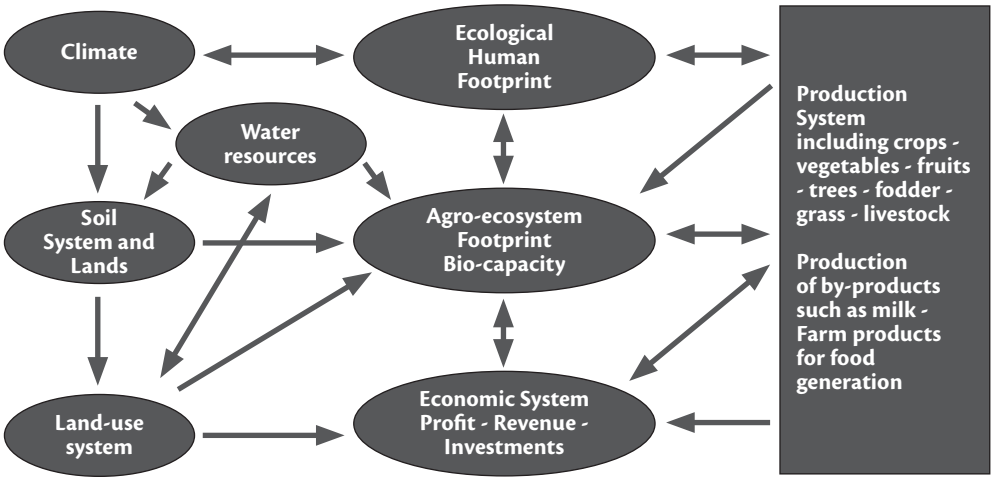
farmers in many countries in the world. For example, eco-tourism of the agro-ecosystem, which has a dimension in the analysis, has not been assessed in the Ecological Footprint. This aspect is adding value to the agro-ecosystems and, at the same time, has a consumption value for the ecosystem. Additionally, the agro-ecosystems added more employment values to these ecosystems and this has not been assessed from the point of view of consumption from these systems.

The Ecological Human Imprints (E_{HI}), terminology has another dimension which is the amount of calories that can come from the sun to enter all the activities of human beings, organisms and plants above ground and organisms below ground and all other species, live or not, on the earth, in addition to considering what human beings release of energy wasted. This gives a broader sense to the ecological footprint and in consequence to the "***Ecological Human Imprints***". The ultimate process of the calories absorbed from the sun in any live and non-living organism is the motor function of all processes on the earth. The ultimate goal for these scenarios is the survival of human beings and it increases the functionality of our planet.

1. The Ecological Footprint of Agro-ecosystems Scheme (EFAES)

The concept of agro-ecosystems is that of a system that has complex parameters that interact with each other to form the direct products of crops such as wheat, rice, vegetables, fruits, fodder crops and intermediate products coming from these such as meat, milk and other products and perhaps secondary products that can return to the soil. Furthermore, sustainable food production is inextricably linked to environmental stewardship. In order to sustain food security, it is mandatory to improve access to culturally appropriate, health-promoting foods for food insecure families by impacting on food availability, food access, food quality, and food use. Figure. 1 shows the Ecological Footprint Agro-ecosystem Scheme (EFAES) that includes the Ecological Human Footprint in the agro-ecosystem which comprises the activities that provide human-beings with their needs, and the products consumed. The system includes the economic and the natural resource components that participate in food production and ultimately the food security of the world.

Fig. 1 - The Ecological Footprint of Agro-ecosystem Scheme (EFAES)



These important values give many dimensions to be assessed in agro-ecosystems.

2. Measuring the Ecological Footprint of Agro-ecosystems

To measure the footprint of the agro-ecosystem, many procedures have been adopted by scientists and researchers [(Rees 1992, 2000, 200, 2006, 2008, 2010), Rees and Wackernagel, 1994, and Borucke, *et al*., 2013)]. However, the most important aspects of measuring the footprint of agro-ecosystems are to use a global hectare measurement for commodities produced from the farms locally, regionally and globally and exported and imported (Borucke, *et al*., 2013 and Kissingera and Gottliebb, 2012).

3. The Impacts of Ecological Footprint on Global Agriculture Policies and Food Security

The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". Commonly, the concept of food security is defined as including both physical and economic access to food that meets people's dietary needs as well as their food preferences (WHO, 2013). In our discussion here, we need to stress that food security is related to the availability of food and the availability of food is concentrated on the availability of arable lands that produce food most efficiently. In this respect, arable land and agricultural land need good quality soil, water resources, less pests and plant diseases and important climatic factors[1] These factors will participate in producing good quality and yields of crops for humans. One of the major concerns of food security is the sufficiency and affordability of food to support the growing global human population

The question now is: is our global ecological footprint and, in consequence, the ecological cropping system (i.e. the demands for crops and the earth's cropping system bio-capacity), on the sustainable path for food security for humanity or not? Let us discuss some scenarios of food requirements for humanity in terms of the minimum required calories needed to support the population. USDA indicated that the required average number of calories per day for human survival is 2000 calories per day. This means that the total need for all human beings is 2000 times 7.2 billion people on Earth and continues to grow (i.e. 14000.4 billion calories per day and 5110146.0 billion calories per year). In other words we need about 14 trillion calories per day to feed the whole of humanity. From that scenario we can ask ourselves where we can get all these calories to feed our human population The obvious answer is from our global productive lands that produce the crops and by-products that support human beings. Additionally, the question is: is our earth producing these calories transformed from the energy that the sun emits to the earth? We need to ask ourselves if the conversion factor from energy emitted from the sun to produce food, is sufficient, with other parameters in soil and climate, to generate the commodities that we need to support our existence and food security. Accordingly, Krenz (1976) has estimated that reflectivity and emissivity constants are averaged to values that depend on cloud coverage and atmospheric composition at 227 Watts/ m^2 of the earth. From the conversion of the earth watts of energy per m^2 to calories, the earth will receive and emit in the range of 26.1- 28.0 million trillion calories annually (Shakir and

[1] [i.e. drought poses a problem to agriculture, especially in US: the lack of rain has already contributed to devastating wildfire in the West, which created more than $450 million worth of damage in Colorado alone. Additionally, the most apparent, immediate impact of the drought has been a reduction in crop yields across the 29 states in the affected area. Estimated U.S. corn yields have dropped steadily as the drought has worsened. Reduced yields and the threat of outright crop failure have severe and immediate impacts that stretch beyond farmers and the communities who rely on their crops for their livelihoods. Ranchers faced with increased feed prices are also affected. (WRI, 2012 by Robert Kimball)].

Osborne-Lee 2012). From the earth's agricultural lands (36% of earth's total surface, World Bank Data Group 2012), it can produce 10.0 million trillion calories per year. Therefore, the earth is providing about 20 times the requirements of the earth's current population in absolute number of calories. However, the real maximum number of calories that we are able to use from the Sun to produce agricultural products and food is in the range of about 30%. On this assumption, therefore, the earth's maximum ability to produce is 6,600,000.0 billion calories per year for feeding the whole population. Accordingly, from this scenario, with the increasing human population and the increasing demands for agricultural products, we are in a very dangerous zone of shortage of food and food security will be in question.

Material and methods

This paper has used series of published data from United States Department of Agriculture (USDA Data web site, 2005, 2006, 2007, 2008, 2009, and 2012), Food and Agriculture Organization (FAO, 1960-2008, 2008), World Bank Data Group (1960-2008, 1960-2012), WRI- Earth-Trends (1960-2005, 2000, 2012), United National Environmental Program (UNEP,2009), World Wildlife Fund (WWF, 2002, 2004, 2006, 2008, 2012), Global Footprint (2008), EPA (2012), UNFPA (2001)and National Oceanic and Atmospheric Administration (NOAA, 2012, www.noaa.gov - Blunden and Arnd, 2012). These data were transformed to units of global hectares of the agro-ecosystem data. The global ecological footprint was calculated by using the data from cropland, grazing lands and energy lands. The data were analysed by regression, correlation, and statistical methodologies using Sigma Plot Soft, 2D software (SPSSSCIENC, 2008) and SAS (2010). The following indices were calculated to explore the Agro-ecological Footprint on earth and it's relationships to food security issues that are of great importance to all human beings living on this earth.

- MI Index = G_{BC} / G_{BD} *100 (1)
- G_{BC} = C_F + G_{LF} + F_{GF} + F_F +T_{EF}+ B_L (2)
- G_{BD} = C_F + G_{LF} + F_{GF} + F_F +T_{EF}+ B_L consumed (3)
- G_{DC} = G_{BC} – G_{BD} (4)
- G_{EAgLI} = (C_F Bio-capacity / Total Agriculture lands) (5)
- G_{EALI} = (C_F Bio-capacity / Total Arable Lands) (6)
- Ratio of Global Bio-capacity of the Earth to Global Agriculture Land G_{BC}/ G_{AL} (7)

Where (G_{BC}) is the total Global Biological Capacity and defined as the ability of the Earth to produce renewable natural resources in term of global hectare/capita, (G_{BD}) is the total Global Biological Demand and defined as the resource consumption of human beings in term of global hectare/capita; (C_F) is Cropland Footprint in million global hectares; (G_{LF}) is Grazing Land Footprint in million global hectares, F_{GF} is Forest Ground Footprint excluding fuel wood in million global hectares, (F_F) is Fish Ground Footprint in million global hectares, T_{EF} is the Total Energy Footprint in million global hectares, (B_L) is Built-up Land in million global hectares, Global Deficit Capacity (G_{DC}) in million hectares, G_{EAgLI} is the Global Efficiency of Agriculture lands Index, G_{EALI} is Global Efficiency of Arable Lands Index, and Maintenance Index (MI) or Maintenance Sustainability index is a percentage of the total Global Biological Capacity (G_{BC}) (i.e. total availability or supply of natural Resources) in global hectares to the total Global Biological Demand (G_{BD}) (i.e. consumption or demand) in global hectares from the earth. In this respect, the index of MI explains the ability of the earth to regenerate biological capacity from the prospective of natural

resource availability. In other words, the MI index explains the status of our Global land (i.e. the earth) in providing natural resources for the production of goods and services for the needs of the human population Additionally, the predictions from year 2011 to 2100 were made on the basis of annual data from the time series of years 1960 to 2010, almost 50 years of published data.

Results

1. Analysis of Ecological Footprint of Agro-ecosystems

The global agro-ecosystem is a very important sector in the global economy. It provides the essential products that support human beings' existence, present and future for the process of the global economic cycle. In other words, the agro-ecosystem provides the major energy for the economic cycle by feeding the human population (H_p) to work and produce the major products that are used throughout the world.

Figures (2-9) provide the essential picture of what is happening in the agro-ecosystem and its ecological footprint, global demands on it and the bio-capacity of the system. Figure 2 shows that the relationship between the global croplands' footprint (i.e. demand for cropland products) and the global croplands' bio-capacity (i.e. the products available from croplands). The regression line shows a significant negative relationship (r^2=0.93) indicating that there is a shortfall between the products available from the agro-ecosystems and the demand from these systems. However, the most positive relationship is between the agro-ecosystem bio-capacity (i.e. arable lands) and the global bio-capacity of the earth. This trend is most important because the maintenance of the earth's bio-capacity depends on the agro-ecosystems (Fig. 3). Furthermore, the human population (H_p) in billion people is growing and crop production in the form of crop production index, shows a similar trend (r^2 = 0.97). However, the trend has shifted to a slight reduction in recent years, as indicated by the regression line in (Fig. 4). This is a concern for the food security issue because the regression line shows a tendency towards increase in human population rather than an increase in the crop production index.

On the other hand, the agro-ecosystem trend shows a significant negative relationship between global ecological footprint and the efficiency of arable lands (Fig. 5). This is shown in the regression line where the correlation coefficient is negative (r^2 = 0.83). This indicates the reduction in efficiency of agricultural lands and it is not on the same trend as the demands of humans from this system. Further, the agro-ecosystem shows a significant and sharp negative relationship between the human population in billions and the efficiency of agricultural lands (i.e. r^2 = 0.93, r^2 = 0.97, r^2 = 0.96, and r^2= 0.65 Fig. 6, Fig. 7 and Fig. 8). This indicates that food security for the human population is in danger and a very alarming situation for world food security and the possibility of achieving less hunger and famine. It is a serious issue for world leaders to avoid this condition which has many implications and ramifications. This can be seen from Fig. 8 which explains the negative relationship between total ecological footprint and the ratio between biological capacity and arable lands available for producing agricultural products. It indicates that productive agricultural land is approaching exhaustion and a dangerous depletion of the renewability of its productivity.

Considering, all these aspects, it is important that the United Nation Food and Agriculture Organization (FAO), United Nation Development Program (UNDP), United Nation Environmental Program (UNEP), and all governmental and non-governmental agencies, should take this matter seriously, otherwise the globe will be in chaos.

Fig. 2 - Relationship between global cropped land footprint and the global cropped land biocapacity

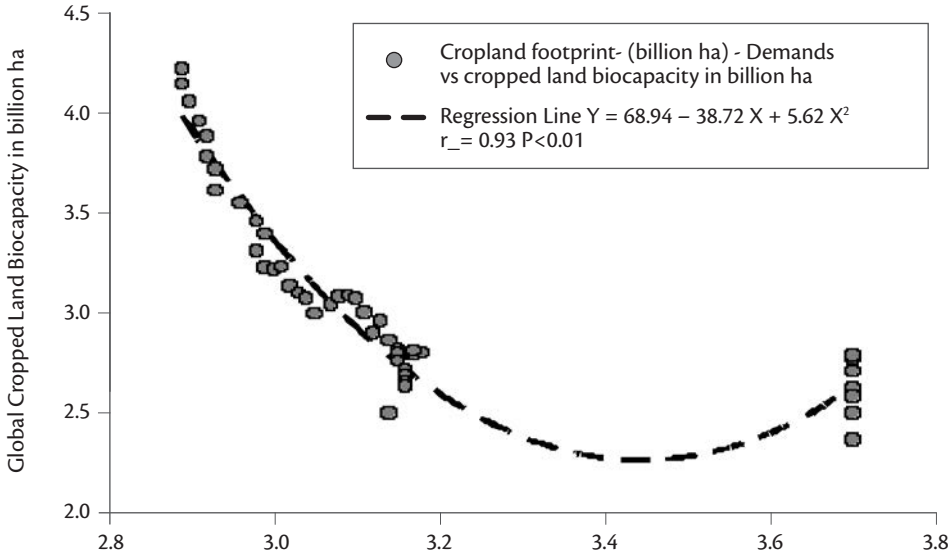


Fig. 3 - Relationship between the global available arable lands and global biocapacity of the earth

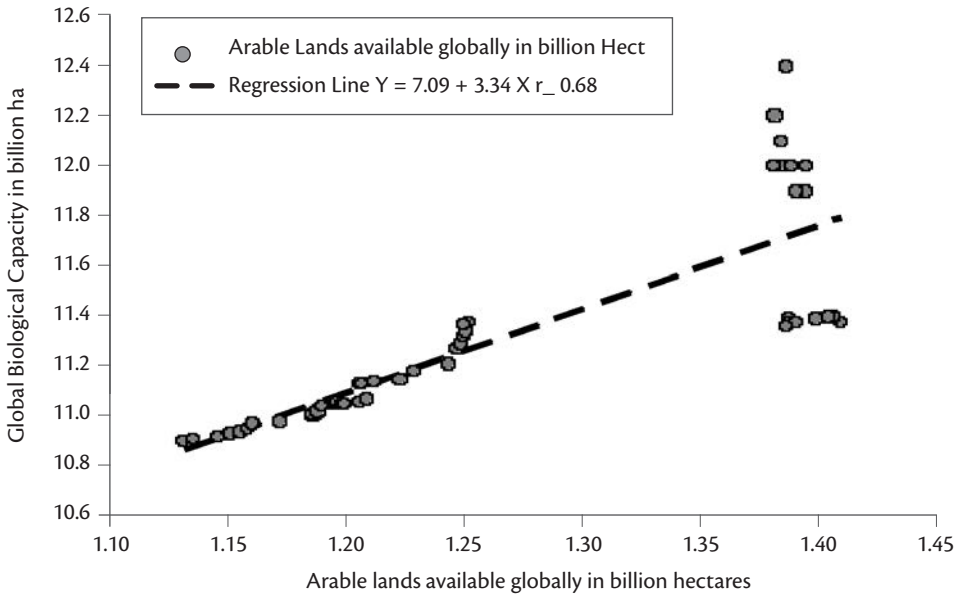


Fig. 4 - Relationship between world human population and global crop production index

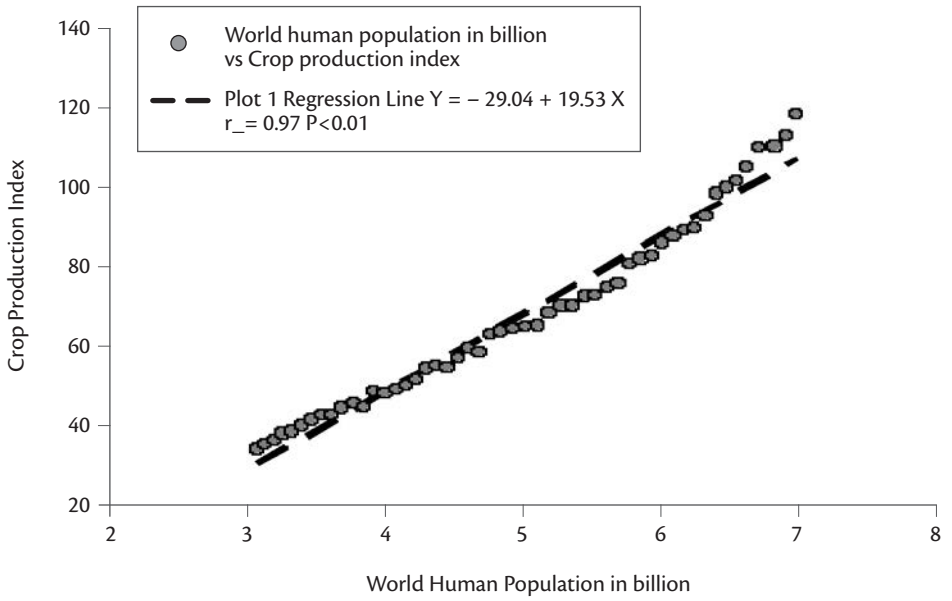


Fig. 5 - Relationship between global ecological footprint and the efficiency of arable lands

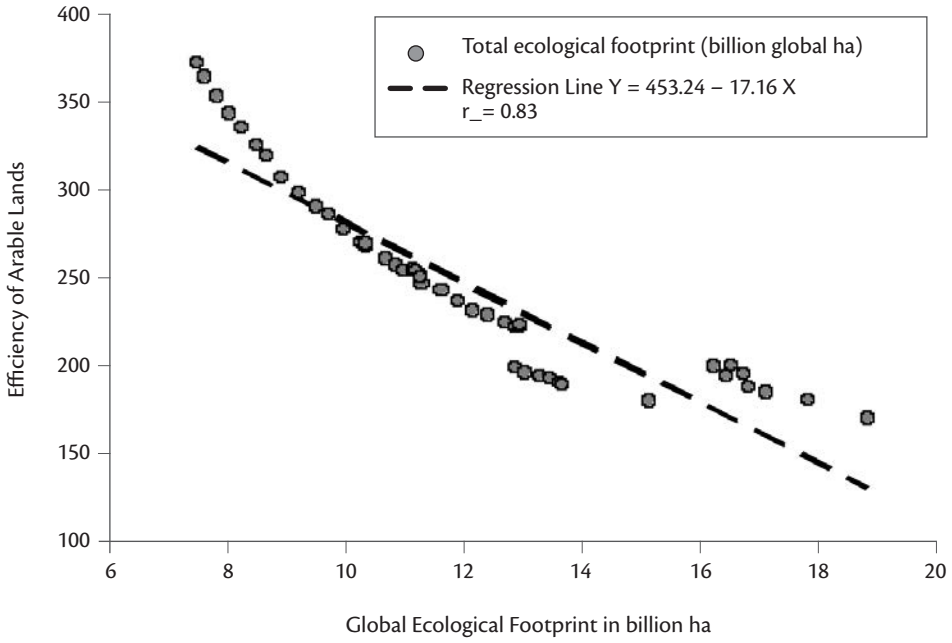


Fig. 6 - Relationship between world human population in billion and efficiency of cropped land as %

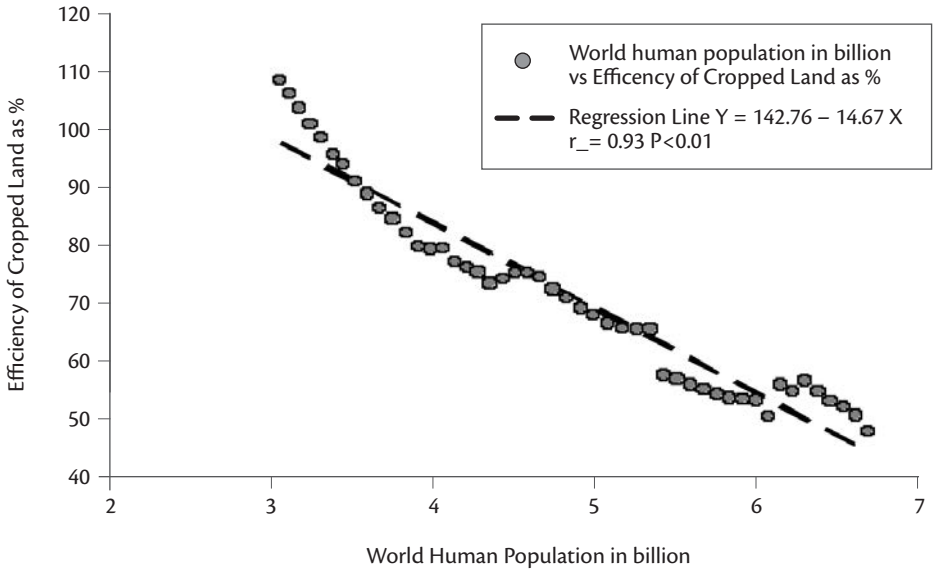


Fig. 7 - Relationship between world human population and cropped land biocapacity

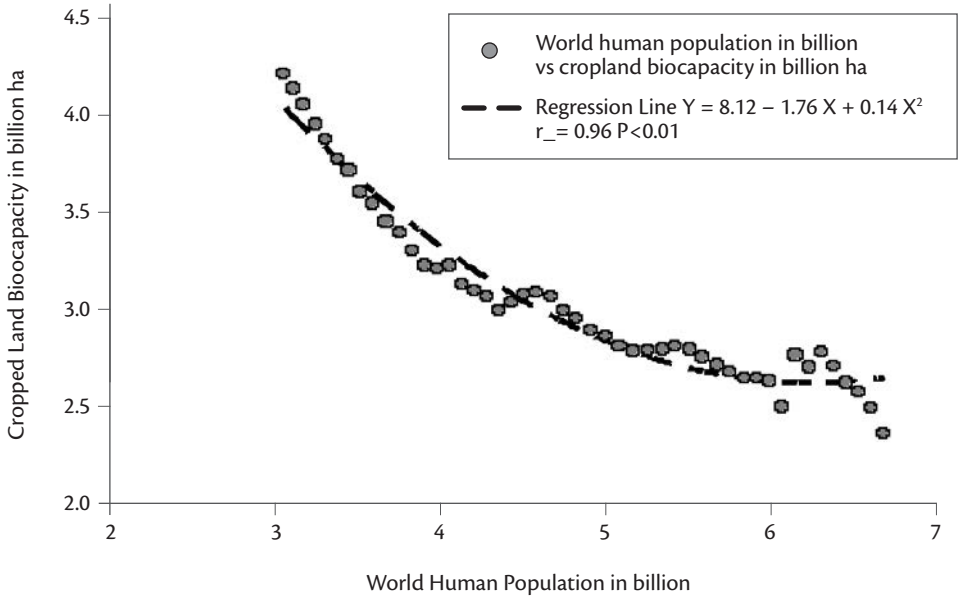


Fig. 8 - Relationship between global human population in billions and efficiency of available arable lands in producing global biocapacity for the Earth

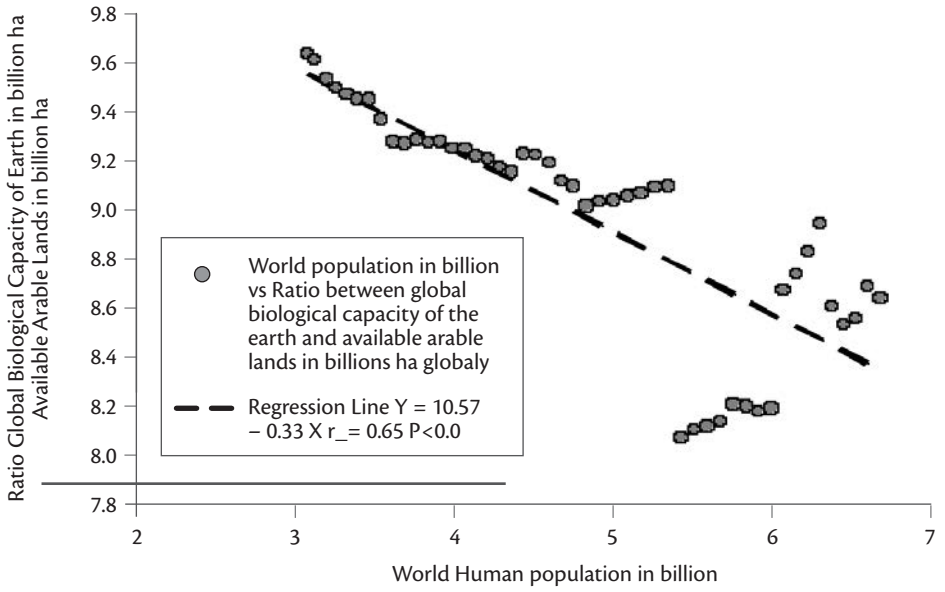
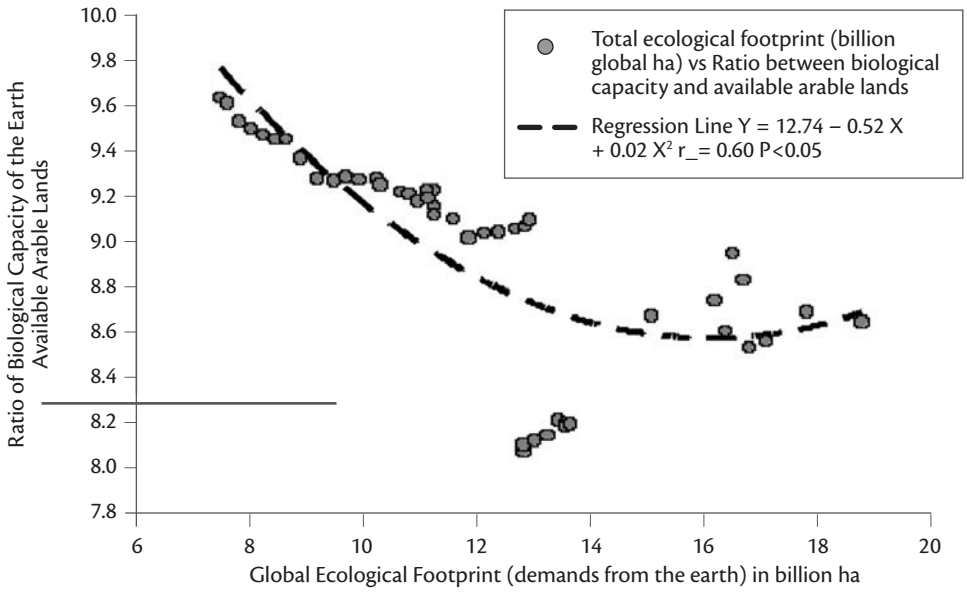


Fig. 9 - Relationship between total ecological footprint and ratio between biological capacity and available arable lands



2. The Ecological-Footprint Agro-ecosystem Model (EFAM)

A) Description of the Model

The Ecological- Footprint Agro-ecosystem Model (EFAM) is designed to predict the impact of human consumption of agricultural products, to predict the future of the global agro-ecosystem for providing the goods and services to support food security, and to assess the human need for food products. The model will be a tool to measure the changes in the parameters that will impact on agro-ecosystems as regards their ability to regenerate bio-capacities which support the planet in sustaining the human population (H_p) globally. This model was written using STELLA modeling software package (2001) – and the version is number 8.0. The model used an annual time step with the fourth Runge–Kutta integration method (Ouyang, 2008). The EFAM model predicts the condition of the agro-ecosystem globally, and determines the future needs for agricultural bio-capacity from the earth for the period 1960 to 2050, almost one hundred years. The simulation period can be from one year to several years and be for a short time period of simulation. Background data and literature parameters were used to initialize the model and short-term data was collected from different sources and data sets of series available on the web sites of World Research Institute (WRI)-Earth-Trends, World Bank, Food and Agricultural Organization (FAO), United States Department of Agriculture (USDA), United Nation Development Program, World Wildlife Fund (WWF) and Global Footprint Network. Table (1) shows the list of variables and parameters in the Model and its interpretation.

Tab. 1 - List of variables and parameters that are used in the Global Ecological Footprint and Climate Change (GEF-CH) Model and its interpretation.

Variables	Interpretation	Unit used in the model
H_p	World Population Series	In billion individuals
E_F	Total Ecological Foot Print	In billion global hectares
G_{BC}	Global Biological Capacity of the Earth	In billion global hectares that generate the biological capacity of the earth
G_{BD}	Global Biological Demand from the Earth	In billion global hectares that consumed from biological capacity by human beings from the earth
C_F	Cropland Footprint	In billion global hectares of croplands
G_{LF}	Grazing Land Footprint	In billion global hectares of grazed lands
F_{GF}	Forest Ground Footprint	In billion global hectares of forest lands excluding fuel wood
F_F	Fish Ground Footprint	In billion global hectares of fish farming
B_L	Built-up Land	In billion global hectares
G_{DC}	Global Deficit Capacity	In billion hectares
G_{EAgLI}	Global Efficiency of Agricultural Lands Index	As a ratio
G_{EALI}	Global Efficiency of Arable Lands Index	As a ratio

The model used parameters such as world human population series (H_p) from year 1961 to 2009, Ecological Foot Prints, Maintenance Index (MI) In addition, other terms such as the G_{BC} which is the Global Biological Capacity and G_{BD} which is Global Biological Demand, Cropland Footprint (C_F) in billion global hectares, Grazing Land Footprint (G_{LF}) in billion global hectares, Forest Ground Footprint (F_{GF}) excluding fuel wood in billion global hectares, fish ground footprint (F_F) in billion global hectares,, Built-up Land (B_L) in billion global hectares, Global Deficit Capacity (G_{DC}) in billion hectares, are used in calculations, G_{EAgLI}, is the Global Efficiency of Agriculture lands Index, G_{EALI} Global Efficiency of Arable Lands Index and Ratio of Global Bio-capacity of the Earth to Global Agriculture Land G_{BC}/ G_{AL}

B) **Model Formulas**

The following are the formulae that the model used in the prediction of what will happen beyond the period for which data is available.

1) The relationship between global cropland footprint and the global cropland bio-capacity is $Y = 68.94 - 38.72 X + 5.62 X^2$.
2) The relationship between global available arable lands and global bio-capacity of the earth is $Y = 7.09 + 3.34 X$.
3) The relationship between global human population (H_p) and global crop production index is $Y = - 29.04 + 19.53 X$.
4) The Relationship between global ecological footprint and the efficiency of arable lands is $Y = 453.24 - 17.16 X$
5) The relationship between global human population (H_p) and the efficiency of cropped lands as % is $Y = 142.76 - 14.67 X$
6) The relationship between world population and efficiency of available arable lands in producing global bio-capacity for the earth is $Y = 10.57 - 0.33$.
7) The relationship between total ecological footprint and the ratio between biological capacity and available arable lands is $Y = 12.74 - 0.52 X + 0.02 X^2$.
8) The relationship between world populations and cropland bio-capacity is $Y = 8.12 - 1.76X + 0.14X^2$.

3. Model Simulation and Analysis

In the application of the EFAM model and the simulation analysis the data used for the model are the year, human population (H_p), according to the assumption of a growth rate of human population and according to the calculated global bio-capacity produced per global hectare. The model output (Table**s** 2 & 3), (Figures 10 and 11) showed that there is a trend of decreasing efficiency in the arable lands available, decrease in the efficiency of croplands and alongside is the increasing human population (H_p) (i.e. in the range 9.0 – 9.5 billion people by year 2050 at growth rate of 1.0%). Furthermore, the model predicted that croplands' biological capacity may be increasing because of heavy machinery, fertilizers and cropping systems which occupy land several times during the year in specific areas. However, global available arable land may increase towards the period 2030-2040. This could be due to the extensive use of agricultural lands, biotechnologies of which now there is an extensive use, i.e. of genetic materials to produce and enhance the crop yields. This will lead to the fullest use of agricultural land.

The model, further, predicts that global available arable lands will start decreasing around the period 2040- 2050. This may be due to the increasing human needs for arable lands and also the demands from an increasing ecological footprint from the earth's resources in the form of goods and services. This is alarming for our global agricultural system. The trend will continue beyond 2050 unless other measures are taken.

These scenarios and predictions, give an opportunity to governments and international agencies and other non-governmental agencies to think of an approach to help support nature in order for it to regenerate itself without degrading resources, and to keep providing them for the coming generations. Interestingly, from Fig. 10 and Fig. 11, we can see that with the increase in the growth rate of human population (H_p) from a 1.0% annual increase to 1.5%, there is still a gap between the growth of cropland biological capacity and human

population. This will lead to a shortage of food supply to support the growing human population.

Tab. 2 - Global Population, Global Biological Capacity (G_{BC}), Global Biological Demand (G_{BD}) and Maintenance Index of Our Planet Earth from Year 1961 to Year 2008 - Data are in 10 year intervals*

	1961	1970	1980	1990	2000	2008
Global Population in billion	3.08	3.70	4.44	5.27	6.10	6.69
Total Global Biological Demand (G_{BD}) (billion global ha)	7.47	9.50	11.25	12.93	15.1	18.8
Total Global Biological Capacity (G_{BC}) (billion global ha)	10.90	11.00	11.13	11.38	12.00	12.00
Deficit in global biological capacity billion hectare = G_{BC}-G_{BD}	+2.43	+2.50	+0.12	+0.55	-3.10	-6.80
Maintenance Index = G_{BC}/G_{BD}	1.46	1.15	0.98	0.88	0.79	0.68
Cropland Biological Capacity (in billion global ha)	4.21	3.45	3.03	2.79	2.49	2.36
Global Available Arable Lands in billion global ha	1.13	1.18	1.21	1.25	1.38	1.39
Efficiency of arable lands Index = total cropped bio-capacity/ total arable lands	3.72	2.91	2.51	2.22	1.80	1.70
Efficiency of Cropland Index = Cropland Biological Capacity/ Total Agriculture lands	1.08	8.86	0.74	0.65	0.51	0.48

** Data Sources are World Bank- FAO – WWF – Ecological Footprint Network – WRI-Earth Trends - US Estimates,*

Tab. 3 - Predicted Values calculated for Global Population, Global Biological Capacity (GBC), Global Biological Demand (GBD) and Maintenance Index of Our Planet Earth from Year 2009 to Year 2050. The data presented are in 10 year intervals on the basis of current trend of estimate of population growth rate and other parameters

	2009	2010	2020	2030	2040	2050
Global Population in billion	6.74	6.79	8.83	9.17	9.51	9.84
Total Global Biological Demand (G_{BD}) (billion global ha)	16.98	17.11	22.46	28.62	31.30	33.36
Total Global Biological Capacity (G_{BC}) (billion global ha)	11.94	11.95	12.13	12.31	12.52	12.73
Deficit in global billion hectare = G_{BC}-G_{BD}	-5.04	-5.16	-10.33	-16.31	-18.79	-20.73
Maintenance Index = G_{BC}/G_{BD}	0.65	0.64	0.54	0.43	0.40	0.38
Cropland Biological Capacity (in billion global ha as predicted from the model	2.59	2.59	2.67	2.87	3.19	3.62
Global Available Arable Lands in billion global ha as predicted by the model	1.02	1.03	1.08	1.11	1.10	1.06
Efficiency of arable lands Index as calculated from the model	8.47	8.45	8.24	8.03	7.81	7.60
Efficiency of Cropland Index as calculated from the model	0.49	0.49	0.39	0.30	0.20	0.11

Climate change (G_{EF}-C_H) Model and its interpretation.

Fig. 10 - Simulation analysis of the EFAM Model showing the prediction of 1) Cropland biological capacity, 2) Efficiency of arable lands, 3) Global available arable lands, 4) Efficiency of croplands and 5) Population accumulated on the basis of human population growth rate at 1.0% and the availability of global bio-capacity

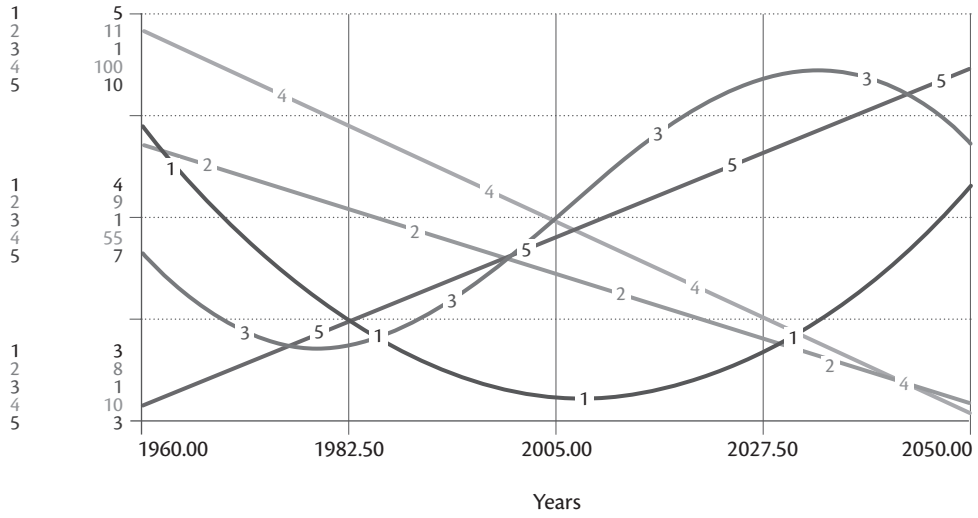
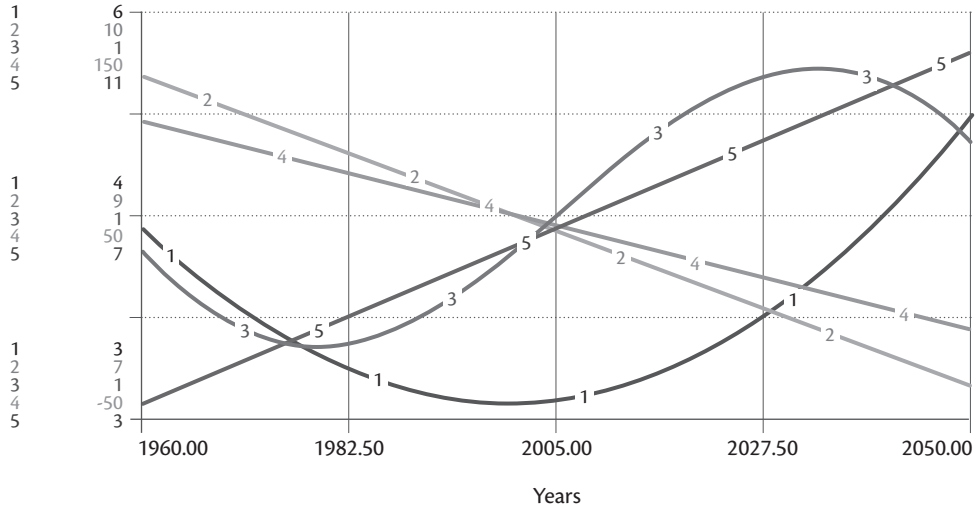


Fig. 11 - Simulation analysis of the EFAM Model showing the prediction of 1) Cropland biological Capacity, 2) Efficiency of arable lands, 3) Global available arable lands, 4) Efficiency of croplands and 5) Population accumulated on the basis of human population growth rate at 1.5% and the availability of global Earth bio-capacity



Discussion

The agro-ecosystem is one of the productive systems around the world and, together with the forest ecosystem, is that able to store the energy from the sun in its vegetative components. The sustainability of the agro-ecosystem depends on the maintenance of its economic, biological and physical elements. In addition, this system must be given the time completely to regenerate itself, otherwise it will be depleted in an alarming and irreversible manner. Once it is degraded, this ecosystem will take too much time to recover, especially the soil properties of the system. In this respect, we must consider all the aspects and components of the system Furthermore, the agro-ecosystem can be defined as indicated by Wood *et al*., 2000, as *"a biological and natural resource system managed by humans for the primary purpose of producing food as well as other socially valuable non-food goods and environmental services."*

In the present study, the ecological footprint bio-capacity of agro-ecosystem (i.e. the productivity of the system) and ecological footprint demands from this system have been assessed in several ways that can be of importance to human food security. As indicated in this study, the ecological footprint demands from the agro-ecosystem have a declining relationship with efficiency of productive arable lands. In this respect, Wood *et al.*, 2000 indicated that cropland and managed pasture detected by satellite interpretation cover some 28 percent of global land surface. This is supported by the World Bank Data Group. Overall, 31 percent of agricultural areas are occupied by crops, and the remaining 69 percent are under pasture. Annual cropland is relatively stable at around 1.38 billion hectares, while permanent crops occupy around 131 million hectares and show a net growth of almost 2 percent per year. Pasture areas are estimated to be increasing at around 0.3 percent per year. These data have been converted into global calories received from the sun which are stored in agricultural products and show that land is marginally producing the calories that the human beings are in need of. However, the increasing population will impact on the globally required calories from the stored energy in the agro-ecosystems; this will result in shortage of these products, and an inability of the agro-ecosystems to provide the essential food security to all the global population.

Another concern, as indicated by Wood *et al.*, 2000,is that irrigated areas occupy 270 Mha, around 5.4 percent of global agricultural land and 17.5 percent of all cropland. Irrigated area continues to expand, but at a slowing rate, now around 1.6 percent (about 3.3 Mha) per year. This net amount is presumed to allow for irrigated area losses estimated at up to 1.5 Mha per year from salinization. Our recent results have supported this statement, as indicated in the reduction of efficiency of agriculture lands, and it is not in line with trends in the demands of humans from this system. Additionally, Wood *et al.*, 2000 showed the following results: data on production systems and resource management aspects of land use are extremely scarce at regional and global levels. This is an alarming fact that has been indicated about thirteen years ago and, our results continue to produce an alarm bell regarding the status of of the global agro-ecosystem which depends on the ecological footprint of the agro-ecosystem's ability to produce products that can support food security to all human beings. Additionally, our new analysis of trend of as presented here, using the earth's agro-ecosystem calorie production to provide the number of calories to support human existence and survival, gives another dimension to the ecological footprint, which is the **"*Ecological Human Imprint* (E_{HI})"**.

The policies for agro-ecosystems should monitor the agricultural condition in the world, from climate change to land productivity and distribution of food around the world. This may be by subsidizing world food production through United Nation programs or governments. In

this respect, the UN or governments should have reserve funds to support subsidizing food production in the impacted areas of lower production but without changing policy for the market commodities. This fund should be used not for emergencies but to support farmers in producing agricultural commodities and to ensure food security.

Conclusions

The EFAM model has predicted the status of the ecological footprint of global agriculture worldwide. It predicts that cropland efficiency will decline. Furthermore, the model predicts that cropland's biological capacity may be increasing due to powerful machinery, use of more fertilizers and the use of multiple cropping during the year in specific areas. However, global available arable land may be increasing until around the year 2030. This could be due to the extensive use of agricultural biotechnologies employing genetic materials to enhance crop yields which would lead to the use of agricultural land to its fullest capacity. The model further predicted that the global available arable lands will start decreasing from 2030 to 2050. This may be due to the increasing human pressure on arable lands and also the increasing demands of ecological footprint on the earth's resources in the form of goods and services. This is alarming for our global agricultural system. The trend will continue beyond 2050 unless other measures are taken. Continuous assessments of the status of global agro-ecosystems should be taken seriously and be monitored to avoid a disastrous condition that may be leading to unsustainable agricultural systems, instability in the world economy and instability in political conditions. These scenarios would lead to chaos worldwide. Agricultural policies should monitor the conditions in the world from climate change to land productivity to good distribution of food around the world. Further, the United Nation Agencies should work with all governments to ensure food security and policies that must be directed to massive food production for ensuring food security globally.

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BUILDING A MULTIFUNCTIONALITY AGRICULTURAL HOUSE AND INDICATORS FOR SOCIAL/HEALTH FARMS

JEL classification: Q10, Q18, O13

Francesco Contò*, Mariantonietta Fiore*, Assunta di Matteo*

Abstract. *The importance of multifunctional farming activities is clearly demonstrated by the significant changes made to the EU's Common Agricultural Policy (CAP) in its rural development policy. Multifunctionality has received a lot of attention over the last decade from scholars and policy-makers. A new rural paradigm stands out as the interrelationship between agriculture, landscape protection and social services (e.g. Social Agriculture, Teaching Farms, Social Farms, Horticultural therapy and so on). Models based on forms of solidarity or trust could be a crucial driver for fostering the competitiveness of rural areas. Evaluation tools are needed for analyzing the current system and for improving the social approach. The aim of this paper is to provide an analysis of the educational and social opportunities deriving from multifunctional agriculture. Furthermore, we define indicators focusing on the social/education dimension. The paper is structured as follows: after a review of literature and policies on the social/health dimension of rural development, we investigate the role of didactic agriculture and the 'helping relationship' and so we define new Non-Commodity Outputs (NCOs). In addition, starting from the house of functions model by Fleskens (2009), we define a Multifunctional Agricultural House taking into account the educational and network dimension of an agricultural system; we then select indicators having an educational, social and helping dimension. Finally, conclusions are drawn.*

Keywords: *multifunctionality; social/health farm; rural development; indicators; NCOs*

1. Social/Health dimension of agriculture

In recent years, European political, professional, and scientific interests in care farming - based on promotion of human health and social benefits - have been growing. European agriculture and rural areas are facing multiple socio-economic changes, including a transition from an agriculture-based to a service-based economy (Dessein *et al.,* 2013). Generally speaking, social and human indicators (UNDP, 1990, 1997; Anand and Sen, 1997) have taken into account quantitative elements only (Pressman and Summerfield, 2000; Roemer, 2006).

In particular social dimension and social support by the farmer appear more and more important (Berget *et al.*, 2011; Sempik *et al.*, 2010; Hine *et al.*, 2008) and better encapsulate the complexity of agricultural and rural change into a new way of looking at the future of agriculture (Wilson, 2007). The social dimension of agriculture and the important role it plays in the lives of small farmers all the world over is recognized widely (Hermans *et al.*, 2010). In addition, the

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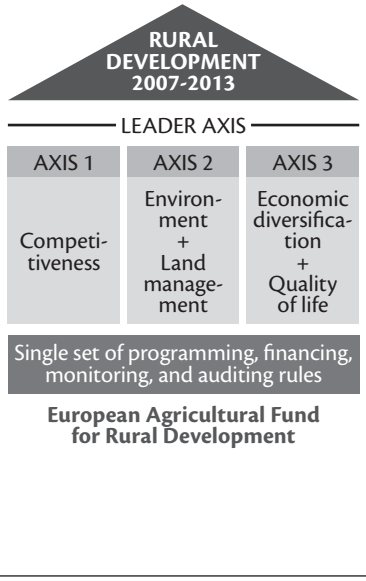
importance of a context conducive to social dimension in rural areas (Dessein *et al.*, 2013; Poeg *et al.*, 2000) and to altruism and so on (Nussbaum, 2002; Sen, 1999; Gintis and Khurana, 2008) stands out. In this framework, the EU in recent years has focused its attention on multifunctional farming activities fulfilling the combination of functions required by society: multifunctional land use and the creation of multiple values in the rural areas are thus creating new challenges (Jongeneel, 2008; Rogge *et al.*, 2013). In fact multifunctionality has received a lot of attention from scholars in the last decade (Andersen *et al.*, 2013; Barbieri and Valdivia, C. 2010; Potter *et al.*, 2002; Bernard *et al.*, 2006; Freshwater, 2003; Grouiez, 2011; Ohe, 2011; Contò, 2005 and 2010; van der Ploeg *et al.*, 2009; Wilson, 2008; Kizos, 2010). Some researchers, for example, define multifunctional agriculture as a rural space which could develop multifunctionality beyond agriculture, i.e. a complete loss of the productive function of agriculture (Fleskens *et al.*, 2009). On the other hand, the OECD (2001, 2003; 2005) presents a thorough analysis of the multifunctionality concept from an economic perspective; in fact OECD highlights the opportunity for a country to maximize positive externalities, minimize the negative ones and make sure that the fusion of the outputs derived from agriculture corresponds to the needs of society. Within the latter, an innovative combination between agriculture and social development gives rise to so-called 'Social Agriculture' (SA) that is an agricultural model based on closer complementary relationships between rural and urban areas: SA uses agricultural resources to carry out certain social activities which include the service user and the institution, such as introduction to work, rehabilitation, promoting mental and physical health etc. (Foti *et al.*, 2013; Sempik *et al.*, 2010; Dessein, 2008). The term Social Agriculture or Social Farming is often used interchangeably with other concepts such as farming care, farming for health or green care (ENRD, 2010). Green care can be defined as an umbrella term, whose aim is the use of nature to produce health, social or educational benefits (Sempik *et al.*, 2010). The interrelationship between agriculture, landscape protection and social services (e.g. Social Agriculture, Teaching Farms Farms, Social Farms, Horticultural therapy and so on) introduces opportunities for a new rural model (OECD, 2006) linking sustainable economic, environmental and social targets and motivations. So the countryside "cultivates" and promotes values (Di Iacovo and Ciofani, 2005).

At EU policy level also, the social approach is in evidence. Figure 1 summarizes the measures of Rural Development Programmes, including opportunities for Multifunctionality in a social dimension. Axis III of the National Strategy Plan for Rural Development - *Quality of life and diversification* – and the activities of the Rural Development Plans confirm the importance of the social dimension within the context of practices and professions in agriculture in order to promote improvement in the quality of life. As for the EAFRD (European Agricultural Fund for Rural Development), for Regional Policy and Cohesion (ERDF - European Regional Development Fund) and for ESF – (European Social Fund), the National Strategic Framework reveals the ten priorities that give relevance to Social Agriculture. It takes into account the priority 1, improvement and development of human resources that will support the training of professionals. This can be applied to those who intend to innovate through the acquisition of skills in the field of Social Agriculture and activities associated with it, such as the farm and the farm office. Priority 1, relating to social inclusion, services for quality of life and the attractiveness of the region, aims to enhance social capital underutilized in urban and rural areas by improving the quality and accessibility of services of social protection: training and learning systems are therefore aimed at vulnerable people including of course, the disabled and those who are not independent.

As may be seen, Axis 3 is aimed at enhancing the quality of life in rural areas and diversification of the rural economy, offering support for developing local infrastructure and human capital

in rural areas, thus improving the conditions for growth and job creation in all sectors and the diversification of economic activities. For example, the main objective of Measure 323 is to improve the quality of life in rural areas by undertaking tangible and intangible investments that serve to reverse the trends leading to ecological, economic and social decline, thus making rural areas more attractive to live in and to visit. Finally, the social dimension aims at revealing a sense of ownership and civil pride in the rural community, ensuring the sustained use of the resources of rural heritage for economic and social benefits.

Fig. 1 - The Social Dimension in the Rural Development Programme



Measure 311 "Diversification into non-agricultural activities"
- Action 2: Investments for the supply of educational services and education for the population, with particular reference to the school and students and in synergy with the national education system;
- Action 3: Investments for the supply of health services for the benefit of vulnerable groups.

Measure 312 "Support for business creation and development"
- Action 3: services to the local population especially for young children and the elderly (creation of play areas, baby-sitting, recreation centres for the elderly).

Measure 321 "Basic services for the economy and rural population"
- Action 1: services of educational, cultural and recreational events for young people of school age;
- Action 2: socially useful services on social inclusion for the elderly and disabled (pet therapy, horticultural therapy, agro-therapy, art therapy, hippotherapy);

Action 3: childcare services (child entertainment centres and countryside nurseries).

Measure 323 "Conservation and upgrading of the rural heritage"
Action 3: environmental awareness and educational actions and events, including general and site-specific actions, linked to approved plans and studies.

Measure 331 "Training and information"

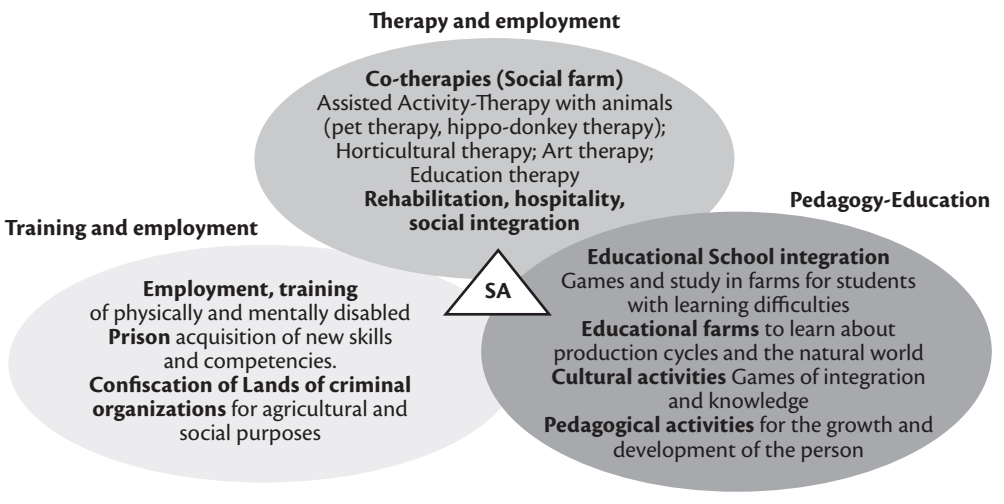
Source: our processing on EU Scheme, available on following link:
http://enrd.ec.europa.eu/policy-in-action/rural-development-policy-overview/axes-and-measures/en/axes-and-measures_en.cfm

1.1 The educating and helping relationship in agriculture

Agriculture has always had a crucial role within society as the vast historical and sociological literature demonstrates (Foti *et al.*, 2013). In fact agriculture has played a role in education and in educational space, has always induced the farmer to learn how to take care of the land, crops, livestock, tools, and of all that is in the agricultural area. Agriculture has always led children to play, as they try to catch grasshoppers, when finding nests, harvesting grapes; in agriculture children play and mimic the real educational space through gestures that allow free creative writing in airspace (Pesci and Mani, 2004) and land. Agriculture has always induced respect for the germination of life and has taught to satisfy hunger without any waste and in compliance with the earth itself, by taking care of the requirements of persons with special needs (Dessein and Bock, 2010). The educational role of agriculture is consolidated in its dimension of Multifunctional Agriculture and specifically in its role as Social Agriculture. With social farming, agricultural activities assume a role of tertiary nature and begin to provide a social service for the disadvantaged, by making the helping relationship explicit to people in a state of psycho-physical disadvantage (INEA, 2009; Finola

and Pascale, 2008; Di Iacovo and Senni 2006; Di Iacovo, O'Connor, 2009; Hassink and Van Dijk, 2006; Berget *et al.*, 2011). For example, in Ireland the use of agriculture and horticulture as an activity within or closely aligned with care settings such as the Mental Health Services and Intellectual Disability Services has a long history (ENRD, 2010). In farming for health, a range of services can be grouped in three main areas as can be seen in Figure 2, where social agriculture (SA) is the container and muse of a Territorial Multifunctional Network (TMN). For example, as regards 'Co-therapies' these are aimed at people with physical and mental disabilities and people with psychiatric disorders; as regards 'Rehabilitation, hospitality, integration', activities are aimed at groups with risk of social marginalization (people not self-sufficient, people with addiction, victims of violence, ex-offenders, socially disadvantaged). So rural scenery changes its appearance; with the introduction of the social approach, the farm becomes an educational farm, countryside nursery and countryside kindergarten, therapy centre, reception centre for disabled and/or elderly and/or people with a disadvantage. In this perspective, there is a need for interdisciplinary areas and skills on the farm, the farmer has therefore to manage a multi-functional firm including a team made up of pedagogists, psychologists, psychiatrists, educators. In addition, social farms facilitate the inclusion/integration of people with low bargaining power by adopting forms of corporate social responsibility (Senni, 2007). Those operating in social agriculture construct a level of protection which is flexible, lightweight and able to respond to the needs of remote areas, enabling innovative forms of local self-help aiming to care for the needs of local society. The helping relationship present in rural areas considers the human being in his entirety and complexity, where the dynamics of the same individual are influenced by and influence the (rural) territory. Giving help to the person means, therefore, helping the person to find within himself the resources to deal with difficult situations in a integrated context, taking into consideration the rural system to which he/she belongs, characterized by low population density and/or isolation. Helping a person in a rural setting supports development of the territory, human too. In this matter, agriculture can deal with both disadvantaged people and disadvantaged areas. Figure 2 shows the social dimension of farms that can be grouped into 3 areas: therapy and employment; pedagogy-education; training

Fig. 2 - The social dimension of farms



and employment. Social agriculture can amplify the advantages and reciprocal benefits in order to obtain social and environmental sustainability (Foti *et al.*, 2013).

So green care is seen as one of the caring and curing activities which farms can deliver (i.e. health restoration and protection, disease prevention and health promotion). Farmers may be involved as providers of the green (farm) environment but cannot be involved in the therapeutic process. Green care arrangements may take place but always under the responsibility of health professionals (ENRD, 2010). The farm-based promotion of human health and social benefits links two formerly distinct sectors with actors operating at different institutional levels (including care farmers, care institutions, farmer and care sector representatives, and representatives of the Ministries of Agriculture and of Public Health) (De Krom and Dessein, 2013). Some authors (Hassink *et al.,* 2013) define three major types of initiatives: (1) individual care farms; (2) regional foundations of care farmers; and (3) care institutions collaborating with groups of farmers at a regional level.

We thus have a critical point of intersection between different styles of life, social fields or levels of social organisation, where social discontinuities based on discrepancies in values, interests, knowledge and power, are most likely to be located (*Rogge et al.*, 2013). The socio-economic situation shows that the agricultural sector is diversifying with complementary activities, offering services for enhancing welfare. To become a social multifunctional farm, the agricultural enterprise must be willing to offer cultural, educational, charitable, training, rehabilitation, and employment for the benefit of vulnerable people. The rural environment is thus opened in favour of human development because the rural environment is an environment more suitable for the development of the individual than an urban environment (Di Iacovo and Senni, 2006). A recent research by Oliviero Ferraris (2011), shows that children want to have more and greener available space in which to play and move around (Di Iacovo and Ciofani, 2005). All these needs are easily met on the social farm. Several clinical observations and scientific studies show how the contact with nature and freedom of movement as well as play decreases the frequency of psychological problems in childhood and creates emotional states contrasting anxiety and depression and promoting learning. Another important consideration is that in a rural setting there is much more space to move that allows children to run and jump, with advantages for their psychomotorial activity and knowledge of space and body aimed at developing psychological well-being and self-knowledge not easily obtainable in an urban environment. Human development and respect for the land converge. Proximity and direct knowledge of social realities can develop new behaviours and new ways of thinking. By trying to exploit local resources, these actions offer new prospects for a territorial approach taking into account the needs and resources in the area. Social agriculture, with its pedagogical methodology, leads to social and educational renewal, and is a valuable tool that enhances the individual and their needs within a rural area (Di Iacovo and O'Connor, 2009). Social inclusion plays a crucial role in the revival of rural areas where the improvement in the quality of life is a necessary condition in order fully to exploit the human resources and the territory.

2. Defining new Non-Commodity Outputs (NCOs)

Multifunctionality refers to the fact that an economic activity may have multiple outputs and, by virtue of this, may contribute to several societal objectives simultaneously (OECD, 2001). It can be explained via two approaches. One is to interpret multifunctionality as a

characteristic of an economic activity that has several activities with interconnecting outputs or effects. The second is in terms of multiple roles assigned to agriculture (OECD, 1998) and this is our starting point. The broad portfolio of products and services of multifunctional farms can be analyzed classifying the different agricultural function in three macro categories (Bassi and De Poi, 2012):

– productive functions: production of raw materials (farm core business), processing activities, production of traditional wines and foods, hospitality services such as accommodation and catering, on-farm sales, bio-energy production, food security etc.;
– social functions: recreational, cultural, educational and therapeutic activities, social employment, maintenance and transmission of traditions, social cohesion, etc.;
– environmental functions: organic production, landscaping and protection of biodiversity, reproduction/consumption of natural resources and so on.

Farmers can choose their style of production and land use, that are the "key drivers" of change: when land is converted from one use to another or from a conventional to a non-conventional style of production such as that with social activities, a change occurs in the vector of inputs (means of production and workers) and in the vector of outputs including public goods (Eboli *et al*., 2010). So a new role has been and can be attributed to the primary sector in terms of multifunctionality, which means that socio-agro-environmental policies promote non-commoditiy outputs (NCOs) jointly produced with agricultural commodity outputs (OECD, 2000a; 2003; 2005; 2006; Capitanio and Adinolfi, 2009; Knickel and Peter 2005; Contò, 2005). Because the non-commodity outputs detain characteristics of public goods, there is no private or partial market reward (Bryden *et al*., 2011) and therefore the State has a role in promoting NCOs (Capitanio and Adinolfi, 2009) together with all stakeholders. In Europe, within the EU Rural Development Scheme framework, there are several examples of promoting: a "European" subsidy for these programmes: the English Countryside Stewardship Scheme, the German MEKA programme, and the French «La prime a l'herbe»; TOP-MARD (Towards a Policy Model of Multifunctional Agriculture and Rural Development) (Capitanio and Adinolfi, 2009; Bryden *et al*., 2011); POMMARD (Policy Model of Multifunctional Agriculture and Rural Development) encompassing the multifaceted interrelationships between the several public and private 'functions' of farming and farm households, regional economic development and quality of life, demographics and public policies, enables the solution of the 'additionality' problem in policy analysis (Fleskens *et al*. 2009; Johnson *et al.* 2008).Consequently multifunctionality includes socio-cultural and also environmental functions (Ohe, 2007).

In particular, care farms offer day care, supported work- and/or residential places for clients with a variety of disabilities (people with mental illness, addiction, intellectual disabilities, older people, children, problematic youth, and long-term unemployed) improving the quality of life of clients (Hassink *et al*., 2013, 2007; Di Iacovo and O'Connor 2009; Aznar-Sánchez *et al*., 2011). The possibility of being part of a community, an informal context and useful and diverse activities within a green environment make care farms an appealing facility (Hassink et al. 2010); furthermore this chance increases relationships of solidarity, trust, mutual cooperation (proximity) that are non-commodity outputs. The perceived benefits of care farms lead to physical, mental and social wellbeing, to positive emotional states and to the rooted idea aiming at social inclusion/integration. In *Table* 1 we define some examples of NCOs starting from the classification by Bryden *et al*. (2011).

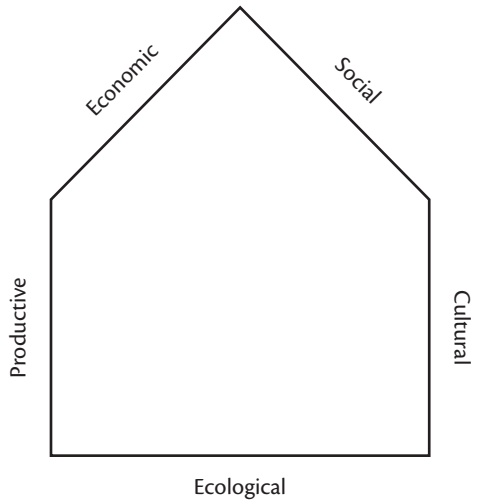
Tab. 1 - Some examples of NCOs from farming	
NCOs	**Type of Market**
Spread of Solidarity, Trust, Proximity	Non market
Social inclusion/integration Idea	Non market
Positive emotional states	Non market
Life Pedagogy-education	Non market
Psychology well-being	Not market
Wellness	Not market
Environment and landscape quality	Not market
Quality of life	Non market
Sympathies (Sen, 1999)	Not market
Public access to countryside (Bryden et al., 2011)	Non market
Landscape quality (Bryden et al., 2011)	Non market
Water (quantity and quality) (Bryden et al., 2011)	Non market
Soil quantity (Bryden et al., 2011)	Non market
Air quality (Bryden et al., 2011)	Non market
Wildlife habitats (biodiversity) (Bryden et al., 2011)	Non market
Greenhouse gases/carbon sequestration/renewable energy (Bryden et al., 2011)	Partly market
Cultural heritage (Bryden et al., 2011)	Non market
Food quality (Bryden et al., 2011)	Partly market
Food safety (Bryden et al., 2011)	Partly market
Source: our processing on table by Bryden et al. (2011)	

The first NCOs in the table are identified in the "evocative" sense too (see NCOs such as 'Spread of Solidarity', 'Trust', 'Proximity', 'Emotional states', 'Psychology well-being' and so on) in order to highlight the crucial role of Social agriculture/Care farming on human development and well-being as well as rural development. A crucial factor defining rural areas is the dominance of livelihoods/economies based on agriculture combined with a strong relationship with tradition, high value of family ties, scales of social aggregation, and a framework given by landscape (Wehner *et al.*, 2014). The inter-linkages among economic, social and environmental features determine both the complexity and the dynamics of rural development. So care farming combines agricultural production, healthcare and social services generating NCOs that can strengthen the proper assessment and aggregation of social welfare.

3. Multifunctional house of function

Here we refer to the 'House of functions model' by Fleskens *et al.* (2009) which comprises five functions: (i) ecology: the basis of the living space (comparable to the concept of ecological footprint); (ii) production: provides us with products from nature – links ecology to economy; (iii) economy: the revenues of the system; (iv) society: the social dimension of the system; and (v) culture: the window on life – links ecology to society. These functions can metaphorically be conceived as constituting the five lines of the silhouette of a house (Fig. 3).

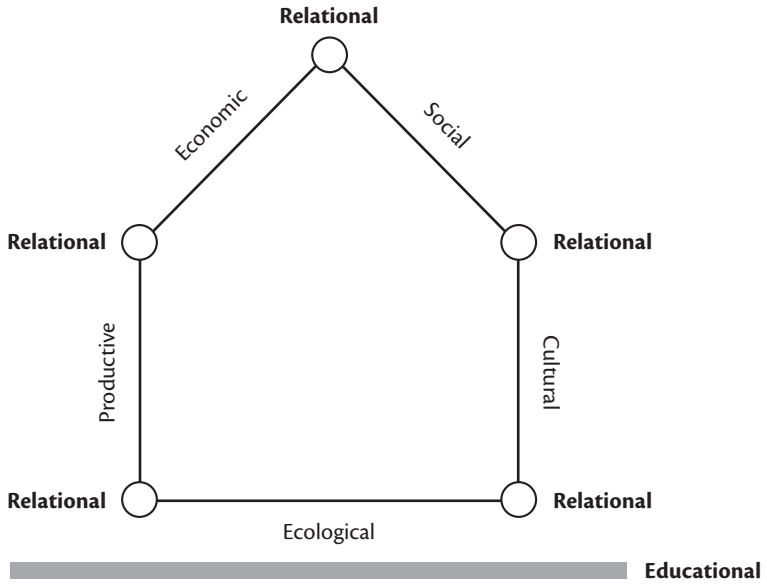
Fig. 3 - The House of Functions



Source: Fleskens et al. (2009)

Starting from this model, we build the 'Multifunctional house of functions' in order to take into account the educational and relational functions of multifunctional agriculture. We add two more functions; (v) the educational dimension to support all functions; (vi) the relational dimension: crucial 'junction' between different functions and stakeholders involved in care farming. Each set of functions has a place in the House (Fig. 4). As regards function (v), a house will conserve its functionality and operability only if the area of abutments has an adequate load-bearing capacity (educational dimension) essential for durable stability. The function (vi) underlines the importance of nodes (relationships) between structural elements (functions) and several stakeholders that are required for implementation of care farming. Culture links ecology to society and production links ecology to economy; economic and social functions are linked at the ridge of the roof. Education is the basis of support to all functions: nodes (relationships) are crucial and are activated by stakeholders with a bottom-up (LEADER) approach; the aim is to develop an area by using its endogenous development potential. Under Art. 61 of Regulation (EC) 1698/2005, the Leader approach is characterized especially by the concept of multi-sector strategy, based on the interaction between parties and projects of different sectors/functions of the local economy and on the implementation of innovative approaches, cooperation between projects, driven by bottom-up approaches aimed at sustainable rural development, with a focus on local partnership and network exchange experiences.

Fig. 4 - The Multifunctional House of Functions



Source: our processing on House of functions model by Fleskens et al. (2009)

The focus is on the spirit of responsibility and the importance of evoking choices by House (Fleskens *et al.,* 2011) and on the crucial role of the education function and on functions of networking several stakeholders. Management of multifunctional land models is by several components which structure development deriving from the new rural paradigm (OECD, 2006); in this respect, the need to define indicators concerning the economic and social/health dimensions of agriculture and rural development stands out. Several studies provide indicators (OECD, 2000b and 2000c; EU Commission, 2001; Riley, 2001; Reed *et al.*, 2006) based on local data such as a practical method to monitor progress towards aims and new models. However, since there are many conflicting frameworks proposed to develop indicators, it is unclear how best to collect these data (Reed *et al.*, 2006). Here we select from existing literature and propose possible indicators with a special look at the health and social dimension and not only. There is no unique way of defining or measuring the "attractiveness" of rural areas but important aspects include the level of income, the possibilities for employment and new opportunities for income in these areas, the physical infrastructure, the social capital, the quality of the environment, and so on (Contò *et al.*, 2012). Far from being exhaustive, Table 2 below gives an insight into the main indicators defined in this work and selected by an analysis of the scarce existing literature and in particular of the RDP for Wales 2007-2013; further steps will be needed in order better to define the construction methods of selected indicators. As is evident, indicators and methods of construction aim at evaluating the green care dimension of rural areas and can be used, where available. Further research should focus on the construction of indicators across different areas, regions, countries. These evaluation tools can be very interesting in the light of the ongoing transformations within the agricultural sector (from productivity towards multifunctional practices) and within the health and social service

sector (from highly institutionalized to community care) (de Krom and Desseim, 2012). The availability of data needed to calculate the indicators in each rural area depends on the capacity of the statistical services.

Tab. 2 - Main indicators focusing on the education/networking dimension

Objective	Indicators, method of construction
Promoting the integration approach between the city and villages	**Training course in rural areas** Number of courses per year in proportion to square meters of rural areas
	Recreational activities promoting the spread of culture and tradition in rural areas Number of activities per year in proportion to square meters of rural areas
Improving quality of life and social inclusion of people, especially disadvantaged people in rural areas, focusing on the relationship between humans and the environment	**Pet therapy, hippo-therapy, donkey-therapy, horticultural therapy** Numbers of therapies carried out in rural areas per year on numbers of total patients Number of patients beneficiaries of social therapies per year on numbers of total patients
	Sociality of rural areas and urban areas Number of Voluntary Organizations relative to total rural population Number of Voluntary Organizations relative to total urban population
	Accessibility of rural areas Average time required to reach the major centers in minutes
	Presence of young people in the area Index of youth in rural areas (ISTAT, 2012) Index of Human Isolation (Contò et al., 2012) Number of cooperatives created by young people under 40 years of age launched per year weighed on total youth population in the considered area (WWEC, 2006)
Performing synergies between farms and public sector institutions	**Conferences, workshop, seminars, reports, newsletter (named 'events')** Number of events in relation to % of rural population in the area considered Extent of Participation (numbers of courses/numbers of farmers) in Training and Landcare (Eu Commission, 2001)
Promoting the integration of business-school educational training aiming at rediscovery of ancient crafts and antique farm tools	**Courses on ancient crafts and antique farm tools** Numbers of courses/numbers of farms Gross number of jobs safeguarded (WWEC, 2006) Number of individuals retained, regained or attracted to the rural area (WWEC, 2006)
Promoting opportunities for meetings between members who participate in social and educational services and local farm workers	**Meeting among LHU (Local Health Units), Schools, University, Hospital, Church and local farm workers** Numbers of meetings per year in relation to total rural population Percentage increase in non-agricultural gross value added in supported farming households and number of new non-agricultural products or services launched by a farming household member (WWEC, 2006)
Promoting and spreading awareness amongst different stakeholders for diversification of business opportunities in the field of multifunctional agriculture and rural development	**Conferences, workshops, seminars, reports, newsletter** Number of Conferences, number of workshop, number of seminars, number of reports, Number of newsletters in relation to rural population Number of seminars, workshops & conferences attended by members of farming households to encourage diversification into non-agricultural activities in relation to rural population
	Integrated projects in multifunctional agriculture Number of integrated projects financially supported to diversify into non-agricultural activities (WWEC, 2006)

Objective	Indicators, method of construction
Encouraging reproduction of the values of solidarity, reciprocity and mutual support	**Programs of communication, information and training, awareness of land, the participants of the third sector (social) issues related to multifunctional agriculture (agricultural office)** Number of events per year Number of cooperatives created (WWEC, 2006) Number of cases of co-operation between farms (EU Commission, 2001)
	Events associated with various local folk traditions Number of events per year
Promoting the training process for local operators and stakeholders in terms of building a network of new skills and competences	**Training process and new professionalism** Number of seminars, workshops & conferences attended by farming household members Number of d hours of vocational training supported (EU Commission, 2001) Gross number of jobs safeguarded (WWEC, 2006) Number of individuals regained or attracted to the rural area (WWEC, 2006)
Promoting the application of skills related to funding programs concerned with the integration of multi-regional development	**Projects involved in multifunctional agriculture** Number of members of farming households financially supported to diversify into non-agricultural activities Gross number of jobs created (WWEC, 2006) Number of individuals advised to support the creation of a new micro-enterprise (pre-start) (WWEC, 2006)
Encouraging the preservation and maintenance of the environment	**Farms whose activity is directly related to the production of environmental and cultural goods** Number of farms involved/Numbers of total farms
Source: our processing	

The characteristics and the complexity of the concept of the social farm, as well as the fact that it reaches out into the future, make multifunctionality a concept which gives a certain direction for policy-making rather than serving as a benchmark that could be precisely defined. It seems difficult to identify indicators which allow judgement about whether a certain process contributes to movement in the right direction. It is not easy to define indicators that monitor progress towards new models with new dimensions, new policy choices. Further research should be better focussed and structured on the construction of indicators and across different areas, regions and countries. These evaluation tools can be very interesting in the light of the ongoing transformations within the agricultural sector (from productivity towards multifunctional practices) and within the health and social service sector (from highly institutionalized to community care) (de Krom and Desseim, 2012). The availability of data needed to calculate the indicators in each rural area depends on the capacity of the statistical services: indicators must be elaborated using data available on related variables or other methodologies.

Conclusions

Modern agriculture, in addition to the vital function of food production, contributes to the formation of the landscape, to the sustainable management of renewable resources, to the improvement of the quality of life and to human development in rural areas. This characteristic of multifunctionality, although common to other sectors of the economy, has special importance in agriculture for the weight of these "joint products". Ensuring stability of agricultural supply and promoting sectoral productivity are the objectives of Article 39 of the Rome Treaty

(now Article 33 of the Lisbon Treaty) that, combined with the new opportunities discussed, can generate renewed and stable policies for the farm sector and for rural areas (De Castro *et al*., 2011). The complexity of issues related to the food system requires integration within systems of knowledge in agriculture (research, training, dissemination). A social, multifuncitonal approach improves the relevant knowledge and increases the participation of farmers, thus reinforcing the creation of new networks of agricultural knowledge. The concept of multifunctionality becomes a broadly used term both in the CAP and in the Doha Round of the WTO negotiations, as well as by researchers and policymakers. The social approach to the new rural paradigm helps towards reconsideration of the human habitat, and an ongoing process towards an improvement in terms of quality of life. The decline in agricultural employment in rural areas entails a separation between the place of residence and the place of work. Social inclusion and helping relationships play a crucial role in revitalizing rural areas where the improvement in quality of life is a necessary condition in order fully to exploit human resources and territory. So green care can be a new source of farm income and one of the multiple new functions that agriculture can fulfil in an urbanizing society; in general there is a lack of coordination among Social Farming practitioners and poor knowledge of the opportunities offered by the RDP, so SA falls into the "middle ground" between welfare and agricultural policy (ENRD, 2010). It is crucial to highlight empirical evidence of studies and research. In this regard rural development can become a "social inclusion policy". The aim of this work has been to provide an insight into the role of Social Agriculture. Far from being exhaustive, our analysis utilized a multidisciplinary approach in order to capture the essence of Green Care. The present paper puts the focus on the importance of green care activities and on indicators concerning the social/health dimension of agriculture and rural development. As a general requirement, indicators have to be policy-relevant (OECD, 2001; EU, 2001) and can guide policy-makers in their decisions; furthermore, indicators should help to identify the policy fields where action is needed. Scholars (Di Iacovo and O'Connor, 2009) argue that an improvement of knowledge and awareness about care farming is considered the key to promoting a shared recognition of care farming amongst agricultural and health care agents, and as well as following up institutionalization of care farming arrangements in policy frameworks. We have provided an extension to the multi-level dimension of agriculture, as asked for in EU policies and in previous studies (e.g. Andersen *et al*., 2013; Barbieri and Valdivia, C. 2010; Bernard *et al*., 2006; Grouiez, 2011; Ohe, 2011; van der Ploeg et al., 2009; Wilson, 2008; Kizos, 2010). In line with these studies, we argue that a new rural paradigm stands out and, furthermore, we highlight that this paradigm strengthens solidarity, trust, proximity, emotional states, psychological well-being such as NCOs. To conceptualize and formalize we have defined the Multifunctional Agricultural House starting from the House of functions by Fleskens (2009) by taking into account the educational and relational dimension of the agricultural system. Moreover, we have used insights from existing policy reports and scientific studies in order to define indicators focusing on the educational/social dimension. Our study thus contributes to the development of evaluation tools which are necessary for analyzing and for improving the social approach. Indicators have to be appropriate to the context and adapted across regions, areas and countries in order to 'cultivate' values (Di Iacovo and Ciofani, 2005). The success of initiatives is linked to the commitment and competences of the farmer, to the creation of alliances, to the quality of the new regional organizations and to the implementation of care farm services in care organisations. The relative importance of the factors varies between the different types of initiative, be they on a local or regional level (Hassink *et al*., 2013; Wiggering *et al.* 2006). In fact, the char-

acteristics of green care depend on regional, local and national conditions and so it is hard to define common indicators. We therefore underline the importance of analysing further details of the methodology for constructing indicators. In future studies, we will test our hypothesis by analyzing initiatives in care farming and evaluating them by means of the indicators elaborated. Much more remains to be done.

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RISK ASSESSMENT OF MAJOR CROPS IN EGYPTIAN AGRICULTURE

JEL classification: Q18, Q14, Q15

Ibrahim Soliman*, Fabian Capitanio, Luigi Cerciello*****

Abstract. *The increase in agricultural commodity prices is driven by several factors. One of the principal amongst these is the headlong growth in food consumption, associated with population growth, and especially with higher purchasing power among increasingly broad ranges of the population in emerging countries. The largest increases in population will take place in developing countries, while in high-income economies it will remain almost stable and in some areas, especially in some regions of Europe, there may even be a decline. By contrast, in Africa the population is expected to double, growing from one to two million by 2050. Against this background, the present study focuses on the major variables which influence the risk to incomes in agricultural production in Egypt.*

Keywords: *Egyptian agriculture, risk management, food security*

1. Introductory background

Since the early ' fifties there has been a long period of stagnating and declining prices on agricultural markets, interrupted only by some sharp variations in coincidence with extraordinary events (such as the "oil shock" in the 1970s). The scenario changes in the mid 1990s when an inverse trend began, with sharp peaks in farm commodity prices in 2007/2008 and 2010/2011. The most recent forecasts indicate sizeable price rises for the coming years.

Several causes are contributing to the increase in agricultural commodity prices. One of the most important is the headlong growth in food consumption, associated with population growth, but especially with the higher purchasing power among increasingly broad ranges of the population in emerging countries. According to FAO, world population will exceed nine billion in 2050. This represents an increase of about one third against the current population of 6.9 billion, an increase that will be lower than in the past. In fact, the population increase of over 30% predicted by the FAO for the next 40 years is well below the relative growth in the past four decades, during which population more than doubled.

Moreover, the most important contribution to the global convergence of diets will be made by the expansion of the middle classes in emerging areas. Individual income in countries such as India, Brazil and China has risen at sustained rates in recent years, only to slow down, but not stop, during this long phase of world economic recession. The cases that stand out most are those

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of China and India which have recorded annual growth rates close to the double figures in the years immediately prior to the recession and which are forecast, according to the International Monetary Fund, to continue their trends at least for the next 20 years. This means, on one hand, that expenditure on food consumption will grow fast, but, on the other, that food habits will change radically (the so called "substitution effect" explained by Engel's Law).

As populations gradually become richer, in their diets the unprocessed starch products (like rice and flour) are replaced by products with a higher protein content (such as meat, milk and other dairy products) and by processed products with greater value added, promoting a process of dietary convergence worldwide along the models of richer populations. This trend is involving several billion people in emerging countries and the demand for livestock products is forecast to increase very fast in the coming years with the consequence of a multiplier effect on the demand for some agricultural raw materials, such as soya and wheat, which are at the basis of animal feed.

Against this background, the present study has focused on the major variables that determine risk in agricultural production in Egypt, variables here identified as land use and yield variability. Almost all the agricultural area in Egypt, except for about 3%, is fully irrigated. Fluctuation in rainfall is not, therefore, a main factor behind risk in agricultural production. Accordingly, farm price was considered as an explanatory variable assumed to affect the fluctuations in the variables considered, i.e. the area and the yield. Farm price is the market signal for producers to expand or to reduce production. To complete the investigation, the impact of international price levels on domestic prices was also assessed. Other factors that may cause risk (fluctuation) in either the crop area and/or yield level would be the plant protection programs against infection. Some vegetables such as tomatoes could be also be affected by the differences of temperature during the year, as it is cultivated three times a year (winter, summer and fall, "Nili season")

The major crops were selected on the basis of their share in the cultivated area. The crops with the highest share in the acreage of each subsector were selected. The subsectors were field crops, fruits and vegetables. However, additional criteria were also applied in selection. Cotton and onions were selected, not only on the basis of their share in area, but also because they are major exportable crops, together with potatoes, tomatoes and citrus. Sugar cane was selected as the major permanent crop: it occupies land for 3 successive years and is the crop that consumes most irrigation water per unit of land. Consequently, sugar beet was selected as a promising crop to substitute sugar cane. It is a perennial winter season crop. Tables 1, 2, 3, and 4 show the agricultural land use and cropping pattern of Egyptian agriculture in 2010. It should be mentioned that the period of time concerned (1981-2010) included years of dramatic changes in the Egyptian economic system. The first period was 1981-1986, when Egypt was still to a large extent a planned economy. The second period (1987-1995) included the boom of the economic reform program, which aimed at moving the economic system strongly towards privatization and the free market mechanism, freeing the exchange rate and interest rate as well as prices of inputs and outputs, keeping only subsidies only for the common Egyptian bread, quotas of some food items that were distributed via ration cards, and fuel prices. The third period 1995-2010 was that after the application of the reform policies.

2. Data base and analytical procedures

The data used in this study were compiled from the agricultural statistics bulletin which is issued annually by The Economic Affairs Sector of the Egyptian Ministry of Agriculture and

Land Reclamation and from The Food and Agricultural Organization of the United Nations (FAO) Statistical Data Base. The risks in crop area, yield and farm price levels were estimated using the instability coefficients (Equation 1) over a reasonable historical time trend, (1981-2010). The derived average annual growth rate from the time trend model (Equation 2) was also considered in investigation of the time series data of the crops concerned, either to estimate $\hat{Y}$ for getting the instability coefficient, or to estimate the average annual growth rate (Equation 3). To investigate the effect of farm price on a certain crop area, the supply response model was estimated for each considered crop (Equation 4), where the effect was specified as a lag response of the farm price one year earlier. The effect of farm price on crop yield was estimated using Equation 5. The effect of the world price inflation of the considered crops on their domestic price levels was assessed using Equation 6.

Equation 1: Instability Coefficient: $\sum (|Y_{ij} - \hat{Y}_{ij}|) / \sum(\hat{Y}_{ij})$

Equation 2: Linear Time Trend Model: $\hat{Y}_{ij} = b_0 + b_1 T_j$

Equation 3: Average Annual growth Rate: $r_i = b_1/\hat{Y}$

Equation 4: Crop Area-Supply Response: $\hat{A}_i = a_0 + a_1 P_{i\,(t-1)}$

Equation 5: Effect of farm price on Crop Yield: $\acute{y}_i = a_0 + a_1 P_{i\,(t-1)}$

Equation 6: Response of Domestic Price to average world price in the year t: $P_{di\,(t)} = b_0 + b_1 P_{wi\,(t)}$

Where:

Y_{ij} = Actual value of the variable i (Area, Yield or Farm price) in the year j,
$\hat{Y}_{ij}$ = Expected value of the variable i (Area, Yield or Farm price) in the year j,
b_i = Parameter to be estimated
$\ddot{Y}$ = Estimated Annual Average of the variable i (Area, Yield or Farm price)
$\hat{A}_i$ = Expected value of the Area of the Crop i in the year j,
$P_{i(t-1)}$ = Farm price per ton of the crop i in the previous year (t-1)
a_i = Parameter to be estimated

The ANCOV (Analysis of Covariance) model was applied to test for the significance of the impact of the three successive periods of change in economic policy packages on the supply and/or yield response to farm price of each crop. Three regression lines were therefore estimated. The first was for the period before the application of the economic reform (1981- 1986); the second was for the period within such implementation (1987-1995) and the third reflects economic performance after the implementation of the reform program. The economic policy was introduced as a dummy variable (a qualitative variable) while the price was introduced as a quantitative variable, including the interactions between the two variables. The ANCOVA model is written as in Equation 7

Equation 7:
$$y_i = \beta_0 + \sum_{j=1}^{p} \beta_j X_{ij} + \sum_{j=1}^{\sigma} \beta_{k(ij)} j + \varepsilon_i$$

Where:

y_i is the value observed for the dependent variable for observation i,
X_{ij} is the value taken by quantitative variable j for observation i,
$k_{(ij)}$ is the index of the category of factor j for observation i and
ε_i is the error of the model.

The hypotheses used in ANCOV are identical to those used in ANOVA: the errors e_i follow the same normal distribution N (0,s) and are independent.

One of the features of ANCOV is to enable interactions between quantitative variables and factors (Dummy variables) to be taken into account. The main application is to test if the level of a factor (a qualitative variable) has an influence on the coefficient (often called slope in this context) of a quantitative variable. Comparison tests are used to test if the slopes corresponding to the various levels of a factor differ significantly or not. A model with one quantitative variable and a factor with interaction is written as in Equation 8.

Equation 8: $$Y_i = \beta_0 + \beta_i X_{i1} + \varepsilon\beta_{k(i1)1} + \beta_{k(i1)2} X_{i1} + \varepsilon_i$$

Three steps should be conducted successively:

(1) To test the homogeneity of variance of the two regression lines (before and after the implementation of the economic reform program in Egypt),
(2) To test whether the dummy variables (the successive periods of policy packages) changes interact with the price effect and
(3) To test if such dummy variables have an independent effect on either the area or the yield of the crop.

If the first step showed heterogeneity of the variances of the three regression lines, the other two tests are not not relevant. If homogeneity of the three variances results step (2) is conducted; if there is an interaction effect of the three qualitative and quantitative variables step three is not carried out. Otherwise, the **"Bartlett's Test"** for homogeneity of variances was applied. This test is very sensitive to departures from normality:

The Null hypothesis of the Bartlett's test is a commonly used test for equal variances (Equation 9).

Equation 9: $$H_0 = \sigma_1^2 = \sigma_2^2 - \ldots = \sigma_k^2$$

Against alternative hypothesis (Equation 10)

Equation 10: $H_0 = \sigma_i^2$ are not all equal

The model assumes the samples are of size n_i from the ith population, $i = 1, 2 \ldots K$, and the usual variance estimates from each sample: $s_1^2, s_2^2, \ldots, s_k^2$

Where each sample variance is estimated as (equation 11)

Equation 11: $$s_1^2 = \sum_{j=1}^{i} \left(x_{ij} - x_i \right)^2 / \left(n_j - 1 \right)$$

Introducing the following notation: $\upsilon_j = n_j - 1$ (the υ_j are the degrees of freedom) and

$$\upsilon = \sum_{i=1}^{k} \upsilon_i$$

$$s^2 = \frac{\sum_{i=1}^{k} \upsilon_i s_i^2}{\upsilon}$$

The Bartlett's test statistic M is defined by Equation 12.

Equation 12:
$$M = \upsilon \log s^2 - \sum_{i=1}^{k} \upsilon_i \log s_i^2$$

Bartlett showed that when none of the degrees of freedom is small, M is distributed approximately as χ^2_{k-1}. The chi-square approximation is generally acceptable if all the n_i are at least 5. However, this is a slightly biased test, according to Bartlett. It can be improved by dividing M by the factor (C), (Equation 13). Then instead of M, it is suggested to use M/C for the test statistic.

Equation 13:
$$C = 1 + \frac{1}{3(k-1)} \left[\left(\sum_{i=1}^{k} \frac{1}{\upsilon_i} \right) - \frac{1}{\upsilon} \right]$$

In our model(s) there was no homogeneity between the three variances of the three regression models (the three successive time periods). Therefore, the study concerned only the estimation of the area and yield response for the period 1995-2010 i.e. after the implementation of the economic reform, to be used for interpretation of the fluctuation in the area and yield of the concerned crops.

It should be mentioned that the best fitting model for the estimated supply response was identified depending on the magnitude of the adjusted R^2, in addition to the statistical significance of the estimated parameters and, above all, the economic logic of the effect. Therefore, some of the models estimated were polynomial curvilinear models, rather than simple linear regression, to reflect the cobweb model of price movements over time.

3. Results and discussion

Egypt is one of the few places where agriculture is almost fully irrigated and the available land is intensively cultivated for more than two seasons a year. In 2010 the total agricultural area in Egypt was around 3.7 million hectares, of which 78% arable land and 22% permanent crops. The arable land is of two subcategories: the main one is perennial field crops that occupied 56% of the total agricultural area; the second is vegetables that occupied 22% of the total agricultural area in 2010 (Table 1). Among the category of permanent crops are fruit trees, which took up 12% of total agricultural area in Egypt in 2010 (Table 1), and sugar cane that represented 4% of the total agricultural area.

Tab. 1 - Agricultural Land Use in Egypt		
Subsector	**(000) ha**	**%**
Agricultural area	3,689	100
Arable land of which:	2,884	78
Field Crops	2,072	56
Vegetables (including melons)	812	22
Total Permanent Crops, of which:	805	22
Forest		2
Dates	42	1
Fruit Trees	435	12
Sugar Cane	135	4
Alfalfa	124	3
Source: Compiled and calculated from: http://faostat.fao.org/site/570/default.aspx#ancor.		

Sugar cane yields 3-4 cuts over 3-4 years before replacement. It occupied more than 17% of the total land under permanent crops in Egypt, (Table 1) and, with rice, is the crop which uses the most irrigation water, (Table 1A).

Tab. 1A - Ranking of Major crops in Egypt by water use/ha (m3)			
Crops	**(000) Hectare**	**% of total Cropped area**	**Water Use/ha (m3)**
Sugar cane	141	3	18,585
Rice	703	14	12,350
Mango	77	2	12,250
Alfalfa	16	0.3	11,900
Groundnut	65	1	8,182
Citrus	166	3	7,461
Grapes	71	1	7,461
Cotton	242	5	6,716
Tomatoes	226	5	6,664
Potatoes	108	2	6,378
Perennial clover	766	16	5,995
Maize	774	16	5,553
Sugar beet	104	2	4,422
Wheat	1,141	23	3,713
Faba beans	89	2	2,849
Green beans	31	1	2,618
One-cut clover	203	4	2,242
Total	4,923	100	6,690
Source; Compiled and calculated from: Egyptian Ministry of Agricultural and Land Reclamation, (2009) Sustainable Agricultural Development Strategy Towards 2030.			

Wheat is the most important of the field crops studied. It is a winter crop. It represents about two thirds of the total field crops area (Table 2). Maize is a summer crop. It comes at second place in acreage. It occupied 47% of the total area of field crops in 2010, (Table 2). Rice is also a summer crop and occupied about one-fifth of the total area under field crops in 2010.

Tab. 2 - Share of Crops studied in the area under Field Crops in Egypt

Crop	(000)ha	%
Field Crops	2,072	100
Sugar beet	135	6
Wheat	1,288	62
Rice	460	22
Maize	969	47
Cotton	155	7

Source: Compiled and calculated from: http://faostat.fao.org/site/570/default.aspx#ancor.

Annual exports of rice are at fifth place among the leading six exportable agricultural products (Table 2A). Although cotton (a summer crop) and sugar beet (a winter crop) do not occupy a high proportion of the area under field crops in Egypt, i.e. only 7% and 6%, respectively, (Table 2), they were involved in this study because cotton still occupies the third rank of Egyptian exports of agricultural products by value and sugar beet is a promising crop that saves water and replaces sugar cane which has the highest rate of consumption per hectare of irrigation water, (Table 1A).

Tab. 2A - The Share of Crops studied in Total Agricultural Exports of Egypt in 2010

Commodity	(000)$	%
Total Agricultural Exports	2,451,586	100
Total Oranges	402,502	16.4
Total dry Onions	170,396	7.0
Cotton	140,123	5.7
Potatoes	129,562	5.3
Rice – total (Rice milled equivalent)	120,932	4.9
Total Tomatoes	6,740	0.3
Total Studied Commodities	970,255	39.6
Other Commodities	1,481,331	60.4

Source: Compiled and Calculated from: FAOSTAT: FAO Statistics Division 03 January 2013, http://faostat.fao.org/site/535/DesktopDefault.aspx?PageID=535#ancor.

Citrus, particularly orange, occupies more than one third of Egypt's acreage of fruit trees, (Table 3) and is the first of the exported agricultural commodities, (Table 2A). The vegetables investigated in this study were onions, tomatoes and potatoes. They come at the 2nd, 4th and 6th ranks by value of agricultural exports, (Table 2A) and together occupied more than one half of the total area of vegetables in Egypt in 2010, (Table 4).

Tab. 3 - The Share of areas of fruits studied in the Total Field Crops Area in Egypt		
Crop	**(000)ha**	**%**
Fruits	435	100
Citrus	158	36
Others	277	64
Source: Compiled and calculated from: http://faostat.fao.org/site/570/default.aspx#ancor.		

Tab. 4 - The Share of Areas of vegetables studied in the Total Field Crops Area in Egypt		
Crop	**(000)ha**	**%**
Total Vegetables (including melons)	812	100
Onion	62	8
Tomatoes	216	27
Potatoes	141	17
Others	394	48
Source: Compiled and calculated from: http://faostat.fao.org/site/570/default.aspx#ancor.		

Annual growth rate of area, yield and farm prices of major crops studied

Table 5, presents the estimated time trend models of the domestic and world farm price of the crops studied over the period 1981-2010 and Table 6 presents the estimated time trend models of the area and yield over the same period. If the time response (regression) coefficient was statistically insignificant, the derived annual growth rate of the corresponding variable was considered of zero value, i.e. no significant growth had occurred. A very important fact that can be seen from Table 5 is that all crops investigated showed an annual average farm price lower than the average world level for the period 1981-2010. This might be considered as a sign of comparative advantage of Egyptian agriculture, even though the ratio varied between the different crops. In general, the lower the ratio the higher is the comparative advantage of the crop. It should be noted, however, that the existence of a comparative advantage does not necessarily mean competitiveness of the Egyptian crop exports on the world market. The latter criterion depends upon other techno-economic variables.

Tab. 5 - The Time Trend of Local and World Farm Prices of Major Crops in Egypt

Crops	Item	Estimated Constant (Ton/ha)	Estimated Annual Change (Ton/ha)	Annual Average Price ($/ton)	Annual growth Rate (%)	R2 (%)	F	Significance of Annual Trend
Cotton	Local	948.42	-4.395	880.30	-0.5	2.9	0.84	n.s.
	World	1444.61	-9.487	1349.73	-0.7	5.4	0.97	n.s.
Rice	Local	308.15	-4.212	242.86	-1.7	18.1	7.42	Significant at ² 5%
	World	315.78	4.584	361.61	1.3	17.2	3.53	Significant at ² 5%
Maize	Local	288.17	-3.944	227.03	-1.7	11.0	4.60	Significant at ² 5%
	World	205.98	2.519	231.17	1.1	12.3	2.38	Significant at ² 5%
Wheat	Local	278.94	-3.515	224.45	-1.6	20.3	8.37	Significant at ² 5%
	World	225.58	0.167	227.53	0.1	0.1	0.01	Significant at ² 5%
Sugar cane	Local	27.94	0.053	28.75	0.2	0.7	0.20	n.s.
	World	70.06	-0.094	69.13	-0.1	0.1	0.02	n.s.
Sugar beet	Local	28.20	0.131	30.23	0.4	-0.9	0.74	n.s.
	World	39.79	1.825	58.04	3.1	57.0	22.55	Significant at ² 5%
Tomatoes	Local	181.89	-3.602	126.06	-2.9	71.4	73.30	Significant at ² 5%
	World	482.45	11.984	602.29	2.0	32.7	8.24	Significant at ² 5%
Potatoes	Local	194.93	-2.271	159.72	-1.4	14.4	5.88	Significant at ² 5%
	World	240.60	6.167	302.28	2.0	34.5	8.95	Significant at ² 5%
Onion	Local	159.80	-3.834	100.37	-3.8	39.9	20.28	Significant at ² 5%
	World	330.80	4.672	377.52	1.2	15.0	3.01	Significant at ² 5%
Citrus	Local	50.19	3.72	174.46	2.13	0.433	21.35.	Significant at ² 5%
	World	329.32	7.174	401.56	1.8	26.4	6.11	Significant at ² 5%

Local Price Series (1981-2010), World Price series (1991-2009)
Source: Compiled and Estimated from:
(1) Ministry of Agriculture and Land Reclamation (2009) Agricultural Statistics Bulletin, Issued annually by The Economic Affairs Sector, Cairo, Egypt.
(2) http://faostat.fao.org/site/570/default.aspx#ancor.

Tab. 6 - The Time Trends in Area and Yield of Major Crops in Egypt

Crops	Item	Estimated Constant	Estimated Annual Change	Annual Average	Annual growth Rate (%)	R2 %	F	Significance of Annual Trend
Cotton	Area (000) ha	517.69	-11.591	338.03	-3.4	90.3	261.71	Significant at ² 5%
	Yield (tons/ha)	2.18	0.008	2.30	0.3	7.9	2.39	n. s.
Rice	Area (000) ha	374.22	11.41	551.07	2.1	79.5	108.59	Significant at ² 5%
	Yield (tons/ha)	4.98	0.193	7.96	2.4	96.6	803.25	Significant at ² 5%
Maize	Area (000) ha	713.64	3.234	763.77	0.4	18.5	6.36	Significant at ² 5%
	Yield (tons/ha)	3.95	0.162	6.47	2.5	94.4	471.75	Significant at ² 5%
Wheat	Area (000) ha	430.08	29.354	885.07	3.3	89.7	244.35	Significant at ² 5%
	Yield (tons/ha)	3.54	0.12	5.39	2.2	91.2	292.92	Significant at ² 5%
Sugar cane	Area (000) ha	83.41	2.128	116.39	1.8	86.0	172.57	Significant at ² 5%
	Yield (tons/ha)	93.88	1.055	110.23	1.0	94.0	439.44	Significant at ² 5%
Sugar beet	Area (000)ha	-13.74	3.543	41.18	8.6	81.4	122.82	Significant at ² 5%
	Yield (tons/ha)	34.95	0.555	43.55	1.3	54.4	33.35	Significant at ² 5%
Tomatoes	Area (000)ha	125.28	3.319	176.73	1.9	79.2	106.83	Significant at ² 5%
	Yield (tons/ha)	20.02	0.758	31.77	2.4	91.8	311.67	Significant at ² 5%
Potatoes	Area (000)ha	58.14	2.045	89.84	2.3	51.4	29.56	Significant at ² 5%
	Yield (tons/ha)	17.83	0.266	21.96	1.2	82.0	127.57	Significant at ² 5%
Onion	Area (000)ha	57.29	-0.183	54.46	-0.3	4.2	1.24	n. s.
	Yield (tons/ha)	11.11	0.537	19.44	2.8	93.0	370.19	Significant at ² 5%
Citrus	Area (000)ha	50.18	3.724	107.90	3.5	43.3	21.35	Significant at ² 5%
	Yield (tons/ha)	16.88	-0.04	16.29	-0.23	0. 93	0.265	n. s.

Source: Estimated from:
(1) Ministry of Agriculture and Land Reclamation (2009) Agricultural Statistics Bulletin, Issued annually by The Economic Affairs Sector, Cairo, Egypt.
(2) http://faostat.fao.org/site/570/default.aspx#ancor.

Table 7, therefore, presents the estimated average annual growth rate of the three variables (area, yield and farm prices) of the crops studied. Table 8, presents the ranking of the crops by their average annual growth rate of both area and yield. The average annual growth rate was calculated from equation 3. The estimated annual growth rate of the variables studied was ranked by its estimated value. Sugar beet has shown the highest rate of expansion of area over the period 1981-2010 (8.6%), which reflected the policy intended gradually to increase its area in order to replace sugar cane as a source of sugar for domestic supply, However, this policy has succeeded only partially in slowing down the growth in sugar cane area to 1.8% which put it at the 8th rank among the crops considered. Unfortunately, the growth of sugar beet yield has not matched the high expansion in its area. It was only 1.3% a year which placed it at the 6th rank. It seems that the price policy has not played a role in accelerating the expansion of sugar beet area or yield. As shown in Table, 7 the annual growth rate of local farm price of sugar beet was 0.4% over the period 1981-2010, while the comparable average world price increased at 3.1%.

Tab. 7 - The Estimated Average annual Growth Rates in Area, Yield, Local and World Prices from 1981 to 2010 (%)

Crops	Area (%)	Yield (%)	Local Price (%)	World Price (%)
Cotton	-3.4	0.0	0.0	0.0
Rice	2.1	2.4	-1.7	1.3
Maize	0.4	2.5	-1.7	1.1
Wheat	3.3	2.2	-1.6	0.1
Sugar cane	1.8	1.0	0.2	-0.1
Sugar beet	8.6	1.3	0.4	3.1
Tomatoes	1.9	2.4	3.1	-2.9
Potatoes	2.3	1.2	2.0	-1.4
Onion	0.0	2.8	2.0	-3.8
Citrus	3.5	0.0	2.1.	1.8

Source: Abstracted from: Time Trend Models in (Table 5).and (Table 6)
When the regression coefficient of the time trend equation is not significant, the estimated growth rate was recorded as zero
All variable trends for the period (1981-2010), But the world Prices for the period (1991-2010)

Even though the area under oranges has grown at 3.5% a year over the last two decades, which brought it to the 2nd rank area-wise after sugar beet (Table 8), its yield has not shown any significant growth over the same period. Farm price has shown a significant moderate annual growth of 2.13%, which could be an incentive to expand the area. Orange is not only a promising exportable product: it is also a fruit commonly consumed in Egypt.

Wheat is most important as a subsistence food crop. The growth rate in its area occupied the third rank among the crops investigated, with a value of 3.3% a year. This expansion may be at the expense of the other main competitive winter season crop of cultivated green fodder (Egyptian clover). Even though the growth rate in yield of wheat occupied 5th place (Table 8), it was significant at 2.2% a year. However, the area and yield expansion corresponded with a significant annual decrease in the farm price of wheat, of 1.6% a year.

Tab. 8 - Ranking of Average annual Growth Rate of Area and Yield (%) of Major crops

Crops	Area (%)	Rank	Crops (%)	Yield (%)
Sugar beet	8.60	1	Onion	2.80
Citrus	3.50	2	Maize	2.50
Wheat	3.30	3	Rice	2.40
Potatoes	2.30	4	Tomatoes	2.40
Rice	2.10	5	Wheat	2.20
Tomatoes	1.90	6	Sugar beet	1.30
Sugar cane	1.80	7	Potatoes	1.20
Maize	0.40	8	Sugar cane	1.00
Onion	0.00	9	Citrus	0.00
Cotton	-3.40	10	Cotton	0.00

Source: table 7

Surprisingly, the area allotted to onion, an exportable crop, has almost stagnated but the annual growth rate in its yield, at 2.8%, comes in first place among those of the crops studied (Table 8) and farm price increased at 2% a year, (Table 7).

The area under cotton has shown a significant decrease, of 3.4% a year, and there has been no increase in either the yield or farm price over the last two decades, in spite of the outstanding quality of this extra-long staple fine cotton. Until the early 'seventies it was the first exportable cash crop. However, it was the victim of the economic reform program and a poor foreign trade policy. During the central planned economy (1952-1986), the government used to buy cotton from farmers at much lower a price much lower than its world price, assuming that providing inputs at a subsidized price would compensate such differences. However, economic analysis has shown that until the mid 'seventies of the last century there was a net tax on cotton Therefore, the domestic spinning plants had the opportunity of getting raw cotton at a low price and of superior quality and were capable of delivering the output of cotton textiles at low price to consumers, even though they had old technology that was not suitable for this high quality cotton, leaving much waste and a high rate of loss of raw cotton. Exports were secured under permanent contracts with Eastern Europe at that time. The trading process was conducted using an accounting exchange rate for the US$, but the trading of cotton, rice and oranges were effectuated as required imports from Eastern Europe, as physical commodities without actual monetary payments. Sometimes such exports were delivered to Eastern Europe markets as repayment of imported military equipment. After the open market economy and privatization strategy was adopted the existence of an export policy lacking in rationality, particularly for cotton, has encouraged adoption of the advice of some international organizations to reduce the area under cotton, on the grounds that the domestic demand and world market could not provide enough incentives to make reasonable profit. Therefore, the distorted price policy for cotton, both for domestic and foreign trade, have exposed this important crop to considerable decline over the last three decades.

Degrees of instability in Egyptian agriculture

The instability coefficient of crop area, yield per hectare and farm price per ton of each crop was estimated using Equation 1 and the time trend models presented in Tables 5 and 6 over the period 1981-2010. These instability coefficients are presented in Table 9. For comparative analysis they were ranked by magnitude of the instability coefficient for crop area and yield in Table 10 and for local and world farm price in Table 11.

Sugar beet has shown the highest area instability, of 28.8%, followed by the citrus area with an instability coefficient of 27.7%, then potatoes with an instability coefficient of 15.5%. The least crop area instability occurred in maize, tomatoes and sugar cane, of about 7%, for the first two crops and 5% for the third. The instability in crop yield was generally less than that of the crop area. The highest yield instability was for citrus, about 17.4%, followed by cotton 8.2% then sugar beet 7.5%. The lowest instability coefficients were associated with rice (3.5%), potatoes (3.3%) and sugar cane (1.7%)

The instability in farm price for onion has been quite high over the last two decades, about 33%, followed by rice, wheat, and cotton, which ranged from 24.5% to 20.4%. The least instability of farm price is associated with maize, 3.5%. There was no association between local farm price instability of the 10 crops concerned and the comparable world price, except for citrus.

Tab. 9 - Estimated Instability coefficients of performance of major crops in Egypt				
Crops	**Area (%)**	**Yield (%)**	**Local Price (%)**	**World Price (%)**
Cotton	7.9	8.2	20.4	14.8
Rice	7.5	3.5	24.5	12.3
Maize	6.9	4.5	3.5	13.8
Wheat	8.4	5.2	21.0	15.3
Sugar cane	4.9	1.7	14.7	16.3
Sugar beet	28.8	7.5	19.1	12.3
Tomatoes	6.8	5.2	12.3	18.5
Potatoes	15.5	3.3	18.5	12.3
Onion	11.4	5.6	33.1	13.4
Citrus	27.7	17.4	13.2	13.5

Source: Estimated from:
Time Trend Equations in (Table 5).and (Table 6) using
trends for all varuiables for the period 1981-2010 except for world prices which are for the period (1991-2010)

Tab. 10 - Ranking of major crops by instability coefficient of area and yield					
Crops	**Area (%)**	**Rank**	**Crops (%)**	**Yield (%)**	**Rank**
Sugar beet	28.80	1	Citrus	17.40	1
Citrus	27.70	2	Cotton	8.20	2
Potatoes	15.50	3	Sugar beet	7.50	3
Onion	11.40	4	Onion	5.60	4
Wheat	8.40	5	Tomatoes	5.20	5
Cotton	7.90	6	Wheat	5.20	6
Rice	7.50	7	Maize	4.50	7
Maize	6.90	8	Rice	3.50	8
Tomatoes	6.80	9	Potatoes	3.30	9
Sugar cane	4.90	10	Sugar cane	1.70	10

Source: (Table 7)

Tab. 11 - Ranking of local and world farm price of major crops by instability coefficient					
Crops	**Local Price (%)**	**Rank**	**Crops**	**World Price (%)**	**Rank**
Onion	33.10	1	Tomatoes	18.50	1
Rice	24.50	2	Sugar cane	16.30	2
Wheat	21.00	3	Wheat	15.30	3
Cotton	20.40	4	Cotton	14.80	4
Sugar beet	19.10	5	Maize	13.80	5
Potatoes	18.50	6	Citrus	13.50	6
Sugar cane	14.70	7	Onion	13.40	7
Citrus	13.2.	8	Rice	12.30	8
Tomatoes	12.30	9	Sugar beet	12.30	9
Maize	3.50	10	Potatoes	12.30	10
Source: Table 7					

Crop area supply response

As mentioned earlier, changes in weather can not explain instability either in area or yield of the crops considered, as Egypt enjoys an apparently stable climate. The existence of a fully irrigated agricultural system also excludes the possible impact of fluctuations in rainfall on instability in production of the major crops cultivated in Egypt. The study, therefore, has tried to estimate the impact of the farm price response on the crop area, using a lag-response model to simulate the ordinary supply response.

The study, however, has considered the dramatic socio-economic changes that the Egyptian economy has experienced over the last three decades in which there were three stages: an economy which tended to be fully centrally planned until 1996; it then moved to what was called the economic reform program until1995 and this was associated with policies and instruments applied in the Egyptian economy after 1990, and particularly, in agriculture after 1986/1987.

A covariance analysis model was therefore applied to compare supply response models of each crop in the three periods, i.e. 1981-1986, 1986-1995 and 1995-2010. The purpose was to see whether there has been interaction between price response and policy changes, or whether the policy impact was independent. The test of homogeneity of the variances of the three regression lines was applied (Equation 8) that showed heterogeneity of the variances of regression models the three periods. Therefore, the analysis was restricted to the period (1995-2010), i.e. after the end of the economic reform program of the agricultural sector. This period also reflects the present performance of the Egyptian economy, except for the two years of the 25th of January Revolution, i.e., privatization of economic enterprise, free output and input prices, free exchange rate and free interest rate and free market mechanism with limited subsidy of some food items and fuel.

It should be mentioned that, the supply response for sugar cane and orange was not estimated. This is because both crops are permanent crops. Special treatment is needed to estimate supply response models in these cases, which is beyond the scope of this study.

Among the eight estimated crop supply responses, maize, potatoes and cotton models were statistically insignificant. Therefore, the farm price changes over the concerned period could not

explain the variations in area. The reasons behind such insignificant supply response are as follows: for maize, no explicit price policy has been practiced over the last three decades to encourage farmers to expand maize area by providing price incentives or guaranteed price. For potatoes, it seems that the plant diseases, particularly, the "brownish rotten" have been behind instability in area as the infection blocks the possibility of exporting which is assumed to be the main objective behind the farmers' economic decisions. The case of insignificant farm price-area response of cotton is probably due to the continuous decrease in area due to stagnating domestic and foreign demand for Egyptian extra-long staple, which in turn was due to the imposed practice of a distorted cotton price and marketing policy.

Area response to farm gate price for tomatoes and onions has corresponded with a polynomial curvilinear model, where 74% and 31% respectively of the variation in the area of the two crops, were explained by the changes in the one year lagged farm price. The significant polynomial response reflected the market behaviour of Cobweb theory because both crops have 2-3 cultivation seasons a year. Rice and wheat are almost the only two crops that have shown an ordinary supply response of a one year lagged farm price, where 39% and 36% of the variation in crop area was explained by the changes in farm price. However, the magnitude of the price response of wheat was almost three times that of rice, i.e., 2.1 and 0.82 ha for additional increase of 1-US$ per ton of output. The lower response of rice to price changes was due to other governmental intervention policies that affect the rice area. These included limits to the maximum rice area to save irrigation water in summer and prohibition of rice cultivation in certain areas, restriction of exportation of rice in some seasons to limit the increase in domestic market price, and sometimes the guaranteed price was announced after the farmers' decision to cultivate and some other times such guaranteed price was not satisfactory, i.e., much lower than the world price or not considering the sudden increase in costs of production.

On the other hand the government, usually, provides a guaranteed price of wheat higher than the world price to encourage farmers to expand wheat area and also to secure a certain domestic quota of wheat supply to produce the subsidized local bread and limit the quantity imported (Table 12).

Tab. 12 - Area supply response of major crops in Egypt									
Crop	**Estimated Parameter**	**Estimate**	**S.E.**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Adjusted R2 (%)**	**Fcal**
Rice	Intercept (b0)	453.87	55. 80	8.13	<0.001	336.64	571.10	29.7	9.10
	Farm Price P(t-1)	0.82	0.27	3.00	0.01	0.25	1.39		
Maize	Intercept (b0)	761.59	55.14	13.81	< 0.01	645.75	877.43	-5.1	0.79
	Farm Price P(t-1)	0.08	0.30	0.27	< 0.79	-0.55	0.71		
Wheat	Intercept (b0)	662.45	116.93	5.67	< 0.01	416.78	908.12	36.4	0.0029
	Farm Price P(t-1)	2.10	0.61	3.45	< 0.01	0.82	3.37		
Sugar beet	Intercept (b0)	-44.80	17.19	-2.61	< 0.05	-80.91	-8.68	65.1	36.38
	Farm Price P(t-1)	3.47	0.58	6.03	< 0.01	2.26	4.68		
Tomatoes	Intercept (b0)	-53.62	44.98	-1.19	0.24	-146.08	38.85	73.9	0.04
	Farm Price P(t-1)	2.59	1.16	2.23	0.03	0.20	4.98		
	P2(t-1)	-0.02	0.01	-2.36	0.03	-0.04	0.00		
	P3(t-1)	0.0001	0.00	2.35	0.03	0.00	0.00		
Potatoes	Intercept (b0)	81.52	27.48	2.97	0.01	23.53	139.50		
	Farm Price P(t-1)	0.12	0.19	0.65	0.53	-0.28	0.52		
Onion	Intercept (b0)	-36338.25	11414.23	-3.18	0.00	-59800.52	-12875.97	31.1	5.36
	Farm Price P(t-1)	638.67	202.14	3.16	0.00	223.17	1054.16		
	P2(t-1)	-3.73	1.19	-3.13	0.00	-6.18	-1.28		
	P3(t-1)	0.0072	0.0023	3.0973	0.0046	0.0024	0.0120		
Cotton	Intercept (b0)	368.63	92.59	3.98	0.00	168.60	568.66	3.3	1.49
	Farm Price P(t-1)	-0.14	0.11	-1.22	0.25	-0.38	0.11		

Source: Estimated from:
(1) Ministry of Agriculture and Land Reclamation (2009) Agricultural Statistics Bulletin, Issued annually by The Economic Affairs Sector, Cairo, Egypt.
(2) http://faostat.fao.org/site/570/default.aspx#ancor.

Yield-price response of the major crops

Only five crops have demonstrated a significant effect of the one year lagged farm price on crop yield: rice, maize, wheat, onion and tomatoes. The variation in the yield of the other three crops (cotton, sugar beet and potatoes) has not apparently been affected by the changes in farm prices, (Table 13). These results may reflect the Egyptian market situation and policies.

Tab. 13 - Estimated yield response of major crops in Egypt

Crop	Estimated Parameter	Estimate	S.E.	t Stat	P-value	Lower 95%	Upper 95%	Adjusted R2	Fcal
Cotton	Intercept (b0)	2.51	0.27	9.25	0.00	1.94	3.09	0.016	0.276
	Farm Price P(t-1)	-0.0002	0.0003	-0.53	0.61	-0.0009	0.0005		
Rice	Intercept (b0)	7.48	0.74	10.06	0.00	5.91	9.05	18.4%	5.05
	Farm Price P(t-1)	0.008	0.00	2.25	0.04	0.00	0.02		
Maize	Intercept (b0)	4.16	0.51	8.08	0.00	3.08	5.25	69.0%	41.15
	Farm Price P(t-1)	0.02	0.00	6.41	0.00	0.01	0.02		
Wheat	Intercept (b0)	5.10	0.50	10.29	0.00	4.05	6.14	15.9%	4.41
	Farm Price P(t-1)	0.005	0.003	2.101	0.051	-0.00002	0.011		
Sugar Beet	Intercept (b0)	49.93	2.62	19.06	0.00	44.40	55.46	2.3%	1.42
	Farm Price P(t-1)	-0.103	0.087	-1.19	0.25	-0.29	0.08		
Potatoes	Intercept (b0)	24.57	2.41	10.20	0.00	19.49	29.65	-3.7%	0.36
	Farm Price P(t-1)	-0.010	0.017	-0.60	0.56	-0.04	0.03		
Onion	Intercept (b0)	-87.90	8.90	-9.88	0.00	-106.67	-69.13	89.5%	153.75
	Farm Price P(t-1)	0.63	0.05	12.40	0.00	0.52	0.74		
Tomatoes	Intercept (b0)	46.01	3.99	11.53	0.00	37.59	54.43	22.2%	6.15
	Farm Price P(t-1)	-0.096	0.039	-2.479	0.02	-0.18	-0.01		

Source: Estimated from:
(1) Ministry of Agriculture and Land Reclamation (2009) Agricultural Statistics Bulletin, Issued annually by The Economic Affairs Sector, Cairo, Egypt.
(2) HYPERLINK "http://faostat.fao.org/site/570/default.aspx" \l "ancor"http://faostat.fao.org/site/570/default.aspx#ancor.

Rice, onion and tomatoes are the main cash crops and also exportable ones. Farmers are therefore keen to raise the yield to secure higher cash income, as long as there are market incentives to do that in terms of higher farm-gate price. Wheat is not only a subsistence crop for domestic consumption of the farm household: it is also a source of farm income, by selling the surplus either to the free market traders or to milling plants for processing for subsidized bread at a price guaranteed by the mills. In this respect, the Egyptian government used to follow a certain policy to encourage farmers by determining a domestic wheat price usually higher than the world price, and also with an added bonus for a better quality of wheat. Maize is also a subsistence food crop in some rural areas and also a source of livestock and poultry feed. As a summer crop, there is no scope for expanding its area at the expense of rice because the latter is more profitable. Therefore, when rice cultivation is forbidden, particularly, in southern governorates, farmers have only one opportunity, which is to increase their revenue from the maize area by raising the yield in response to higher farm gate price.

The effect of world prices on domestic prices of the major crops

Table 14 shows that only four crops, cotton, maize, rice and onion demonstrate a positive impact of the average world price on the domestic farm price. These results are apparently logical for three of the four crops, onion, cotton and rice, because they figure significantly in revenue from agricultural exports. Therefore, their prices have been affected by world market price inflation and fluctuations. However, Egypt is a main importer of corn, mainly for processing for

poultry and livestock feed. The effect of the world price on the domestic maize price fluctuations and inflation could therefore be indirectly a result of demand pressure. When the world market demand for yellow corn increases and faces a shortage in world supply, the domestic market would shift some of its demand to domestic maize production which might raise its price.

Tab. 14 - World price effect on domestic farm price of major crops in Egypt

Crop	Estimated Parameter	Estimate	S.E.	t Stat	P-value	Lower 95%	Upper 95%	Adjusted R2 (%)	Fcal
Cotton	Intercept (b0)	153.76	173.92	0.88	0.39	-213.17	520.69	41.5	13.79
	World Farm Price (Pt)	0.47	0.13	3.71	0.00	0.20	0.74		
Maize	Intercept (b0)	-24.38	39.56	-0.62	0.55	-107.83	59.08	57.7	25.59
	World Farm Price (Pt)	0.85	0.17	5.06	0.00	0.50	1.21		
Rice	Intercept (b0)	2.94	47.57	0.06	0.95	-97.42	103.30	46.0	16.35
	World Farm Price (Pt)	0.52	0.13	4.04	0.00	0.25	0.80		
Wheat	Intercept (b0)	112.77	43.99	2.56	0.02	19.95	205.59	8.1	13.79
	World Farm Price (Pt)	0.31	0.19	1.61	0.13	-0.10	0.71		
Sugar Beet	Intercept (b0)	13.56	7.72	1.76	0.10	-2.73	29.86	12.4	3.56
	World Farm Price (Pt)	0.21	0.11	1.89	0.08	-0.02	0.44		
Tomatoes	Intercept (b0)	106.05	42.14	2.52	0.02	17.14	194.95	-2.3	1.43
	World Farm Price (Pt)	0.11	0.14	0.77	0.45	-0.18	0.39		
Potatoes	Intercept (b0)	106.05	42.14	2.52	0.02	17.14	194.95	-2.3	0.59
	World Farm Price (Pt)	0.11	0.14	0.77	0.45	-0.18	0.39		
Onion	Intercept (b0)	1.67	20.11	0.08	0.93	-40.75	44.10	34.0	10.27
	World Farm Price (Pt)	0.17	0.05	3.20	0.01	0.06	0.28		
Oranges	Intercept (b0)	139.32	34.48	4.04	0.00	66.22	212.41	-3.8	-0.04
	World Farm Price (Pt)	0.05	0.09	0.61	0.55	-0.13	0.24		

Source: Estimated from:
(1) Ministry of Agriculture and Land Reclamation (2009) Agricultural Statistics Bulletin, Issued annually by The Economic Affairs Sector, Cairo, Egypt.
(2) http://faostat.fao.org/site/570/default.aspx#ancor.

In other words, Egypt's agricultural resources, with a fully irrigated system, fertile soil, moderate climate and human resources with profound and long standing experience, should not display significant fluctuations or instability in output. It seems that a lack of proper management and farm practices, as well as irrational policies have been behind this degree of risk in agricultural production

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CONSUMER BEHAVIOUR IN RURAL TOURISM. CONJOINT ANALYSIS OF CHOICE ATTRIBUTES IN THE ITALIAN-SLOVENIAN CROSS-BOUNDARY AREA

JEL classification: Q01, Q26, Q56

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Abstract. *Understanding consumer behaviour in rural tourism is a necessary condition for the successful diversification of any rural socio-economic system. This paper aims to analyse the consumer behaviour of tourists and residents in an Italian marginal rural area in order to verify the opportunities for sustainable local development through rural tourism activities.*

First of all we give some conceptual consideration to the notion of rural tourism and the relationship with sustainable local development. Secondly, we examine the suitability of conjoint analysis for predicting consumer behaviour in relation to rural tourism. Finally, we report on a survey which we carried out in a rural area located in a region of North-Eastern Italy: the Natisone Valley. The results provided insights into how each type of characteristic of rural sites competes for the selection of destination. In particular, the most important attribute in selecting rural sites for tourism is the availability of information.

These results could provide useful insight for decision makers, in particular as regards local planning strategies. We discuss the results with emphasis on the implications for marketing of rural tourism. In fact, recommendations are made in view of the findings, specifically focusing on internal marketing strategies.

Keywords: *consumer behaviour, rural tourism, conjoint analysis.*

1. Introduction

Rural tourism offers opportunities for improving the socio-economic development of rural areas, in particular by emphasizing a bottom-up approach that involves local stakeholders and uses endogenous resources (Cawley and Gillmore, 2008; Kastenholz *et al.*, 2012). Understanding consumer behaviour in rural tourism is necessary for the successful diversification of rural economic systems.

There are several studies about demand for rural tourism (Park and Yoon, 2009; Roberts and Hall, 2001). Nevertheless, studies on consumer behaviour are scarce. In general, they agree on the complexity of tourism experience (Kastenholz *et al.*, 2012; Park and Yoon, 2009; Sharpley

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and Jepson, 2011; Uriely, 2005). In detail, demand for rural tourism seems to be influenced not only by demographic features but also by attitudes and motivational concepts.

How people make trade-offs among the various categories of rural destinations or assess their respective utilities still appears difficult to understand. In order to manage rural tourism destinations successfully, operators should provide consumers with alternatives more useful for competing by offering them the type of services they expect. As stated by Albaladejo and Díaz (2005), for strengthening rural tourism it is necessary to determine the tourist profile corresponding to different types of accommodation, existing or to be developed. In particular, purpose-designed products of rural tourism, tailored to the needs of consumers, should be identified in order to facilitate the formulation, promotion, and delivery of rural tourism products (Park and Yoon, 2009).

They would increase the probability of the specific rural destination being chosen. In fact, consumers select the alternative that maximizes their utility which is based upon the evaluation of services available and their corresponding quality.

In this study we have tried to give support to decisions by operators in rural tourism by examining consumer behaviour. The study presents findings of a research investigation aimed at understanding the factors that explain how consumers make choices between rural tourism destinations and analysing the characteristics considered in choosing a rural area. In particular, specific attention was paid to consumer behaviour in a cross-border rural area between the Friuli Venezia Giulia Region in Italy and Slovenia.

A conjoint analysis was carried out in order to predict consumer behaviour by considering the preferences of respondents for hypothetical alternative tourism destinations. We surveyed a sample of tourists.

The results of the study establish how each type of characteristic of the rural site competes for the selection of the destination.

The empirical results provide support for decision makers, in particular as regards local planning strategies. We discuss the results with an emphasis on the implications for marketing of rural tourism.

2. Literature Reviews

2.1 The concept of rural tourism

There is not a unique, clear and basic definition for rural tourism (Cawley and Gillmor, 2008; Lane, 1994; Sharpley and Roberts, 2004; Sznajder *et al.*, 2009). Although a full review of the literature on rural tourism is beyond the scope of this paper, we carried out a wide-rangeing examination of it that reveals the existence of numerous labels and definitions based on a variety of characteristics. Nevertheless, we can take, as a definition of rural tourism, a tourist activity developed in rural areas, where the main motivation of tourists is the contact with a rural way of life and/or landscape and environmental resources (Gannon, 1994; Lane, 1994; Sznajder *et al.*, 2009).

In spite of the strong expansion of rural tourism in most Western countries, there is an absence of systematic sources of data regarding its diffusion, but it must be pointed out that there are several constraints on collecting accurate data: for example, neither the World Tourism Organization (WTO) nor OECD are able to use appropriate measures to quantify the diffusion of rural tourism.

It is should also be noted that there are many disparities between national definitions and descriptions of this type of tourism: for example, on one hand you can consider only farm and nature tourism, on the other, you can include many economic activities located outside of urban areas. It must also be kept in mind that many rural tourists are excursionists, rather than tourists making overnights stays. Moreover rural tourism is characterized by great diversity and fragmentation: in fact there are many and varied private enterprises and, in some cases, also public initiatives.

It seems, nevertheless, to be important to study rural tourism as it generates several benefits first of all for the host community, i.e. creation of new businesses especially in the service sector, improvement of local infrastructures and public services, etc.; secondly, in favour of local countryside capital (Garrod *et al.*, 2006), in particular landscape preservation and environmental resource conservation, and last but not least it is of benefit to the tourist by improving his/her physical and mental well-being or cultural exchange (San Martin and Herrero, 2012; Sharpley and Jepson, 2011).

Due to these benefits there is a consensus about some key objectives in developing rural tourism (Roberts and Hall, 2001). The first regards the economic field: development of rural tourism could be considered as a way of helping to revitalize struggling rural areas. It could increase jobs, thus stimulating socio-economic growth and arresting rural depopulation and degradation of the local socio-economic system. It could also improve the standard of living of the local population as it offers an opportunity for income generation and job creation. Rural tourism is therefore able to help the provision of additional economic activity, but it could also replace traditional rural economic activities now in decline, like agriculture.

The second key objective is the protection of landscape and environmental resources. In fact, these resources are of strategic importance to rural tourism. To conserve these resources it is consequently necessary to create appropriate legislation, and also a balanced approach to planning. Moreover the adoption of the best practice approach to running rural tourism enterprises is fundamental in order to ensure that the environment will be protected.

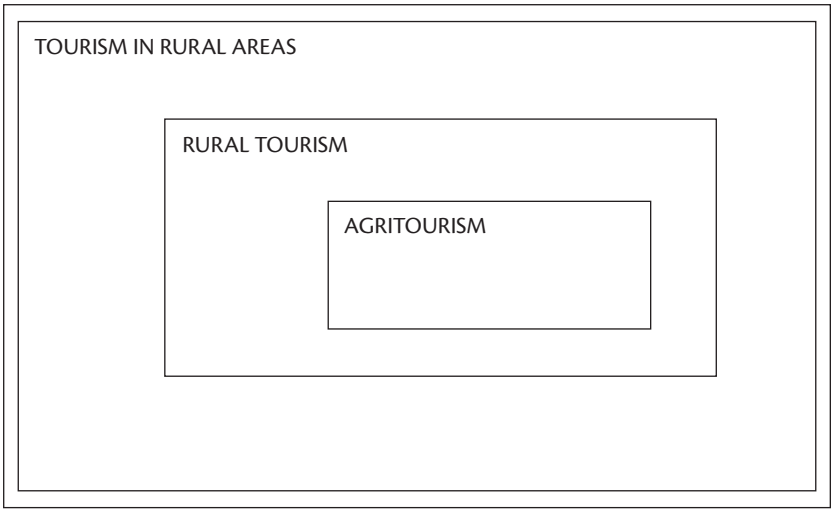
The third strategic objective regards the legal framework. The provision of appropriate legislation and rules is a necessary pre-condition for obtaining successful rural tourism development. Moreover the support and involvement of a number of institutional decision makers seem to be fundamental.

Another very important key objective regards the quality of life and is linked to the first key objective we discussed. As previously stated, the presence of a flow of tourists into rural areas can help the maintenance or the improvement of existing services, thereby contributing to raising the quality of life of the local socio-economic system.

Last but not least, the conservation and protection of local culture and traditions are also key objectives as they can play a significant role in ensuring satisfaction of the rural tourist.

Rural tourism includes several activities conducted in rural areas (Hall *et al.*, 2003; INEA, 2001; Marangon, 2008; Yun, 2009). One of these is agritourism, which is a style of vacation that is normally spent on a farm. Consequently it is possible to create a relationship between rural tourism and agritourism (Phillip *et al.*, 2010): Fig. 1 shows firstly that rural tourism comprises agritourism, secondly, it is a specific subset of tourism in rural areas as a broader concept, that could be also mass tourism and alternative tourism (European Commission, 2010; WTO, 2010; WTTC, 2010).

Fig. 1 - The "hierarchical positioning" of rural tourism



Source: Sznajder et al., 2009

Local government investment in rural tourism and private stakeholders' projects can attract tourists and increase local socioeconomic development (Smith *et al.*, 2010). An increasing number of institutional and private efforts are trying to create or improve rural tourism attractions in order to strengthen development in rural areas, in particular as regards marginal rural areas. In fact, many undeveloped and marginal countries have detected it as a chance for socio-economic prosperity.

A necessary condition for the successful development of tourism activity is to understand consumers' behaviour. It seems necessary to understand this profile also as regard rural tourism.

3. Methods

3.1 Conjoint analysis

Several descriptive analyses have been conducted on rural tourism (Asciuto *et al.*, 2013; Cawley and Gillmor, 2008; Ohe, 2002); nevertheless a more generalized framework is required in order to allow exploration of consumer behaviour in greater detail and the creation of useful rural tourism services in order to compete more effectively.

Conjoint analysis is a statistical technique applied in market research to determine how people value different features composing an individual product or service. This technique originated in mathematical psychology and was developed by P.E. Green (Green and Srinivasan, 1978). Other prominent conjoint analysis researchers include Richard Johnson, who developed the Adaptive Conjoint Analysis technique in the 1980s, and Jordan Louviere.

Conjoint analysis allows the researcher to measure consumers'preferences for products or services in a direct, controlled manner. This is possible by measuring consumers' responses when facing hypothetical products or services (Dellaert *et al.*, 1998). Conjoint analysis is a multivariate

technique. It has been applied to understand how respondents develop preferences for products or services, including tourist services (Thyne *et al.*, 2006). In fact, it helps in estimating and predicting consumer's preferences given a set of alternatives that are specified in terms of levels of different attributes (Green and Srinivasan, 1978 and 1990; Hair *et al.*, 1998). While traditional techniques used to assess consumer's preferences tend to consider each attribute independently, conjoint analysis can help to understand how a consumer trades off one attribute against another. Consumers do not consider each product attribute independently when formulating a choice decision. They evaluate the total value of a good/service (tourist service) by combining the separate amounts of utility for each attribute level. Conjoint analysis gives information on how consumers are likely to make a buying decision. Therefore, it is possible to understand how respondents develop their preferences.

Conjoint analysis determines what combination of a limited number of product attributes is most important in respondent choice or consumer decision making (Levy, 1995).

Conjoint analysis asks the consumers to choose among a controlled set of potential products or services. By analyzing the respondent's preferences among these products, the implicit importance of a specific attribute of the product or service can be identified. Conjoint analysis also points out the tradeoffs that respondents make during the decision-making process and the price they are willing to pay for it (Toombs and Bailey, 1995). Conjoint analysis assumes that the choice between the alternatives is driven by the respondent's utility. In detail, the respondent's indirect utility is broken down into two components. While the first component is deterministic, and is a function of the attributes of alternatives, the second one is an error term and regards the characteristics of the respondents and a set of unknown parameters.

The utility of an attribute is a numerical expression of the value the respondents give to an attribute level and represents the relative value of the attribute (low utility means less value, while high utility indicates more value).

It is also possible to quantify the importance of an attribute. In fact, it can be calculated by analyzing the difference between the lowest and the highest utilities inside the range of the levels of attributes.

Conjoint analysis is very useful in identifying consumer segmentation as it groups respondents with similar preferences.

The implicit valuations (utilities or part-worths) can be used to create market models that estimate market share, revenue and even profitability of new products or services.

4. Materials

4.1 Analysis of rural tourists' behaviour in a cross-border region

To investigate the opportunities for developing the rural socio-economic system through rural tourism, we analysed consumer behaviour. The aim of our study was to collect preferences about the factors that can increase rural tourism. In detail, to identify the preferences, we carried out a survey in a rural area located a in a cross-border region located between the North-Eastern part of Italy, the Friuli Venezia Giulia region, and Slovenia. In particular we chose a marginal rural area, the Natisone Valley, in order to help the local decision making process in counteracting depopulation and the decline of this area.

Tab. 1 - Inhabitants, surface and density of population in the Natisone Valley					
Municipality	**1951 inhabitants**	**2012 inhabitants**	**% change 1951-2012**	**Surface (km²)**	**Density (in/km²)**
Drenchia (Dreka - Drèncje)	1,392	134	-90.4	13.28	10.1
Grimacco (Garmak - Grimàc)	1,737	370	-78.7	14.5	25.5
Pulfero (Podbonesec - Pulfar)	3,735	1,031	-72.4	48.03	21.5
San Leonardo (Podutana o Svet Lienart - San Lenàrt)	2,283	1,156	-49.4	27.00	42.8
San Pietro al Natisone (Špietar - San Pieri dai Sclavons)	3,088	2,219	-28.1	23.98	92.5
Savogna (Sovodnje - Savògne)	2,077	477	-77.0	22.11	21.6
Stregna (Srednje - Stregne)	1,883	403	-78.6	19.7	20.5
"Valli del Natisone" (Natisone Valley)	**16,195**	**5,790**	**-64.2**	**168.6**	**34.3**
Source: calculations on ISTAT data (2010)					

In Table 1 the decline in local population and the low value of density of population in this rural area are evident.

To understand consumer behavior and tourists' preferences better, we used the conjoint experiment. The conjoint experiment was designed and administered through a questionnaire by using a convenience sample. We conducted 400 interviews in the area (200 pilgrims to a local holy place and 200 tourists to a local Lombard town). The questionnaires were collected between August 2009 and January 2010: the choice of this period is based on an expert opinion that it is important to ensure that responses were based on a full range of experience at different levels of tourism. This ensures that a wide range of opinions were captured, deriving from respondents with different experience. The conjoint experiment was included in a larger questionnaire which was also designed to measure further aspects of the social impacts of rural tourism. The conjoint experiment was pre-tested to determine the most efficient format. The questionnaire also included a general demographic section.

A set of tours in the rural cross-border area considered were shown to respondents. We chose four types of rural destination of the Natisone Valley. The first one is Matajur, a mountain 1642 meter high in the Julian Alps on the border between Slovenia and Italy. The second is the cave of San Giovanni d'Antro, which is an original cave church. The third concerned votive chapels that are widely distributed over the territories of the Natisone Valleys. Typically, they date from the 15th and 16th Centuries and were mainly erected in isolated locations away from human settlements, where they were more secure from depredation. Last but not least we chose the "Villaggio degli orsi" (Bears' Village) visitors centre located in Stupizza village, where one can learn about the bear and the other carnivorous animals (lynx, wolf), which inhabit the wildest and most evocative areas of the Friuli Venezia Giulia region and Slovenia.

The respondents were asked to select and rank the tours they were shown. All examples were similar enough to each other so that consumers would see them as close substitutes, but dissimilar enough clearly to determine the respondent's preference.

4.2. The selection of attributes

As stated, this study aims to identify the choice attributes of general tourists, therefore we selected the constituent attributes of previous tours using a questionnaire based on literature

reviews (Green and Srinivasan, 1990). Generally, three to seven attributes are suggested (Green and Srinivasan, 1990). We selected four attributes for our study: 1) meal; 2) information; 3) transport; 4) price.

4.3. The selection of levels

The sets of tours were created from a combination of levels of the attributes. The levels are the differentiated representation of an attribute. Meal, in this case, was presented with two levels: as "yes", i.e. presence of meal, or "no"., i.e. no meal,. Information was presented as "guided tour", i.e. the presence of an expert who describes the context, or "brochure", i.e. the tourist is invited to read some information without an opportunityof putting questions. Transport was presented as "bus", or "car". Price was presented as "€ 5", or "€ 30" (Tab. 2).

Tab. 2 - The attributes and levels included in the factorial design of the conjoint analysis

Tour Attributes	Levels
MEAL	yes; no
INFORMATION	guided tour; brochure
TRANSPORT	bus; car
PRICE	€ 5; € 30

4.4. Full factorial design

We were able to consider all the number of combinations of attributes and levels (profiles), i.e. a full factorial design, to determine the consumer preferences. In full factorial design the ideal profile can be designed where the correlation between parameters becomes 0. With the full profile method, the number of cases would be 16 (2×2×2×2).

We constructed 8 choice sets. Each choice set consists of 2 alternatives (Fig. 2). We also included the "status quo" option (or "do nothing" option), i.e. pay nothing and get nothing, so the experiment could be used to compute the value (Willingness To Pay - WTP) of each alternative. In fact, by designing the study in an appropriate manner it is possible to use statistical analysis to identify the value of each attribute of the tour in driving the customer's decision. Nevertheless in this paper we do not describe these results.

Fig. 2 - The choice set

Options	Tour 1	Tour 2	
MEAL INFORMATION TRANSPORT PRICE (€)	Only tour Brochure Car 5	Tour and meal Guided tour Bus 30	Neither tour 1 nor tour 2. I will not go on a tour
Please indicate your preference (check only one option)	☐	☐	☐

In order to evaluate the preference of respondents we decided to adopt a scoring method using Likert's scale. As this method tends to lead to the centralization of responses and consequently to reduce the power of discrimination, the interviewers had to guide the respondents to produce

a wider range of responses. Specifically, a 10-point Likert's scale was used for the measurement of respondent's preference of each profile, where 1 point refers to the lowest preference and 10 points the highest (Goossen & Langers, 2000; Yun & Im, 2006). This scaling does not have a mean point, unlike the widely used 5-point or 7-point scales, but we chose 10-point Likert's scale as it is easier to convert it into percentages. In addition, more reliable data can be captured by collecting more variable values compared with other scales.

The range of the utility values for each factor provides a measure of its importance. We know that factors with greater utility ranges play a more significant role than those with smaller ranges.

Conjoint utilities are scaled to an arbitrary additive constant within each attribute and are interval data. The arbitrary additive constant, origin of the scaling within each attribute, results from dummy coding in the design matrix. However, if we add a constant to the part-worths for all levels of an attribute or to all attribute levels in the study, it does not change our interpretation of the results. When using a specific kind of dummy coding called effects coding, utilities are scaled to sum to zero within each attribute.

5. Results and discussion

5.1. General statistics of respondents

General statistics about the respondents show that females predominated (51%) among respondents and that the age group 30-59 years prevails (52.2%), while 26.0% were under 30 years of age (Tab. 3).

Data on education indicated that 73.5% respondents had at least a high school education.

Tab. 3 - Some basic socio-economic information

Characteristic	%	Characteristic	%
Male	49.0	Young (< 30)	26.0
Female	51.0	Adult (30-59)	52.2
Primary	3.0	Senior (60 and +)	21.8
Secondary	21.8	Local (FVG)	73.5
High	49.5	Other (Italy)	26.5
Graduate	25.7	Young (< 30)	26.0

In order to illustrate certain characteristics of consumers we analyzed their behaviour by age (Tab. 4). The percentages describe the number of respondents within their category.

We clarify that the scores greater than or equal to 8 (in a scale 1-10) are considered as "excellent".

Tab. 4 - Consumer behaviour by age				
Age (years)	**Tours**			
	Matajur mountain		**Votive Chapels**	
	N° of excellent scores	**%**	**N° of excellent scores**	**%**
<30	66	63	17	16
30-60	153	73	83	40
>60	61	70	51	59
Total	280	70	151	38
	Church cave		**Bear village**	
	N° of excellent scores	**%**	**N° of excellent scores**	**%**
<30	68	65	59	57
30-60	144	69	125	60
>60	60	69	41	47
Total	272	68	225	56

The respondents indicated Matajur mountain as their most preferred destination (70% excellent scores). Also the cave of San Giovanni d'Antro obtained a good percentage of preferences (68%).

As regards education, we noticed that the higher the level of education, the less the votive chapels were preferred (Tab. 5).

Tab. 5 - Consumer behaviour by education				
Education	**Tours**			
	Matajur mountain		**Votive Chapels**	
	N° of excellent scores	**%**	**N° of excellent scores**	**%**
Primary school	10	83	7	58
Secondary	56	64	36	41
High	143	72	75	38
Graduate	71	69	33	32
Total	280	70	151	38
	Church cave		**Bear village**	
	N° of excellent scores	**%**	**N° of excellent scores**	**%**
Primary school	9	75	4	33
Secondary	59	68	48	55
High	135	68	109	55
Graduate	69	67	64	62
Total	272	68	225	56

Source: own calculation

Moreover the higher the education level, the greater was the preference in favour of Bear Village. It is important to note that the great part of interviewees over 60 years old had attended only primary school and most of the respondents under 30 were graduates.

Gender does not influence the preferences.

5.2. Importance and utility

We used SPSS to analyse the data we collected. The utility analysis on the entire responses indicated very high internal validity of the model. In fact it resulted in Pearson's R index of 0.991 and Kendall's tau index of 0.933. These indices provide measures of the correlation between the observed and estimated preferences and represent a correlation between the preference of each profile and deduced utility value. Since higher correlation can be interpreted as a higher explanatory power of deduced utility, it is useful for evaluating the internal validity of the model. The average preference of the concerned profile was represented by the value of the constant, which was uniformly distributed close to 7.3.

The importance of each attribute was between 21-27% (Figs. 3 and 4). These results show that consumers who intend to visit rural sites consider all attributes important during the choice process. However, the meal was shown to have less importance in the choice of rural site. This is because, unlike ordinary tourist's behavior, those who intend to visit rural sites aim to enjoy a unique experience that cannot be similar to those available in urban settings.

Fig. 3 - Conjoint analysis results

SUBFILE SUMMARY

Average Importance	Utility	Factor		
		METAL		
21,14	,2106	–		0
	– ,2106	–		1
		INFO	informazione	
27,86	,3230	– –		0
	– ,3230	– –		1
		TRANSPORT		
26,65	– ,0969	–		0
	,0969		–	1
		PRICE		
24,34	– ,1267	–		5,00
	– ,7605	– – – –		30,00
	B = – ,2106			
	7,2601	CONSTANT		

Pearson's R = ,991 Significance = ,0000

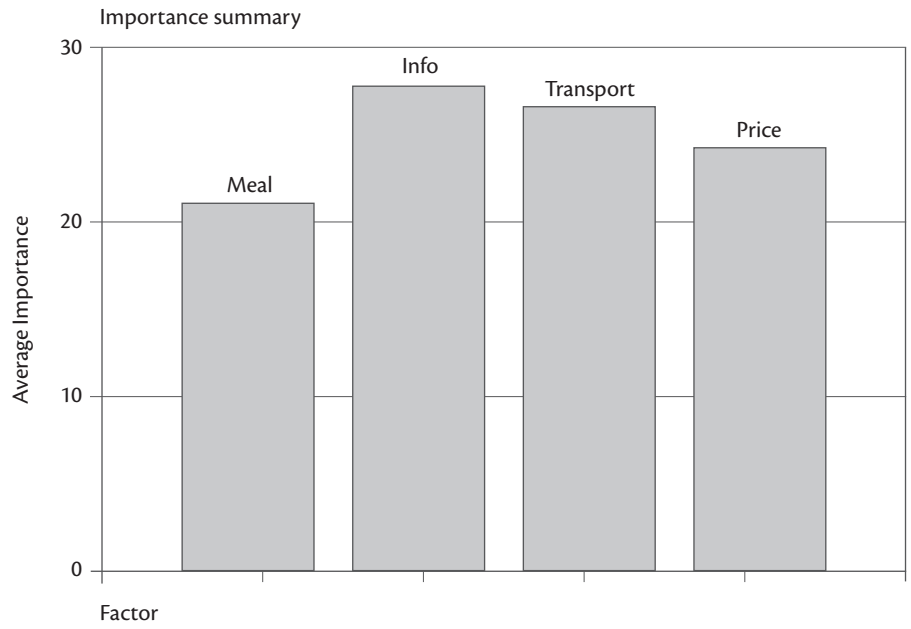
Kendall's tau = ,933 Significance = ,0000

Source: own calculation

The presence of a meal ("0") has a positive utility value, while the absence received a negative utility value. We clarify that this does not mean that the absence was unattractive. In fact, the absence may have been acceptable to all respondents. But, all being equal, the presence is better.

The utilities are scaled to sum to zero within each attribute, so the absence must have a negative utility value. The guided tour ("0") has a positive value. The auto ("1") received positive utility value too. It can be seen that with a higher price we have a negative utility value.

Fig. 4 - The importance of attributes



The respondents who intend to visit rural sites consider information and transport important attributes.

6. Conclusions

The key contribution of this paper is an insight into consumer behavior in rural tourism. In particular, the paper has provided insight into a research area underdeveloped,as regards tourism i.e. tourist behavior in a rural marginal area (Marangon *et al.*, 2008). Often, in this type of zone, tourism could be a strategic activity in favour of local socio-economic development. Nevertheless, the supply of tourism activities is not preceded by an analysis of consumer behaviour/demand. It is important to identify tourist needs in order to create the best supply of rural tourism. In order to improve this knowledge, the present study seems to provide useful information through the analysis of attributes determining choice from the consumers' perspective for the selection of rural tourism sites, as part of the rural development planning process.

In detail, through conjoint analysis it was possible to detect those characteristics or preferences of the tourist facilities offered that will be most influential in the choice of one type of rural tourism experience as opposed to another.

The results of the analysis revealed a high level of importance for information facilities and transport. It was also noticed that the presence of a meal and the cost were considered less important.

As marketing strategies should identify what the potential tourist needs and then provide it; according to the results shown in this paper, information facilities and programs should be developed or increased.

In order to improve the provision of information, cross-border cooperation also seems to be important, with an integrated and territorial approach for increasing participation and including support for the creation of equitable, sustainable, and integrated rural tourism (Cawley and Gillmor, 2008; Saxena and Ilbery, 2008). It is necessary to enable cooperation and to form cohesive cross-border, nature-based tourism business partnerships.

Having drawn these conclusions, it is also important to consider some of the limitations of the research. Firstly, we were not able to use conjoint analysis for valuation purposes. To overcome this limit we are still processing the data in order to compute the value of each alternative. Secondly, relating to the notion of integration in favour of rural cross-border tourism, further research is needed to obtain a deeper understanding of the mechanisms that help to improve tourism activities. These will be our next steps.

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